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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

MEETING OF THE SUBCOMMITTEE ON

RELIABILITY AND PROBABILISTIC RISK ASSESSMENT

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THURSDAY,

FEBRUARY 19, 2004

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ROCKVILLE, MARYLAND

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

COMMITTEE MEMBERS:

GEORGE E. APOSTOLAKIS, Chairman

MARIO V. BONACA, Member

F. PETER FORD, Member

THOMAS S. KRESS, Member

STEPHEN L. ROSEN, Member

WILLIAM J. SHACK, Member

MICHAEL R. SNODDERLY, ACRS Staff

NRC STAFF PRESENT:

GOUTAM BAGCHI

FRANK CHERNY

STEPHEN DINSMORE

JOHN FAIR

DAVID FISCHER

FRANK GILLESPIE

HOSSEIN HAMZEHEE

DONALD HARRISON

KEN HECK

THOMAS KOSHY

STU MAGRUDER

EILEEN McKENNA

MATTHEW MITCHELL

TIM REED

THOMAS SCARBROUGH

PAUL SHEMANSKI

JIM STRINSHA

DAVID TERAO

I-N-D-E-X

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

8:31 a.m.

CHAIRMAN APOSTOLAKIS: This is a meeting of the Advisory Committee on Reactor Safeguards, Subcommittee on Reliability and Probabilistic Risk Assessment. I'm George Apostolakis, Chairman of the Subcommittee.

Members in attendance are Mario Bonaca, Tom Kress, Peter Ford, Steve Rosen and Bill Shack.

The purpose of this meeting is to discuss the resolution of public comments on the proposed 10 CFR 5069, risk-informed categorization and treatment structures, systems and components.

The Subcommittee will also discuss implementing guidance contained in Revision D to NEI 00-04, 10 CFT 50.69 structures, systems and components categorization guideline.

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

Mike Snodderly is the designate Federal official for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of

this meeting previously published in the *Federal Register* on January 30, 2004.

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

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

We have received no written comments or requests for time to make oral statements from members of the public regarding today's meeting.

The Committee issued a letter, dated March 19, 2002, on this matter. We had a number of conclusions and recommendations in that letter, among which we stated the following:

That the criteria used by the integrated decision making panel for categorizing SSCs should be made explicit and should include consideration of risk metrics that supplement, record the frequency and large early release frequency such as late containment failure and inadvertent release of radioactive material.

We found that materials degradation was not directly assessed in NEI 00-04 Revision B. The

Committee recommended that the aging phenomena and the management of degradation should be considered in the IDP deliberations concerning effected SSCs and passive system components.

NEI 00-04 Revision B did not provide guidance or encouragement for licensees to perform uncertainty analysis and relied heavily on sensitive studies. The Committee recommended that uncertainty analysis should be performed where possible.

The justification for increasing failure rates in that report by a factor of five to do a sensitivity analysis was weak, according to the Committee's judgment. The Committee requested a better justification.

That letter also referred to the Committee's report, dated October 12, 1999, which commented extensively on the decision making process and the need for guidance and training in conducting expert panel sessions.

The draft final rulemaking to add to 10 CFR 50.69 is due to the Commission by June 30, 2004. The full Committee will review and comment upon the draft final rulemaking package at its July meeting. So this Subcommittee is expected to make a recommendation to the full Committee concerning this

matter.

Are there any comment from the members present?

We will now proceed with the meeting, and I call Mr. Tony Pietrangelo of the Nuclear Energy Institute to begin the presentation.

MR. PIETRANGELO: Good morning.

CHAIRMAN APOSTOLAKIS: Good morning.

MR. PIETRANGELO: We really appreciate the opportunity to come back to the Committee. The Chairman noted in his opening remarks, we were here with Revision B, took into account the ACRS' comments on Revision B. Subsequent to that Revision C was developed. I think we had another turn with the Committee following that with Revision C where we took our first cut at addressing some of the comments that the Chairman noted in his opening remarks.

Revision D goes well beyond that. We got the staff's comments as part of the draft regulatory guide 1121. We've had internally a couple of revisions to the document that resulted in Revision D that you have before you now.

The presentation that Doug True's about to go through tries to address the comments that the

ACRS had, and we also had provided in advance of the meeting a table that went through the staff's comments. We had a meeting with the staff about two weeks, went through that entire table.

We don't think, at least from our interactions with the staff and from the meeting summary, that we have any major issues left with the staff, at least, on the categorization guidance. I think they're mainly in the form of clarifications, and the staff will give you their perspective this afternoon.

Again, this has been a long process to get the document to the point it's at now. I think we started developing it in 1999. So this, a lot of thought, a lot of comment, a lot of review, a lot of hard work has gone into the development of this document. It really is the centerpiece of 50.69, this categorization process, so it's very important. We think we have a rigorous process described on how to do a proper categorization. And we think we've addressed the major issues that the Committee and the staff have provided to us.

So we look forward to the review today and your thoughts on the document. It is our intent to finalize this document at about the same time the

final rule will come out. So we have some loose ends we need to tie up with the document, but we're clearly close to the finish line now. And, again, we look forward to your comments today to further enhance the document.

So with that, I'm going to turn it over to Doug to start the presentation.

MR. TRUE: I'm Doug True from ERIN engineering. I was here the last time, the last couple of times we've talked with you about the categorization process for 50.69. And we have a couple of other task force members here also who may be able to contribute if certain questions come up from the pilot perspective.

But as Tony said, this has been going on for about four years and we've had a lot of meetings with the staff and a lot of meetings with the utilities and our task force. And we believe we've addressed the major comments we've received so far.

So I'm going to start with the obligatory RISC-1 through RISC-4 chart just to reenforce that we're trying to do in the categorization process is basically divide the SSCs that are currently considered safety related into two categories, RISC-1 and RISC-3, those being

safety significant to RISC-1. Those that fall through the categorizations process as being not safety significant are categorized as RISC-3. The nonsafety related SSCs have been similarly into two other categories, RISC-2 and RISC-4. I won't belabor that, we all understand that.

Since we were here last, we have revamped the process a little bit based on feedback from the pilot processes that went on. Fundamentally, we're doing the same kind of thing but we've moved the whole process up to system function level, which resolved a number of the issues that were coming up in the original process. I want to quickly go through this diagram, which is also in the categorization process document.

Basically we start with a assembly of a fair amount of of plant specific information on design basis, risk information, operational experience, maintenance rule functions, maintenance rule categorization. And out of that process one of the things we do is provide an assessment of the adequacy of the PRA or the RISC information, which may include PRAs and none PRA information. That is then also provided to the IDP and NRC staff as part of the submittal, but it's primarily purpose is to

support a categorization using that RISC information.

We then go through kind of in parallel with that a system engineering evaluation where we break the system into parts and functions that those portions of the system support. And we map each component to those system functions.

That mapping is also fed back into the categorization process so that at that point we can identify which components support which functions. And we use the risk information, the PRAs and importance measures out of those and deterministic considerations for the non-PRA information to do a preliminary component safety significance assessment that ties back to the safety significance of the functions for that system.

CHAIRMAN APOSTOLAKIS: I'm a little bit confused, Doug. Why put the functions there? I mean, shouldn't the main box be the preliminary SSC categorization and the functions is something that's on the side? What do you gain? I mean, you don't the risk sensitivity study under functions, you do it on the SSC?

MR. TRUE: Right. What it allows us to do is address non-modeled components more

completely. Because PRA will only include --

CHAIRMAN APOSTOLAKIS: In defense-in-depth?

MR. TRUE: No. Components that are reflected directly in the PRA, but support a function.

CHAIRMAN APOSTOLAKIS: Right.

MR. TRUE: Are then considered to be either significant or nonsignificant based upon that information. And we don't have the assessment of all these unmodeled components. We can do it at the function level rather than on a component-by-component basis. So it streamlines the process and it tends to be conservative and it brings more components in to be more significant under each condition.

CHAIRMAN APOSTOLAKIS: But the word function is not real well defined, though. I mean, it's function provided cooling in an accident? That's too high level.

MR. TRUE: Yes.

CHAIRMAN APOSTOLAKIS: You're talking about the lower level?

MR. TRUE: It's lower level, yes.

CHAIRMAN APOSTOLAKIS: Lower level. So

I found that a bit confusing. I mean, it's not a major problem, but it was a little bit confusing that part. I mean, what is the role of all these? And once you define the function and you declare it as safety significant, then everything supporting the function is --

MR. TRUE: Correct. Correct. On the first pass through.

CHAIRMAN APOSTOLAKIS: Yes. It seems to me that, I mean I don't know how important this diagram is, but it should be a little bit more accurate. For example, you don't do a risk sensitivity study for the components that are not part of the PRA, do you?

MR. TRUE: No. Correct. Right.

CHAIRMAN APOSTOLAKIS: Because they are not part of the PRA.

MR. TRUE: Right. Right.

CHAIRMAN APOSTOLAKIS: So the direct arrow from preliminary engineering categorization to risk sensitivity is not quite accurate. It's only for a part of the -- because you don't do it for all the components.

MR. TRUE: Right. I guess this is more a step phase --

CHAIRMAN APOSTOLAKIS: Yes. That's why I'm asking you how important.

MR. TRUE: -- rather than a spread or passing of information.

IT's the order of which we go through the evaluation process. It wasn't intended to reflect that everything is that functional.

CHAIRMAN APOSTOLAKIS: But it seems to me that this diagram can play a very important role in showing what follows in the document. And making sure that -- I mean, it's not a major change of distinguishing between what you do to PRA components SSCs and non-PRA and having the arrows, you know, separate and then meet again somewhere. That would go a long way towards making the diagram much clearer in my view.

MR. TRUE: Okay. One of the reasons that the risk sensitivity study, for example, does follow that engineering functions or engineering categorization of functions is that we have to have the defense-in-depth assessment done in order to know what are low safety significant and what are high significant SSCs. Because as the risk sensitivity study adjusts the failure rates for the low safety significant SSCs, something might be low

PRA perspective but might be considered high based on defense-in-depth.

CHAIRMAN APOSTOLAKIS: I understand that. That it is clear -- I mean the ones that are in the PRA you use importance measures, you do sensitivity studies and so on, for the others you don't. And I don't see how the diagram didn't show it.

DR. BONACA: And I agree totally with your comments because, you know, I was looking for that split exactly. Whereas with you, the first time I see it clearly is at the bottom of page 24 where you say the system is not evaluated until it is done PRA, then the SSC is categorized -- and you have that information.

CHAIRMAN APOSTOLAKIS: No. The report does that. Yes.

DR. BONACA: Oh, yes. But you have to go to the report.

CHAIRMAN APOSTOLAKIS: That's right.

DR. BONACA: And so in the diagram at the beginning it would help if it had --

CHAIRMAN APOSTOLAKIS: Just make it more accurate, that's all.

DR. BONACA: -- a parallel path that

says -- make a distinction.

MR. ROSEN: A couple of comments on this point. It's my understanding that this mapping to components and the function, the termination up front and then mapping to components is the way the proof of concept work at South Texas was done?

MR. TRUE: Yes, it's the way it was done in South Texas, yes.

MR. ROSEN: And the other thing is, there was a staff comment about this very point about this function mapping, and it had to do with what functions are you talking about. Are you talking about system functions or trains within system function? Trains within systems? And I think the answer for that was given by NEI and was that we're talking about functions at the level, not of the trains, but as for instance high pressure injection.

MR. TRUE: Right.

MR. ROSEN: And you may have three trains for high pressure injection, but you ask the question of the system this is a need for high pressure injection at this point. So anything that supports high pressure injection, whether it's in train A, B or C if there are three trains or train A

and B, if there are two, then those components are categorized as risk significant if high pressure injection if RISK significant, which it usually is.

MR. TRUE: Correct. That's correct.

CHAIRMAN APOSTOLAKIS: Another point here is that I think, and I will raise the issue later, but why this diagram is important, I think that the IDP review and approval should be different for components that are in the PRA and for those that are not. And the staff also has made some comments in their document. And I think we should show that clearly here. And I will raise the issue later again, because I don't want you to spend two hours on the third slide.

MR. TRUE: Right. Right.

CHAIRMAN APOSTOLAKIS: So, anyways, maybe we're giving more importance to this than you, but I guess the sense of at least the members who spoke is that the information is in the document. But I think making it more explicit here would help the reader, because you do do different things to components that are in the PRA, that are not in the PRA and so on.

MR. SHACK: Let me just add one more quibble with this figure while we're at it.

MR. TRUE: Okay.

MR. SHACK: What I miss from here as part of the inputs is the emergency operating procedures and the severe accident management guidelines which, to my surprise, are mentioned nowhere in the document. And it would seem to me that that is input to the IDP that they should consider.

Now, you can sort of argue that it's subsumed with the PRA, but in many ways I think that would bring things out more explicitly than the PRA would.

MR. ROSEN: Well, and that trouble goes beyond that. I mean, there are things like operating experience that are considered by the IDP, you know, the licensing history. There's a lot of other things considered that are not --

MR. SHACK: Well, I assume that subsumed under the operational.

DR. FORD: I have another question on this particular document just to finish the whole committee. On the inputs, I'm surprised. All of those inputs are based on current operating experience or past design decisions. There's nothing about what you expect to happen in the future like

materials degradation, which there's enough information around in the industry to indicate that you might expect problems in certain components in the future. It is not a part of the input to this overall categorization process. Do you have a comment on that?

MR. TRUE: Yes. The NEI categorization process really addresses the active functions of the systems. We rely on the ASME code case N-660 as the basis for dealing with the passive aspects where those kind of aging mechanisms you'd expect to see. And they go through a whole process of looking at degradation mechanisms that are present for the system as a whole.

DR. FORD: Well, the reason for my concern, and maybe I'm misreading the draft of 50.69. Because if you're in a RISC-3 category, if you go through this process and you're in a RISC-3 category and you say hey, it may be a safety component but it's not risk significant or safety significant, therefore you will need not inspect. So could we not therefore have the problem that you've gone through this process and you've said okay this component need not be inspected and then by gum, two years later you have a problem because

of materials degradation, which was never even part of your thinking process.

So the first you know of it, you got a thing in two parts on the floor. Is that a possible outcome or is that --

MR. PIETRANGELO: No. You're making an assumption that the licensee doesn't do anything to the thing that's categorized as RISC-3. That's not correct.

DR. FORD: Maybe I'm misreading 50.69.

MR. PIETRANGELO: There are treatment requirements for the RISC-3 SSCs in the rule.

DR. FORD: Okay. Well we'll get to that. Maybe that's something for the staff to answer. But the way I read 50.69 that you can be forgiven certain ISI requirements in the RISC-3 category.

Yes. Okay.

MR. TRUE: But I want to reiterate that the passive functions of the systems are categorized using a different process as ASME Code case N-660 which is more like a risk-informed ISI process where you look at the degradation mechanisms, the impact of failure and you would be triggered to do inspections on those various --

DR. FORD: I guess as an informed member of the public, this is where I get frustrated that when you bring up something like this, you say ah but that's covered in another part of the process.

MR. PIETRANGELO: Yes, you'll have a presentation on that this afternoon.

DR. FORD: Okay.

MR. ROSEN: Is that mentioned in Revision D? Is that point specifically made in Revision D that N-660 covers the passive components?

MR. TRUE: Yes.

CHAIRMAN APOSTOLAKIS: I believe it is, yes. You don't have to find it now, Doug.

MR. TRUE: Okay.

DR. BONACA: But again going back to that issue there, have to repeat it a lot, but you know one important -- was that only five percent of the components were modeled in the PRA and 95 percent were not. Now, that already is a statement as to the significance or knock off. But I think that it is an important statement to be made and it is a clarification that should come, you know, up front right in the beginning, it would be helpful. You have it clear, but you have to go into the report and have those statements at the bottom of

each one of the evaluations to understand that you really are considering all those. And an applicant is likely to have a lot of components classified under deterministic process rather than by that. So I think it would be helpful to --

MR. PIETRANGELO: If I can summarize what I think I heard, in particular with this chart is that it doesn't do as good a job maybe in depicting the non-modeled components in their treatment in the process? Is that a fair summary?

CHAIRMAN APOSTOLAKIS: Yes. Yes.

DR. BONACA: Yes.

MR. ROSEN: And the passive components. Doesn't give you any hint about the way they're handled.

CHAIRMAN APOSTOLAKIS: And also -- well, maybe not in the chart, but the word "functions" should be defined somewhat early in the report or maybe put an asterisk what you mean.

MR. ROSEN: And before there's any pejorative conclusions drawn about the 5 percent versus the 95 percent, I think it should be clear at what Mario hinted at, that the people who did the PRA knew that the 95 percent didn't enter any dominate sequence.

DR. BONACA: Yes. Yes.

MR. ROSEN: So there's no reason to model components that don't enter into important sequences.

DR. BONACA: Yes.

MR. ROSEN: So it's a work saving method to not model things that end up not having any impact on CDF. So it has nothing to do with the fact that they were just leaving out half -- more than, you know, almost a 100 percent of the plant. It was just that they started with the full plant and said all these things will never enter into any of these sequences, so why model them.

DR. BONACA: Yes.

MR. ROSEN: It was rational.

DR. BONACA: Because it's a burden on the expert panel to review them for conclusion. I'm sure the expert panel would ask questions of the PRA people why didn't you include this component. And the answer is -- well, there isn't an answer for it.

MR. ROSEN: IT doesn't show up.

DR. BONACA: And, again, to fit it into the expert panel would include all those components, irrespective of whether or not they're modeled, right?

MR. ROSEN: Yes, but I mean the answer is always the same. Why didn't you include this component. Because we could have, but it never enters into any sequence, so leaving it out doesn't have any impact at all in the result.

DR KRESS: Shouldn't that be part of the specification of the PRA quality required?

CHAIRMAN APOSTOLAKIS: In a sense it is. Because if something is important, the PRA reviewers will raise the issue.

DR. BONACA: And I would expect the expert panel would probably go on an audit basis.

CHAIRMAN APOSTOLAKIS: Yes.

DR. BONACA: I mean, if I were on one, I would want to know about this system or that component just to test it.

CHAIRMAN APOSTOLAKIS: Why don't we go on. I think that there is an agreement unless the members feel that we should continue this discussion. We're still on slide three.

Okay, Doug.

MR. TRUE: Okay.

CHAIRMAN APOSTOLAKIS: Okay. Go ahead.

MR. TRUE: I'll take it.

CHAIRMAN APOSTOLAKIS: No, if you want

to say something, say it.

MR. TRUE: I think that the function aspect is what's really key. Is that the SSCs that aren't modeled generally do not support a function that's important to the CDF effort.

CHAIRMAN APOSTOLAKIS: Yes. Absolutely.

MR. TRUE: So by tying it back to function, that's how we think we've dealt with the unmodeled SSCs rather than going component by component having to make that decision.

CHAIRMAN APOSTOLAKIS: Yes. Very good.

MR. TRUE: Okay. This figure is a new one that we developed actually as part of the comment package for the 50.69 proposed rule. And it attempts to try and show the overall process and the screens that have to be gone through in order for an SSC to be determined to be low safety significant.

And it, hopefully, does a little bit better job of trying to characterize the move through all the IDP and the various processes.

It starts on the left with the risk characterization process. We go through categorization for internal events, fire events, seismic, other external hazards and shutdown risks. If anything is determined to be high through those

categorizations, it is considered high. It goes to the independent or integrated decision making panel and their job is basically to confirm that that was reflected correctly. They don't move those SSCs to a low safety significance. It's just an approximation.

CHAIRMAN APOSTOLAKIS: So the task -- the task line there means that the IDP does get involved, right?

MR. TRUE: They get involved --

CHAIRMAN APOSTOLAKIS: To confirm?

MR. TRUE: -- to confirm that they're reflected appropriately.

CHAIRMAN APOSTOLAKIS: Fine.

MR. TRUE: Not to decide whether they go into low or not.

CHAIRMAN APOSTOLAKIS: Right.

MR. TRUE: And they basically do is if they determine that it wasn't reflected right, then it's sent back through the categorization process and we go back through the process again. So they're just confirming that it is reflected appropriately. They aren't given the flexibility to move something to low that was categorized as high.

MR. ROSEN: They have no flexibility?

MR. TRUE: They have no such flexibility.

MR. SHACK: It is true even for non-internal events PRA where there's a little box that sort of goes off to the side and says the IDP evaluates the components that came from a non-internal events PRA?

MR. TRUE: That's for ones that were not reflected in a non-internal events PRA.

MR. SHACK: Well, it says other PRA categorization, which I assume was, you know, a seismic PRA, a fire PRA. We'll get to it on figure 17.

MR. TRUE: Right. Okay.

MR. ROSEN: The optimist.

CHAIRMAN APOSTOLAKIS: Keep going.

MR. TRUE: Okay. The same thing is true with the defense-in-depth characterization, which is a set of deterministic questions that the categorizing team goes through to assess from a defense-in-depth perspective whether the SSC function is safety significant or not. If it is identified as being high safety significant, it is again passed through the IDP and they're asked to make sure that it was reflected properly.

Finally, the risk sensitivity study is done looking at those that have made it through all those screens as low safety significant. And if in doing that risk sensitivity study, any SSCs are identified that cause the guideline to be exceeded, then those would be moved to high safety significant. Again, the IDP would review to make sure those have been reflected properly.

Finally, if you get through all those steps as low safety significant, then it's given to the IDP and the IDP is asked to look at those low safety significance SSCs from the standpoint of defense-in-depth and operational experience and make their assessment of whether those should be moved to high or they can remain low. And in the end you end up with the two categories -- four categories of safety significant RISC-1 through RISC-4.

CHAIRMAN APOSTOLAKIS: Now, I think again this diagram should be consistent with the comments we made on the previous diagram. But I think this is an excellent opportunity with these two diagrams and then the accompanying text to again make it clear that when there is a PRA and the more complete the PRA it is, you follow a certain path and if you don't have that, you follow another path.

The staff has a very interesting sentence in there, DG1121. "It should be recognized that the degree of relief that can be expected with will be commiserate with the assurance provided by the evaluation." That's at the end of section 5 on page 5.

So I think that's an important statement. And you can make that explicit here by showing one part with PRA and one part without the PRA. That will also clarify something else. I don't think that the defense-in-depth characterization should be very detailed when you have a PRA. Because the PRA include -- the importance measures do reflect in that. You may want to have a task line there that the IDP looks at it quickly. But the defense-in-depth characterization is much more important when you don't have the PRA. In fact, you and the staff disagree, as we will see later, because the staff has a whole list of questions which really refer to the cornerstones of the ROP and they consider those questions are part of the defense-in-depth evaluation. But when you have a PRA, I don't see why you should go through that because it's already in the importance measures.

So this is a very important issue

because we have to make it clear. And that way if you do it, you're actually encouraging people to have a better PRA.

DR KRESS: Since Dana's not here, the structure of some of the committee would tend to disagree with you a little, George, and from two viewpoints.

One, we don't properly pose what defense-in-depth is in the PRA in terms of how it fits in there. So it's hard to take the PRA and say well this has proper defense-in-depth and this doesn't.

The other thing is the reason for some of the structure is defense-in-depth is the distrust of the PRA or the large uncertainties. So that there should be some functions that are almost independent of the PRA that says now this in defense-in-depth and we're going to make this a safety related system, even though the PRA may not tell you it is because with such high uncertainty in some of the risk characterizations with the PRA.

CHAIRMAN APOSTOLAKIS: But let's not forget what the purpose of this rule is. We are not eliminating trains here. We're not eliminating any barriers. We're reducing as appropriate some of the

requirements. Right? We're not really eliminating anything. We're not --

DR KRESS: Yes we are. We're eliminating some special treatments --

CHAIRMAN APOSTOLAKIS: Yes, but not--

DR KRESS: -- which probably have something to do with reliability, maybe not. So we are doing some things to systems that maybe we should not do if they have a defense-in-depth function.

CHAIRMAN APOSTOLAKIS: But there is a contradiction there. I mean, you have the PRA that tells you that this particular component passes through the fossil vessel --

DR. KRESS: Oh, that's another issue.

CHAIRMAN APOSTOLAKIS: Let me put it in a different way. I don't think that the defense-in-depth characterization should be the same for components that are in the PRA and components that are not. Because we're wasting our time here. There is no reason. And, again, you don't make the distinction between --

DR KRESS: Well, let's talk about one specific item.

CHAIRMAN APOSTOLAKIS: Yes.

DR KRESS: Long term cooling.

CHAIRMAN APOSTOLAKIS: Right.

DR. KRESS: That's going to show up as not risky in the PRA. It doesn't have anything to do with CDF and very little to do with LERF. It's a hell of an important issue, and anything having to do with long term cooling ought to be a safety system and component. Now, you can't use the PRA to tell you that. The expert panel will probably tell you. But it ought to be explicit that this a defense-in-depth issue --

CHAIRMAN APOSTOLAKIS: Because it refers to which accident? The late containment failure?

DR. KRESS: Sure. And that maybe ought to be the other way to use the PRA for it. But it's not part of this system yet.

CHAIRMAN APOSTOLAKIS: Okay. But I don't think at this point is inconsistent with mine.

DR. KRESS: We're probably on a different -- we're probably done.

CHAIRMAN APOSTOLAKIS: For the SSCs for which we have a PRA and we worry about CDF and LERF, there is no reason to go through a detailed difference in that characterization. Now if you want to change that and say but CDF and LERF is not

the only thing I worry about, then it's not in the PRA anymore. So now it falls in the other category of defense-in-depth. So then you look at it more carefully. Late containment failure, for example.

But I don't want to have a blanket thing that no matter where the information is coming from, I have to go through the cornerstones, I have to do a full defense-in-depth characterization. Because I'm making two mistakes there.

One is I don't really show to the licensees that what the staff says here, that the degree of relief can be expected to be commiserate with the assurance provided. And if you do a good job on the PRA, you're providing more assurance. And second, the IDP will have to do work that is really unnecessary.

So defense-in-depth at the higher level, I agree. But --

DR. BONACA: That's why we had recommended that the other criteria also be used.

CHAIRMAN APOSTOLAKIS: Yes.

DR. BONACA: What I think here is important in regulation, what I mean is that -- has to do with core damage and recognizing that there may be additional criteria, then you would apply

that concept to those criteria.

CHAIRMAN APOSTOLAKIS: Right. Then you think in those terms and you say the PRA has not addressed this.

MR. PIETRANGELO: Can I make a suggestion at this point? Every one of these blocks that shows on this charge Doug has additional slides in the presentation --

CHAIRMAN APOSTOLAKIS: I understand that.

MR. PIETRANGELO: -- that really get at the issues I think you're discussing now.

CHAIRMAN APOSTOLAKIS: But my point, Tony, is that this chart and the preceding one are sending messages that are very important, in my view anyway. I mean, the Committee eventually will have to discuss these things. And I think you have to show explicitly that you follow one particular path if you have a PRA and another path if you don't.

Now, we may want to say even when you have a PRA that are certain defense-in-depth issues that are not covered by your CDF and LERF. That's fine. Then you do a defense-in-depth characterization.

DR. KRESS: And there are certain issues

that are covered by CDF and LERF that aren't explicit in here. And they're defense-in-depth issues like are we too much uncertainty in one given set of sequences.

CHAIRMAN APOSTOLAKIS: Absolutely.

DR. KRESS: Or do some sequences overly influence the whole risk picture compared to others. Those will show up explicitly in these things, but I'm anxious to see that they're in there.

MR. ROSEN: Let me say one thing about this block that says independent decision-making panel review, and it relates to all this other discussion.

Well, I would have liked to have seen a bullet there, Doug, that said other reasons. And in particular, it's the kind of things that George and Tom are talking about. For example, feed and bleed. Yes, you can use it in your analysis in PRA and you may get to see CDF and LERF down. But the independent decision-making panel when it looks at sequences that use feed and bleed, it's going to say I'm not going to mess with that. I'm just going to consider anything that I need for feed and bleed as high safety significant, regardless, and put it in there. And I have seen that happen in IDPs where

the IDP says notwithstanding all of that stuff, thanks very much to the working group or whoever brings it to the information, we're still going to make this stuff high safety significant even though it passes all these other screens just because we feel that way today. And that's the role of the IDP. It's going to be senior people who say I just don't want to do that. It just doesn't make me feel, I have an intuition it's not a good idea. Or if you had an hour or two, I'd tell you why I think that. But you don't have a hour or two so just leave it high safety significant. That's the role.

CHAIRMAN APOSTOLAKIS: One last comment why I appear to be insisting on this.

As you know, the issue of PRA quality and scope is a major issue. Not only here, but elsewhere as well. And I think by showing explicitly what benefits you get by doing a better job in the PRA is an important elements of this. Because it's sending a message that, you know, look, you have the IDP, it's an integrated decision making process but as the staff says, the relief will be commiserate with the quality of information. So if you do a very good job here, then the defense-in-depth characterization is relaxed. And as we talk

about things that are not in the PRA and so on.

If you want to rely more on the IDP, then here is a list of questions like the staff has in the DG that follow really the ROP. And they say it does the frequency of initiation events increases, is their pressure boundary intact and so on. So you spend more time there and in direct encouragement to do a better job somewhere else. Because we can't talk about PRA quality in isolation of the actual regulations.

Okay. That was my last. Let's go.

MR. TRUE: Okay. So starting the first block on risk characterization that we identified that the five different risks sources that we look at in the characterization process; internal events, fire, seismic, the other external events and shutdown.

And we allow different approaches depending upon what's available for the facility, except for in the case of internal events, in which case we require a PRA. There's no allowance for some other screening approach.

And basically what we've adopted in Revision D is for the internal events period that has to meet DG-1122 requirements which Reg. Guide

1.200 now will be adjusted in the next version.

For fire, the licensee is allowed to use either a fire PRA or a FIVE analysis for their categorization.

And what we do in the case of the FIVE, which is a not full fire PRA, is we take a lot more conservative approach to which things are characterized as safety significant in that application. And I guess I thought this is kind of where the staff was coming from with the comment you just read, that if you had more PRA you should get more things identified as low safety significant. And we've designed this process from the very beginning to try to do that, but in the context of the risk characterization.

In the defense-in-depth characterization we apply across the board equally whether you have a PRA or not.

CHAIRMAN APOSTOLAKIS: Now, Doug, regarding FIVE and the comment applies to SMA as well, on page 6 of the NEI document it says, the last paragraph, "In the event of a FIVE analysis is used, the categorization process is necessarily more conservative." Has anybody showed that FIVE is conservative in SME or is it something that is

widely accepted for some reason?

MR. TRUE: The short answer is there hasn't been a side-by-side analysis to show that. But I think I can walk you through the logic to show why I believe it is.

In FIVE, the process is basically a screening process.

CHAIRMAN APOSTOLAKIS: Yes.

MR. ROSEN: That you work just hard enough to get things to be screened and the resulting answer is something that's probably greater than a CDF if you summed up all the sequences. Because you haven't credited all the success paths that you could possibly credit for every single scenario.

And what we did there was we said that any SSC or function that you credit in mitigating those unscreened, the remaining fire risks, are all safety significant. And you might actually find if you did importance measures, that that isn't really the case. Because you have, you know, greater and lesser scenario --

CHAIRMAN APOSTOLAKIS: They're not all equal?

MR. TRUE: -- frequencies. They're not

all equal. We treat them all equal. Plus, we went even further and we said anything that you credited to get something from an unscreened scenario to a screened scenario, in effect, if you didn't credit it it would make it an unscreened scenario. That also becomes safety significant SSC.

So we tried to make it be as restrictive as possible in terms of identifying those things that are safety significant. Whereas in a PRA, all the scenarios are treated equality. The probabilities are used to determine the importance measures. WE've tried to look at it from the mitigation side and say what are the things are you crediting and keeping that fire risk low.

CHAIRMAN APOSTOLAKIS: Now, what if some sequence -- well, first of all, I agree that there are a lot of conservative assumptions. But the last time I looked at it I found some things that wasn't clear to me that they were conservative. For example, if you model something burning as a ceiling there, then it's everything that's within a cone above it and the cone has an angel of 35 degrees, I think.

MR. TRUE: Yes.

CHAIRMAN APOSTOLAKIS: Is supposed to be

damaged completely and everything that's outside survives. Now why 35 degrees and not 30, not 40, why not fire model and it fails completely, doesn't fail completely. So that assumption, that particular assumption might be conservative.

Overall I think yes, most of the assumptions are conservative. But it would have been nice to have an evaluation, at least, or some sort of an example where yes the FIVE and SMA results are indeed conservative with respect to a fuller analysis. That would give me higher confidence.

Now, what if a sequence does not survive the screening process of FIVE? Then you have to do a PRA on it?

MR. TRUE: No. Not survive the screening process? You mean it remains as an --

CHAIRMAN APOSTOLAKIS: It remains as a important -- yes.

MR. TRUE: Yes. Then all the SSCs that are credited in mitigating that are high.

CHAIRMAN APOSTOLAKIS: Are high safety significant?

MR. TRUE: They're all high. We don't get to grade them, we don't get to do -- they're

just all high.

MR. ROSEN: When you talk about risk sources on this table, Doug.

MR. TRUE: Yes.

MR. ROSEN: You're talking risk of these sources during all operational modes? For example, high winds during shutdown? For example, fire during shutdown? Is that inclusive, that column?

MR. TRUE: Yes and no. There are two different answers to that.

CHAIRMAN APOSTOLAKIS: Is it a fair answer, yes, no, what?

MR. TRUE: Well, with respect to high winds, for example. Basically the way that process is done when you don't have the PRA is that you are looking for those features of the plant that are there to protect the equipment in the plant from high winds. So, missile barriers, the structures themselves that house the equipment; those are all considered high. We don't evaluate the systems in the plant that are used that's safe to shutdown the plant because those are treated in the other elements of the PRA.

With respect to fire, it's an internal events at power fire PRA that we are -- or FIVE that

we are using in that RISC source.

And shutdown, we look at primarily at the functions related to shutdown and which systems are the primary safety systems to support those functions during shutdown. And it's more at a functional level than at a hazard level.

MR. ROSEN: So if I could summarize your answer, I would say that there's a weakness here in the sense that some of these risk sources in other operational modes other than full power are not fully evaluated? One could postulate a component that's important during a fire during shutdown that's not important when the plant is running? It's a little hard, because the plant obviously after a fire usually shuts down and then that component might become important. But at least intellectually one's troubled by that idea.

MR. TRUE: There could be a situation like that. And, in fact, if you use the non-quantitative shutdown approach, you probably would catch that because you'd be identifying functionally which systems are safety significant.

In the shutdown PRA area, in my personal opinion we don't have the methods available to do shutdown fire, seismic analyses that would be

necessary to make those distinctions anyway.

MR. ROSEN: Well, I'll grant you'll find distinctions. But it's a matter of completeness.

CHAIRMAN APOSTOLAKIS: But shutdown is not a risk source, is it?

MR. PIETRANGELO: It's an operating --

MR. TRUE: It's operating, yes.

CHAIRMAN APOSTOLAKIS: Yes, but I mean it's under the problem of rick source.

MR. SHACK: Now one thing the PRA guy gets stuck with that the other guys don't, is that he has to do accumulative assessment of all the risk associated with these low safety significant components.

MR. TRUE: Right.

MR. SHACK: And you explicitly exclude that from the guy that does the margins analysis. Now, if I do a seismic margin analysis, I do have to keep my one way of saving my plant, and I protect that, and I assure that that's low risk. But I've got all these other things that undoubtedly if I neglect them could increase risk. But I don't have to look at the cumulative effect. It's only when I do a PRA that I have to look at the accumulative effect, the things that I've classified. So in

fact, I've got a negative penalty. I don't think I want to do a seismic PRA. I want to stick with my seismic margins analysis. I'm only making trouble for myself.

MR. TRUE: I think that I look at it differently than that. In the SMA case or FIVE case, all the things you had credited as maintaining low risk in your plant are required to stay high safety significant, and therefore you wouldn't expect their reliability to change. Those are the things that you are relying on to keep the plant safe.

So whether those other ones change or not doesn't really have an effect on whether or not you can keep -- whether you're maintaining --

MR. SHACK: But it may change my level of risk according to my 1.174 criteria, which is what I'm out there doing when I'm looking at the accumulative risk for all the stuff that I classified as low safety significance in the internal events PRA, I have to look at how all that adds up. But I don't get to add these others into that cumulative total when I do a screening analysis.

CHAIRMAN APOSTOLAKIS: My understanding

is that when you do the bounding analysis, you don't declare anything as low safety significant that's part of the sequences --

MR. TRUE: Right. Right.

MR. SHACK: No, but you don't bring anything in as safety significant because you've neglected those other paths.

MR. TRUE: Yes, I guess in a way --

CHAIRMAN APOSTOLAKIS: You've neglected them?

MR. SHACK: You don't consider the possibility that they could be important because they have a contribution to the cumulative risk.

CHAIRMAN APOSTOLAKIS: But if they --

MR. SHACK: In the internal events PRA, if you don't pass the Fussell-Vesely, but yet you come up with a cumulative risk that's too large, you're going to have to include components.

CHAIRMAN APOSTOLAKIS: Because in the internal events PRA you do declare SSCs as low safety significant. In the bounding analysis you never do have it. So what sensitivity are you going to do. You never declare anything low safety significant when you do a FIVE.

MR. SHACK: But I don't declare anything

a RISC-2 because it turns out that it's a nonsafety significant component that becomes important.

MR. PIETRANGELO: No, I think there's things for fire and seismic that are RISC-2 that aren't safety related.

CHAIRMAN APOSTOLAKIS: That are RISC-2?

MR. TRUE: But not too much seismic.

MR. SHACK: But there are other components if I looked at cumulative I might raise to RISC-2. That's my --

MR. PIETRANGELO: Yes, you're correct, I think.

CHAIRMAN APOSTOLAKIS: I don't understand that.

MR. PIETRANGELO: But that's why I think we treat these individually. If there isn't the mechanism to get accumulative total like as you're suggesting, I think that's our rationale for considering these all separately. And when you don't have a quantitative PRA that you could have put it into the more accumulative assessment, you take the conservative approach for that hazard. And that's our answer.

CHAIRMAN APOSTOLAKIS: If I do a bounding analysis and I never declare anything is

low safety significant when I do that, what kind of sensitivity study would I be expected to do. The sensitivity studies are on the SSCs are that declare that there is a low safety significant.

MR. ROSEN: Yes, you got a point there.

CHAIRMAN APOSTOLAKIS: So I do a bounding analysis that never results in anything in low safety significant, I don't need the risk sensitivity? Am I missing something?

MR. TRUE: I think the idea is that there might be an SSC out there that could help you in a seismic event that wasn't considered in your success path for seismic margins assessment.

CHAIRMAN APOSTOLAKIS: Yes.

MR. TRUE: That because you didn't credit it in the safe shutdown assessment, that it is identified as low.

CHAIRMAN APOSTOLAKIS: No. Because you never say it's low unless some other --

MR. PIETRANGELO: Everything he's credited is high. If you didn't credit it, it doesn't get high. It stays where it was.

CHAIRMAN APOSTOLAKIS: It stays where it was?

MR. PIETRANGELO: Right.

CHAIRMAN APOSTOLAKIS: So still I don't sensitivity study. The only reason for --

MR. SHACK: But I don't have to see if that in fact contributes to accumulative risk. If I did a seismic PRA and I went through and I screened the components, everything would be high or low and then I would look and see what the accumulative effect of all those low components were.

CHAIRMAN APOSTOLAKIS: Right.

MR. SHACK: And it could be that some of those low components became important because I didn't pass my cumulative risk criteria?

CHAIRMAN APOSTOLAKIS: Right.

MR. SHACK: I don't have to apply that tests when the seismic margins.

CHAIRMAN APOSTOLAKIS: Because I don't declare anything as low. That's where I get lost.

MR. SHACK: But I don't have the possibility of raising anything either to a RISC-2 type category.

CHAIRMAN APOSTOLAKIS: Right.

MR. ROSEN: There's an important take away from this discussion for both the NEI and the industry and the staff, and it's this: That if a licensee comes in with a lot of screening approaches

a little PRA, they're going to get a lot more questions than the guy who comes in with a lot of PRA and a little screening analysis.

MR. PIETRANGELO: I beg to differ with that, Steve. I think they'll get just as many questions, whatever way you come in.

DR. BONACA: But that's exactly why I made my earlier comments.

MR. PIETRANGELO: In fact, you may even get more questions. Because you opened the box, okay, what about -- and we're going to get uncertainties later, how do you combine the risk contribution from seismic and fire and those uncertainties with what you have at internal events; that's another problem.

MR. ROSEN: That's another problem.

MR. PIETRANGELO: Yes. So it's another box. We'll talk about that in a little bit.

CHAIRMAN APOSTOLAKIS: But that's exactly why I wanted slides three and four to show explicitly two different parts. PRA/non-PRA or outside the scope of PRA. Because they can still be internal events but you worry about late containment failure, for example. And show explicitly what the steps are. And then I think Steve's concern will be

taken care of there.

DR. KRESS: The other issue with these bounding analysis like fire, seismic and even shutdown in my mind is you're relying on importance measures to determine category. I mean, it's part of the system.

MR. PIETRANGELO: One input.

DR. KRESS: One input. And when you don't have a full PRA that actually includes fire, seismic and shutdown, I think that's skews an importance measures.

MR. PIETRANGELO: Sure.

DR. KRESS: And I'm not quite sure how much it skews them or whether the system with their sensitivity study actually captures everything it should.

CHAIRMAN APOSTOLAKIS: That's why the question of whether of FIVE and SMA are really conservative is important. Because if they are, and then they take everything that is credited as being a fire safety significance, then that's a conservative approach. It's skews it the right way.

MR. PIETRANGELO: Yes. Can you guarantee with those analyses that you capture anything that might possibly be safety significant? No, you can't

guarantee it. But it's a conservative treatment of those hazards. And I think the other part of the answer to that is that's why you have an IDP at the end of the process.

CHAIRMAN APOSTOLAKIS: I know --

MR. PIETRANGELO: That's why you do monitoring at the back end of it when you do implementation. Okay. There's checks and balances in this because no one's done the comparison that you suggested, George. And we don't have a lot of the fire during shutdown, and during shutdown, all that other stuff. So you have to look at the whole context of the process. That's why we put that one slide up early to try to give you the context for this and that you had to pass through all these screens to get to be low. And in every case --

CHAIRMAN APOSTOLAKIS: That's why I still think that that the diagram should be revised to show.

MR. PIETRANGELO: We'll come back to that. That's an interesting point.

CHAIRMAN APOSTOLAKIS: There should be something --

MR. PIETRANGELO: We'll come back to that later.

We should probably get on with this.

CHAIRMAN APOSTOLAKIS: So what do we do about the issue of conservatism? I mean, we just accept it that these are conservative? Does the staff agree that they are conservative? I don't know. Maybe we'll ask later.

MR. REED: Ask later.

CHAIRMAN APOSTOLAKIS: You don't want to make a comment now?

MR. HARRISON: This is Donnie Harrison from the NRR staff.

The way I take a look at how this approach works is, it's a scope issue. If I don't have a fire PRA, fire is outside the scope. And so you can't do any special treatment reductions to any components that are part of the fire safety shutdown path. It's out of scope.

Same with seismic. If you don't have a shutdown PRA, and seismic they all work --

CHAIRMAN APOSTOLAKIS: So how does this approach differ from what Doug told us?

MR. HARRISON: It's not. It's consistent with what he's saying.

MR. TRUE: It's the same thing.

MR. HARRISON: But it's a different

perspective, if you will, that I would add if when you look at this if you don't have a PRA, then it's out of the scope of the 50.69 for those components that make up those safety paths. So you can't touch them.

CHAIRMAN APOSTOLAKIS: In which case again the issue of sensitivity doesn't arise. And I'm still lost.

MR. HARRISON: Right. Because it stays as it is. Those paths will stay as is.

CHAIRMAN APOSTOLAKIS: Those stay as it is.

MR. HARRISON: Now, if I did a seismic PRA and a seismic margin, I took my two lists and laid them up against each other, there would be different components in the list. That's a recognition that you would get different lists.

CHAIRMAN APOSTOLAKIS: So if you did a seismic PRA you may declare if your components is of low safety significant. Otherwise you don't touch it?

MR. HARRISON: Right.

CHAIRMAN APOSTOLAKIS: Okay. Makes sense to me.

MR. HARRISON: So that's how the staff

looks at it in the perspective of why we can accept this.

CHAIRMAN APOSTOLAKIS: This is only a relief, it is nothing else.

MR. HARRISON: Right.

CHAIRMAN APOSTOLAKIS: If you don't change the status quo, you don't change the status quo. So then what you are saying is that whether they're conservative or not is irrelevant for this regulation?

MR. HARRISON: That's our take away. Again, I would like to do the proof thing when we do one of these pilots is to come up with what we would think the seismic margins risk would give you and then lay it against what we --

CHAIRMAN APOSTOLAKIS: Are these seismic margins analysis the one that was developed by the NRC?

MR. HARRISON: I think it's up to the licensee. They can follow the EPRI approach --

CHAIRMAN APOSTOLAKIS: Well, it's another seismic analysis --

MR. TRUE: It's EPRI version, NRC version.

MR. HARRISON: So both of them generate

a list.

CHAIRMAN APOSTOLAKIS: Yes, thank you very much.

MR. HARRISON: Thank you.

CHAIRMAN APOSTOLAKIS: Okay. Let's move on to the next slide. Oh my, okay.

MR. PIETRANGELO: Just an example.

CHAIRMAN APOSTOLAKIS: I understand. We understand. Now you're going down to the --

MR. TRUE: Well, I wanted a way to dive into the importance measures, the jigsaw.

CHAIRMAN APOSTOLAKIS: Yes.

MR. TRUE: And what better way then to --

CHAIRMAN APOSTOLAKIS: Then to show it?

MR. TRUE: -- present some numbers. Yes.

Okay. This table comes out of the report and it basically helps characterize how we looked at the importance measures in cases where we have PRA analyses. And we looked at -- well, we changed this a little bit from Rev. B, so we looked at basically three different criterion for safety significance using importance measures. The first being the Fussell-Vesley importance. And what we basically do there is a sum up the Fussell-Vesley

importances for all of the component failure modes and we compare that sum of those importance measures to the .005 criterion to assess whether that would designate it as being safety significant.

That summing we had some discussion, we had some discussion of this the last time. That summing is a conservative way to look at that Fussell-Vesley importance as opposed to looking at them individually or doing something more mathematical. So it creates a bounding assessment of the Fussell-Vesley importance.

Now, on the raw side we take the maximum risk achievement worth for the independent component failure modes and we compare it to a criterion of raw greater than two to determine whether it's safety significant.

And then we've had a lot of dialogue with the staff on the subject of what to do with the common cause basic events in the model. And we've identified a new criterion for those. Because common cause raw involves basically a simultaneous failure during D failure of a whole group of components. It's more like a system level kind of assessment rather than a component level assessment. So we believe that it required a different

criterion. And we designated a criterion of 20 considering those to address the consideration of common cause failures.

CHAIRMAN APOSTOLAKIS: What does that mean? It's not clear to me from reading the report what the conclusion would be. For example, here you have a 54.

MR. TRUE: Yes.

CHAIRMAN APOSTOLAKIS: And the highest is common cause failure of all three valves.

MR. TRUE: Right, which is what you'd expect.

CHAIRMAN APOSTOLAKIS: And what do you do? You say all three valves are safety --

MR. TRUE: Yes.

CHAIRMAN APOSTOLAKIS: Each one?

MR. TRUE: Yes.

CHAIRMAN APOSTOLAKIS: So that's the conclusion?

MR. TRUE: Yes.

CHAIRMAN APOSTOLAKIS: Because there is no room in the RISC categories for events, it's only SSCs that go there?

MR. TRUE: Right.

CHAIRMAN APOSTOLAKIS: All right.

Great.

MR. ROSEN: And the IDP can't change that?

MR. TRUE: Right. And the functions associated with that -- and all that functions associated with those valves are --

MR. ROSEN: From the PRA tends to be out of the common cause part of the PRA, but it's a PRA conclusion just like greater than two for raw for individual components?

MR. TRUE: Absolutely.

CHAIRMAN APOSTOLAKIS: So suppose now I have a common cause failure event, that if I assume it occurs, increases my core damage frequency by a factor of 10. According to this criterion, I shouldn't really declare of high safety significance, and I have difficulty understanding that.

Why shouldn't the SSC raw criterion also be two? What is the difference?

MR. TRUE: It's measuring something entirely different. It's measuring the impact of a whole system failing rather than an individual component.

CHAIRMAN APOSTOLAKIS: It's an event in

the PRA. Strictly speaking in my view what you should do is use one of the multiple Greek letter, or whatever, and say the CFM contributions instead of being treated as separate event is the original failure rate of A times beta, times gamma, you know.

MR. TRUE: Right.

CHAIRMAN APOSTOLAKIS: And then you have the failure rate of A all over the place and you say something about A without having to worry about CCFs being a separate term. But, okay, you don't do it that way. You have it this way.

But still, I mean the probabilities are there, right? You're saying that it's because it's really too drastic to assume that all three fail at the same time, I shouldn't be using a cut off level of two. I should be using something greater. That's really what you're saying? Because now in the common cause case the probability of common cause failure, let's say, is ten to the minus three, and you are raising it to one.

I mean, I don't see why I have to use a different criteria for the CCF, not only different but dramatically different than for individual events.

MR. TRUE: My guess, the explanation was

-- and I've already said this, is that it's measuring it's only different thing. It's measuring the impact on the system based on the way the common cause propagates rather than on an individual component SSC.

CHAIRMAN APOSTOLAKIS: No. Actually, all of these measures measure the impact on the CDF.

MR. TRUE: Right.

CHAIRMAN APOSTOLAKIS: If so, what --

MR. TRUE: But effectively by assuming the common cause failure happens all the time for all those components, you're looking at the impact of all those components failing at the same time which fails the system.

CHAIRMAN APOSTOLAKIS: Well, I don't know. I'm troubled by this. Because you may be right eventually, but it's not clear to me that I should use a cut of value of a magnitude greater. And the argument about the intermediate system and so on, so what? I mean, the other component, you know, is it reasonable to assume it's down all the time? No. But we still say it's down and we look --

MR. TRUE: But individual components do go in and out of service and they are -- that

condition does exist fairly regularly.

CHAIRMAN APOSTOLAKIS: Oh, you mean, that all three are never --

MR. ROSEN: Well, this discussion reflects a conclusion that I would draw also, is that this document to append REV-D, or the new one, final one, needs to justify the 20 more than it does. Because I would say 4.9, I mean one can argue -- I think it has to be higher or it could be done the way George is talking about. But --

MR. TRUE: Can you explain again your way of looking at it? Was the way you looked at just what's the risk impact of assuming a common cause failure happens all the time? And you say that they are equal to one?

CHAIRMAN APOSTOLAKIS: I mean, we never say all the time. Even in the individual components we're saying we want to know what happens to CDF in LERF if this component is always down. Then you go to the CCF and you say what happens if this is always down.

Now, I don't have any reason to say but it's unreasonable to assume it's always down when it's CCF and it's reasonable to assume for it an individual component, because the individual

component will not be down all the time either.

The question is now why -- there are two questions. One is, and the computer codes, it's the fault of the computer codes. The available computer codes treat CCF events as separate events. So that's the starting problem.

Having done that, now you can calculate raw -- by the raw, why didn't you calculate Fussell-Vesley, too?

MR. TRUE: It's considered its sums as part of the --

CHAIRMAN APOSTOLAKIS: Oh, you're saying it's counted already?

MR. TRUE: Right.

CHAIRMAN APOSTOLAKIS: You're probably right.

MR. TRUE: Yes.

CHAIRMAN APOSTOLAKIS: So you're calculating now the raw of that separate event that's called the common cause failure. What's not clear to me is why I should screen that by having a higher standard like -- well, actually a lower standard comparing with the fact of 20 when for individual events I should have a factor of two. Maybe some -- I don't know, some sensitivity

examples, something that would -- you know, I do realize this is an arbitrary choice. But some supporting evidence would have been -- even the other stuff. I mean, it's just the reason why we don't question the five in a 1,000 and the two is because everybody's doing it, right?

MR. TRUE: Right.

CHAIRMAN APOSTOLAKIS: So democratically we have selected --

MR. ROSEN: No. It was done in the proof of concept. Those are the numbers are the proof of concept work.

CHAIRMAN APOSTOLAKIS: Yes.

MR. ROSEN: And so to say we want to use three, would introduce a whole other series of questions. So they stick with the proof of concept thing.

I think this discussion is a good one in the report. It's helpful to the reader, but it needs to also discuss how you pick A, B and C talking about what makes something part of the common cause failure group. You know, shouldn't it also include A, B, C and D and E as well? I mean, you have to say some place how you pick the things that you're going to put in this analysis.

CHAIRMAN APOSTOLAKIS: I guess in that respect they follow the standard approach.

MR. TRUE: Right. Right.

CHAIRMAN APOSTOLAKIS: They are nominally identical components within the same system, right?

MR. TRUE: Right.

MR. ROSEN: Within the same system is what I'm troubled by. Because one can envision a failure mode introduced, for example, by maintenance to a set of valves that are identical but they're not in the same system. And there are valves like that in different systems. But the same maintenance guy goes in and adjusts the packing too tight on all these valves.

MR. TRUE: But I think that the common cause modeling approaches that are used in PRAs are set up to identify the right set of those. In fact, sometimes we do treat cross systems in PRAs.

CHAIRMAN APOSTOLAKIS: Very rarely, though.

MR. TRUE: But the reason is that the environment and the testing, and all the activities that go around those SSCs are different if they're in different systems, generally.

MR. ROSEN: I'm referring to how this document will be used by the industry. It will become very important to independent review panels and working groups, and people who are trying this process. So in a sense it would help those people to give them a little bit more discussion about how to pick the common cause failure group, I think, rather than just say here, it's A, B and C.

MR. TRUE: But that's driven by the PRA standard and the peer reviews that are done on that PRA standard. I think there's -- in fact, I think there's a statement here too that says that if a SSC isn't part of a common cause group, you should make you review to see whether it should be part of a common cause group before you go into the categorization process.

CHAIRMAN APOSTOLAKIS: If you had been more modest and used the factor of five, for example, you wouldn't have gotten all these questions. But, boy, 20. It's pretty high.

MR. PIETRANGELO: Do you have any evidence this ever happened anywhere?

CHAIRMAN APOSTOLAKIS: No. But you do have any evidence --

MR. PIETRANGELO: Right. Well,

individual components fail and are out of service all the time.

CHAIRMAN APOSTOLAKIS: Yes. Well, there is a whole record of common cause failures, so the stuff is --

MR. PIETRANGELO: So to apply the same criteria to an individual component to everything failing at the same time and then use the same criteria?

CHAIRMAN APOSTOLAKIS: We agree what it is. We're arguing about price, okay? Should it be two versus 20 or two versus five? I should it should be the --

DR. KRESS: George, even the principle worried me. What the principle seems to me like is if you look at this event A, B and C common cause failure, that has a reliability. I man, it has a probability associated with that. It's very low. So we're saying because that probability is very low, we can have an acceptable raw that's higher. But we don't do that with all the other components. We don't care what their probabilities are. We don't do that. We just simply don't do it.

CHAIRMAN APOSTOLAKIS: We don't do it. Exactly.

DR. KRESS: And it seems like it's an inconsistency ---

CHAIRMAN APOSTOLAKIS: That's why I'm asking, why isn't it two?

DR. KRESS: Yes. It's an inconsistency to me. I mean, I can see some concept of when you use the raw of having very low probability of failures, having different raw values associated with accepting them. But we don't do that and we don't have any concept of that. So I'm troubled by this also.

CHAIRMAN APOSTOLAKIS: I mean, it's again the issue of the price you pay.

DR. KRESS: Yes.

CHAIRMAN APOSTOLAKIS: If the computer codes choose the easy way out and treat the CCF as a separate event, then the price you pay is that the saw should be 2. Why? In fact, they tend to be the dominant contributors to risk, don't they?

MR. ROSEN: And more dominant in two train systems than in three train systems, I would say.

CHAIRMAN APOSTOLAKIS: Sure. Sure.

Anyway --

MR. ROSEN: More likely to be.

CHAIRMAN APOSTOLAKIS: -- somehow we have to justify that a little better. Why should it be different? Probably should be. But why 20? Twenty sounds too drastic.

I mean, maybe some example of something just to build a case.

MR. TRUE: Okay.

CHAIRMAN APOSTOLAKIS: I'm not asking for a major research project.

MR. TRUE: I understand. I mean, the fundamental philosophy is that, you know, the old beta; if you just look at a beta factor approach and you look at bounding beta factors, they tend to be on the order of .1.

CHAIRMAN APOSTOLAKIS: Ten percent.

MR. TRUE: .1. Maybe actually lower these days.

CHAIRMAN APOSTOLAKIS: Yes. For beta, but then gamma goes down, right?

MR. TRUE: Gamma is a little bit smaller.

And so that's a factor of ten kind of difference in what you would expect to see the raws for those kind of SSCs. So what we're trying to do is pick up the ones that have a different impact,

given that common cause occurs which means that their raw goes up by more than what we would expect it to go up by.

CHAIRMAN APOSTOLAKIS: And this would be a good -- I don't know, I had -- I hate to say that, but if the CCF term is important, maybe you should worry defense-in-depth at that level. Because not all defense-in-depth measures there are included in the PRA. And our pragmatic approach says --

DR. KRESS: The PRA.

CHAIRMAN APOSTOLAKIS: -- it's not explicitly in the PRA, you switch to structurally.

DR. KRESS: So basically it's risk important?

CHAIRMAN APOSTOLAKIS: Yes. So this is something, I don't know, we have to see something more, I guess.

MR. PIETRANGELO: Let's go on.

MR. TRUE: Okay. There are kind of two tiers of --

CHAIRMAN APOSTOLAKIS: But you did change a few things from the previous version we reviewed. I mean, at that time I remember you said that CCF should be excluded from --

MR. TRUE: Yes. We excluded it. We

actually made the argument that if you looked at it from the standpoint of just the common cause term, the beta --

CHAIRMAN APOSTOLAKIS: Yes.

MR. TRUE: -- beta, gamma, delta whatever --

CHAIRMAN APOSTOLAKIS: Yes.

MR. TRUE: -- that the Fussell-Vesley would be bounding anyway, which I think is sort of the direction you were arguing that we should look at them separately. But then when discussions with the staff, we -- you know, we came to the proposal that we would use a factor of 20, yes. So that is different from REV-B to REV-D.

CHAIRMAN APOSTOLAKIS: Okay.

MR. TRUE: Okay. For each of the different PRA studies that are used in the categorization, there are a set of sensitive studies that are mandatory to be applied. These are not the risk sensitivity studies within looking at the importance measures. This is the internal events list. But there's a list for fire and seismic.

There is a set of prescribed and then there is a final bullet which is any sensitivity studies that are identified in the PRA adequacy

process that might be something like RCP, LOCA model, differences in the RCP to LOCA models or differences in some key source of uncertainty that would be used in that -- they effect that particular contributor to risk. And basically you apply sensitivity studies and look at the results.

Now, if you hit a Fussell-Vesley or raw criteria for each of these sensitivity studies, it doesn't automatically trigger something to be high the way it does in the base case. What we do with these, is we keep track of them --

CHAIRMAN APOSTOLAKIS: Are you saying you are recalculating raw and Fussell-Vesley with --

MR. TRUE: For each one of these sensitivity studies.

CHAIRMAN APOSTOLAKIS: It's not clear in the report. In the report I think it says that you do this and then you compare it with 1.174 criteria. Because that was a question in my mind.

MR. PIETRANGELO: No, that's the other sensitivity study.

MR. TRUE: That's the --

MR. PIETRANGELO: Accumulative risk.

MR. TRUE: -- accumulative risk.

MR. PIETRANGELO: These are individual

sensitivity studies as part of the risk characterization.

CHAIRMAN APOSTOLAKIS: Where does it say that your -- after I do the -- I'd like to see that. It's page what?

MR. SNODDERLY: Page 32.

CHAIRMAN APOSTOLAKIS: Thirty-two.

MR. TRUE: Again, I guess it doesn't explicitly say that, but the implication by those paragraphs following the table is that you go back through the categorization review for the importance measures. That's the way all the pilots have done it, too.

CHAIRMAN APOSTOLAKIS: So what's the point of increasing the human error rates? I mean, the human error rates are not part of the categorization, are they?

MR. TRUE: But they certainly affect categorization.

CHAIRMAN APOSTOLAKIS: They certainly affect categorization, but they I don't think -- well, speaking of that now, now you're raising the issue of model uncertainty. And you also make another common that the uncertainty bounds in PRAs are relatively small. Experience with plant

specific PRAs has shown that the variations and distributions are relatively small. That's page 32.

Going to the 95th percentile really doesn't make much of a difference. That's the argument.

I think you're probably right when it comes to the uncertainties due to some statistical evaluation of variation of --

MR. TRUE: Right.

CHAIRMAN APOSTOLAKIS: There are two or three, or maybe at most four cases in level one PRA and more in level two PRA where there is a significant issue of model uncertainty.

MR. TRUE: Correct.

CHAIRMAN APOSTOLAKIS: And you guys don't say anything about it. I don't know myself how to handle it. But it's important and the staff, in fact says on page 5, "The NRC staff knows that draft revision C of any" such-and-such "does not address modeling or data uncertainties explicitly." And there it talks about items identified during the assessment of PRA adequacy and so on. So the staff does refer to model uncertainty.

MR. TRUE: Yes.

CHAIRMAN APOSTOLAKIS: I don't know how

you would handle it.

MR. TRUE: Let me tackle it. Let me tackle that a little bit. Because I think we do address it.

A couple of things. First of all, human reliability models are: (a) modeling uncertainty. That's one of the things we know.

CHAIRMAN APOSTOLAKIS: Absolutely.

MR. TRUE: And so the purpose of these first two sensitivity studies on human error rates is actually to see if you've introduced some bias in your categorization through your human error analysis that is causing something to be less significant than it should be. So by pushing all the human error rates up through upper limit, you're looking at well what if the operators were a lot worse, what are if the operators are a lot better; then your analysis by going on the fifth percentile, does that uncover SSCs that would be safety significant if your operators were more reliable?

CHAIRMAN APOSTOLAKIS: But the problem with that argument, Doug, is that it assumes that the baseline PRA that you're working with has included model uncertainty, that's why the 95th percentile is what it is. And, as we know, it

doesn't. I mean, if you use a -- you get a certain distribution. If you go and use something else, you get another distribution. And we have this infamous benchmark exercise from Europe where the results were all over the place. Are you familiar with that paper?

MR. TRUE: No.

CHAIRMAN APOSTOLAKIS: Maybe we should make sure that he gets two papers, the second one being the one I'm coming to.

So the human error model uncertainty is not there. I mean, it's just not there. So by going to the 95th percentile -- on the other hand, you know, I would hate to say that you have to do a complete model uncertainty in order to implement 50.69, but you need to do something.

MR. TRUE: Okay. Can I continue just for a sure.

CHAIRMAN APOSTOLAKIS: Well, sure.

MR. TRUE: Try and address that.

Common cause is another area that we know that there's a lot of uncertainty. So we do a similar sensitivity study for that.

We also know that the plant is never in the average maintenance condition that our average

annual PRAs look at, so we sensitivity study where we look at all maintenance unavailability terms set to zero, which is actually sort of the default stage for the plant.

And then finally, we look for those issues that were identified in the PRA adequacy characterization, which includes the key sources of modeling uncertainty as another source of sensitivity studies. And that's what the last bullet is supposed to look at it.

CHAIRMAN APOSTOLAKIS: Yes.

MR. TRUE: If in the peer review classes and in the assessment adequacy there were identified modeling uncertainties like RPC to LOCA models, those kind of things.

CHAIRMAN APOSTOLAKIS: Yes.

MR. TRUE: Then you would be expected to do sensitivity studies on those also and look at the Fussell-Vesley to raw when you do those sensitivity studies.

DR. KRESS: Now, these sensitivity studies, they're done one at a time? They're not all done at the same time?

MR. TRUE: Correct. Correct.

CHAIRMAN APOSTOLAKIS: So all human

errors are raised and then you do it on computer.

MR. ROSEN: And then you get the answer, then you change it to a 5th percentile --

CHAIRMAN APOSTOLAKIS: Why not the combination?

DR. KRESS: Well, that's one of my questions. The other question is, maybe to you, George, if I increase my human error rate to the 95 percentile I'm going to get an increase in CDF. That means for any other components I'm going to get a decrease in their raw.

CHAIRMAN APOSTOLAKIS: That's right.

DR. KRESS: And a decrease --

MR. TRUE: No, not necessarily.

DR. KRESS: So --

MR. TRUE: No, the raw could go up.

DR. KRESS: Usually it wouldn't.

CHAIRMAN APOSTOLAKIS: Why?

DR. KRESS: There may be a component associated with that action.

MR. TRUE: Right. That's the whole idea is you're trying to bring the sequences that involve human errors up to the top --

DR. KRESS: It could change the sequence, that's true. But --

MR. TRUE: But when you bring those to the top, now when you've set that component to failed, you could make the -- the raw could go way up over what it was when it was in --

DR. KRESS: For some part components that are in those sequences. But for the others it's going to come down.

MR. TRUE: Right. And that's why we do the other one when we say --

DR. KRESS: Yes, you go the other way?

MR. TRUE: -- the HEPs down to the lower level to see if the HEPs aren't masking something that's important.

DR. KRESS: That's what I was going to ask. That's why you do both directions?

MR. TRUE: Right.

DR. KRESS: Okay. And if things change, raw component jumps over the criteria either way, you keep it. But you don't throw anything out?

MR. TRUE: Well, what we do with these when you do sensitivity --

DR. KRESS: You -- the information alone?

MR. TRUE: We don't make it high. We identify that through the IDP for them to consider.

Because these are pretty extreme cases where we're setting all the HEPs way down or all the HEPs way up at the same time. It's not a reflection of reality, it's a sensitivity study. And we want then the PRA analysts to go to the IDP and explain we did the sensitivity study, we found it was now significant and this is why we found it to be significant. And let the IDP make the call on whether that should be high or low.

So what we're trying to do is to make sure that the model doesn't have some ballast in it, human errors, common cause failures or otherwise that is covering up the importance of an SSC.

CHAIRMAN APOSTOLAKIS: Nobody questions the intent of this. It's how to do it.

Let me offer you another idea. As I said, there are very few significant uncertainties in level one. In level two you may have more --

MR. TRUE: In LERF yes. Few in LERF two.

CHAIRMAN APOSTOLAKIS: You recommend in the risk sensitivity study to increase by a factor of two or five the failure rates or the unavailabilities.

MR. TRUE: Right.

CHAIRMAN APOSTOLAKIS: And run it. Why don't you propose something similar here? What would that do? It would do two things.

First, you would not have to rely on 95th percentiles and so on which maybe the licensee doesn't have.

Second, you can cover modeling uncertainty. Because it's easy to go back. If I go back to this European paper and look at the results, it's clear to me that a factor of ten for example, for human errors only of commission during the dynamic situation, would be more than enough to do my sensitivity study and then evaluate it through the IDP.

So you say for human errors, multiple by five or ten, or seven, seven and a half. Then --

DR. KRESS: Which could be about the 95 percentile.

CHAIRMAN APOSTOLAKIS: Well, yes. But the model uncertainty shows it -- then you go to past experience. You read this paper by Bley and other people; reactor coolant pumps, seal LOCA timing is a model uncertainty issue. Maybe there's a factor of two or three there. The age failure is another one. There are no more than three or four.

And give them factors like two and five where you say without tying it to 95th nd 5th percentile, and claim them that model uncertainty has also been covered.

Now, that sounds like a big deal, but it's not. Because this one will be controversial perennially because it relies a lot on this particular distribution they have developed which is based on one model, right? And their 95th percentile. And then you have to question the quality of their distribution, and this and that; whereas if you give them a generic -- because you do that already in section 8 for a different purpose. But you do it. That's a new concept to your document.

MR. TRUE: So you're proposing that instead of saying set all HEPs to the 95th percentile, we increase them by a factor of X.

CHAIRMAN APOSTOLAKIS: Right.

MR. TRUE: And then have Vance come back and testify why I picked X as the --

MR. ROSEN: Oh, yes, there's no free lunch here.

CHAIRMAN APOSTOLAKIS: But then it's easy because you can come back with this figure and

say look guys, this is the scatter and for some reason I don't like the factor of 15 here, but I will have something else. Fine. But they don't have to do it for everything. That's my point.

MR. TRUE: Right.

CHAIRMAN APOSTOLAKIS: There are three or four key --

MR. TRUE: So are you saying that we don't need to do sensitivities studies on human errors and --

CHAIRMAN APOSTOLAKIS: No. You do sensitivity studies of a different kind.

MR. TRUE: -- common cause? Right.

CHAIRMAN APOSTOLAKIS: Yes, of a different kind. Like if you common cause failures, I'm not sure that there is a major modeling disagreement these days. I mean, most people tend to follow now the multiple Greek or the alpha factor. Okay. So to be a structuralists you say, okay, maybe it's not complete, multiple by three and see what happens. Because it's not a major issue anymore. But human error during accidents is a major issue, so your factor now will be higher. You can look at what others have done.

Unfortunately, such comparisons are not

really common, that's why we have to go back to this European exercise and say, maybe a factor of six or five and see what happens. And then the IDP scrutinizes the results in case, you know, that was too much or too little.

And it's consistent with your section 8. And then you have the advantage that you can claim that you have covered more than uncertainty, which is always a vexing issue and what do we do about it.

Nobody likes these things.

MR. TRUE: Okay. Ar you further proposing that we identify a more extensive set of modeling uncertainties?

CHAIRMAN APOSTOLAKIS: I would say, Doug, it will not take you more than half an hour to call up your colleagues who have done real PRAs and they will give you the list of the two or three items that they believe -- I'm telling you, this paper which we will give you a copy of, it does not identify more than three or four. And it's the result of an experience, as you know, with a lot of PRAs.

What I find fascinating here that one utility, PG&E, in fact spent money to modify the plant to reduce the model uncertainty in the PRA.

DR. KRESS: What bothers me a little about that, George, is it deals specifically with CDF. And we're concerned about LERF and releases in a small place, delayed accidents. And we're just throwing those out the window. We're not dealing with them at all in the model uncertainty part of this.

CHAIRMAN APOSTOLAKIS: No. I said in level two there are more significant issues.

DR. KRESS: I know, But your recommendation doesn't deal with that, and I don't know how to deal with --

CHAIRMAN APOSTOLAKIS: No, no. My recommendation was more specific on level one.

DR. KRESS: Yes. Sure.

CHAIRMAN APOSTOLAKIS: Because I'm more familiar.

DR. KRESS: I understand. It's a good thing to do for level one, but we still have the problem of model uncertainty and how to deal with it in a complete sense.

CHAIRMAN APOSTOLAKIS: Yes. Yes.

DR. KRESS: And it doesn't answer the full question.

CHAIRMAN APOSTOLAKIS: Yes. But I

wouldn't want to recommend, though, the 1150 approach. I mean, no. It's out of the question. I mean, we have to be practical.

DR. KRESS: Oh, absolutely.

CHAIRMAN APOSTOLAKIS: But you can approach on 1150.

DR. KRESS: You can build on 1150. And I tell you how I would approach it, and I'm not sure I haven't formulated this yet, but the way to deal with model uncertainty is to incorporate it in your acceptance criteria somehow. Choose your acceptance criteria so you've already incorporated model uncertainty into it.

CHAIRMAN APOSTOLAKIS: Somehow. That would be a little bit more drastic for these guys.

DR. KRESS: Oh, yes. Oh, yes.

CHAIRMAN APOSTOLAKIS: But somewhere else.

DR. KRESS: But somewhere else. You know, we need to think about --

CHAIRMAN APOSTOLAKIS: But in this case for example for the early containment failure, you may go back to 1150. And, again, your buddies in the industry and say well, gee, what were the major model uncertainties here? What is it that they're

showing? And then come back and say you multiple this by three. And you do your sensitivity study.

DR. KRESS: Well you use an acceptable LERF that's different than what they're using that incorporate model uncertainty in it already.

CHAIRMAN APOSTOLAKIS: You can't do that here, can you?

DR. KRESS: Oh, no. No. But that would be the principle.

CHAIRMAN APOSTOLAKIS: But I think that would really make the document very good doing that. And, as I say, this is not a foreign concept to your document. You're already doing it somewhere else for a different purpose.

And I was surprised myself, in fact, when I read this paper by Bley and the others that they only found so few major modeling uncertainties in level one. In level two, of course, it's high.

Your buddies in the industry will experience them, and your own company will not have any problem telling you what the important uncertainties are.

MR. TRUE: Okay. Personally, I don't believe it's only a handful of uncertainties.

CHAIRMAN APOSTOLAKIS: Well, they're not. I agree with you.

MR. TRUE: I want to make sure I understand, though, what you're suggesting some I have some paper disadvantage here. Are you suggesting a factor up and a factor down or only a factor up? I only heard you about the factor up.

CHAIRMAN APOSTOLAKIS: Up is my great interest, of course. But if you want to go down, too, that's fine.

MR. TRUE: But see, that's what I don't understand. You have to go down.

CHAIRMAN APOSTOLAKIS: Okay.

MR. TRUE: Because if the modeling uncertainty is causing to cover something up --

CHAIRMAN APOSTOLAKIS: Sure. Yes.

MR. TRUE: -- then you have to go down.

CHAIRMAN APOSTOLAKIS: Absolutely.

MR. TRUE: And, in fact, in Revision B, I think it was, we used to have a number here. We used to have a factor of 2 or X or something; I don't remember what the number was. And we felt that there was really no basis to justify a number. And we went to a percentile kind of approach.

CHAIRMAN APOSTOLAKIS: But there may be a basis to what I'm saying. I mean, by calling up your friends.

MR. TRUE: Okay.

CHAIRMAN APOSTOLAKIS: They will give you some idea by looking at the literature. And I'm not talking about the 100 things here. I only have two. Maybe there is a third one somewhere else.

MR. TRUE: Okay.

CHAIRMAN APOSTOLAKIS: It's very easy. Because the factor will be essentially a fudge factor.

DR. KRESS: But don't you have to do a model simultaneously in your sensitivity?

CHAIRMAN APOSTOLAKIS: Yes. That's another issue now. If you are unlucky enough that all your models are wrong, I don't know --

DR. KRESS: Yes. That was my point of asking if these were done simultaneously.

CHAIRMAN APOSTOLAKIS: You have to use judgment there. Because, I mean, that's a problem with sensitivity studies; they are ruminants of the old engineering approach that don't prove uncertainty. So now you're saying I ut everything to -- increase everything by a factor of five, in my mind that's an extremely unlikely situation. So maybe you do one or two at the time, I don't know.

Anything else on this slide?

MR. TRUE: No.

CHAIRMAN APOSTOLAKIS: When I chair meetings, we never go beyond an hour and a half without a break.

MR. ROSEN: Good idea.

MR. TRUE: Fine with me.

CHAIRMAN APOSTOLAKIS: Okay. Yes, sir.

MR. SNODDERLY: I'm sorry, George. Before you break --

CHAIRMAN APOSTOLAKIS: Don't take mine because I marked it up.

MR. SNODDERLY: I know. But for the purposes of the record, I just wanted to read in what the title and the authors are. "The Strengths and Limitations of PSA: Where We Stand," by Dennis Bley, Stan Kaplan and David Johnson.

And the other paper "The European Benchmark Exercise on Human Reliability Analysis" by Andre Poucet.

DR. KRESS: Mike, when you get copies made for these people, can you get some for the rest of the committees' members.

MR. SNODDERLY: I'll do that and we'll also include

MR. ROSEN: Yes, a third or fourth one.

MR. SNODDERLY: And we'll include one for the record.

DR. KRESS: Yes, I can read it on the airplane, though.

MR. SNODDERLY: So right now we're about halfway done. We'll be on slide 8. And there's 21 slides. So we're just a little bit passed --

CHAIRMAN APOSTOLAKIS: And we have covered some very important issues. I think it's going to go faster now.

DR. KRESS: How much are you willing to bet on that.

MR. ROSEN: Oh you man of too much faith.

MR. SHACK: That's supposed to be my job up here is to make Doug gets --

CHAIRMAN APOSTOLAKIS: So we will reconvene at 10:25.

(Whereupon, at 10:07 a.m. a recess until 10:26 a.m.)

CHAIRMAN APOSTOLAKIS: Let's continue.

Okay, Doug.

MR. TRUE: Okay. I'm going to continue on the important measures subject to briefly, hopefully --

MR. ROSEN: Briefly.

MR. TRUE: I'll be brief.

One of the comments that the Committee had provided in the letter from a few years ago was raise some of the limitations of importance measures in doing categorization. And we think that we've addressed a lot of those in the design of the process, so I wanted to talk a little bit about the use of importance measures; how we use them and how we think we've addressed the key limitations.

We do use them for the cases where we have PRAs. They're done on the basis of CDF and LERF. And they do measure a relative contribution or relative impact on those metrics. And the philosophy behind that is that we are focusing on trying to maintain the current level of safety.

We could have used absolute criteria, but that would have allowed for, in certain cases, risks to go up and it's very difficult to create an absolute criteria that's one a size fits on proposition for the categorization process. So we decided to maintain the current level of safety approach which uses these relative measures.

A couple of the key kind of generic limitations on importance measures that we believe

we address and the pilots have addressed is making sure that the IDP understands what the importance measures mean and how to interrupt what the PRA is saying when it says the Fussell-Vesley is X or the raw is Y.

And then we also believe that the process addresses the limitations of importance measures that Reg. Guide 1.174 identifies in one of it appendices. This ia new table that had around that never included any documents to date. But I think 1.174 does a pretty good job of identifying a lot of the key associated with importance measures and their use and identifying significance.

There's a paragraph or more on each of these subject, but I tried to pull out kind of the key issue for each of the items in 1.174.

First is truncation limits, and yes importance measures can be impacted by the truncation limit using the PRA. We tried to include explicit guidance in NEI 00-04 on establishing appropriate truncation limits. Even went so far as to address some of the methodological differences that exist in codes that ca impact your calculation of importance measures based on truncation limits. Some codes quality branch points in the PRAs using

fault trees. Generally it cut sets and then they merge those merge those cut sets together into the overall answer. So you really have two truncation limits at play. One is the overall truncation limit and the other is truncation limits for the individual inputs to that. We tried to address that in the guidance explicitly to make sure that we're doing a good job of establishing truncation limits that give us good importance measures.

The risk metric used is identified in 1.174 and it particularly says you should address both CDF and LERF. We do that. We've gone one step further than that in that we do a separate consideration of each of the hazards that has a PRA associated with it. So we don't just throw all the hazards together into one and calculate an importance measure which could totally skew your importances. If for example, you had a particularly large contribution from fire, for example, it might totally overwhelm the importance measures for the general events or seismic. And we wanted to make sure we broke that out and could look at the contributions individually from each of those different hazards.

We do go through a process that I'll get

to later where we bring those back together and look at them in combination. But we think it's important to look at them individually and make a decision on them individually.

Completeness in the important measures really goes to the scope of the hazards. We've tried to address through this process both with and without PRA analyses that overall scope of hazards, and we've kind of gone through that discussion.

Uncertainties can impact the importance measures. Parametric uncertainties can. And I'll get to a little bit of a summary of an EPRI report that you were given last week or week before.

CHAIRMAN APOSTOLAKIS: I have it? I haven't seen. I don't think I have it.

MR. TRUE: Well, you'll get to hear about it today.

CHAIRMAN APOSTOLAKIS: But we do have it in the office.

MR. TRUE: We looked in the parametric uncertainties and the impact on importance measures, actually based on one of your comments two years ago. And did a pretty interesting little study of how they impact importance measures. And I'll get into some of those results in a minute.

CHAIRMAN APOSTOLAKIS: Good.

MR. TRUE: Common cause failures and considering them in the importance measures was raised 1.174. And we've talked about how we've addressed that both in terms of the criteria and the role of CCF in sensitivity studies.

Recovery actions is another area that 1.174 addresses and we have a sensitivity study for the human failure events that we just talked about.

Everyone knows the importance measures look at things in isolation. And so when we're dealing with multiple components we have to deal with that in some way. And our risk sensitivity study that we'll get to in a few minutes helps us make sure that we haven't looked at everything in isolation and missed the big picture that by changing things about multiple components we may have changed the risk.

That carries over also into the change in risk. Because an importance measure itself isn't the measure of change in risk; it's a measure of contribution. So the sensitivity study, risk sensitivity study helps us address that.

And the finally, unmodeled SSCs are addressed by the way that we go about taking the

importance measures that we have, looking at the functions and their importance and then assessing that functional importance and then essentially reflecting that functional importance back on all the SSCs that contribute to that. And that's done on a very gross manner on the first pass through. Any SSC that contributes to that function is considered high, even though if you looked at them individually you might find they aren't, on the first pass through we make them all high and then we force then in an engineering evaluation at the end that go through and deterministically determine whether they actually do contribute.

So we feel like we've addressed. We've importance measures to do what they're good for, and we've tried to address some of the limitations in the overall process that we've designed.

That's the end of importance measures for today.

EPRI study. After the last time that we talked about the use of importance measures, we set about to do a study for EPRI -- through EPRI to look at how parametric uncertainties effect importance measures using the categorization process. Since we had the sensitive studies that look at some of the

other sources of uncertainty, we think that's covered. But particularly there were questions raised about how does the parametric uncertainty effect it.

We took one of the PRAs that had been used in the pilot process for the BWRs group and did it on a sample basis. So it's not, you know, every PRA in the world has been looked at, but one that was used. And we looked at three systems that were used in that pilot.

What the report covers is a sort of general discussion on uncertainties and a lognormal distributions that we have in the model and how that effects our perceptions of an uncertainty.

We looked at point estimate results that we get out of our PRAs. Because one of the things that's important to note is that all the importance measures we get out of PRAs are based on plant estimate models. They're not based on a mean value that's generated using the full integration of uncertainties.

So while the mean that you calculate using uncertainty analysis might be slightly different than the mean you get from your point estimate, the importance measures come from the

point estimate model. I'm not sure that's totally understood by everybody.

CHAIRMAN APOSTOLAKIS: I understood what you're saying. But some PRAs do use mean values as equals or complete distributions. But you're right, mostly --

MR. TRUE: But the correlation effect that isn't accounted for in the importance measures.

CHAIRMAN APOSTOLAKIS: You're right.

MR. TRUE: So we wanted to specifically look at that and see if you considered that, would it change your perception of the categorization.

CHAIRMAN APOSTOLAKIS: Right.

MR. TRUE: And then we also looked at the sensitivity study results to see how they compared to what we were getting out of this look at the different uncertainties. Unfortunately, you don't have the report because there's a whole bunch of analyses that go into it. And I'm only going to hit kind of some of the high points.

MR. PIETRANGELO: But the report Doug's referencing, it's about a 120 page report. We had provided it to Mike last week. We fully expected you would have had a chance to review that. You can look at it afterwards.

CHAIRMAN APOSTOLAKIS: Sure.

MR. PIETRANGELO: If there ar additional questions you have, you can forward them to us.

CHAIRMAN APOSTOLAKIS: I believe --

MR. PIETRANGELO: He's probably looking for it now. But D

CHAIRMAN APOSTOLAKIS: Doug's going to summarize the results.

MR. TRUE: Yes, I'll summarize some of the things.

CHAIRMAN APOSTOLAKIS: Is this the result now or --

MR. TRUE: No. This is -- and we talked about this I think last I was here. But one of the things that I like to reenforce about the term parametric uncertainty topic is that basically our PRAs are dominated by lognormal distributions. So almost all the inputs we put in use lognormal distributions. And when we talk about the fact that there are large uncertainties, when we actually use mean values, that mean is skewed pretty far towards the upper end of that distribution. In fact, as the uncertainties get larger, that mean begins to approach the 95th percentile and can even pass that. And in fact, what this graph shows is that the most

that the mean is off from the 95th percentile is a little bit less than a factor of four for the most cases that we're dealing with, which most parameters and even over all results from internal events, PRAs especially are down in the range factor of five to ten, or even smaller.

When we get into seismic areas and other places, we may have higher range factors up in the 100 or higher. But at that point the mean is rapidly approaching the 95th percentile. So from a parametric standpoint the mean is already skewing us towards the upper bound of the distribution.

CHAIRMAN APOSTOLAKIS: But not the point estimate, though, the mean?

MR. TRUE: The mean.

CHAIRMAN APOSTOLAKIS: You said the PRAs are done by implementing point estimates and getting a point estimate out. That point estimate has nothing to do with this.

MR. TRUE: Well, there are two different aspects to that. There's the individual values that are put into the model that could be point estimates or could be point estimate means.

CHAIRMAN APOSTOLAKIS: Right.

MR. TRUE: In general, the way we try to

do those is to use mean values for those point estimates.

CHAIRMAN APOSTOLAKIS: Right.

MR. TRUE: Right. If you have those means, then they exhibit this property.

CHAIRMAN APOSTOLAKIS: Yes. Then you get the mean out, I agree.

MR. TRUE: No. We don't actually get the mean. You get a point estimate and then there's another aspect of that which deals with the correlation of the data and underlying data which can then move the mean a little bit again.

CHAIRMAN APOSTOLAKIS: Right.

MR. TRUE: And it can actually move the mean up a little bit, usually it's not a large factor.

CHAIRMAN APOSTOLAKIS: True. True. But if you input just .5, then you really don't know what the output is. Not means, just point values.

MR. TRUE: You're making a distinction that -- basically --

CHAIRMAN APOSTOLAKIS: Right.

MR. TRUE: If I just pick a number that I don't know is the mean and put the number in there and propagate it.

CHAIRMAN APOSTOLAKIS: Yes.

MR. TRUE: Yes, it's a garbage in, garbage out.

CHAIRMAN APOSTOLAKIS: Well it's not garbage. But a lot of people do that and they get something out. But we really don't know what that is.

MR. TRUE: And I think we agree, or I agree that it's important that the inputs to the PRA model represent mean --

CHAIRMAN APOSTOLAKIS: Absolutely. Yes, I agree.

MR. TRUE: And so I'm sort of taking for granted that we're going to have a PRA that has man values put in it. In fact, in reality I think we actually tend to use something higher than the mean a lot of times, because we tend to bound things with conservative assumptions.

CHAIRMAN APOSTOLAKIS: I mean, with the availability of codes now, inputting lognormal distributions really is not a big deal, is it? I mean, you don't have to use just a point value as an input.

MR. TRUE: Well, no, and most people don't anymore.

CHAIRMAN APOSTOLAKIS: Yes. You can easily carry over a Monte Carlo routine and pick, get the distribution of the output. Don't you think so?

MR. TRUE: You can, but your importance measures aren't based on that calculation. That's when it's important.

CHAIRMAN APOSTOLAKIS: No, they're based on mean values. Absolutely.

MR. ROSEN: They're based on the point estimate values which are, hopefully --

CHAIRMAN APOSTOLAKIS: Yes. Yes.

MR. TRUE: Okay.

CHAIRMAN APOSTOLAKIS: Did you want to say something?

DR. KRESS: Well, this curve is a general characteristic of lognormal outputs. It has nothing to do with inputs.

CHAIRMAN APOSTOLAKIS: It's actually characteristic of the lognormal distribution.

MR. TRUE: Lognormal distribution period.

DR. KRESS: Yes. It has little to do with what it choose for inputs and their effect on the output because the effect on the output of your

inputs changes both factors on there. I mean, it changes where you are on that curve.

MR. TRUE: But you're never going to know--

DR. KRESS: I mean, it doesn't say anything about me choosing the mean of inputs, how it's going to effect the output. I mean, it doesn't tell me where I am on the output at all.

CHAIRMAN APOSTOLAKIS: I guess there is an assumption here which I think is supported by experience that in general the output can be approximated by a lognormal.

DR. KRESS: Yes. CDF is generally a lognormal distribution.

CHAIRMAN APOSTOLAKIS: In which case these properties apply.

DR. KRESS: Yes.

CHAIRMAN APOSTOLAKIS: That's what he's saying.

DR. KRESS: All you're saying, though, is that if your acceptance criteria on CDF were to say, for example, instead of using the mean which is what's in the 1.174, you should use the 95 percentile, well you know that's not going to be no more than four times higher, so it's not much of

concept.

CHAIRMAN APOSTOLAKIS: Right.

DR. KRESS: I mean, to use --

CHAIRMAN APOSTOLAKIS: That's what he's saying.

DR. KRESS: Yes.

MR. TRUE: That's what I'm saying.

DR. KRESS: But still, I don't know where I am when I use the mean of the inputs. I don't know where I am on output space still. Even if I just u se a point estimate or using the actual mean I don't know what I'm at. Because that depends on --

CHAIRMAN APOSTOLAKIS: Yes. Doug said that you have neglected the correlation and so on. But the input probably is not very dramatic. Probably. You're in the neighborhood of the mean. The real thing is the model. No, but this is all parameter stuff.

MR. TRUE: Right. This is just parametric. Right.

CHAIRMAN APOSTOLAKIS: The fact that, for example, you have used one model for errors of admission or omission versus another model, that can have a major impact. So this is all parametric.

Because there's so many of them, I guess, that a whole lot of numbers --

DR. KRESS: But I would like to see this justification to your statement.

Suppose I choose all means for my parameters?

CHAIRMAN APOSTOLAKIS: Yes.

DR. KRESS: You're saying that I'm close to the mean on the output. I've never seen that justified in anyway.

CHAIRMAN APOSTOLAKIS: Yes. Pretty close.

The only thing you --

MR. TRUE: Well, the study actually looked at that.

CHAIRMAN APOSTOLAKIS: Yes. The only thing you're neglecting if you have a -- state of knowledge for relations where, you know, in the Monte Carlo simulation when you pick a value for valve A, then you have to pick the same value for valve B; that tends to create broader distributions. So the mean moves. That effect you miss when you do just .5. But if that was an important event everywhere, then you would be right. But it's not.

MR. TRUE: And the reason it's not, I

believe, is that in general we don't find cut sets, if you will, as a representation of the results that involve multiple -- a single cut set that involved MOV here, MOV in train A, MOV in train B, MOV in train C as dominate contributors to risk. If we had lots of cut sets where we had the same distribution being sampled --

CHAIRMAN APOSTOLAKIS: Right.

MR. TRUE: -- in the same cut set, then that correlation effect will be much larger. But we don't see that because of the way that the --

CHAIRMAN APOSTOLAKIS: But what's your message from this slide?

MR. TRUE: I'm sorry.

CHAIRMAN APOSTOLAKIS: What message are you sending us from this slide?

MR. TRUE: The message is that the distribution is skewed. And as we worry about how large the answer might be just in using the distribution, the mean is pretty darn close to the upper bound.

CHAIRMAN APOSTOLAKIS: The upper parameter?

MR. TRUE: For the parametric uncertainties. And that's all.

CHAIRMAN APOSTOLAKIS: That's true.

MR. TRUE: I mean, I'm just trying to say we don't need to get too concerned about parametric uncertainties when we're talking about the results. Because we might be off by a factor of three.

CHAIRMAN APOSTOLAKIS: I think the Committee has already struggled, agreed that the parameter uncertainties are not a major driver here. That's why we worry so much about models.

This looks like an interesting table.

MR. TRUE: Okay. This table, this is kind of the answer of the whole study. And like I said, I thought you would have had the report, so I wasn't going to go into a lot of detail of what all we did. So I'm going to try and jump to the answer and I'll explain it.

What we did for the three systems we looked at, which were feedwater, which would be a RISC-2 kind of a candidate system, RCIC which is a RISC-1 candidate kind of system and low pressure course spray, which for the BWR power, that was candidate three or RISC-3 candidate system was we looked at the results of safety significance from four different approaches.

The first being the point instrument, which is just a normal output from the PRA looking at the Fussell-Vesley and raw for each of the SSCs in our system. We actually did a system level and for a component within the system.

And what we found was that the -- well, that was for the base cases. And we used our own pilot.

Then we actually went off and created a little routine that did a Monte Carlo process and actually calculated the Fussell-Vesley raw for every sample, calculated the mean of that Fussell-Vesley raw over a whole population of samples. And we found that in no cases for these three cases did we find a difference between the point estimate and the true meaning.

And those are three examples. So it could be if you're right at the knife edge, you might see a difference. But we didn't see big differences in the categorization resulting from that.

MR. SHACK: How about the numerical differences? The actual numerical -- I mean you didn't change the --

MR. TRUE: I can answer that, but I have

to find the right table.

Well, I can give you some anecdotal valves. For feedwater where we did the point estimate, the raw was 1.33 and we did the mean it was 1.33.

The Fussell-Vesley was 3.06 e minus 2. for the point estimate for the mean value is 3.75. It's table 5-2 of the report gives you this.

RCIC, the raw change from 1.74 to 1.85.

So the changes were, in my opinion, pretty modest. You know, ten, 20 percent kind of a change.

CHAIRMAN APOSTOLAKIS: Do you know that paper that Cherry, Parry and Cheok wrote years ago.

MR. TRUE: Yes.

CHAIRMAN APOSTOLAKIS: Because they found similar results. The only time when the found that it made the difference was when there were very broad distributions, then there were some differences between the point estimate Fussell-Vesley versus the means Fussell-Vesley. But theirs is also I think are consistent with ours.

MR. ROSEN: And to take account of those small differences, what expert panels should do is when they get a raw of 1.9, say, putting it in low

is folly. Because if you think about the mean could be 2.1 just because of the difference between the mean and the point estimate, or when you do a model update you could find yourself with something you previously made low bumped to 2.1. Because it could model the modeling changes which you do of normal updates to keep your PRA current with operating experience and design changes are done roughly, you know, once every couple of years. You can change the categorizations or something. Then you've got a real problem on your hands because you may have treated it differently in the intervening period and you have to go back and look at all the things you did. So it's good practice. Now we're talking about good practice of IDPs and there really is only a few IDPs and we don't have that history of practice yet. But good practice will not doubt be the things that are just below the border line, shouldn't be pushed down. They should be left in the higher category.

MR. TRUE: Yes. I think that's -- and what we found actually in this case is that, you know, the raw -- like for RCIC the raw is 1.95 which is one of those that's pretty close. But the Fussell-Vesley are already over .005. So it's

already high anyway. So it's really the case where you're below on both criteria, but you're close on one of them or both of them that you really need to consider that.

CHAIRMAN APOSTOLAKIS: Explain that shade below there.

MR. TRUE: This was the only case where we found a difference in the categorization when we did two other ways of looking at it. Method three was we did an uncertainty distribution on the Fussell-Vesley and raw and we sort of said what if set a relatively arbitrary criteria that if there was a 25 percent -- if the Fussell-Vesley had 25 percent chance of being above the .05 or the raw had a 25 percent chance of being over, regardless of what the mean was, then we would call that safety significant. It was sort of instead of just using mean, that we were going to use a percentile kind of approach.

And we found that we did that for RCIC because it was just 1.85 thing that sure, and low and behold, it become safety significant on that percentile approach. But then we also looked at when we did the sensitivity calculations what happened there, and we found that the sensitivities

revealed it as being safety significant.

It was all sort of mute because it was already safety significant from a Fussell-Vesley standpoint anyway. But it was the only place where we found any departure from across the four columns with between the point estimate approach, the mean approach, the percentile approach and the sensitivities. So I highlighted it as the one -- so you're looking at a table with S's and L's and H's--

CHAIRMAN APOSTOLAKIS: So the main message that I get from this is that based on the point calculations and the sensitivity calculations, I should not worry about the uncertainty distribution of the importance measures because you will capture the stuff?

MR. TRUE: Yes.

CHAIRMAN APOSTOLAKIS: That's a great example in my view. I haven't read the EPRI report, obviously, but that's a great example of what the ACRS asked for in one of its letters. If it's an approximate method, give the rationale. This is great. This is a convincing case now that indeed I don't have to worry about it.

MR. PIETRANGELO: That's why it was done.

MR. TRUE: That's exactly why we produced this.

CHAIRMAN APOSTOLAKIS: Well, I think it's really love -- love -- no, I'm really serious. I really think that you should be congratulated for doing this because it puts to rest something that wa s a little bit disturbing.

MR. SNODDERLY: George, I have to apologize. It was my fault when I forwarded this to you in email.

CHAIRMAN APOSTOLAKIS: That's okay, Mike.

MR. SNODDERLY: The title on the PDF file is -- it got buried.

CHAIRMAN APOSTOLAKIS: We had a lot of review anyway. So I'm not sure --

MR. SNODDERLY: But we'll make sure that we resend it to the members and we'll take a look at it.

CHAIRMAN APOSTOLAKIS: Absolutely. No problem.

Who did the study, can I ask? May I ask?

MR. TRUE: Ed Burns, Glen Early who works with me.

CHAIRMAN APOSTOLAKIS: Okay.

MR. SHACK: Of course, now even on your method three, I mean presumably you'd have different acceptance criteria if you were dealing with a whole distribution Fussell-Vesley and in a sense your value that you picked is predicated on, presumably that the mean of the distribution. You know, if you were comparing to a 95 percentile or something, you would have picked a different acceptance criteria.

MR. TRUE: I'm not sure I'm following you.

MR. SHACK: When you have a distribution you still have to have an acceptance criteria.

MR. TRUE: Right.

MR. SHACK: When you have a distribution, what is your acceptance criteria? Well, if the acceptance criteria is on the value of the mean --

MR. TRUE: Right.

MR. SHACK: You know, the fact that you have a 25 percent chance --

MR. TRUE: Yes, the 25 is definitely our -- was just our -- if we figured if we used five percent or ten percent, that that would go one way. It seemed like a reasonable -- there's a little bit

of a thought process how we picked that umber in the report. But it's arbitrary --

MR. ROSEN: And you don't say anything about this in any IOU4. And it takes some explanation, more than this table. There's some strength in it that's more than this table. Because, for example, you use more than one indicator raw and Fussell-Vesley and because of that, there's some robustness to the approach.

So, you know, I keep thinking that this document is going to be read by a lot of people who are using the process, hopefully. And that they need to have some history. Maybe put an appendix or two in here that says --

MR. PIETRANGELO: Well, you're exactly right. We've had an attempt all along to have a basis document for the categorization, and at one time we did think about including it as an appendix. We're probably going to do it as a separate document. The document's pretty long already.

CHAIRMAN APOSTOLAKIS: But at least mention it. It's not mentioned in the --

MR. PIETRANGELO: Yes, you can reference. You can say --

CHAIRMAN APOSTOLAKIS: You can say in

this study we did this and that's put to rest now.

DR. KRESS: Now, let's be careful. You know, our congratulate them on this. This is sort of what we wanted to see. But this is one PRA for one plant and it happens to be a low CDF plant. And I don't know how generic the results are or how to generalize to other places. But particular the PWRs which may have higher CDFs.

So, I'm not sure this puts the thing to rest. I'm very glad they did it and it helps me a lot. And it does indicate some robustness, but I'm not sure how generic it is.

CHAIRMAN APOSTOLAKIS: Well, we'll have to look at the study to see whether that is --

DR. KRESS: Yes.

MR. TRUE: Since we're dealing with a relative term, Fussell-Vesley and raw, the absolute value of the CDF shouldn't make to much difference. Probably the place where it could be much different is if you had the area that was dominated by one thing and -- or not dominated at all, that might have a little bit more of an effect. But, anyway, I think --

CHAIRMAN APOSTOLAKIS: It seems to me someone in the 00-04 document you should have a

sentence or two that this particular issue has been investigated, this is the conclusion, go see this reference if you want to.

MR. TRUE: We sort of shied away from that for maybe four reasons. But we were trying to make the guideline B, this is how you do it. Not the background on all the --

MR. ROSEN: I think your mistake, Doug, in thinking that way is that you are writing this for the people who'll use it and not necessarily the people who'll -- of the stakeholders who want to have confidence in it or the public staff, the ACRS.

MR. TRUE: Exactly. That's exactly it.

MR. ROSEN: So I think this document, because it's so central as you said and as we agree, it ought to do some things beyond just looking at what does the user, the stakeholder -- the stakeholder who is the user need, it should respond to some other stakeholder needs as well.

MR. TRUE: Okay.

CHAIRMAN APOSTOLAKIS: These are, you know -- we're still at the beginning of a risk-informing various regulation. So building a case, like Steve says it, makes sense.

MR. ROSEN: And, again, just a couple of

sentence.

MR. TRUE: Yes, that's right.

MR. ROSEN: But the EPRI document is a general availability a document? I mean, it'll be someone who doesn't belong to EPRI will be able to get it?

MR. PIETRANGELO: Yes. You can purchase the document.

MR. ROSEN: Well, you can purchase it? I don't know.

MR. PIETRANGELO: If you're not an EPRI member.

DR. KRESS: $140.

CHAIRMAN APOSTOLAKIS: So writing papers in the open literature from that is out of the question?

MR. TRUE: No, there could be a paper written, I'm sure, on it. We haven't pursued that.

CHAIRMAN APOSTOLAKIS: But these are the major results?

Anyway, that's not of our present meeting.

MR. TRUE: Okay. Just wanted to give you the key conclusions. The report number is included here.

And we talked about most of this. The PRA codes calculate importance measure based on the point estimate models, which hopefully use means as inputs.

The correlation means for the importance measures are slightly higher than a point estimate, which is what we would expect.

That correlation effect could have an impact on the mean values. And, in fact, we think it probably is more likely to have an effect on the ones that have more low Fussell-Vesley importances because it's going to tend to bring those up a little bit more than ones that are caught up in the dominate contributors. We saw a little bit of that in the course spray work. Because course spray was such a low contributor, there weren't a lot of sequences and cut sets in the answers that included them. And so we saw a little bit more sensitivity to the Fussell-Vesley for course spray than we did the other systems, which contributed much more significantly to the result.

However, in all this work all that, the dealing with the mean and the parametric correlation didn't change our safety significance assessment. And that the sensitivity studies we do encompassed

everything we found in the study, no matter which way we looked at it. And so we believe that the parametric uncertainty analysis if someone wanted to pursue that for the importance measures, or the sensitivities that would give us equivalent results and we've opted to retain the sensitivity studies as the basis.

CHAIRMAN APOSTOLAKIS: Now when you say the first bullet point estimate, you mean mean value?

MR. TRUE: Yes, there's a systematic problem here. And between you and me, I think. When I say point estimate models, it's the -- a basic event has a value associated with it.

CHAIRMAN APOSTOLAKIS: That's a mean value --

MR. TRUE: It should be a mean value.

CHAIRMAN APOSTOLAKIS: Okay.

MR. TRUE: Right. But as opposed to propagating all the distributions through a Monte Carlo process.

CHAIRMAN APOSTOLAKIS: I understand.

MR. TRUE: That's my distinction.

CHAIRMAN APOSTOLAKIS: But sometimes you just --

MR. TRUE: And I take for granted that the point estimates that go into a model should be a mean. You have a concern that they're not always means.

CHAIRMAN APOSTOLAKIS: It's not always.

MR. TRUE: And that's a legitimate concern. Hopefully, the standards process and purities will move us in a direction where we are using means.

CHAIRMAN APOSTOLAKIS: Okay.

MR. TRUE: Okay. Defense-in-depth. We have a defense-in-depth section of the report and a process we go through that addresses specifically the RISC-3. It doesn't deal with RISC-4s at all or 1s and 2s because the 1s and 2s have already been characterized as high.

We look at basically three things: core damage prevention, larger containment failure and long term containment integrity.

Any -- and this is another case where if we identify that an SSC is necessary for defense-in-depth purposes, it's moved to RISC-1. From RISC-3 to RISC-1. So it's a go/no go. It goes to the IDP that way and the IDP doesn't get to move it back down.

But another threshold that we have to get through before we got to the --

CHAIRMAN APOSTOLAKIS: See, this is where my area of comment would be applicable. I think you should make a distinction here between the SSCs you have categorized using PRA and the ones that you have not used PRA for.

The structure that's supposed to be defense-in-depth, as Tom mentioned earlier, is I think in the risk-informed environment we have agreed that it should be a higher level so when you have an issue of scope, for example later containment failure which is not included now in the PRA, then of course you applies these ideas. But when you deal with CDF only for things that are not included in the PRA, it seems to me you have to consider issues of defense-in-depth. Because defense-in-depth is already built into the importance measures for the things that have been included in the PRA. So having a blanket defense-in-depth guidance I think does injustice to that. And it doesn't really, again as I said earlier what the staff says here about the relief being commiserate to the quality of the information, this is a place where you can really show that by having

a PRA you don't have to do certain other things. And I think that that would go a long way towards helping this move towards a better risk information.

MR. TRUE: Okay.

CHAIRMAN APOSTOLAKIS: But for issues that are outside the scope of the CDF and LERF, that makes perfect sense. Then you revert to the traditional structurlist approach.

You guys don't have a detailed list, but when the staff comes on to present later, they have a whole list of bullets, you know, that really follow the ROP. Now, I would use those only for SSCs that are not in the PRA.

MR. TRUE: I believe we have a similar list.

MR. SHACK: What are outside the scope.

MR. TRUE: We have a similar list.

CHAIRMAN APOSTOLAKIS: Yes, but theirs is a little bit more details. I know you have a list. But again, this is where we have to make a distinction. You know, you have gone a good job with the PRA --

DR. BONACA: It seems to me, however, that all information has to flow through -- to the expert panel.

CHAIRMAN APOSTOLAKIS: Yes, it does. Sure. Sure.

DR. BONACA: I mean, there is a screening down.

CHAIRMAN APOSTOLAKIS: Yes.

DR. BONACA: Okay. There is information, already there are ground rules for that. There is an assessment here being done based on existing commitments, even if a system is important and is already -- I think it's -- is good to let it --

CHAIRMAN APOSTOLAKIS: Oh, the department will know this. Absolutely.

My point is that we have this integrated decision-making process which takes five -- five six inputs. And as the ACRS pointed out in one of its letters maybe two years ago, an inadvertent consequence of this integrated decision-making process is that people really are not encouraged to do a better job on the lower right hand side box that says delta CDF or LERF because even if you do a poor job, then the argument is the other boxes like defense-in-depth and so on will take care of it. So there was no encouragement to do a better job there.

I think now that we are talking about

specific regulations if you make it clear that there is a price to pay, so to speak; if you don't do a very good job here or it's outside the scope, of course, then you have to go through a more elaborate defense-in-depth evaluation.

Now, again --

DR. BONACA: Let say if I'm an owner at a plant and I do the categorization, what I wanted my people to do is to be as thorough and to go through an evaluation of component by component, I mean I understand --

CHAIRMAN APOSTOLAKIS: Well, they will tell you why should I bother to do a better job with my PRA. And some of these things are obvious. WE need to have three diverse trains, but that's built into it. That's what the importance measure does.

MR. PIETRANGELO: But you're mixing an incentive to develop the PRA scope with kind of confirming the rigor of the process.

DR. BONACA: Correct.

MR. PIETRANGELO: They're different purposes.

CHAIRMAN APOSTOLAKIS: Look, Tony, the utility has spend money to do a PRA. Then there is a PRA review process following the NEI process. All

these things cost money. To do a lot and then to say now make sure that you have two things, in other words redo it, it doesn't make sense to me. For the things that I'm interested in regarding CDF and LEFT, because that's already built into the PRA. That's my point.

To start all over again and confirm that I have three trains, why? If I didn't have them, the Fussell-Vesley wouldn't be the way it is. So I should focus my attention then on things like scope, late containment failure. Dr. Bonaca has raised other issues. He says, you know, that CDF is not the only thing we care about, we want to see other things. And focus on these. And the process is explicit.

I'm not saying completely ignore it. I mean, if the independent panel was to raise an issue, that's fine. But if we've done it, we've done it.

I mean, if I have a three train system, then my importance measures would reflect that, wouldn't they? The redundancy -- if they don't reflect that, what good are they?

DR. BONACA: But, again, I mean I think that, you know, my view is that it is an integrated

decision-making process for Reg. Guide. 1.174. And if I were chairing that expert panel, and I have shared several panel of the type, I would consider here as a very important input, but there are other considerations that you may have. In some cases they may be -- you know on a decision basis you don't want to mess around with. I mean, and so --

CHAIRMAN APOSTOLAKIS: But you're -- you're saying CDF is not the only thing I care about.

DR. BONACA: That's right.

CHAIRMAN APOSTOLAKIS: And I'm saying that's fine. Then you focus on these. If certain things are outside, like PRA does. PRA deals with CDF and LERF right now. I mean, both those measures. I don't have to look at the defense-in-depth with respect of preventing core damage, because I know I've done it. Now for those other things, though, that the importance measure do not reflect, because I really think the issue of perceptions is extremely important here. If the licensee sees the same list of questions regardless of whether you've done a PRA or not, regardless of whether you've gone through the PRA review process, you have spent money to improve it, the same list

applies. Well, why bother? Why bother? It's the same thing that the staff has been arguing for a long time that if you have done the PRA according to what we're telling you in the regulatory guides, then expect a relatively minor review. If you deviate, then we're going to review it in more detail. I mean it's the same principle.

All I'm saying is there should be a distinction when you talk about defense-in-depth between things that are in the PRA having been included already in the importance measures and things that are not.

MR. PIETRANGELO: I understand your overall point. I don't know if I'd apply it in this context for this process, but I understand your larger point.

CHAIRMAN APOSTOLAKIS: Okay.

MR. SHACK: You don't seem to have addressed the staff's comment that defense-in-depth should deal with more than just design basis events.

MR. PIETRANGELO: Now we'll go back to George's argument, I think. That's what the PRA does a good job of.

MR. TRUE: Right, PRA does a good job of beyond design basis events. This table -- because

we're dealing with RISC-3 SSCs --

MR. PIETRANGELO: Safety related.

MR. TRUE: Which are safety related, which are there to mitigate design basis events, we wanted a check on those SSCs to make sure --

MR. SHACK: No, no, I want defense-in-depth for all risk significant events.

MR. TRUE: You can't have it. You're not designed for it.

MR. SHACK: Okay.

MR. TRUE: I mean, there are design basis -- there are a lot of beyond design basis events almost by definition that you don't have defense-in-depth for. So assessing and making some decision about that defense-in-depth can only be done in the context of the likelihood of that occurring, which is what the PRA is very good that. But we wanted to make sure that because we're dealing with safety related SSCs that are there because they're supposed to mitigate a design basis event, that we made a specific check to make sure that the importance measures didn't mislead us and that we had adequate defense-in-depth. Because you could be dominated, not that this would happen, but you could be dominated by interfacing system LOCA as

your number one core damage frequency, 95 percent of your CDF or something and you'd conclude other stuff is important. Because your importance measures would never indicate it was important. Well, that wouldn't be very good way to go about --

DR. BONACA: The safeguard however is that there is a presumption behind that all vulnerabilities for these plants are identified. I understand we have the IPE program in place, but right now we are going from an IPE evaluation maybe, to a much better capable, hopefully, PRA that may identify something that could justify some additional action.

I was thinking about the same thing. I was thinking about, you know, when you go through with these PRAs you might identify some scenarios that may come to be much more frequent than you thought they were. How do you deal with this?

MR. TRUE: And the PRAs should be a very good way to deal with that.

DR. BONACA: Right.

MR. TRUE: And should identify those. But we don't want to be so focused on those scenarios that identify particularly it's something that dominates your answer and could effect the

importance measures, that's really what I worry about in this. Is that we've got one large contribution and the importance measures, therefore, for most systems are relatively insensitive because it's all swamped out by this one large contributor. This is our way to go back and make sure from a design basis standpoint, we haven't lost track of where we started in this process and that we have retained some tracking of the defense-in-depth.

So I think it's important to look at this from this perspective.

CHAIRMAN APOSTOLAKIS: If you have the PRA and you are worried about early failure, looking at defense-in-depth doesn't make sense. Because you have already covered it. Now, you may want to look at it in a cursory manner. But if I don't have the PRA or if I worry about late containment failure, then I would have at least two bullets that I would go over in much more detail because I know my PRA doesn't do that. That's all I'm saying.

If you would put one chapter on defense-in-depth which is applicable no matter what else you have done, then in my view that's a disservice to the applicant. That's all.

MR. TRUE: Okay.

MR. PIETRANGELO: Point noted.

MR. TRUE: Yes.

MR. PIETRANGELO: Next slide.

MR. TRUE: The next slide is the list of deterministic questions that address --

CHAIRMAN APOSTOLAKIS: Now look at containment bypass. Isn't that part of every containment failure analysis?

MR. TRUE: Yes.

CHAIRMAN APOSTOLAKIS: Okay. Can the SSC initiate or isolate an ISLOCA event?

MR. TRUE: What's the largest source of uncertainty in an ISLOCA analysis? It's the initiating event frequency.

CHAIRMAN APOSTOLAKIS: Right. And shouldn't the importance measure reflect that?

MR. TRUE: The importance measure doesn't reflect that that's a major source involving uncertainty in the interfacing system LOCA analysis. That's why we don't in this question address --

CHAIRMAN APOSTOLAKIS: No, but you will think it's -- and go up in your sensitivity study. If it doesn't catch it there, we're in trouble. You just convinced us that the sensitivity study will catch it. Now you're saying no?

MR. TRUE: If -- if --

CHAIRMAN APOSTOLAKIS: It's a failure of the valves right there, insolation valves.

MR. TRUE: Right.

CHAIRMAN APOSTOLAKIS: Then you have an ISLOCA between the high pressure and the low pressure?

MR. TRUE: Right.

CHAIRMAN APOSTOLAKIS: Right. These are fairly uncertain.

MR. TRUE: Yes.

CHAIRMAN APOSTOLAKIS: Okay. So you go with the mean value of point estimate, you calculate your importance measure and let's assume, which I don't believe, let's assume they say it's not safety significant. Then you do your sensitivity, right? You increase it to the 95th percentile for the time being. And it will still be of low safety significance for an interfacing system LOCA? It just don't believe it for a minute that the PRA will say that.

MR. TRUE: It's because you're doing your importance evaluation -- or the sensitivity study. It depends upon --

CHAIRMAN APOSTOLAKIS: I can just look

at it and say, yes, they covered it. I think it will be a safety significant component like that.

MR. PIETRANGELO: Probably.

MR. TRUE: It probably would be.

CHAIRMAN APOSTOLAKIS: And it's a major contributor.

MR. ROSEN: Then what's the harm?

MR. TRUE: What's the harm. What's the harm to make sure you have the --

CHAIRMAN APOSTOLAKIS: Oh, what's the harm? Yes. Well -- the harm is in confidence. Confidence.

Anyway, okay. Well --

DR. KRESS: Are these the whole list of deterministic D-I-D questions?

MR. TRUE: This is the whole list.

DR. KRESS: Now I would have said there was some functions that I think are so important that I need D-I-D on it regardless of the PRA, this is the structuralist approach. And I would have counted among those some of these, but I would have assumed well the shutdown systems. So if it has anything to do with the shutdown or scram system, it's a safety systems.

I would have included ECCS. If it has

anything to do with ECCS, it's safety. And I don't care what the CDF or the raw is, I would put it in there.

If it has anything to do with the containment integrity, I would put it in there. Like the sprays, for examples or fan coolers, or things having to do with hydrogen, for example. And the same thing with long term cooling, which you have on here, integrity.

So I'm just surprised that the list you have. And maybe these things get incorporated in some way. I don't know.

MR. TRUE: Well, but I'll take exception directly to that. You said ECCS. Low pressure course spray is an ECCS system in a BWR.

DR. KRESS: Yes.

MR. TRUE: That's a system in the BWR or the pilot we specifically looked at and found to be safety significant.

DR. KRESS: I know. But I would have said, yes --

MR. TRUE: You would say it's not?

DR. KRESS: I would say just from a structuralist viewpoint I want to be able to cool that core regardless of why the PRA tells me, and I

would put that in as a safety significant --

MR. TRUE: Then you end up with exactly the same safety related list as you have today.

DR. KRESS: No. Because I only have a few of these that I say are so important that I'm not going to believe my PRA.

CHAIRMAN APOSTOLAKIS: But it's not a question of whether you are able to cool the core. The question is whether you need those special -- the staff has made it very clear that the design requirements and the capability to cool are still be there.

MR. TRUE: Right. Core cool is not being taken out.

CHAIRMAN APOSTOLAKIS: You're not removing those. The question is --

DR. BONACA: But if more had been done to provide guidance of for example focusing or what really you need to do to maintain -- let me give you an example.

It's easy to say they still have to work, but if I have MOVs that I decide not to test anymore, I've already made a decision that the MOVs will work most likely during -- in a demand situation. So a characterization could be that for

MOVs that still have the defense-in-depth function because of some criteria, you will suspect that they'll be tested.

MR. ROSEN: Well, first off, Mario, no one ever says we're never going to test the low safety significant MOV ever again. What they do is say instead of testing quarterly or semi-annually, we'll test it every two years or every years.

DR. BONACA: Well I haven't heard that yet. Because I asked a question here at one of these meeting, and I asked of the STP, and the answer was well if it isn't -- we may not test it.

MR. ROSEN: Well, I don't think that's the right answer. Whoever told you that, didn't give you the right answer.

DR. BONACA: Well, I understand.

MR. ROSEN: The right answer is they changed the frequency.

DR. BONACA: Well, I've been looking in this guidance we got here, and those in the NRC information --

MR. ROSEN: Mario, you're getting into an area that I really do want have a chance to talk about, which is the treatment question. Is that part of your proposal?

DR. BONACA: Well, then you should it.

MR. PIETRANGELO: Treatment is not part of this document. Consciously not.

MR. ROSEN: Consciously not. So is the staff going to talk about that later?

CHAIRMAN APOSTOLAKIS: No. This is only categorization.

MR. ROSEN: So it's just going to talk about categorization all day today. Yes.

CHAIRMAN APOSTOLAKIS: Yes.

MR. PIETRANGELO: There are requirements rule that we'll talk about this afternoon.

MR. ROSEN: Because I think that's what you really talk about. I mean, having made these determinations, what does one do with it.

DR. BONACA: Exactly right. Exactly right. Which means I'm all in favor of it, but I want to know what you do with the treatment. What does it mean.

MR. ROSEN: This is very, very important. And I think very important to everybody here, too, to hear from the staff and maybe from NEI what has been done, for instance, in the pilots and the proof of concept test with regard to treatment. Because it's not the horror show they talk about.

It's just extending -- it's not what Tom thinks. It's not we're going to take out of the plant. Everybody knows we're not going to remove core sprays. The question is well how are you going to treat it? Are you going to test it? How you going to maintain it and so on.

DR. KRESS: I didn't think that. I thought they were going to reduce it through liability because they not giving it special treatment requirements.

MR. ROSEN: Well, and that's what we need to talk about. Does changing the treatment requirements change the reliability? Is there any evidence to suggest that that's true? I think that there's evidence to suggest that it's not.

CHAIRMAN APOSTOLAKIS: It depends on what your --

MR. ROSEN: Changing the treatment requirements doesn't have a big effect on the reliability.

DR. KRESS: If I'm changing the frequency which I'm testing, I'm pretty sure it probably doesn't.

MR. ROSEN: Maybe not.

CHAIRMAN APOSTOLAKIS: It depends by how

much.

MR. ROSEN: Maybe if you test less --

MR. PIETRANGELO: That's not part of our--

MR. ROSEN: Maybe if you test less, you'll improve the reliability.

MR. SNODDERLY: George, let me suggest that we go on with the presentations that we have scheduled for today. And then at the end if we conclude that we want to hear more treatment, then we'll follow up.

CHAIRMAN APOSTOLAKIS: But I want to make a comment before we go on. I'm disturbed by the comments that are coming out of my colleagues.

We seem to be reverting here to the structuralist approach and I don't know why you're risk-informing this at all. If we want to do that, then it seems to me we should demand a very explicit guidance when one should implement a structuralist approach.

DR. KRESS: Absolutely. We need guidance. We don't have it. We do not have it.

CHAIRMAN APOSTOLAKIS: We need to -- okay. Then I would go along with that. But just to keep saying, you know, but then this is okay but

defense-in-depth, this is fine too, but defense-in-depth --

DR. KRESS: That's one of my problems with this whole process. We have a very ill-defined and ill-posed concept of what defense-in-depth is. Here is strictly a few deterministic questions and the other part is whether or not you have reliability and redundancy on things associated with the design basis accident. I think there's a very loose definition of defense-in-depth that --

CHAIRMAN APOSTOLAKIS: I'm all for a more detailed section. And, in fact, I have already myself made a couple of suggestions. But this blanket promotion of the structuralist approach, it seems to me is not appropriate.

DR. KRESS: I think we at one time had a letter said that a blending of the structuralist and the rationalist approach would probably be the best bet.

CHAIRMAN APOSTOLAKIS: Yes.

DR. KRESS: What I'm doing is blending it. I'm not having a blanket change to them.

CHAIRMAN APOSTOLAKIS: That's what I'm trying to do, too, by saying the things that are in the PRA, be a little more understanding, more

lenient. But then there are other things. And so maybe what we want is more --

DR. BONACA: And the issue of treatment has nothing to do with defense-in-depth. It has to do with many things. For example, has to do with changing treatment will effect what it's in tech specs. Will effect what is all over the place. And, you know, one thing I want to do for my plant is to make sure that there is no confusion in people's mind that operate the plant as we step back on what is important, what is not important.

We have commitments, for example, to make sure that -- is still functioning, okay. There is expectation for that. I want to make sure that we understand what is going to be important to make a conservative approach and what is not important, then I don't care about what purely putting an end stamp on it. Okay. So those are important issues and they accepted, they go with the other issue of special treatment, and we'll discuss that later. But I'm saying that that to me it's an important issue attached already now.

MR. ROSEN: Let me say a word about tech specs. In plants, tech specs are of paramount importance. They are what the operators run the

plant to. This process doesn't change the tech specs.

If you do something in this process that suggests a change to the tech specs is appropriate or needed, then a request to change the tech specs has to be made separate to that.

DR. BONACA: Of course. But I'm saying --

MR. ROSEN: So there's protection for the tech specs.

DR. BONACA: Oh, no. I agree with you. I'm only saying you're going in a certain direction and you want to have a real plan to communicate why you're doing that, you're changing a lot of things. There are old timers there that believe that those things which are in tech specs are fundamental to safety. We're telling them now, hey, they're not. So there is an issue of credibility there we want to maintain and the way you communicate it, the way you bring it to your plant it's fundamental. I mean, these are fundamental to maintain --

MR. ROSEN: Well, you're touching on a crucial point, Mario, which is the culture. What the effect of this can be on the culture. It has to be handled carefully.

DR. BONACA: Exactly. Right.

MR. ROSEN: Okay.

DR. BONACA: Okay.

CHAIRMAN APOSTOLAKIS: So I guess the whole message here is that this defense-in-depth question needs more elaboration as to what it is, what it is trying to do and how it would be implemented.

DR. BONACA: Yes.

CHAIRMAN APOSTOLAKIS: That's really what we're saying here. Right, Tom?

DR. BONACA: Yes. I'm not at all excited with this at all --

CHAIRMAN APOSTOLAKIS: No, I have no problem with that at all. As long as we don't revert to structuralism and --

DR. BONACA: No, that way we will be already screaming bloody hell.

CHAIRMAN APOSTOLAKIS: Huh?

DR. BONACA: Otherwise -- no. Nobody's going to --

CHAIRMAN APOSTOLAKIS: Okay. Nobody's screaming bloody hell. Just hell.

MR. SHACK: Let me just ask a little question. You changed the wording in the long term

integrity part. "It could be beneficial to preserving long term integrity" to "It would be the only means to preserving long term integrity." What's the rationale for that?

CHAIRMAN APOSTOLAKIS: What's the page number?

MR. SHACK: It's the final bullet here, the long term --

CHAIRMAN APOSTOLAKIS: Yes, but in the document.

MR. TRUE: I thought I cut and pasted it right out of the document.

MR. SHACK: No, you got it right under Revision D.

MR. TRUE: Right.

MR. SHACK: What I'm referring to is the old previous one. It's page 46 in the document. And I see a deletion here. The deletion was "It could be beneficial in preserving long term integrity" and that got changed to "Would be the only means," which is a good deal more restrictive.

MR. TRUE: Yes, and the problem with "could be beneficial," and I think the staff actually even raised this was that "could be" is awfully broad.

MR. SHACK: Pretty broad. Okay. I mean, I figure that was the --

MR. TRUE: So that was really what we came back to. And what we wanted to do was focus on those systems that were your means for preserving long term containment integrity, not anything that could possibly be beneficial. It's a little bit to your point earlier about EOPs and SAMGs.

EOPs and SAMGs invoke a lot of systems that could be beneficial practically speaking whether they really provide any benefit or not is better sorted out through, I think, processes like the PRA. Because you want your SAMGs to be everything plus the kitchen sink because you want to have all those resources ready, but it doesn't mean that everyone of those has the same weight or same significance from the standpoint of safety. That's my personal view on that.

MR. SHACK: Okay.

MR. TRUE: And the same thing is what applied here essentially, is we were looking for the key systems that provided that function.

This one I think we've sort of talked over --

MR. SNODDERLY: I'm sorry, Doug. Could

we just go back real quickly. I wanted to make a point.

My recollection for this SAMGs is that it only -- you only had to include those design basis components that could be available to help with beyond design basis accidents. So, in other words, you didn't have to include all components in the plant, only those that were safety related or there for design basis accidents.

So in other words, if something came out of the design basis it wouldn't necessarily to be included in the SAMGs. Is that your recollection or clarify that.

MR. TRUE: I'm not exactly sure where you're coming from. Let me try answering what I believe about SAMGs. I'm talking about the scope of what's in SAMGs.

MR. SNODDERLY: That's right.

MR. TRUE: The scope of what's in SAMGs, and Bob Lutz from Westinghouse participated in this. He might be more qualified than I. But most plants or many plants included in their SAMGs systems that are not just safety related but that were capabilities that they could use like cross connecting fire water to provide steam generator

injection.

MR. SNODDERLY: I agree with you. You're not restricted from including those. But I thought the guidance for developing is the EPRI guidance specifically references that equipment that is there for design basis accidents using that to help in mitigating in severe accidents.

MR. TRUE: Bob, do you remember that?

MR. SNODDERLY: I didn't think it explicitly says that you have to include all plant equipment available. That's what I'm trying to clarify.

So in other words if something is taken out of the plant, out of the design basis of the plant, then you don't have to explicitly consider it for use in SAMGs. That's my recollection of the EPRI guidance, and that's the clarification I'm looking for.

MR. LUTZ: This is Bob Lutz.

I'm still struggling with exactly what your question is. And maybe it'd helped if we used an example from the recent 50.44 where we took recombiners out, by the new 50.44 we're allowing people to abandon and replace recombiners which previously were safety related equipment. We used

those in SAMG. Now that they're going to be taken out of the plant, we've come up with the point that we'll be probably be taking them out -- or we will be taking them out of the SAMG. Is that where your question was going?

MR. SNODDERLY: That's a good example. And so I guess -- I don't want to take up anymore of the time. I'll go look at the EPRI guidance and see if I can find that statement as I recalled it and then we can pursue it.

MR. TRUE: Okay. This chart was added in Revision D, and it's intended to help clarify how things become categorized as high before they go to the IDP or low.

And basically you come in, and if an SSC was categorized as high based on the internal events categorization it's high. It can't become low.

If it's categorized, and I go down and it would happen to be low for an internal events and then I had a none PRA categorization like SMA-05 and it was found to be high, then it's considered high. So even if it's low for internal events, if it was high for FIVE, it would be high.

If I used another PRA and it was identified as high but it was low in the internal

events, then we go through this integral assessment where we kind of merge the importance measures and calculate a composite importance measure.

If it's high on the integral, then it's high. If it's low on the integral, then we pass it back to the IDP and say you need to know that we did this and it was high for one but it was low for when we combined them all.

Anytime the defense-in-depth assessment is added it's high. So the only way you can get down here to have been low basically all the way down, and then the sensitivity studies are passed on to the IDP as input to their decision. If anything was identified high in one of the sensitivity studies, the ones like the changing the HEPs, changing common cause terms, that kind of stuff, that's provided to them as an input. But if it's low, then it's considered low when it goes to the IDP. The IDP then has to go through their process of confirming that they believe it should be low.

MR. ROSEN: And when you get all done with that and you finally get in low, what you get to change is the treatment?

MR. TRUE: Right.

MR. ROSEN: By, for example, extending

the frequency of testing?

MR. TRUE: That would be an example I would expect, yes.

Okay. There was a lot of confusion in the Revision B and C about how this actually was intended to work. And this figure was an attempt --

CHAIRMAN APOSTOLAKIS: This comes closer to my earlier comment about slides 3 and 4 in the sense that --

MR. PIETRANGELO: Yes.

MR. TRUE: Yes. This gives you the --

CHAIRMAN APOSTOLAKIS: Coordinate all three slides and send a message. I think that would be great.

MR. ROSEN: Yes, and I think when you get down here for this public consumption thing, the other stakeholders, it might say that you now have permission to change the treatment. You don't have their permission to make it nonsafety related, change the design, take it out of that plant; none of those things. What you get to do is to make some reasonable changes to the treatment.

MR. TRUE: There are actually two more steps before something actually becomes low. One of them is the sensitivity study. We have to go

through and do the sensitivity study where we simultaneously change the reliability of those low safety significant SSCs.

CHAIRMAN APOSTOLAKIS: And my point is, I mean you've done all this and you still want structuralist? As has been pointed out earlier this morning, I mean only the guys who -- only on the PRA part you do this, right?

MR. PIETRANGELO: It'll only work on the stuff that's modeled in PRA. That's correct.

CHAIRMAN APOSTOLAKIS: Yes. So, you know, I have to have some confidence in the results. But the results must create some confidence in me that what I'm categorizing makes sense so I don't have to spend the same amount of time reviewing the defense-in-depth implications as I would do in a non-PRA categorization. That's all I'm saying.

MR. PIETRANGELO: We'll come back to that point at the end.

CHAIRMAN APOSTOLAKIS: Okay. I think you covered this, didn't you?

MR. TRUE: The IDP --

MR. ROSEN: Well, you didn't really cover the second bullet.

MR. TRUE: Okay. I was going to jump.

So close and yet so far.

MR. ROSEN: Right.

MR. PIETRANGELO: I thought we were going to fly down that one.

MR. TRUE: The status of the second bullet --

MR. ROSEN: Yes, we're dealing with an old dog with respect to this stuff.

MR. ROSEN: -- is that we had a meeting with the staff a few weeks ago, a couple of weeks ago now. We took away from that meeting a request to come up with a better description of how this process of establishing the factor of increase would be done. But using the corrective action programs and the detection of failures that would be captured in that how we're going to actually do that. And it will involve some sort of a monitoring program and statistical tools to make sure that we can detect and make sure that the performances within the --

MR. ROSEN: You guys are suggesting this is rocket science. It really isn't.

MR. PIETRANGELO: It's not a rocket science.

MR. ROSEN: It's already being done by the maintenance rule programs.

MR. TRUE: Right. It is.

MR. PIETRANGELO: But maintenance rule is excluded from the RISC-3 SSCs.

MR. ROSEN: I understand. But --

MR. PIETRANGELO: We're not going to do the same thing we do on maintenance rule, this is components.

MR. ROSEN: I understand. The trend capabilities that all plants now have that are required by maintenance rule and really required by the corrective action regulation, you know, Appendix B of 10 CFR 50 criterion 60, I think it is -- maybe I'm wrong.

MR. PIETRANGELO: Yes. That's also what--

MR. ROSEN: Will also require you to trend failure rates, not just the failure rates in components that have been recategorized by 50.69 processes but all failure rates of safety related equipment.

MR. PIETRANGELO: That's also --

MR. ROSEN: My point is these things if it happens that some component that you've recategorized has increased its failure rate, it'll send you a message.

MR. PIETRANGELO: Yes. Criterion 16 is excluded from RISC SSCs. All of Appendix B is.

MR. ROSEN: My point was only that the processes required by those regulations already in place in plants.

MR. PIETRANGELO: Right. It is. It clearly is. And in fact there is a corrective action high level treatment requirement in the rule. As Doug said, we have to add something to the guidance to say how we're going to do that. And we see it being -- and it's not rocket science. It'll be a statistically based approach, and it's really embedded in the corrective action program.

MR. ROSEN: Those were my points.

MR. TRUE: Right. And the reason I didn't invoke the maintenance rule, it is like what we do for the maintenance rule. The reason I didn't invoke that is because the maintenance rule isn't part of what we're going to do, so it's going to be different than that. But you're right, philosophically it's going to be --

MR. ROSEN: Consistent.

MR. ROSEN: -- consistent with that for sure.

MR. PIETRANGELO: Let me also make the

point about 1.174 and comparing it to those guidelines. This is a very conservative use of those guidelines. The 1.174 guidelines are for changes that you actually expect to occur not for bounding analysis. And this is bounding risk sensitivity study that we're comparing against the 1.174 guidelines. That's not what those guidelines were intended to do. They were intended to track against actual changes. So this is a conservative application of those guidelines.

MR. TRUE: I'm sorry. I was supposed to mention that.

MR. SHACK: Some experience in your pilot programs. I mean how sensitive were the results to whatever factor you picked? You know, as you went from two to five to ten, did you suddenly find yourself with reclassifying a whole bunch of components?

MR. TRUE: I don't know that we actually looked at a big range of those. We looked at the two to five kind of a thing. I don't think they were particularly sensitive. Certainly in the limit if you got a 100 or --

MR. SHACK: Obviously, I could pick a number to make it --

MR. PIETRANGELO: There's a way to back that number out of the study to see where you go over the line.

MR. TRUE: Yes, you could actually do that. And that may be one input to our process --

MR. PIETRANGELO: Right.

MR. TRUE: -- is to take, do different factors, see where it gets you and then kind of back it out.

MR. SHACK: It would certainly have a certain --

MR. PIETRANGELO: Right.

MR. TRUE: Right.

CHAIRMAN APOSTOLAKIS: By the way, the regulatory guide requires a monitoring system to make sure that there are no surprises. Do we have that?

MR. TRUE: Right. That's one element.

CHAIRMAN APOSTOLAKIS: Are you proposing a monitoring system? Say, as we were discussing earlier, we really don't know the impact of reducing some of the special treatment from the reliability. Will there be a monitoring system --

MR. PIETRANGELO: It's in the corrective action element. There's a program that still

collects all the different failure data. What will happen on a periodic basis is the collection of that failure data, some estimate of the overall demands -

-

CHAIRMAN APOSTOLAKIS: Okay.

MR. PIETRANGELO: -- and then some kind of statistical analysis that there's a liability compared to what you assumed in the study.

CHAIRMAN APOSTOLAKIS: Okay.

DR. BONACA: And there will be pulling out of those components which have been --

MR. PIETRANGELO: Absolutely.

DR. BONACA: Okay.

MR. TRUE: Yes, for the lows.

DR. BONACA: Because you have to look at them --

MR. ROSEN: So then you could take the failure rate over the life of the plant for these components, whatever -- I'm just drawing one here in the air. And you could say, okay, here at this point we change the treatment requirements because of this. And look what happened. The reliability improved. The reliability declined. I mean you could see the difference by taking different time windows in the plant's life. So it really is

possible. Not rocket science, as I said.

CHAIRMAN APOSTOLAKIS: Oh, for heaven's sake with rocket science. Say nuclear science from now on.

DR. KRESS: Yes. Rocket science is nearing the end.

CHAIRMAN APOSTOLAKIS: Brain surgery. Not rocket science.

MR. TRUE: Okay. We talked a lot about this. The IDPs, one of their primary jobs is to confirm the technical basis for the categorization that the inputs they received reflected the design and operation of the plant appropriately.

For the low safety significant SSCs they are asked also to confirm the defense-in-depth and there's a set of questions which I didn't include here.

CHAIRMAN APOSTOLAKIS: But in your report, though, page 57 you have review of defense-in-depth implications. This is really a list from the regulatory guide as I recall. The overall redundancy diversity among the plant systems is not sufficient -- again, let's not forget what we're trying to do here. Is it really possible under 50.69 to reduce the redundancy and diversity? No. You're

not removing any barriers. You're reducing their reliability possibly. So this question doesn't apply.

System redundancy and dependence on diversity is not reserved commiserate with the expected frequency of challenges. May or may not.

But it seems to me that these general question do not apply here. A lot of them do not apply because we're not touching redundancy.

MR. PIETRANGELO: Going back to that defense-in-depth chart.

CHAIRMAN APOSTOLAKIS: Yes.

MR. PIETRANGELO: What was credited in those redundant trains or diverse trains, we didn't credit anything that's categorized. Could only credit things that are high.

CHAIRMAN APOSTOLAKIS: Yes.

MR. PIETRANGELO: I mean, that's designed, again --

CHAIRMAN APOSTOLAKIS: But your --

MR. PIETRANGELO: --the whole design basis not changing the questions.

CHAIRMAN APOSTOLAKIS: You're not changing the design. You're just recategorizing.

MR. PIETRANGELO: But the point is even

if some of these safety related things were categorized as low, we're not crediting them in the defense-in-depth analysis. We're only crediting things that remained high.

MR. TRUE: We're not crediting the thing that we think is low.

MR. PIETRANGELO: Right.

MR. TRUE: There may be instances that are high.

MR. PIETRANGELO: Correct.

CHAIRMAN APOSTOLAKIS: Yes, but it starts by saying "When categorizing a function as low safety significant, the IDP should consider whether the defense-in-depth philosophy is maintained." So in other words, when this becomes low safety significant is not part of defense-in-depth anymore?

MR. PIETRANGELO: It's not credited in that table that Doug showed you.

MR. TRUE: Right.

MR. PIETRANGELO: Even by reducing treatment, we still have that level of redundancy and diversity --

CHAIRMAN APOSTOLAKIS: So even though you--

MR. PIETRANGELO: -- so it's events in the chart.

CHAIRMAN APOSTOLAKIS: Well, wait a minute now. Let's say I have like South Texas is a three train system. Well, let's take an ideal situation. I mean idealized.

I have ten trains. Okay. I have ten trains. Identical. Now the importance of the component in one train must be very low. For heaven's sakes, I have to lose all of them, right?

MR. TRUE: Ten trains of the same system or ten different systems?

CHAIRMAN APOSTOLAKIS: Yes, one system.

MR. PIETRANGELO: Ten trains in one system.

CHAIRMAN APOSTOLAKIS: So you're categorizing now all of these things as of low safety significant because you have such tremendous degree of redundancy, right?

MR. TRUE: That's not the --

CHAIRMAN APOSTOLAKIS: Then when I go to the table you showed us earlier, that Tony referred to, I would say I have no trains because all of these now are of low safety significance? That doesn't make sense to me because I'm only crediting

the high safety significant?

MR. TRUE: Let me clarify that. Two things. First of all, if that was all you had and you had ten, your common cause term would probably cause it to be high. But there's a little --

CHAIRMAN APOSTOLAKIS: Right. Even with a multiple Greek letter, come on, now I'm down to safer and safer.

MR. TRUE: That are all .9s.

CHAIRMAN APOSTOLAKIS: Right? Because I have ten of those?

MR. TRUE: Beyond the third train the multiple Greek letter method doesn't give you much benefit.

CHAIRMAN APOSTOLAKIS: I'm sorry, Doug.

MR. TRUE: Beyond the third train the multiple Greek letter method doesn't give you much benefit.

CHAIRMAN APOSTOLAKIS: It jumps to one, yes.

MR. TRUE: It's approaching one. It's .9 or thereabouts. So I go to the stair step chart. And I say, okay, if I don't credit this system or this train and all of its redundant components, which will be all ten of those trains, I want to

know whether I have a remaining capability that keeps me in this category. If I don't, then I can't make that ten train system --

CHAIRMAN APOSTOLAKIS: But my point is --

DR. BONACA: No, but by the bottom row that covers exactly that, right?

CHAIRMAN APOSTOLAKIS: Right.

DR. BONACA: It says that its low safety significant confirmed, whatever number of redundancies you have. That's what it says.

CHAIRMAN APOSTOLAKIS: Only for LOCAs.

MR. TRUE: You need at least one item to make redundant system.

MR. TRUE: Well, yes.

MR. ROSEN: No, you don't in that case for LOCAs you don't.

DR. BONACA: And low is low.

MR. ROSEN: Low is low even for LOCAs. You don't one redundant --

DR. BONACA: It's right there.

MR. TRUE: In order to confirm low safety significant you have to have one --

MR. ROSEN: That's not the way I read that chart.

CHAIRMAN APOSTOLAKIS: The chart says that you don't even need one redundant for the ones that are below ten to the minus whatever, six -- five.

MR. TRUE: The chart says that you --

CHAIRMAN APOSTOLAKIS: Or if you have one redundant, then you fall there.

MR. TRUE: Then you're still -- we're only talking about the lows. When we get into this chart, we're only talking about the lows.

CHAIRMAN APOSTOLAKIS: Again, you see this is the problem --

MR. ROSEN: I don't understand that chart.

CHAIRMAN APOSTOLAKIS: -- deterministic approaches. You have ten trains. Because you have ten the significance of individual components is very low and yet I cannot take credit for any of those because they're low. That doesn't make sense to me.

DR. BONACA: But isn't it true that all of them will result from this one here, except one, to be low safety significance, all the trains.

MR. TRUE: No. It would be done -- the way this works is you take a train and all of its

redundant components. Remove them from credit and see what's left. And if you're left in this region, then you're confirming that that is low safety significant.

DR. BONACA: Okay.

CHAIRMAN APOSTOLAKIS: But what's left - -

MR. TRUE: If you don't credit that and all of its related components, and you end up in this region, then that one you're not crediting is potentially safety significant.

CHAIRMAN APOSTOLAKIS: That's not what Tony said. Tony said you take this out --

MR. TRUE: Right.

CHAIRMAN APOSTOLAKIS: -- and what's left must be of high safety significance for you to take credit here.

MR. TRUE: That's not what the guidance said. And that's not what --

CHAIRMAN APOSTOLAKIS: Ahh. Okay. If the question is whether you have trains, even though the components may be of low safety significance, then it's fine.

MR. ROSEN: A little comment: This chart is not obvious. I misread it entirely and I

read it five times.

DR. BONACA: And I misread that other line, too, that other point there.

MR. TRUE: Okay.

CHAIRMAN APOSTOLAKIS: Well I'm telling you that redundancy of ten is important.

DR. BONACA: The way I misunderstand it reading the text.

MR. TRUE: Okay.

MR. ROSEN: I misinterpreted the bottom row, is my point.

MR. TRUE: Okay.

DR. BONACA: You know, one thing I want to say about this just to defend the chart. Okay.

Again, I'm stepping in the shoes of a guy who is chairing this panel who has to make a very important decision to this company, right? And if you look at the analysis done, there is a discussion here of BWR. Some of the redundant functions may not be the agreed one or the meanings that if you have plant with multiple way of providing water, your design basis analysis may use two redundant trains of one -- but in reality you do analysis to demonstrate that others ways you can provide water, in fact, from your PRA so your

acceptance criteria are varied, okay.

Now, what you want to have there when you perform this review is your deterministic people. Is it credible that with this train you can -- because typically you have analysis done assuming certain functions. Now what you do with the PRA is you define other means of adding water, they come from some other systems, and you want to make sure from your deterministic people that that's true. And you have success criteria that are being included and so on and so forth. I think it's a verification process.

MR. ROSEN: Well, the deterministic people are always there when a system is being discussed, and typically this process proceeds system wise. And so you're discussing whatever system you happen to -- and you have a system engineer there with you for that system. And he knows the design basis inside and out. So you ask those kinds of questions, you get good answers.

DR. BONACA: Oh, yes. But I think, you know, when somebody comes to me and says you know we have these three redundant trains of emergency injection, right? And now they're all low safety significant. I would, you know, probably if I'm not

a PRA guy, I wasn't involved -- and hopefully I was not because I'm chairing this group -- I want to know could you explain it to me. Could you tell me where it's coming from since I'm now stopped in my commitment to maintain the -- so there is a value --

MR. ROSEN: Let me tell you the way I see it. I don't think the chairman or the members of that group will just walk into a room cold. In fact, the NEI document says that there is a training of the panel. So it seems to me that when these guys are training they should understand the issues that Mario just raised. That look, when we have a PRA and we find low importance measures, which by the way mean this and this and that, then your traditional defense-in-depth to which you are accustomed is suffering this way or is not suffering, you give a couple of examples like Mario mentioned. That's part of the training, in my view. And you have a list of bullets here, you know, details of fundamentals, defense-in-depth philosophy, how it is effected by declaring something of low safety significance.

So I view that always part of that. And I think you guys added it -- I don't know, it's because of our comment or something in provision B,

you didn't have anything about training as I recall.

MR. TRUE: I don't remember anymore. But it might have been less.

We learned a lot in the pilot process about the IDPs.

CHAIRMAN APOSTOLAKIS: Sure. So you --

MR. TRUE: Exactly the things that Dr. Bonaca --

CHAIRMAN APOSTOLAKIS: You're now into 20 or 21?

MR. PIETRANGELO: Twenty.

CHAIRMAN APOSTOLAKIS: We must have covered that already.

MR. TRUE: Yes. I think we've been through that.

Twenty-one. What we believe we have developed here is a rigorous risk-informed categorization process that looks at risk information and defense-in-depth as part of the process. Meets the 1.174 risk-informed decision making process expectations.

We think we've tried to utilize the strengths of PRA where it's good. We've tried to address the limitations of PRA and the importance measures and other things through the different ways

we've manipulated the results.

CHAIRMAN APOSTOLAKIS: Now, in all fairness you should also have the limitations of the deterministic approach. Why aren't you addressing those? In fact, I would change the two bullets and say utilizes the strengths of PRA, therefore eliminating some of the weaknesses of the deterministic approach. Addresses limitations of PRA bringing back the strength of the deterministic approach.

MR. PIETRANGELO: We'll change the slide, George.

CHAIRMAN APOSTOLAKIS: Thank you very much, Tony.

MR. TRUE: Okay.

CHAIRMAN APOSTOLAKIS: I mean, we keep talking about the limitations of PRA as if everything else is perfect.

DR. BONACA: Well, the whole thing is to address the limitations of the current PRA.

CHAIRMAN APOSTOLAKIS: Yes, right. And we are going to back structuralist --

MR. TRUE: And we sort of took that for granted.

Anyway, addressing the limitations of --

DR. BONACA: I think George needs some structure in his life.

MR. TRUE: We allow the use of these PRA analyses, but we use the standard for safety significance that we think very conservative.

And we believe that the major issues have been resolved. We have this one thing to come back with on the assigning the risk significance factor and a few other clarifications of the document. But we're thinking we're getting pretty close with the staff on them, at least the major issues.

MR. ROSEN: I want to take you back to page 5 of the NEI document.

MR. TRUE: Okay.

MR. ROSEN: It's paragraph 1.5. In the second paragraph under 1.5 there's a sentence that's incomplete, and it's the second from last that starts with the words "Here again." What is that supposed to say? It says "Here again the IDP" -- it's just not correct.

MR. TRUE: Good point. Yes, it is incomplete. The IDP cannot recategorize an SSC identified by the categorization process that's high safety significant.

MR. ROSEN: I think it should say: "Here again, the IDP cannot recategorize an SSC identified by the defense-in-depth categorization."

MR. TRUE: Or the risk categorization.

MR. PIETRANGELO: Any of the categorizations.

MR. ROSEN: Well, in the context of this paragraph we're talking about defense-in-depth categorization.

MR. TRUE: It's actually they can't recategorize an SSC identified as high safety significant.

MR. ROSEN: Well, anyway, I make that point because there's clearly something left out there.

MR. TRUE: Yes, there is.

MR. ROSEN: But -- but -- but. This whole discussion on the 1.5 isn't clear. It's just the way it's worded. It seems to me that the key point you're trying to make is that the IDP is not the key. It can make judgments and it can raise things to high safety significance that are low, but it cannot substitute its judgment for the analyses in the PRA or the defense-in-depth characterization.

I think if you read this as a member of

the public that doesn't have a lot of things, you can get some strange convoluted interpretations from the way this -- I would maybe give this to some smart guy who is not involved in this process and ask him what he thinks this says. You may be surprised. But surely, correct the stuff that's left out of that sentence.

MR. TRUE: Yes. Thank you for catching it.

CHAIRMAN APOSTOLAKIS: Any other comments from the members? Doug, Tony, you want to say --

MR. PIETRANGELO: I wanted to come back with this model/nonmodel thing a little bit.

CHAIRMAN APOSTOLAKIS: Sure.

MR. PIETRANGELO: This was a concern when we first came to the Committee about what about the SSCs that aren't modeled in PRA. Between that concern and I think the experience we got out of the pilots in trying to do on a component by component basis being very tedious verses using what was modeled to identify what functions are important and mapping back everything in that flow path, that's how we dealt with it. It both streamlined the categorization process and we thought addressed the

concern that the Committee had.

And what I heard earlier, both in the talk on the charts and things, well you ought to somehow show in the charts that you treat those differently. And we really don't.

I think it's conservative way to address if that function based on that component importance was high, then everything in the flow path is high and it stays that way. There's that little dotted line thing we do for an engineering assessment; that's at the option of the licensee if they want to get down to the next level. A lot of people are going to stop at the previous level based on the pilot experience.

You're right, and I think that this is what you reacting to in the chart, George, is that in terms of the overall risk sensitivity study there's no knob to turn to address those components in the sensitivity study because they're not modeled in the PRA. Okay. But if a function is changed as a result of that sensitivity study, I think we probably have to go back and look at that.

CHAIRMAN APOSTOLAKIS: The ones that are not in the PRA are not affected by the sensitivity study, are they?

MR. TRUE: Right.

CHAIRMAN APOSTOLAKIS: They're not.

MR. TRUE: They can't be.

CHAIRMAN APOSTOLAKIS: And my point was that then you should emphasize the defense-in-depth aspects for those. Emphasize. That doesn't mean you eliminated all the others. But there should be a distinction. That's all I'm saying.

MR. PIETRANGELO: Yes.

CHAIRMAN APOSTOLAKIS: Yes, sir.

DR. FORD: George, I take it this afternoon we'll have time to discuss materials degradation? It hasn't been discussed once.

CHAIRMAN APOSTOLAKIS: And discussed when we raise the issue we'll discuss it.

DR. FORD: It hasn't been discussed at all today.

CHAIRMAN APOSTOLAKIS: I'm hoping that after the staff's presentations maybe we can raise some high level issues.

MR. ROSEN: Well, Peter, you raised it and I think you got only a limited answer from the NEI folks. But the staff is, I think, prepared to--

DR. FORD: Well, the materials degradation is a key part of the rule.

MR. ROSEN: Right.

DR. FORD: And for RISC-3 and it is not discussed at all in this reg. guide.

MR. ROSEN: Yes.

MR. REED: This is Tim Reed from the staff.

The first presentation this afternoon we'll discuss our efforts to address the resolve the public comments. And part of the major issues that fall out of that will go to some of the issues in RISC-3 treatment in degradation and others. So I think there'll be opportunity at that time to discuss some of these issues. And perhaps if we don't cover something, we can always do so later.

CHAIRMAN APOSTOLAKIS: Anything else?

Thank you Tony and Doug. This has been a very informative meeting.

And we will recess until 1:00, at which time the staff will take the floor.

(Whereupon, at 11:59 a.m. the meeting was adjourned, to reconvene this same day at 1:01 p.m.).

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

1:01 p.m.

CHAIRMAN APOSTOLAKIS: We're back in session. The next item on the agenda is a summary of public comments by the gentlemen of NRR.

Mr. Reed, would you introduce your colleagues there?

MR. REED: Okay. Got a lot of help up here today. I have Donnie Harrison from the Systems Division of NRR and Tom Scarbrough and John Fair from the Engineering Division from NRR. Also, we have some more help over at the mikes, too, if you need it.

And just let me get quickly then to what we're going to try to accomplish here with this next presentation.

We'd like to discuss the staff's efforts to address and resolve the comments that we received on 50.69. And that's principally what we're looking at here.

In addition, we'll be talking about the staff's review of NEI 00-04 draft revision D. And I'll be following this presentation.

Generally how we'll be doing this, or at least hopefully this will be an object we'll follow

through on, as we go from proposed rule to final rule we're going to be focusing on what's changed. And so you'll see most of the focus of our presentation and discussion will be what's changed from proposed to final.

There will be some issues we'll be discussing where we've got a lot of public comment on to change something in the rule or the SOC. And if we've elected it not to change it, we'll also discuss that issue, too.

So that's what we are trying to do these next two presentations.

Real quick, I'm not going to take a lot of time on background because I have a feeling we're going to take a lot of time on each of these issues, so this was basically the background. This has been going on for quite a long time, all the way going back to '98 with SECY 98-300. Those are the Commission papers that have gone on since that time. And I won't go through all of these, but as you're well aware is that we just went out for public comment last year. And the public comment period closed at the end of August. And we got quite a few comments, and that's one of the major tasks that we've been working on.

CHAIRMAN APOSTOLAKIS: Now, the comments were on what?

MR. REED: On proposed 50.69.

CHAIRMAN APOSTOLAKIS: But not on the draft guide?

MR. REED: We did get comments on draft guide on 21, too.

This is just an overview of what's going on in the project. And there's actually something important here. I know sometimes you don't follow this, but the schedule of course at the end of this slide, George, is to hand this thing off to the Commission on June 30th. You mentioned this morning that the full Committee meeting was in July. And, obviously, that won't fit with our schedule. We'll have to move that full Committee meeting up to June and to try to get a letter out of the full Committee in June for our schedule right.

In fact, a detailed schedules, it's been put together to go in concurrence for example in the middle of April in order to get this package to you about the middle of May. A pretty good full rulemaking package that won't change, hopefully, too much until we brief you hopefully in June. That's what we were shooting for.

CHAIRMAN APOSTOLAKIS: And are you confident that you will get the final version of the NEI document by then?

MR. PIETRANGELO: Yes.

MR. REED: I'm getting a little more confidence.

MR. ROSEN: Our staff knows, Mike, that this change in the schedule?

MR. SNODDERLY: Yes. Tim mentioned it to me this morning.

Just one more time, Tim, when do you expect the package to be available for our reviews? You said when in May?

MR. REED: Middle of May.

MR. SNODDERLY: Middle of May.

MR. REED: About two weeks. Right now I can't promise you the full 30 days, but two weeks, I'm really trying to make two weeks. And that would be our detailed schedule.

And also I might add that, you know, NEI I think is going to work pretty hard to come back with another draft revision, and we'll try to work that into the process as best as we can. We can work this even if we don't get draft revision E, because we have a reg. guide and we would probably

write a lot of this as exceptions. And then if they come back and clarify, that makes it a cleaner reg. guide. So we can work either way, I think, on our schedule.

CHAIRMAN APOSTOLAKIS: So when you say rulemaking package, that's the rule itself plus the regulatory guide.

MR. REED: Yes. And the same in considerations, the whole thing. It's a huge package.

CHAIRMAN APOSTOLAKIS: Okay. Very good.

Now why June 30th? The Commission wants it by then?

MR. REED: That's just been the schedule for at least 12 months. Yes. And we're trying to stick to it. And so far we're still on it.

CHAIRMAN APOSTOLAKIS: Okay.

MR. REED: There's been quite a bit of pressure, frankly, to make that schedule.

One of the major tasks that we're working on, and there's really kind of two big ones that we're working on. One is to review the public comments and address and resolve those issues. And then the other one is to review NEI 00-04. But first the task is to review the public comments.

We received 26 sets of comments apprising hundreds. I just said approximately 250. I didn't sit down and count them all, but quite a few comments. And those comments came from a broad spectrum of groups. Basically all the major industry groups, some public interest groups, two different states, ASME, a nuclear organization for example and others. So, a pretty set of comments from a lot of stakeholders. Quite a bit of interest in this rule.

Just to give you a quick overview then of the comments, they reflected a wide range of views. I think anytime you go out with a rulemaking these days you're going to get that, especially with this kind of rulemaking, with this kind of interest.

They did in fact though represent a divergent range of interpretations of what our rule language meant. And that was a concern for us. As well as what the statement of considerations meant that supported those rule words. And so that's an issue that we have to look at.

In general, the states and public interest groups wanted a lot more review in terms of prior review of RISC-3 treatment, an issue that the Committee got into a little bit this morning. I was

kind of surprised. But that's where they're coming on that.

Of course, industry is more along the lines of what we have been. In fact, the entire project is to go with no prior review of RISC-3 treatment, and that's the way the framework was structured, as you're well aware.

CHAIRMAN APOSTOLAKIS: What does that mean?

MR. REED: That means that the RISC-3 treatment program that licensees would apply to these safety related but low safety significant SSCs would be something that the licensees would implement without coming to the NRC for prior review and approval. Okay. They would have to, in fact, meet the requirements in 50.69(d)(2). That's how we're handling it. Exactly the opposite from categorization which we're reviewing and approving in detail.

CHAIRMAN APOSTOLAKIS: But the actual treatment, special treatments that apply to RISC-3 will have been explicitly stated by the NRC?

MR. REED: In 50.69(d)(2), yes. That's correct. That's what I was trying to say.

CHAIRMAN APOSTOLAKIS: So what would you

review?

MR. REED: We're not going to review RISC-3 treatment.

CHAIRMAN APOSTOLAKIS: But what do these people want?

MR. REED: Oh, they wanted an -- I think I'm characterizing the comments correctly. But I think they wanted both the review and the requirements in the rule.

MR. SCARBROUGH: This is Tom Scarbrough.

The rule itself has very high level requirements. It says you have to have reasonable confidence that this equipment can perform its safety related function, and that's about as far as it goes. It doesn't go much farther than that.

The licensees have to develop processes that provide that reasonable assurance. And we're going to -- or the current proposal is we're going to allow the licensees to go ahead and develop those on their own without any more guidance than just that. And then start to implement. And then there's some more discussions of what possibly for inspection down the road might be done. But that's the plan.

and one of the considerations was should

we review some of those processes, those planned processes in advance before they start to implement them. And our current proposal was not to do that because of the individual low risk of these components, we feel it's reasonable to not do that.

CHAIRMAN APOSTOLAKIS: So you would never review them?

MR. SCARBROUGH: We're discussing right now in terms of inspection guidance down the road. And we have a slide on that, we'll talk about that some more.

MR. REED: In fact, coming to that issue, inspection. That was another issue that we got a little bit of range of views on. Generally the public wanted a lot more in depth inspection of 50.69. I would characterize the industry as being more along the lines of what we would typically do under the ROP today. But just the range, just to give you an idea. And it's an issue, just mentioned, and we'll be discussing it here in a few minutes.

Also, as far as PRA requirements, something that's near and dear to this Committee's heart.

Industry, of course, is pretty much in

line with the staff's proposed rule position in terms of the requirements in paragraph C. Industry groups wanted a lot more PRA requirements. Typically level two full mode type PRAs. And they also wanted them review and approved, and even periodically re-reviewed and approved. So quite a range there also in that.

Just to give you an idea of some of the big comments and some of the range that we saw.

What are we doing as a result of that? Well, basically we're looking at that and kind of the output of all this is to basically clarify the rule language where it's appropriate. Simplify and clarify the SOC, as you'll see in a second, continuing with the same structure to the framework as we have been for the last four years. And that would be no prior review of RISC-3 treatment.

We will do some inspection. It will be of a sampling of plants in regions, and there will be a temporary instruction on that. And that will be discussed a little bit more in a second.

And, of course as a typically do in these kinds of rulemaking, we'll conduct a public workshop to discuss the final rule.

MR. ROSEN: Now the inspection

implementation is going to be broader than just treatment, I assume?

MR. REED: Yes.

MR. ROSEN: I mean mostly it should be it categorization and the implementation of categorization and the qualifications for the expert panel and its procedures for the panel and the working group. I mean, it should be the guts of the thing rather than treatment sure, too. But the guts?

MR. REED: Obviously the temporary instructions aren't written right now, but I would expect the focus would be more towards what you're just saying, but nonetheless, it would be I would suspect a sampling in the RISC-3 area.

MR. ROSEN: Right. But because you were talking in the prior bullet about treatment, one could construe that, that's all about treatment.

MR. REED: No, that's not the case.

MR. ROSEN: I'm trying to make sure that what the heart of what you do in the field with respect to this regulation will be inspection of the process that the licensees use for categorization and, oh yes, treatment as well. But principally categorization.

MR. REED: Why don't we hold off on that.

MR. HARRISON: Yes. This is Donnie Harrison.

The thing I would add, though, is that since the categorization process will be reviewed and approved by the staff beforehand, the inspection part of that is kind of a confirmation that they're following that process. And so that may mean that the inspection TI that actually gets written actually focused more on treatment and just goes back and says are they doing what they committed to do.

MR. ROSEN: Boy, you make me nervous. Because, you know, you can write down a lot of things and I'm sure you'll look at their procedure before you bless it, but you really need to go out and see how it's actually done, the categorization.

MR. HARRISON: Yes.

MR. ROSEN: We think categorization is the heart of this process. And I think we all agree that it is. And we need to look at how they plan to do the categorization at the level of their procedures and then go out and see that they're carrying their procedures out correctly.

MR. HARRISON: And I agree with that. I just wanted to make it clear that if you were to look at strictly at the TI you could get almost a balanced view between categorization and treatment because we've already reviewed that up front and then we're just confirming in that phase.

MR. ROSEN: Yes, but if you give your inspectors the idea that what they should focus on is treatment --

MR. HARRISON: That's all they're going to do.

MR. ROSEN: -- you'll give the plants that idea. And that's absolutely the wrong impression. So I'm just arguing for the other side of this.

MR. HARRISON: Gotcha.

DR. KRESS: And how will you resolve the PRA scope issue?

MR. SCARBROUGH: We'll get to that.

MR. REED: Yes. It's one of the issues that we discuss.

DR. KRESS: Okay.

MR. REED: With that, in fact, I'll turn it over to the meat of the discussion and Tom Scarbrough will start off with the first issue.

MR. SCARBROUGH: Just a little background about how we set up the proposed rule itself.

The proposed rule was intended to have high level treatment, and I'm just talking treatment. High level treatment requirements and the SOC, statement of considerations, would provide expectations or guidance to explain what those high level words meant. And then without any additional regulatory guidance; we weren't going to have a regulatory guide or anything like that. That was decided as to how we'd do that.

When we issued the rule for proposed comments we received a number of comments which indicated that, as Tim mentioned, the interpretation of the words in the rule by the licensees was not what our expectations were listed in the SOC. There was a quite significant difference between those two sets. We thought we were explaining the rule pretty clearly in the SOC, but obviously we weren't. So what we've decided to do is go back and simplify the SOC. Take out a lot of the guidance, expectations and focus more on just a meaning of the words in the rule rather than trying to give expectations or guidance and simplify it in that way.

One of the areas that we found with respect to interpretation of what the SOC said, was the SOC had indicated, had just noted that the design requirements, the current design requirements for fracture toughness would continue to apply. Like the ASME code is a design code and all for class two and three materials, it's all being removed. So the design may change for all that class two and three equipment. You know, as long as they meet their functional requirements, they're not required to meet the original design. They can change the design as long as they meet the functional requirements.

But one of the areas that the materials engineers felt was a key parameter with respect to design was fracture toughness. And so we had mentioned that in the SOC. And the response we got back from public comments was no, the commenters did not consider fracture toughness to be a design consideration. And we interacted with our materials branch and it was determined that fracture toughness is a fundamental material property that is considered necessary to be retained as part of the design.

So what we plan to do is clarify the

rule, because at lot of the SOC is going to be simplified and a lot of the language is going to go away. Simplify or clarify the rule to indicate that if you have fracture toughness requirements on a piece of material that's safety related, it needs to retain those fracture toughness requirements.

MR. ROSEN: Tim, you're the first staffer I've ever hard say that design can be changed under this rule. You said it could be changed.

MR. SCARBROUGH: Yes. Absolutely.

MR. ROSEN: That's not my understanding

MR. REED: Design basis functional requirements need to be maintained.

MR. ROSEN: That's basis for functional --

MR. REED: Yes. Sometimes people say design basis being maintained --

MR. ROSEN: But detail from the design can be changed as long as the --

MR. SCARBROUGH: Absolutely. Absolutely.

MR. REED: Sure. Absolutely. I mean, a detail in design could come from special treatment. Right?

MR. SCARBROUGH: Right. That's a common -- you know, in the words of how we use our language, sometimes that slips by.

MR. ROSEN: Well, let's be careful here. Because let me just try an example.

MR. SCARBROUGH: Yes.

MR. ROSEN: What if a lower significant component, the licensee's been buying X piece of gear since day one. Safety related. But now because it's found to be low safety significant he can replace that X piece of fear with a piece of gear made by vendor Y. It meets all the same design functional requirements, but it's a little different shape, painted a different color, its design details are different but functionally it's the same. Is that what you're talking about?

MR. SCARBROUGH: Right. It's still intended to be able to withstand an earthquake, that's the appropriate earthquake G levels, but it could be designed differently. It could have a completely design.

MR. ROSEN: Okay. That's a useful clarification.

MR. SCARBROUGH: Yes. Yes. And we consider that for the class two and three ASME

reasonable for this low risk material. However, the materials engineers felt fracture toughness was such a fundamental property, that was one of the ones we wanted to hang onto because that will maintain the strength in material. And so we wanted to clarify that.

CHAIRMAN APOSTOLAKIS: Could you explain a little with me the difference between functional requirements and design requirements?

MR. SCARBROUGH: Functional in case it has to be able to continue to provide so much -- if it was a pump, so much flow under design basis conditions. It has to be able to stand an earthquake, but it may be designed of different material. It may be different material entirely.

CHAIRMAN APOSTOLAKIS: Okay. Okay.

MR. SCARBROUGH: But as long as would withstand that earthquake with the proper Gs it's okay. So they might change the design --

MR. ROSEN: It can fit up to the support that it's being held by with four sets of bolts instead of six sets of bolts because as long as you can show that the four sets of bolts will hold it through the earthquake just adequately.

MR. SCARBROUGH: Right. Right.

MR. REED: Right.

MR. ROSEN: So the design to not to fall down if you have an earthquake or rip out of the support if you have an earthquake and you're able to show in the new design that with four sets of bolts it still can do that.

MR. SCARBROUGH: Right.

MR. ROSEN: And it's a different design detail.

MR. SCARBROUGH: But not functionally different.

CHAIRMAN APOSTOLAKIS: I think you want to say something?

MR. FAIR: No. I was just going to add that, you know, this is unique in that in repair and replacement we're taking ASME code design components and saying you can replace them with a non-ASME code design component, where a number of other special treatment rules are like QA requirements. And the particular piece of component wouldn't change but the amount of checking and things like that you would do would change.

MR. SCARBROUGH: Okay. So that was fracture toughness, that's the first issue.

The second one had to do with the

consistency between the treatment process and the categorization process. As you start to think about what changes you might want to make to treatment, how you want to handle this equipment in the future, what impact those changes in treatment might have on the categorization process.

One of the -- these are the public comments we received. Some of those comments indicated that licensees might assume the historical reliability of the equipment and not think about what impact a change in treatment might have on that. We had comments that sensitivity studies might eliminate the need to consider changes in reliability to do treatment entirely. And the concern there is that we might have some specific problems with a set of components, like motor operated valves things of that nature, that might have a severe affect on those particular pieces of equipment, but in general the rest of the component are not going to see much affect at all.

Those are the types of things that we heard. Also, we had comments that cross system common cause interactions aren't modeled in the PRAs and they're really handled through plant practices. And that sort of goes to treatment. And so we wanted

to deal with that.

We also had comments that degradation mechanisms resulting from the treatment process or reductions of treatment processes are typically not handled in the PRAs. They're handled through the treatment. So what we wanted to do was try to ensure that licensees as they make adjustments to their treatment, reduce the treatment from all the current special treatment down to something that they consider to be reasonable for this lower level risk component, that they think about what assumptions they've made in their categorization process for that equipment and is it reasonable what they plan to do.

It doesn't need to be quantitative. It doesn't need to be, you know, so much percent decrease here and here. But they need to think about what they're doing in terms of are they going to lubricate it, are they going to do testing, are they going to maintain this equipment the same way or some reduced way. They need to think about what they're assuming in their categorization process and make sure that they're consistent, that they're reasonable between what you're going to do here and what you're assuming in the categorization and what

you're doing in treatment.

And so that didn't come through very clearly. We thought it did, but it never ended up in the proposed rule. And so we wanted to clarify that in the rule itself.

DR. BONACA: The perspective is sensitivity studies that meet the need. You know, support that? You don't agree with that point, right?

MR. SCARBROUGH: Right. Right. Because of the sensitivity studies, because of the fact that even if you assume a factor of three or so increase in unreliability, you're not really changing the reliability very much. 99.9 percent to 99.7. And there are certain groups of components that might have a much more severe effect if you stopped maintaining them properly.

DR. BONACA: That's right.

MR. SCARBROUGH: And so that was the thing that we wanted to think about as they do this. Of course, they can reduce a lot of the treatment, a lot of the paperwork, a lot of what they're doing can be reduced down without much effect on reliability, but they need to at least think about it and decide how far they want to go on the

reductions in treatment. And we thought this was a way to have them do that that tied back into the categorization as they start to set up their program.

CHAIRMAN APOSTOLAKIS: Now that you explain it, it makes more sense. But just by looking at this last paragraph, I got a bit confused. I man, I don't recall this morning talking about making assumptions anywhere. Which part of the categorization process requires you to make these assumptions?

MR. HARRISON: The assumption part that's being referenced here is really the assumption in the risk sensitivity study when they take the factor of all the low safety significant components and they adjust it by a factor of three.

CHAIRMAN APOSTOLAKIS: Right.

MR. HARRISON: The think is that that study needs to be maintained as a valid answer. So when this is talking about when you do your treatment, make sure you don't have an effect that would be greater than that factor used in that study. And, again, that drives you again into the corrective action program and monitoring program to make sure you get the information to confirm that

categorization process.

CHAIRMAN APOSTOLAKIS: Well, that factor of three would be applied to all.

MR. HARRISON: All.

CHAIRMAN APOSTOLAKIS: Is there anyway that an assumption on a particular item would really violate that? I mean, that's a pretty serious assumption that everything goes up by a factor of FIVE, actually.

MR. HARRISON: Right. And the key here this is not a concern on an individual component basis. Again, it goes back to the comments about something that would have to go across the plant effect.

CHAIRMAN APOSTOLAKIS: Ah.

MR. HARRISON: Okay. So this degradation mechanism or a common cause cross system interactions that's happening.

CHAIRMAN APOSTOLAKIS: So I suppose it would be clearer in paragraph (d)(2) than it is on the slide? Because right now it doesn't say that?

MR. HARRISON: I think the comment in (d)(2) is just a linkage sentence that takes you back that says be consistent with the treatment. Treatment needs to be consistent with the

categorization process.

CHAIRMAN APOSTOLAKIS: Well, I like the other way you put it; that if you use a factor of five or the low safety significant component, make sure you haven't done anything somewhere that will negate that.

MR. HARRISON: Right.

CHAIRMAN APOSTOLAKIS: Which I doubt will exist. Because, as I say, this is pretty conservative thing to do.

MR. SCARBROUGH: Well, it's sort of across the entire plan.

CHAIRMAN APOSTOLAKIS: Yes.

MR. SCARBROUGH: But the concern would be that there would be components that you might decide to stop lubricating the valve stem for motor operated valves. And for that groove, it's going to have a much more severe than a 99.5 percent reliability. I mean, it could drop it severely. And so that's what we want them to think about, you know, across the board it is true. For across the board. But for individual groups of components they need to think about what they're doing in the future to those, just so they don't lose track of them, they just sort sit in there forever.

CHAIRMAN APOSTOLAKIS: And then there's no requirement in the categorization process to look at smaller groups, is there?

MR. SCARBROUGH: No. No, sir.

CHAIRMAN APOSTOLAKIS: All right.

DR. FORD: I'm struggling to understand the physical consequence of the statement about Dominion Power. Let's take an example.

This particular rule also applies for licensing of new designs. Let us suppose --

MR. ROSEN: Is that true?

DR. FORD: Yes.

MR. ROSEN: So in other words someone can come in with a 50.69 in the process of analoging the Part 52 reactor?

MR. HARRISON: Yes. Correct.

MR. ROSEN: Okay.

DR. FORD: So let's take a case of ESBWR and the core shroud of that particular reactor. Let's assume that you go through the safety significance of that particular component and come to the conclusion it's a RISC-3 category. Does that mean from those two statements that therefore you need not necessarily make that particular component out of, for instance, 3-16-L. They could for a

cheaper 304?

MR. HARRISON: Yes, you could.

DR. FORD: Even though we know that that would crack easier or more liable to crack that 3-16-L.

MR. SCARBROUGH: Well, no. They're supposed to evaluate whether or not they have a known degradation mechanism. And if they have a known degradation mechanism, they have to deal with that. So that would be an issue they would have to address.

DR. FORD: Okay. In that case that would negate that being categorized as a RISC-3 component because we know 3-16-L will crack.

MR. HARRISON: Or if it's categorized as RISC-3, they would still carry that aspect of the design basis functional requirement or treatment through to the other side.

DR. FORD: Okay. But then Dominion Power says that that wouldn't be carry through on a PRA?

MR. HARRISON: Right.

DR. FORD: So where do we stand? We've now got a component by this rule which we know can crack would normally be characterized as a RISC-3

and so where do you go from there in terms of treatment.

MR. HARRISON: The way the rule is set up is in section B, I think it's (b)(4) or something like that, as part of the license application that comes in they're supposed to also discuss known degradation mechanisms, identify known degradation mechanisms and cross system common cause interaction potential. And the intent there is so that they identify them up front. We know they're not modeled in the PRA, and so they need to be captured on the back end. And so it passes through the categorization process to the treatment process.

DR. FORD: And so presumably there'll be a line in your decision making process that would say once you've gone through that -- presumably the IDP would go through this sort of argument. You'd have people in the IDP who could make informed decisions about what might happen, and it would be bumped up to a RISC-2, is that right?

MR. HARRISON: Well, whatever it is in the categorization process, that treatment piece that was identified early, we would have to make sure it was being addressed in the treatment part. So if they identify a section of piping that's

susceptible to some type of degradation, even if that piping gets ranked as RISC-3, they can't let go of that treatment program. They're going to have to treat that on the treatment process and they can't let go of it.

MR. REED: Yes, I guess what you're getting to is you come up with a scenario where you're going to allow degradation to basically cause the thing to not be functional.

DR. FORD: Right.

MR. ROSEN: And that's doesn't comply with 50.69. You'd have to maintain the things design basis functionality. I mean, that's a requirement of 50.69. So the process is structured to maintain that.

If you really are, I guess, implicitly and you are in fact in the PRA assuming that the thing can function and degradation would disable that function well then, in fact, you'd better make sure that degradation does not do that. So that's kind of what we're saying here.

I don't think I would happen in this case. I think they would put the right steel in, it's a little simpler. But --

DR. FORD: Okay. And that is in fact almost stated quite specifically in your paragraph (d)(2). It's not addressed, however, in the NEI document.

MR. HARRISON: Correct.

DR. FORD: So how do you look on that?

MR. HARRISON: When I talk later this afternoon.

DR. FORD: Okay.

MR. HARRISON: We've got a recommendation on that.

MR. ROSEN: I've got a question. I'm a little confused now.

I thought Part 52 would require you to use the risk-informed approach, use the PRA, and that using -- for a new reactor we're talking about. Using that PRA and the design you would identify what's risk significant and what's not. And the things that are risk significant would be safety related and the things that are not would not be. So where does 50.69 come into that process?

I mean, I don't understand the implication of 50.69 if I have the Part 52 right.

MR. REED: Okay. You're going to ask me to go back to the Part 52 license and stuff I

haven't looked at for at least a year.

But in general the way it would work, if you want to use 50.69 and you look at the language in 50.69 uses the word safety related and nonsafety related and then you put it down into the four boxes to get to where we add a RISC-1, 2, 3 and 4. So if you want to use 50.69, unfortunately, you got to divide to roll it up first all into the standard safety related and nonsafety related design. And then go in and basically on an overlay, if you will, put in this expert panel and categorization process and put it into the four boxes.

Now, having said that, Part 52 I think they're shelf designs, right? Am I in the right part? Okay. I'm drawing a blank exactly how we came out on that. How Jerry Wilson came out on that one. But I think --

MR. ROSEN: I think that the safety related but not risk significant component in Part 52 would be empty. There would be no --

MR. REED: Right. I'm not sure.

MR. GILLESPIE: I kind of asked this question this morning of the staff, so I can only give you the briefing that I got.

MR. REED: Yes.

MR. GILLESPIE: And they used as an example AP600. In fact, under Part 52 there's a number of systems in AP600 which are not considered safety related but have a safety function in the traditional sense of an older design which actually have lesser treatments. And we can get someone from Advanced Reactors, but you almost might say that some of the Advanced Reactor reviews have already taken advantage of some of the principles.

DR. BONACA: Are you referring to regulatory treatment of nonsafety related components?

MR. GILLESPIE: Yes. Yes. So in principle I have a feeling from just the brief discussion that I had on this morning, that actually the Part 52 design certifications have kind of already considered this kind of thing as part of them. And as Tim said, it would actually be --

DR. BONACA: They still have features to deal with anticipated transients and, you know, the old fashion approach although now they're supported by a PRA. So you do go with the categorization that is still consistent with the core SFER approach, you're going to bump into the same problem. Now you have to go down to 56 and reorder components to deal

with this issue.

MR. GILLESPIE: Right, but they've already got systems in there that under the old system if they were licensed under Part 50 would have actually had special treatments on them more than they actually do in the certifications.

MR. ROSEN: So is AP600, for example, a certified plant, right?

MR. GILLESPIE: Yes.

MR. ROSEN: It was licensed under Part 52 or --

MR. GILLESPIE: Under Part 52.

CHAIRMAN APOSTOLAKIS: But not 69.

MR. GILLESPIE: But not 69.

MR. GILLESPIE: But it has some of the traditional functions not necessarily Appendix B'd fully. So within the certification itself the way I understand it, there is actually some systems that if we had licensed this plant 20 years ago, we would have viewed with a higher pedigree than they actually have in the certification.

CHAIRMAN APOSTOLAKIS: Well, I'm not so sure. Because Westinghouse claims that those systems were not needed --

MR. GILLESPIE: They claims that they

were -- in essence, George, what I'm saying is they claimed they were not needed and we agreed with them.

CHAIRMAN APOSTOLAKIS: Yes.

MR. GILLESPIE: And so they are treated in a slightly lessor way than if we had licensed them, like when South Texas came in and said we've got another extra train of this, give us credit for it, and we said no. In the case of the certifications we actually listened and some dialogue.

CHAIRMAN APOSTOLAKIS: Okay.

DR. BONACA: Well, this I mean it's central issue that we've spoken on and will come up at some point, this issue of coherence of the regulation. Okay. And I know one of the difficulties has been that we still have one set of criteria that you design the plant by and they are in the SFER and you are controlling and then you have a special treatment which is based on other criteria which are risk-informed. Until you have -- I mean, I thought there was an effort to improve the coherence of the regulations. We haven't seen any further presentation of that, but that would be helpful to remove this incoherence.

CHAIRMAN APOSTOLAKIS: Well, and the other thing is, of course, the reason why the safety and nonsafety related categorization was kept is because it's everywhere in the regulations for existing reactors, which have been difficult to change it.

DR. BONACA: Sure.

CHAIRMAN APOSTOLAKIS: But why continue it for future reactors? But you have to change the same set of regulations, though, so the argument comes back.

MR. GILLESPIE: Yes.

CHAIRMAN APOSTOLAKIS: It's really a very unfortunate situation that you have to start with the traditional safety/nonsafety related and then go down.

DR. BONACA: Right.

CHAIRMAN APOSTOLAKIS: I think the diagram from NEI was nice with the arrow. This is how you start -- but you are forcing future designs to do the same thing. I guess that's easier than changing all the regulations.

MR. GILLESPIE: And I'll say we haven't reacted to. But NEI actually has a white paper in now that's probably approximately two years old

which was in kind of parallel with our coherence effort or they stimulated each other to some degree. And quite honestly, the staff has not been working on that for about the last year. We kind of started. We had a couple of meetings and then we got diverted by trying to get 50.46 out and 50.69 out.

And it's a fair comment to say we should go back and revisit that because trying to apply 50.69 to a new plant is extremely difficult because you have to design it in the old context in order to apply 50.69 to it. And they're actually designing them to the next context, which is why I said the experience was we had a dialogue so that the risk insignificant systems never got pulled into this context, if you would.

So we do have a need for some coherence between what we're doing.

CHAIRMAN APOSTOLAKIS: And, of course the question of defense-in-depth comes up. I mean, defense-in-depth doesn't mean the same thing now for the new design --

MR. GILLESPIE: The design. For some of the new design, it does not. It has a different more risk-informed meaning.

MR. ROSEN: It ought to be very simple.

MR. GILLESPIE: Yes.

MR. ROSEN: Those things that are risk significant should be safety related. Those things that are not, should not be. It ought to be very simple.

CHAIRMAN APOSTOLAKIS: In 52.

MR. ROSEN: In 52. It seems to me you're having difficulty yes for an answer.

MR. GILLESPIE: And we've taken yes for an answer under design certifications, which in and of themselves are a rule which allows them to have a real advantage.

MR. REED: Actually, I think some of those design certifications get a little bit more complex in terms of what's really rolled into the certification in terms of implement, procurement, what's assumed and what we actually reviewed and approved. And so that may have some implications, too, as to what you can change.

Design certification would be difficult and we'd have to look at it pretty carefully. We're not ruling it out, though. If you look in the SOC for the proposed rule, you can see the discussion there.

MR. ROSEN: I'm not sorry I brought it

up.

CHAIRMAN APOSTOLAKIS: Maybe it's not so bad for evolutionary designs. But for generation four in the future it might be important to go back and change.

MR. ROSEN: If we don't start pretty soon, by the time we get to generation four we'll have the same problem.

CHAIRMAN APOSTOLAKIS: Assuming DOE's demand holds.

MR. GILLESPIE: That'll be my next project.

CHAIRMAN APOSTOLAKIS: Don't you do it by June 30th.

MR. ROSEN: Yes. Let's roll the clock back to 1955. Now to design the first reactor. We have PRA by that time, let's say -- assume. Would we have designed them this way? I think not. I think we would have said okay, here's a design. What's risk significant? And we would have said okay these things are risk significant, these things are not. Okay. We're going to pay real good close attention to those things that are risk significant and the rest we'll just do a normal industrial practices like a chemical plant. And everybody would

have, uh-huh, uh-huh. And it would have been so simple. The trouble is we're not there. We can't roll the clock back. But we somehow have to make a transition from where we are to that place.

CHAIRMAN APOSTOLAKIS: Can we move on to the next slide.

MR. SCARBROUGH: In the SOC we have referenced the use of voluntary consensus standards as one effective means for meeting the high level treatment requirements and then we referenced a study that NRC sponsored in NUREG 67.52 which looked at industrial practices and found that there's a large range of industrial practices in the industry.

And some of the industry comments indicated that only industrial practices might be applied when implementing the treatment requirements. And what that might involvement was, for example, we had some commenters indicating that they were going to not test components anymore, they were going to just exercise them. And if they happened to be exercised during normal plant operation, that was going to be considered good enough. But they wouldn't have anyway of gathering any data or have any information regarding the capability of that component to work under a design

basis conditions. But because of that we started to have some concerns regarding what was this interpretation of industrial practices that was being indicated in the comments.

When the ASME sent in their comments, they said that we didn't need to put a provision for voluntary consensus standards in the rule because the SOC provided guidance on using the ASME code cases and things of that nature. However, those aren't required. That was just indicated to be as recommendations or suggestions.

And also we had a number of other stakeholders raise concerns, such as the state of New Jersey and some of the public industry groups, regarding the lack of detail in the rule, as we talked about, the need for prior review and some operating experience issues that they raised. So there was quite a bit of concern regarding this sort of use of industrial practice that rose.

So what our plan is to clarify in the SOC that industrial practices might not satisfy the rule requirements. They have to have sufficient processes that provide reasonable confidence in the design basis capability of the component. And that might be industrial practice or it might not. It

wouldn't be exercising a valve where you wouldn't have any knowledge of understanding whether or not it would really perform its function or not.

So that's our plan to try to resolve that issue to address this different interpretations of the rule and the varying expertise licensee. And try to clarify the meaning of what the discussion was under this area in the rule and specify --

CHAIRMAN APOSTOLAKIS: How do you answer the last comment?

DR. BONACA: Yes.

CHAIRMAN APOSTOLAKIS: I have no idea. The last one says "Additional stakeholders raised concern that proposed rule was not adequate to maintain plant safety." The answer is no, it is? I mean how do you answer that comment.

DR. FORD: Can you give us some --

MR. SCARBROUGH: Right. For example, several of the stakeholders indicated that the lack of detail would provide such a wide range of practice among industry that there wouldn't be any confidence that one stakeholder would be doing something sufficient and the other one wouldn't without anything more than what was in the high level requirements. And so that what one concern.

And amplified by the fact that the NRC is not planning to do any prior review because of that, that was -- and so what some of the proposals were was that the staff review the treatment up front to deal with that. And so those were some of the types of concern that they raised.

Of course, they pointed to Davis-Besse and different, more reasons --

CHAIRMAN APOSTOLAKIS: Are those not valid concerns?

MR. SCARBROUGH: They are concerns. And that's why we decided that we were going to amplify in the SOC regarding -- although voluntary consensus standards are not required, industrial practice itself because of the wide range of those levels of practices, may not be sufficient. You just can't walk in and say I'm going to go and I'm going to start exercising pumps or exercising valves unless you have a basis for doing that. You're going to have to be able to maintain the design base capability of that component and that may not be just an exercise. And so that's what was concerning us.

Some of the comments we received indicated that the level of competence in this

equipment was expected to be so slow that simple things like exercising or not performing any inspections whatsoever, that sort of thing, was just going to be sufficient for this. And that's what raised our concerns.

We plan is to try to clarify that in the SOC that you have to have a basis for your treatment. You can't just say that this equipment is negligible in its importance and then assume that, you know, such a low level of confidence that you could almost have no confidence that it would work. We still want to use low pressure cross braces, things like that, to work if they're called upon. But they can have less confidence in their reliability, but they still have to have a basis for it.

MR. REED: Well, let me just add, this rule structure around maintaining basically the current risk profile is a very small change. And we don't put rule packages together off of public comment. It goes through the clearance process that we don't think maintain adequate protection. So, obviously, we don't agree with that comment.

But nonetheless, we're listening to the concerns of these stakeholders and seeing whether in

fact, as Tom said, there's ways to improve this thing. But obviously we --

CHAIRMAN APOSTOLAKIS: Yes, because it's kind of a blanket statement.

MR. REED: It's a simple thing to say. It's difficult to back that up.

MR. SCARBROUGH: But they have a large number of pages and we just summarized it right here. But they had a lot of discussion of why they felt that way.

DR. FORD: So to come back to my example of the core shroud in the practical guide, there are a number -- and you said that the licensee would have to address the fact that these components can degrade. And what you're saying is the level to which they counter that is a whole range of material, environment, surface treatment, etcetera of way you can counteract it. They've got to come up with some argument as to how they're going to manage this problem. They can't just say it's a RISC-3, therefore we no longer have to apply Appendix B or any of the procurement concerns. They've got to address it up front.

Now the problem arises such a range of ways that you can counteract this. What will you

regard as adequate to maintain safety?

MR. SCARBROUGH: There's significant reliance on the licensees here. I mean, they're given a significant amount of flexibility on how they do that.

DR. FORD: Because someone has to decide okay, you're right. That must be you, is that right?

MR. SCARBROUGH: Yes. There is plans to develop --

CHAIRMAN APOSTOLAKIS: Is there a prior review?

MR. REED: Yes, I was going to say actually we wouldn't make that decision. We're not going to say whether a specific practice is acceptable or not. That would be a prior review and approval type of approach I think you're falling into here.

We've, hopefully, structured the requirements in this particular section of 50.69(d)(2) that maintain that level of sufficient confidence to do that.

CHAIRMAN APOSTOLAKIS: Without prior review?

MR. REED: Exactly.

CHAIRMAN APOSTOLAKIS: Why is that prior review an anathema? I mean, you spoke of it as if as if -- oh boy. I mean why? Is that too much work, unnecessary work?

MR. REED: It's got a history to it. It starts all the way back on the review of the South Texas exemption where we went on for just about a year, I think, trying to do just that before they changed the approach. Where you're basically trying to get engineers from South Texas to agree with engineers from the staff on exactly what you're doing when everyone of these things, every nut and bolt down there was RISC-3, and it was just a lot of missing.

CHAIRMAN APOSTOLAKIS: But then you didn't have a 50.69.

MR. REED: Excuse me?

CHAIRMAN APOSTOLAKIS: We did not have a 50.69 at that time, so I can see --

MR. REED: That's correct. But we learned a lesson, hopefully we learned a lesson.

CHAIRMAN APOSTOLAKIS: If there is some prior review, it should be much weaker than what happened with South Texas. Because --

MR. REED: It could be quicker. But I

think it also had been a right term a Mexican standoff, a disagreement. You know, a lot of these are engineering opinions and what is sufficient, what's necessary.

DR. BONACA: But let me ask a question in this regard, okay. In many places the general comments or revisions here of NEI 00-04, the statement says the degree of relief that can be expected will be commiserate with the assurance provided by the evaluation, these show completeness and so on and so forth.

How can you enforce -- how can you stand behind the statement when you're not going to review the evaluations, the written implementation?

MR. SCARBROUGH: I'm not sure what you're looking at there. Now categorization, there is going to be significant review for categorization.

DR. BONACA: Okay.

MR. SCARBROUGH: Significant review. And it could go either way with prior review for treatment. But it was just decided that with the individual low importance of the RISC's recompliments, we would let the licensees go ahead and develop a program. I mean, there's a leap of

faith here.

DR. BONACA: But in the categorization you will be involved?

MR. SCARBROUGH: Yes. Yes. Absolutely.

DR. BONACA: In the review?

MR. SCARBROUGH: That will be a fairly thorough review.

MR. REED: I mean, this whole framework is really based on robust categorization and having a lot of confidence that when it comes out of that, truly is the safety significant boxes 1 and 2 and what comes out in 3 and 4 is truly low. And you have to have confidence in that. And if you have confidence in that, then you can let go of the treatment and allow the licensees to apply what they think meets the requirements of 50.69(d)(2).

DR. BONACA: And I agree with you. It's just simply on page 6, I mean, you left it hanging there. It wasn't clear what you'd be reviewing and what you would not. I don't know what you do about that. That will be issue of stakeholders generally supporting the inspection of 10 CFR 50.69 implementation. And so now you're specifying that you'll be involved in review of the categorization?

MR. REED: Right. Yes. sir.

MR. SCARBROUGH: Okay. That was issue three.

Issue four revolved around design control attributes. In the SSC we had identified a few design control attributes which we thought would be very important for design of RISC-3. NEI came in and had a slightly different list. And with our simplification of the SOC we thought it would be important to move those design control attributes into the rule itself so we don't have to get into what's the SSC and what does that mean, what's it standing in terms of legal standing and what's in the rule. So our plan is to clarify the rule itself in (d)(2) to specify some of those design control attributes that NEI had suggested.

And we also included -- we're considering including installation. At one point we had installation as an addition process, control of installation. But it sort of was moved around to different places and ended up only being in the SOC. And we felt that if we're going to simplify the SOC, we want to make the rule stand more on its on. And so we've moved into the rule itself. That's four. It's pretty straightforward in what we did.

The fifth one revolved around the

methods for qualifying equipment, RISC-3 SSCs for environment and seismic. RISC-3 SSCs are going to be exempt from the special treatment requirements for environmental qualification and seismic qualification. But it's only with respect to the special treatment. They still must be capable of performing their safety related functions under applicable environmental conditions or seismic conditions. So we're retaining that.

One of our concerns with the comments was that it appeared that there's an interpretation that there wasn't any evaluation of environmental or seismic capability that was intended. It was going to be almost pure engineering judgment where you might look at the ruggedness of a piece of valve to see if it was rugged enough to handle an earthquake or just assume that a piece of electrical equipment could survive under high temperature conditions for as long as you needed it without any evaluation of that capability.

Another area with respect to design life, and that's mentioned there. And that's Nuclear utility group on equipment qualification.

So those were some of the comments that we had that raised our concerns. So what we planned

to do was clarify the rule that you have to develop and implement documented treatment processes. And we weren't going to change the environmental or seismic capability language. And so this is one case where we decided not to make a change to the rule because we wanted to emphasize that you still must be capable of performing your safety function under environmental conditions or seismic conditions, whatever they are. Just your reliability or your confidence level might be less for that. But you're still required to be able to perform safety function.

Now what we've planned to do is in the SOC clarify that a procurement specification might be sufficient to do this. You might be able to specify in your procurement document that you want this piece of equipment to be able to handle a certain G earthquake, and that's what you'd get back. You wouldn't have to do a significant amount of more detail than that. So because of the lower level of risk importance, we thought that would be sufficient for this equipment. But you have to at least have it documented that you're purchasing or procuring a piece of equipment that can handle its environmental or seismic design conditions. So

that's what we intend to do with response to this comment.

MR. ROSEN: But the qualification methods that the vendor does to give you that reduced assurance that it can meet the functional requirements that you've specified can be different than for safety related equipment? Am I correct.

MR. SCARBROUGH: Well, yes. The vendor has much more flexibility in how they do that. I mean, there's not going to be a 50/49 very specific how you're going to do an EQ qualification for environmental.

MR. ROSEN: Well, the vendor might choose to do that, but he doesn't have to?

MR. SCARBROUGH: Right. Exactly.

MR. ROSEN: He might do it with calculations or analysis, or by comparing them into component to ones that he has does testing on before and saying it's as least as good as that?

MR. SCARBROUGH: Yes, sir.

MR. ROSEN: That kind of thing?

MR. SCARBROUGH: Yes, sir.

DR. FORD: I'm sorry. Could you go back to your previous slide?

MR. SCARBROUGH: Sure.

DR. FORD: And it says NEI states that environmental or seismic requirements, etcetera. Again the environmental aspects, you know, temperature, pressure variation, influence, flux do you agree with that statement that it should be deleted?

MR. SCARBROUGH: No, we have not deleted it. And that's what we were saying.

DR. FORD: Okay. I didn't hear that.

MR. SCARBROUGH: We decided to retain what was in there.

DR. FORD: It's going to stay?

MR. SCARBROUGH: Yes. One of the areas that where the comments came in on was the concept of aging. And is aging a treatment or a special treatment or is it a design consideration. And it may just be in schematics, but the electrical branch considers aging to be a consideration as part of design. It has to be able to operate and preform its safety function over its life, service life, under the conditions it's going to see. And how you consider that, you know, you might test it or you might not, or you might do elevations or calculation, but you still have to consider that as part of your design. And our concern is if we took

language out of the rule, it might give the appearance that you don't have to consider the age of the equipment in making sure it conforms.

MR. REED: Yes. I think to be fair to NEI, and I think it's NEI -- I get all these comments confused. But I think they referenced UDC 4, or at least somebody did, as the governing regulation here that would still require you to maintain environmental and seismic capability. But that 50.49, in fact the specific way you do that program has been renewed. And as Tom said, we wanted to emphasize some aspects of that, so --

DR. FORD: Okay. And not only is there aging of cables, but there's also aging materials, materials aging.

MR. SCARBROUGH: Exactly.

DR. FORD: And in the previous one to this, keep talking about adequacy. Adequate design. The quantification of what is adequate, will that come into your discussion of 00-04?

MR. SCARBROUGH: No.

DR. FORD: Where in this process, the decision making process, who is going to decide what is adequate?

MR. SCARBROUGH: The licensee.

MR. REED: The licensee will.

DR. FORD: And you'll just take his word for it as adequate?

MR. SCARBROUGH: Well, we're going to get to the inspection aspect later. We're going to --

DR. FORD: Well, let me return.

MR. SCARBROUGH: Okay.

DR. FORD: You said that this could conceivably -- I'm just choosing this because it's an easy one to use in an illustration. There's a component in the EBWR which they say is RISC-3. And yet you could have -- and therefore you might build another 3 or 4. And they conceivably could have it without Appendix B according to procurement criteria. And yet you could have a 360 degree crack, and by this 3 or 4 you probably will have a 360 degree crack at that -- in the core weld. What's adequate? Are you going to allow that to occur? What happens if you have a seismic event, then you couldn't put in your control blades? There's different degrees of adequacy.

MR. SCARBROUGH: Right. Well, there's certain safety nets here. One is that they have to deal with known degradation of mechanisms. I mean,

they have to acknowledge them and then they have to ensure that they are required to maintain design functional capability. I mean, so they are required to do that. And then another aspect is that they are required to feed back operational experience in the industry. So along the way there if that type of cracking was identified in any one of those processes, they have to deal with it. They can't ignore it. So that's how that would be caught.

But there's a potential there that something could slip through all those safety nets.

DR. FORD: I haven't heard who has got the lead on defining what adequate is. You keep saying the license will decide that. And now I want to know who is going to review, who is going to decide hey that's a good engineering judgment or analysis of what adequacy is within my design life for this component.

MR. REED: I think it's pretty clear that the level of uncertainty associated with these components is going to go up. I think that's the one thing that's pretty clear. As to whether the reliability changes or not, that's a different issue.

I think licensees are very motivated to

comply with rules and to do things that make sure from an engineering perspective are reliable. That's go for the plant, everything. I think they certainly wouldn't do something that was known to have degradation that would create major -- major problem with the facility.

So, I know you just picked that example. I don't want to pick on that one, but in general, you know, design base function requirements are known very well for the components we're talking about here. There's quite a bit of history and I don't think licensees are going to ignore that history. In fact, they're required to keep an understanding of that. I think they'll factor that into it.

DR. FORD: I'm taking too much time here.

MR. GILLESPIE: Could I add a comment?

DR. FORD: I think we could go a bit more about this one.

MR. GILLESPIE: I think it's important. The basic premise is that we are going to review and approve the categorization process. And so if the core shroud is all of that unimportant in any accident sequence, then the answer would be yes.

But first it has to come out within a system that the staff has reviewed and approved and we are going to see a summary, at least, of the PRA and the peer review of the PRA that within that system if this component is that unimportant that it makes RISC-3, then the answer is yes.

And the definition of adequate is kind of a backwards definition. What we're doing is saying a minimal increase in risk basically from the RISC-3 components. So we're not putting an absolute value on safety, but we are saying that the degradation is expected to be minimal.

So I think it's difficult to talk, to pick a component in a sequence in a seismic event which we know is important and say, well, if this was unimportant would you let it happen? We're counting on categorization. There's going to be a lot of effort in the categorization end for the staff to review and approve. And so there is a staff handle on it.

CHAIRMAN APOSTOLAKIS: Shall we move on, Peter?

MR. PIETRANGELO: Can I add one comment? Just to clarify our comment on this piece.

50.49, the EQ rule was one of the

special treatment requirements that was within the scope of 50.69 and if your RISC-3 would be removed from that scope. Part of our comments on some of the treatment requirements in the proposed rule it was taking a language out of the rule that was excluded in the scope and putting it back into the treatment requirements. It didn't make any sense to us. Okay.

The design basis is not changed. 50.49 isn't even the design basis for environmental concerns. It's elsewhere in the regulations, and that does not change.

We also had some comments about what some of the treatment requirements that are in the proposed rule even went beyond what was required for safety related today. That should not be the case. Okay.

So, again, it didn't make any sense for us to put back into the high level treatment requirement language stuff that was excluded within the scope of 50.69.

The other comment I wanted to make was on industrial practice. The staff did a study with a contractor and said, yes, practice vary very widely. They didn't look at the results of any of those

practices. They just looked at the practices. Okay. Yes, people do things differently.

Industrial practices encompasses the use of voluntary codes and standards. You don't find people out there just inventing it on their own. They use codes and standards that are available. That's what we mean by industrial practice is using what's out there.

It's a lot cheaper for a licensee to use a consensus standard for how to do something versus to develop their own way of doing it and having to justify it on their own. So from our perspective, industrial treatment encompasses the use of voluntary codes and standards.

I just wanted to make a comment and clarify that here.

CHAIRMAN APOSTOLAKIS: Thank you.

Okay. Let's move on.

MR. SCARBROUGH: Okay. Item 6 is an issue where NEI had noted that the rule in terms of corrective action did not deal with common cause issues very well. They indicated -- and came up with some proposed words to try to deal with a potential for common cause. Significant conditions adverse to quality, such as measures are taken to

provide the reasonable confidence that the cause is determined and the corrective action is taken to preclude repetition.

And also the state of New Jersey and also one of the public interest groups also raised concerns regarding common cause.

We agreed with that comment from NEI and planned to clarify the rule in paragraph (d)(2) to deal with that significant conditions adverse to quality. So it's one of our resolutions.

DR. BONACA: Okay. I'll wait for that. I just had some question. You had, in fact, a number of comments on revision C. And some of them were asking the industry to identify, you know, actions to the corrective actio program, review, etcetera. And it's not completed yet? There's more to be done?

MR. HARRISON: If that's NEI 04 -- yes. We have a couple of slides later on that we'll talk about, some things that need to be added to the guide to --

DR. BONACA: Yes. Because I would expect, I mean, that you know you would see through the corrective action program that some issues, some items come up that are tied to this. And I think

that should be monitored and tracked that way.

The reason why I am bringing it up is that a year ago we were reviewing, I believe the -- and we had a situation where there was a plant where there was scram and then there were nine failures resulting from that scam. I mean, there were a lot of different components that failed. I think there were eight or nine. And we have the CNO of the plant coming here talking to us. And he pointed out that they recognized that they were all components which had been removed from their preventive maintenance program sometime before. He said and that was a shortsighted decision, but that's what happened. And low and behold, you have eight or nine components that do not function properly.

So I'm saying, you know, we're not talking about -- just one thing. These things happen. And so I think at least I personally would have an interest at some point to -- if there is a discussion of, you know, any hook on the corrective action program to monitor this process that is taking place and what the expectation of the staff are going to be.

MR. REED: Yes. And I'm sure you're aware that in paragraph (e) of 50.69 we have

requirements to monitor and feedback the performance data and corrective actions will have you into process. In fact, (e)(2) is for RISC-3. In fact, paragraph (e)(2) is actually for RISC-3.

DR. BONACA: Yes. I mean the industry said --

MR. REED: (e)(3), excuse me.

DR. BONACA: -- favor.

MR. SCARBROUGH: And we have a couple of places we address that concern because we have that same concern.

Item seven had to do with operating experience feedback where the Commission asked for comments regarding how operational experience should be considered in light of Davis-Besse and other things. You know, we had public interest groups indicating, you know, that we should provide more oversight of some of the equipment. Some of the industry commenters pointed to programs, existing programs that would provide feedback. Of course, it was maybe maintenance rule or things of that nature which are going to be eliminated by 50.69.

So what we did was what we're planning to clarify the feedback portion of the rule (e)(1) to incorporate a reference to plant operational

experience. And that would include things like corrective action feedback and things of that nature.

Currently it says industry operational experience, but it didn't have that sort of link to plant experience, what you might find from your own corrective action program or indicate, you know, issues that had happened at your own plant. So we wanted to clarify that in the rule, and that goes to our concern of making sure that information that you gather from your corrective program is fed back into your processes. And that's what we're trying to do.

There were a couple of other administrative aspects that we hoped to change. There was a 36 month reference for updating and there was a comment recommending the two refueling outages. And we consider that to be reasonable. So there was a couple of administrative type of improvement we think we're going to make there, too. So we think that will help that.

The next area is seismic, and John Fair was going to talk about that.

MR. FAIR: Yes. The next area is the use of seismic experience data. And we had a lot of comments, and the comments really were not on the

rule itself but on the language in the SOC.

What the rule says for Part 100 is that you don't have to meet the specific testing or analysis requirements of Part 100, but that the remaining requirements still apply. And in the SOC language we said that it may be difficult to still meet Part 100 with experience data alone if you have multiple earthquake inputs as part of your design basis or you have additional load combinations with earthquake.

Some of the comments came back that this would impose additional requirements on the pre-Part 100 plants that were evaluated under USI A-46. Obviously we were talking about requirements under Part 100. So we're going to clarify the SOC to say that the rule was not going to impose any additional requirements on old plants that were evaluated under the USI A-46.

There were also concerns by commenters even for the Part 100 plants that the language in the SOC is going to make it impossible for them to use experience data. And again, we'll point out that the language in the rule says it may be difficult to use experience data alone to quality these components if you have multiple earthquakes or

additional load combinations, but it doesn't rule out the use of it.

The problem with just using experience data without any other evaluation or looking at it, you may have some experience data that you picked up from some seismic event that maybe only saw half the number of cycles that you have in your design basis for the plant, and therefore how good could that experience data for qualifying that particular component. Or you might have some component that has to operate under a combination of DVA and seismic loads and just to have some seismic experience by itself doesn't quality it for both load combinations. So, that as really the point of the SOC language.

so, again, what we're going to do is clarify the SOC to say that we're not changing any requirements on USI A-46 plants and still say that it still may be difficult to use just experience data alone if the experience doesn't cover your design basis event.

MR. SCARBROUGH: Issue number nine goes back to the review of the treatment and inspection of implementation. And the Commission had requested comments on this area, what should we do with the

review treatment and the inspection program. The state of New Jersey recommended that we review the treatment as well as one of the public interest groups. The industry essentially indicated that they recommended no prior review of treatment. But essentially all the commenters, all the stakeholders indicated that some type of inspection process would be appropriate for this equipment. And it was just a matter of level of detail among all the stakeholders.

The BWROG group suggested that we develop inspection guidance for 10 CFR 50.69 processes. And as well, NEI suggested that the existing inspection enforcement process address the functional areas of procurement, you know, maintenance testing, surveillance. So there was an indication that there was vehicles in place to inspect.

So what our current proposal is that we would allow licensees to develop their programs based on the guidance for treatment and regulatory requirements for treatment in 50.69, and then we would develop a temporary instruction, a TI, that would sample plants as they implement 50.69 and focus on performance and risk-informed aspects and

be particularly sensitive to conditions that could significantly increase risk. And what that means is it would be more programmatic in nature and focusing more on common cause issues. Because basically we don't have much concern for individual RISC-3 components. Individually they don't have much importance. But it's the group of the them. So we'd be focusing on discussing with the inspectors and giving them guidance to look for programmatic concerns or common cause concerns that might raise an issue that might reflect on the risk significance overall of implementation of the rule. So that's our thought process going in, and we'll be developing working with the inspection program branch to develop a temporary instruction along those lines.

MR. HARRISON: On issue ten, this is a PRA scope issue. It's here because there was a wide range of opinion on what the rules should require. The states typically recommended that we have a full scope PRA and it states here New Jersey recommended that the staff actually do a PRA review on a periodic basis of that.

We had some other stakeholders that suggested not being able to go forward since PRAs can change over time.

and then others have recommended that the PRAs have to be updated and submitted for NRC review again.

The industry wanted to stay as it was in the draft rule, which was that you would need a full power level one PRA that had been peer reviewed. We now have Reg. Guide 1200 and it would have to meet capability category two in the standard.

The staff is also agreeing to that position, and I think it's enforced with the idea that if you use non-PRA approaches, you don't get any relief for those supporting SSCs and so it kind of takes those out of scope.

Plus, we also believe we're being consistent by just requiring a level one PRA as a minimum, that that would be consistent with the recent Commission SRM on the PRA quality phases.

CHAIRMAN APOSTOLAKIS: It's not an issue of quality. It's an issue of scope.

MR. HARRISON: It's a scope issue, but it touched on quality. About what -- the question came in at what phase of PRA quality are you for the various scopes that you have available.

CHAIRMAN APOSTOLAKIS: But you can have level one PRA that's a very poor quality or a very

good quality.

MR. HARRISON: Correct.

CHAIRMAN APOSTOLAKIS: And that's not what you're referring to?

MR. HARRISON: No. No, this would be --

CHAIRMAN APOSTOLAKIS: And the Reg. Guide requires uncertainty analysis.

MR. HARRISON: Right.

CHAIRMAN APOSTOLAKIS: But okay. So --

MR. HARRISON: Forgive me for mixing the two.

CHAIRMAN APOSTOLAKIS: Yes. For non -- oh, I forgive you.

MR. HARRISON: Oh, thank you.

CHAIRMAN APOSTOLAKIS: For non-PRA applications if there is a bounding analysis like the FIVE or something, then what you said is correct.

MR. HARRISON: Right.

CHAIRMAN APOSTOLAKIS: No credit.

MR. HARRISON: No credit.

CHAIRMAN APOSTOLAKIS: No credit. But then there are others situation where there is not even a bounding analysis I take it?

MR. HARRISON: Well, it would be

screened out.

CHAIRMAN APOSTOLAKIS: Huh?

MR. HARRISON: It would have been screened out, like if you had a tornado screening or aircraft hazard, you would screen those out typically.

CHAIRMAN APOSTOLAKIS: So we'd never really declare anything of low safety significance --

MR. HARRISON: Related to those things.

CHAIRMAN APOSTOLAKIS: And we don't use a PRA? No. That's not true.

Is PRA the only way to declare something is non-safety significant?

MR. HARRISON: It's not that your --

CHAIRMAN APOSTOLAKIS: I get the impression it's not.

MR. HARRISON: The way the guidance is working is you have to have a PRA in that area to be able to make things low, otherwise they stay as is today. So if I don't have a fire PRA, then my fire --

CHAIRMAN APOSTOLAKIS: Then it stays?

MR. HARRISON: It stays.

CHAIRMAN APOSTOLAKIS: So the rule is

unless I see a PRA, nothing changes?

MR. HARRISON: Right.

CHAIRMAN APOSTOLAKIS: Wow.

MR. HARRISON: In essence that's what it is. Now, I think on the other external events there's --

CHAIRMAN APOSTOLAKIS: I don't understand that, thought. When we see the South Texas request for rated quality assurance, we were told that they had looked at about 50,000 components.

DR. BONACA: Because what they --.

CHAIRMAN APOSTOLAKIS: But wait a minute. No, no, no. The PRA was about 12 to 1400 per unit.

DR. BONACA: That's right.

CHAIRMAN APOSTOLAKIS: Okay. So you have now 3,000 -- 50,000 minus three; 47,000 SSCs that they looked at and they categorized.

DR. BONACA: Because what they said was that it's not only PRA because it doesn't belong there.

MR. HARRISON: No, let me correct, though. I see where we're going and I see where we're going wrong.

CHAIRMAN APOSTOLAKIS: Please don't say there's --

MR. HARRISON: Yes. You have to remember we're doing the -- at the functional level. So if it's not in the PRA -- I'm not saying that the component has to be modeled in the PRA. But that topic, if you will, has to be there. So if I've got an internal events PRA on a system and there's a number of components in that system that are in the model and some that aren't, then when they do the functional importance ranking the non-model ones will pick up whatever the importance of the system is they support. Okay. So we'd have to go all the way back to the NEI --

CHAIRMAN APOSTOLAKIS: So the PRA is not the only way to declare something is RISC-3

MR. HARRISON: Now that I understand where you're going, right. If you're not modeled but you're in a system that shows that that system is a low safety significant, then those non-modeled things could be called low safety significant, too. Because it's at the system level.

DR. KRESS: At level one? You mean level one plus or you can get a LERF?

MR. HARRISON: Level one plus LERF.

Yes.

CHAIRMAN APOSTOLAKIS: Level on.

MR. HARRISON: Right.

MR. ROSEN: Or if the component is in a modeled system, which is safety related and has no significant functions but the components that you're looking at don't have the functional requirements to support that function? In other words, there are things in the system designator but they are for testing or maintenance or some other, vents and drains; they don't operate to support the function.

MR. HARRISON: Right. I think --

MR. ROSEN: And those components would not be necessarily RISC-1? They'd be RISC-3 or --

MR. HARRISON: If you wanted to do the effort to go through the detail evaluation and start saying which components support the functions and don't support the functions, you could --

MR. ROSEN: Well, you have to. That's the process that was laid out this morning by NEI. First, you start with the system functions and then you map the functions --

MR. HARRISON: You map the components to the functions.

MR. ROSEN: Components to the functions.

So if I have a drain valve on a safety related system that has an important safety functions, but that drain valve is only used when you drain the system down maintenance, then you can say that drain valve even though it's in a safety related system that has functions that are safety related and important to safety and risk significant, it doesn't map. It doesn't map. That component to the drain valve's function doesn't map to the system function? It's not --

MR. HARRISON: Yes, the function that it provides that it maps is low.

MR. ROSEN: That drain valve is low even though the system function is high?

MR. HARRISON: Right.

MR. ROSEN: And that's typical of what happens. There's lots of things on systems. One of my colleagues calls them ornaments because he's a PRA --

CHAIRMAN APOSTOLAKIS: We've heard that.

MR. ROSEN: -- type person. He thinks only in terms of components that have safety functions and function in dominate sequences. These ornaments that the operators use all the time in the vent and draining system have no important function

to risk but they are important to the operators. But those things become some of the things that will go to RISC-3.

MR. HARRISON: Correct.

CHAIRMAN APOSTOLAKIS: So, getting back to my question on slide five NEI had for example fire. There is a fire PRA, but you go with the ranking. If you use a screening method like FIVE, it says all SSCs necessary to maintain low risk.

MR. HARRISON: Right.

CHAIRMAN APOSTOLAKIS: But what may happen is that something was there to protect you against a fire that is not part of the SSCs necessary to maintain low risk and now you are free to declare that as low safety significant? Is that correct?

MR. HARRISON: I believe so.

MR. ROSEN: If you have a fire PRA.

CHAIRMAN APOSTOLAKIS: No. No.

MR. HARRISON: No.

CHAIRMAN APOSTOLAKIS: If you do a screen --

MR. HARRISON: Yes. If it's --

CHAIRMAN APOSTOLAKIS: If it's not part of all the SSCs necessary to maintain --

MR. HARRISON: Yes, if it's not part of like the fire -- if you had a fire shutdown --

CHAIRMAN APOSTOLAKIS: If you have a PRA, yes, sure.

MR. HARRISON: If you had a list. Like I keep thinking seismic --

CHAIRMAN APOSTOLAKIS: Well, even in seismic.

MR. HARRISON: If you have a shutdown safety list that says this is my list that I declared as part of my IPEEE.

CHAIRMAN APOSTOLAKIS: Yes. Yes.

MR. HARRISON: If it's not on that list, then it's available to be declared low.

CHAIRMAN APOSTOLAKIS: Exactly. Exactly.

MR. HARRISON: If all the other analyses that you do says it's low --

CHAIRMAN APOSTOLAKIS: And then you ask questions of defense-in-depth and --

MR. HARRISON: Right. Right.

MR. ROSEN: But I still need a clarification here, Donnie. Now let's take this exact same example where you have a component that's a fire component that would be used to protect the

equipment and safety related equipment. But none of the equipment it protects is important, you know, risk significant. But all you have to prove that is a FIVE analysis, not a full PRA. So what would you do in that case?

MR. HARRISON: Now I think we've got a comment that's in there that talks about fire barriers. So, that if they're not analyzed directly, you can't touch them anyway.

MR. ROSEN: What about suppression system in that area? Let's be clear what we're talking about here. It's a space that has risk significant equipment in it. Okay. And you've done an analysis, but based on FIVE not a PRA. Not a fire PRA.

MR. HARRISON: Right.

MR. ROSEN: And you want to take that suppression equipment, maybe sprinklers or something like that, out of the treatment program. Would you allow that in the case if it was just a FIVE analysis?

MR. HARRISON: If the suppression system is credited in the screening of that room, then you couldn't touch it. If it's not credited, if you could take that credit off and it would still screen

out, then you can play with the fire suppression.

MR. ROSEN: Okay.

MR. HARRISON: So you would have to go back and look at what you screened out.

MR. ROSEN: Okay. So you're saying you're not requiring a fire PRA. A FIVE is enough.

MR. HARRISON: It establishes --

MR. ROSEN: A FIVE is okay, but we also understand that you're not going to get as much credit with a FIVE analysis as you would with a fire PRA?

MR. HARRISON: Right. Because if you screen that room out, you're screening out at a very low level. And if it's what's crediting you to get that room screened out, then you can't touch it. So if you did a PRA, you could have screened it out and you would have shown it would be low.

DR. KRESS: Let me ask you a question. I'm sorry to ride my hobby horse into this thing. But if you have a site where there's more than one plant and you calculate raw and Fussell-Vesley for the LERF, will you add those up for the different plants.

MR. HARRISON: No.

DR. KRESS: You're just going to use it

for one plant?

MR. HARRISON: That's the intent right now, yes.

DR. KRESS: Do you think that's the right thing to do?

MR. HARRISON: I know we've had this discussion a number of times. And I know Research has provided a chart that shows how they derived the LERF acceptance guideline from the QHOs and how there's about a factor of 1.7 or something like that as the margin, which you know is close to 2, but not quite 2 for a plant. But to cut this short, this is what we do right now. And we license the plants on a plant basis.

We could have a plant come in that says I want to do this for unit one but not unit two. And then unit two could come five years later and ask to do it, and we wouldn't be in a position to -- I don't think legally to say no, you can't do it because unit one got it.

But until we change the way -- I mean, you would, I think have to fundamentally change the regulations.

DR. KRESS: I understand the box you're in, yes. But it's just that the box doesn't seem to

be right. But, you know, it's a hobby horse --

MR. HARRISON: Right.

DR. KRESS: And I keep trying to change this in 1.174, but I'm not having much --

CHAIRMAN APOSTOLAKIS: So you would divide by two, is that what you're --

DR. KRESS: I would either divide the acceptance criteria --

CHAIRMAN APOSTOLAKIS: For each unit?

DR. KRESS: For each unit, not two. Or I would add them up to see if the total meets the value.

CHAIRMAN APOSTOLAKIS: Yes. They should be equivalent of that.

DR. KRESS: There might be three of them, so I'd divide --

CHAIRMAN APOSTOLAKIS: Okay. Can we move on?

MR. HARRISON: Okay. Issue 11 is the crediting of components as part of the selective implementation. The direction on the rule is that a licensee can apply the rule on a system basis. He can do 1, 2, 20 systems. He's not required to do the entire plant. However, there's some consequences to that because when you try to make

something low safety significant, you're usually taking credit for something else being high safety significant. And so there's two ramifications that occur.

One is, is when we do our review of the license submittal for categorization, that review needs to recognize that the scope of its implementation may be broader than the initial implementation that's proposed. So our review of the process needs to encompass the entire PRA. Because we don't know where they may go in the future.

The second part of that is that we've clarified the SSC so that the credit -- I have to read my own little comment. Oh, okay.

IF you credit a component for being able to do a function, let's say that's beyond its normal design basis capability, you have to have a basis for that capability even though it may not be the component you're categorizing.

The ramification would be, for example, if you're doing feed and bleed and you're taking credit for the pores passing water, then there needs to be a technical basis for that capability. Even if you're not categorizing the feed and bleed part,

you may be categorizing another system. But this capability is why this one's low. And so that's a ramification of this process. And so we've done that in the rule.

MR. REED: Okay. Back to me on the last slide here. We're going to add one additional rule to the list of special treatment requirements in paragraph (b) and that rule 50.69a(b). As the Committee will remember, I think, that 50.44 is risk-informed. Certain provisions within the old 50.44 were actually identified way back in SECY 99.256 the special training requirements. One of these was the specific application of Appendix B quality assurance requirements to reactor vessel head vents. This has not been simply relocated to 50.46a(b). And so we would remove just the appendix quality assurance requirements in that paragraph and list it, in fact, as one of the special treatment requirements in paragraph (b).

There's also GEC Appendix A in that, if you're familiar with that 50.46a there. We wouldn't be touching that.

So there was a heads up in the SOC in the proposed rule and, in fact, it's come to pass. So you'll see this as another special treatment

requirement list.

That's all the 12 issues we had on the public comments. Is there any more comments from the Committee on this part?

CHAIRMAN APOSTOLAKIS: I don't know. Is there any comments? If not, is there anything from you?

MR. REED: Now we would go, I guess, to Donnie, or you want to --

CHAIRMAN APOSTOLAKIS: Well, we take a break.

So we'll reconvene at 2:50.

(Whereupon, at 2:31 p.m. a recess until 2:52 p.m.)

CHAIRMAN APOSTOLAKIS: So now we hear the staff's views on Revision D of NEI 00-04. Mr. Harrison?

MR. HARRISON: Thank you. Do we have a quorum?

CHAIRMAN APOSTOLAKIS: It's a subcommittee, so --

MR. HARRISON: Okay. It doesn't matter. Okay.

What I'm going to do is give you the staff's perspective on Revision D of NEI 00-04.

They were kind of some thoughts on the resolution of the staff comments on the prior revision. And any remaining issues that the staff thinks needs to be addressed or clarified in the current version.

The focus I want to do is on what remains as issues or areas that differ from where the staff had made prior comments. And I just note that we met with the industry on February 5th to go over the resolution of those comments. And I think that was a productive meeting and I believe we're coming to some type of closure on a number of the issues.

So we'll just jump into the specific issues.

The first one deals with the quality attributes to the analysis. It was comments A, and then also if you go into section E of the specific comments it was 6 and 1. It dealt with the staff had recommended guidance be developed to address the expected attributes for the external events PRA and the non-PRA type analyses for this specific application.

I note Revision D provides some guidance in section 3.3, but it leaves that quality justification up to the licensee for their plant

specific application. And what that means is there won't be any application specific guidance for external events PRAs or for the non-PRA type analyses.

The bottom, the staff accepts that approach. We just recognize that that puts the burden on the licensee to justify the quality of their analyses. And the staff will have to verify that quality.

DR. KRESS: So will the staff develop some internal guidance on criteria and what it will use to decide whether the quality is sufficient or not or will that be just sort of an ad hoc determination?

MR. HARRISON: I would guess it would be for right now we would be ad hoc. That's what we have been doing.

DR. KRESS: Yes.

MR. HARRISON: But it would be ad hoc. We might at some point decide to --

DR. KRESS: You know, this is a specific application. Every plant's going to you use it for the same application. It looks like you might be able to develop a set of things about the PRA which you would say would guide your judgment.

MR. HARRISON: Right.

DR. KRESS: Because, you know, just internal?

MR. HARRISON: For the PRA part of it, for at least the internal events part of it, we'll be relying on the Reg. Guide 1.200 and the capability. We'll review against that.

The real concern here was for the, say, the non-PRA type analyses --

DR. KRESS: Well, I think you've dealt with that pretty well. You know, just say it's out of scope.

MR. HARRISON: Okay. Right. And that was the bottom there.

DR. KRESS: Yes.

MR. HARRISON: Is one of the reasons why we can accept this approach is that those things I call them out of scope, but it limits what you can take into low safety significant.

DR. KRESS: Okay.

DR. BONACA: In any event, I mean this is placing burden on the staff, a lot of burden on the staff to evaluate, you know, how the arguments can be supported.

MR. HARRISON: Right. But let's say

someone comes in with a seismic margins analysis and anything they credited in that safe shutdown path, associated with that can't be touched.

DR. BONACA: Okay.

MR. HARRISON: Okay. What we really are needing to know the quality is does that seismic margin analysis reflect the plan. So when they did that analysis, did they take credit for fixing something they haven't fixed. That really becomes the focus of the review. And if they've done everything in accordance with what they had analyzed, then we can move on. If they haven't, then we'll have to back up and say, wait a second, how did you address these things that haven't been fixed yet, if you will.

DR. BONACA: What do you mean by fixed?

MR. HARRISON: Some of the seismic margins analysis, what they'll do is they've identified in the IPEEE that they're going to fix things down the road.

DR. BONACA: Okay.

MR. HARRISON: And then they've done the analyses assuming the fix has been made. We've had cases where when they've come in for an application we ask that question and we find out that they

haven't made it. So then we have to ask well what is your plant risk for seismic. So --

CHAIRMAN APOSTOLAKIS: Now, on page 5 of the draft regulatory guide, you state section 7, "The NRC staff notes that draft Revision C of NEI 00-04 does not address modeling or data on certain this explicitly." And then later on on the attachment page 3 "The NRC believes that the higher grade for PRA quality cannot be achieved by sensitivity studies, though sensitivity studies can be used to explore the impacts of modeling and certainties on the categorization."

Right now Revision D doesn't say anything about model uncertainty, and we've had some discussion with NEI this morning. You here at that time?

MR. HARRISON: Yes. Yes.

CHAIRMAN APOSTOLAKIS: Do you have any comments on that?

MR. HARRISON: We will get to that on issue 4.

CHAIRMAN APOSTOLAKIS: Okay.

MR. HARRISON: If you hold on just a couple. A couple of these we'll go over similar to what was discussed with the Committee this morning

NEI.

CHAIRMAN APOSTOLAKIS: Okay.

MR. HARRISON: I think this is one of them. This is the factor used to represent the reduction in treatment. This is that factor in the risk sensitivity study.

CHAIRMAN APOSTOLAKIS: Yes.

MR. HARRISON: We had proposed that a method be developed to come up with this factor and also how to deal with the non-PRA types. Revision D provides some guidance on that, but the linkage to the corrective action program and how they come up with the factor is not explicitly stated. So our bottom line is that we expect additional guidance to be provided in the next revision in the NEI guide to describe how that factor is used in the risk sensitivity studies so that it comes within what's detectable within their corrective action program.

And, again, the non-PRA type is not a concern because it's scope is limited of it's a PRA.

CHAIRMAN APOSTOLAKIS: No, it's not of concern because their staff also recommended a method for develop --

MR. HARRISON: The top part is our

comments that were from Revision C.

CHAIRMAN APOSTOLAKIS: Yes.

MR. HARRISON: And so on Revision C we had given a comment that said we recommended a method be developed for non-PRA type analyses.

CHAIRMAN APOSTOLAKIS: Oh, okay.

MR. HARRISON: What they've come back and said you can't touch those systems that are credited in the non-PRA type analyses. So it's a mute point.

CHAIRMAN APOSTOLAKIS: Yes.

MR. HARRISON: Issue, the limitations of the types of analyses used. We made that comment that we believe the state-of-art --

MR. SHACK: I'm sorry. Just to come back to my point this morning. Those systems may well be touched. They won't be touched as part of the seismic thing, but as you put the other day, you know they're now free -- they're fair game for any other reduction.

MR. HARRISON: If it's credited --

MR. SHACK: If it's not credited in the seismic, you can then --

MR. HARRISON: Oh, right. If it's not credited.

MR. SHACK: In another analyses somewhere else, then never have to go back and look at that cumulative risk in the seismic?

MR. HARRISON: Correct. And the reason is because we're holding firm whatever the pathways that were designated there don't move. So they stay at whatever they were.

MR. SHACK: Except there's a cumulative change.

MR. HARRISON: I agree.

MR. SHACK: So you're really doing a PRA, you know, you have to look at the cumulative change in the one case. You don't look at it in the other. There's just an inconsistency.

MR. HARRISON: Right. And part of that is just a practical, you can't do it if you don't have the numbers. And that's partly why you hold that list firm is because you can't play with it.

MR. SHACK: Right. If you're in George's camp and you want to hold their feet to the fire, you say once you freeze because of the seismic, you're not allowed to lower it under any other consideration.

MR. HARRISON: Well, then you would get no benefit from the rule. There would be no rule.

MR. SHACK: Then you'd better get a seismic PRA.

MR. HARRISON: Right.

MR. SHACK: You live here in Florida? That's an easy one.

MR. HARRISON: Okay. If we can move on to three. The staff would recognize that the state-of-the art PRA methods are available to quantity the risk. And I probably would agree with Doug True's comments this morning. I would kind of caveat my first statement there to say it's probably therefore full power, but I think there's probably questions in shutdown risk and how you do that. But that's still a development area.

We made the statement, I think George you read it this morning, that the degree of relief that can be expected under the rule is commiserate with the type of analysis you can perform. Again, Revision D recognizes that limitation that's imposed by not using non-PRA type analysis. And we accept that approach.

I lumped three things, Issue 4, uncertainty consideration, integral assessment and the sensitivity studies. We had noted in Revision C that there were potentially large differences in the

levels of uncertainty and modeling and data and recommended that because of that that the most conservative categorization should be used, and that included whatever type of analysis you performed and from all the sensitivity studies.

Again, in Revision C I think we didn't fully understand how the process worked. And so we were taking a position that was very conservative.

Revision D provides some additional guidance. It still does not explicitly discuss uncertainty considerations though it does provide a number of sensitivity studies to get at part of that.

Also Revision D also the integral assessment of the various types of event and also recognized that the sensitivity studies don't make the categorization. What they are i s a piece of information that goes through the IDP where they take that information and combine that with what the PRA gives them to make a final determination on the component.

The staff expects that uncertainties will be addressed in the risk sensitivity assessment consistent with Reg. Guide 1.174, and that's the section that deals with the what the different types

of uncertainties there are. We expect that to be addressed in an application.

Again, the last bullet just gets at the fact that there's --

CHAIRMAN APOSTOLAKIS: You think, coming back to a discussion earlier this morning, that if they identify the major areas where there is an issue of model uncertainty and do something about it, that that would be satisfactory.

MR. HARRISON: I think a recommendation you made this morning was one we would agree with, that if you could identify those, the HRP LOCA modeling, the HRA modeling and deal with those through sensitivity studies, then we would say you've address model uncertainty.

Again, I think the issue becomes coming up with that list.

CHAIRMAN APOSTOLAKIS: Do you agree with the way they're doing the sensitivity -- well, you're talking about the integral assessment now?

MR. HARRISON: Well, this is --

CHAIRMAN APOSTOLAKIS: They do things.

MR. HARRISON: Right.

CHAIRMAN APOSTOLAKIS: One is go to the 95th percentile and recalculate the importance

values.

MR. HARRISON: Right.

CHAIRMAN APOSTOLAKIS: And they do that, I Believe, one at a time, right?

MR. HARRISON: Yes.

CHAIRMAN APOSTOLAKIS: And then they do the integral, which is you multiple by five and do everything --

MR. HARRISON: Well, no. I'm sorry. We're mixing up a couple of -- the integral assessment here is to take, say, a fire PRA result and combine it with your internal events and then see what the priorities.

CHAIRMAN APOSTOLAKIS: Actually, the formulas they show are really the exact formulas for doing the whole PRA.

MR. HARRISON: Yes. Right. The sensitivity --

CHAIRMAN APOSTOLAKIS: But for the first part --

MR. HARRISON: Right.

CHAIRMAN APOSTOLAKIS: -- where they take their assumptions -- I mean they change the 95th percentile one at a time, would you agree with that or would you like to see anything else?

MR. HARRISON: Your recommendation this morning was one that I think we would be open to. Again, the struggle I think for the industry becomes one of establishing the basis for the factor for the use. And I got a copy of the report that Mike cited, so I'm want to read that with some interest.

CHAIRMAN APOSTOLAKIS: What report is this?

MR. HARRISON: This is the '89 paper on--

MR. SNODDERLY: The ones you handed out this morning.

CHAIRMAN APOSTOLAKIS: Oh. One of ours.

MR. HARRISON: Yes.

CHAIRMAN APOSTOLAKIS: Okay. You should get excited.

MR. HARRISON: But if that could be used to form a basis for a factor to be used, I think that would be a good approach. But we didn't raise an issue with using the 5th and 95th approach either.

CHAIRMAN APOSTOLAKIS: No. It's not an issue of what. If you use the 95th. Again, I don't think that would make a big difference. But taking them one at a time is something that I think -- to

be bothered. Now taking them all the same time, again, I don't know. See, that's the problem with sensitivity analysis. They're all part of a theory where you have some guidance.

MR. HARRISON: And, again, you have to remember the intent of the sensitivity study is to get -- is time to get at model uncertainty. And it's a piece of information that's given to the IDP. It doesn't form the ultimate answer. So, it could say this could be high given these changes.

CHAIRMAN APOSTOLAKIS: Yes, but you know judging from the reaction of my colleagues on this committee, some of them -- not necessarily them, the full committee. They were not aware of this issue of modelings. Unless you have really worked in this area and you have participated in debates with your peers, some people were not aware, have not used -- so I wouldn't expect the IDP to be an expert on this or to contain an expert. I think some guidance -- but, again, it's not a big deal because there have been so many PRAs, people know where the problems are. It's a matter of picking up the phone and calling people. A very simple expert opinion. It doesn't haver to be very elaborate because a lot of the stuff that has been done is conservative. So if

you say, okay, these people think it's between two and three, I'll go with five, you know, so nobody will raise any problems.

So it's great. I think that that will put to rest that issue, at least in this context, in my view.

Now, you say something else here that I found intriguing. And don't tell me you'll talk about it in a later slide.

MR. REED: That's not working anymore.

CHAIRMAN APOSTOLAKIS: The sensitivity studies performed to support the categorization of SSCs using PRA models are intended to address the major identified sources of uncertainty, that is human error probability, cross failures and items identified during the assessment of PRA adequacy. Who is assessing the PRA adequacy and how are --

MR. HARRISON: This goes back to the peer reviews. So when a peer review is done on a PRA, they may have identified areas of weaknesses within the PRA or identified something that was essentially in error. And a license may have dealt with that by performing a sensitivity study saying if I change that information, there would be the impact on the analyses.

CHAIRMAN APOSTOLAKIS: But I didn't see anything in the NEI document today that --

MR. HARRISON: Yes. On the bottom of each of their -- on the sensitivity --

MR. SHACK: The sensitivity peer review to address the comments from the peer review. That was his last final catch-all bullet.

MR. HARRISON: Right. If you look at those little tables they have for each of the sensitivity studies, the last bullet is one that's talking about the peer review, or that's my interpretation. Correct me if I'm wrong about that.

CHAIRMAN APOSTOLAKIS: Okay. Fine.

MR. SHACK: And that really is their answer --

MR. TRUE: It might also the place where we address model uncertainties that are know to exist like an RCPC LOCA model, that kind of thing.

And that last bullet was intended to be those other values.

CHAIRMAN APOSTOLAKIS: When it comes to assumptions, I'm not sure how would you do it? Because there are so many different kinds of assumptions. And you can't anticipate in a generic document what kinds of issues people will raise when

they review the individual PRA. So the guidance will have to be sort of channeled. Change it a little bit and see what happens or --

MR. SHACK: Well, no. But I think that's the argument against your list of four or five times. I'm sort of more supportive of their thing. And when somebody reviews their PRA, they've identified the weaknesses in that PRA and therefore, you know, I'm a little worried about there's really only three items you have to look at. Well, you know, I don't believe that. I think if I looked at -- if I get three items in maybe each PRA --

CHAIRMAN APOSTOLAKIS: What I have seen the peer reviewers look at standard practice and they identify issues. Standard practice does not cover model uncertainties. So that's why it won't be handled separately. Nobody will come. Nobody has done it and say we used syrup, but look if I use creme I get something else, so let me do that, too. No one ever does that. And no PRA peer review team will say this is an assumption.

So it's okay to have that last bullet for the standard assumptions that deviate perhaps from standard practice, but then the three or four issues that are out there and they have significant

model uncertainty I think do need to be listed separate.

But your catch-all bullet is great. I mean, I obviously missed it.

So it's not necessarily one or the other.

MR. TRUE: No. It's actually the union of those.

CHAIRMAN APOSTOLAKIS: It is a union. That's correct.

MR. HARRISON: Okay. The next few viewgraphs are going to be almost editorial in nature. I think we're getting to the point where we're now talking about what do you mean by the words. And this is an example of it.

In figure 5-1 in Revision D they have a box that talks about prevents or mitigates core damage. The staff had a concern in Revision C that that could be misinterpreted and suggested that it be changed to prevent or mitigate severe accident. We were afraid that you could miss the level two part of this, the containment part of this if you just should said mitigate core damage. Now the intent that NEI has told us is it was supposed to capture those things.

We'd like to see the terminology in that figure changed so that it would make it clearer and people wouldn't miss the containment systems.

The next issue was the phrase "relevant failure modes." Again, in Revision C the staff thought that that phrase was open to interpretation, and so we had stated that you needed to consider all the failure modes appropriate for an SSC. You couldn't screen some out just because they're not related.

And Revision D it maintains that phrase at least in section 5-1. But NEI has stated its intent was to allow the exclusion of failure modes that might be in a PRA that are related to how the component's performance. But they've also said that they'll clarify that phrase in a future revision of the document. And the staff expects that to be done.

Issue seven was, again, interpretation of the phraseology of safety significant attributes. In Revision C it wasn't sure what the intent of -- if you made something safety significant, it said write down its safety significant attributes. And I guess the question I had was why. It's safety significant, you're not going to change again. It's

going to get the treatment it's got, why do you need to know?

MR. SHACK: But weren't they intending to preserve only those aspects of the treatment needed to keep the attribute that was important? Wasn't that the idea behind that?

MR. HARRISON: I think that was the idea behind that. But, again, it was one of those things of you couldn't quite figure out why the guidance was there to do that. If a component was safety significant for a -- it's a valve and it has to open and that's safety significant, but the closure function is not, did that mean at that point in Revision C we thought well maybe what they're trying to do is say you could take the treatment off the closure part. That's not their intent. Okay. But we think that phrase needs to be clarified so no one gets the idea that you could intend it that way. If I'm only telling you one side, someone may take it the other way.

MR. ROSEN: Well there are valves whose function is pressure boundary only. I mean, but they don't have to close or open.

MR. HARRISON: Right. I'm just saying if it --

MR. ROSEN: So in some cases that is important information.

MR. HARRISON: Right. The question we had was from the negative. Let's say you have a valve that can work in either position but what makes it safety significant is only one of those failure modes. When they do that raw in the Fussell-Vesley, if it's only the open function that makes it that way and the closure function's low enough to not be important, but you still need it, the concern was why are you doing these attributes only one direction? Why don't you still have to maintain the closure capability. And I don't believe that that was the NEI intent and we're expecting that maybe they need to discuss in a subsequent revision and make it clearer.

MR. TRUE: This is Doug True again. Just add one thing.

Another reason for those attributes is to make sure that there aren't new attributes that aren't design basis attributes that should be controlled.

For example, in RISC-1 and RISC-2 you could identify a risk significant or safety significant function that's different, maybe even

opposite, from the design basis function. For example, a containment vent valve in a BWR is a containment isolation valve. Its function is to close. But you need to open it in order to vent containment. And it has to be able to open at 60 psi or whatever the procedural requirements are for that. That's something that we want to bring into the design control process that's going forward is those other aspects an attributes of the function that are safety significant. It wasn't to be able to delete consideration of other attributes.

MR. HARRISON: Thank you, Doug.

So this is just asking for more clarification, again.

The next one was the phrase that on primary shutdown the safety system was being used in talking about shutdown and the use of NUMARC 91-06 guidance. It's not clear, at least from just reading the words, what's really meant by that, by that phrase of what systems would be invoked. And so what we're asking is that they clarify that in the revision of the NEI 00-04.

I think our understanding is, is for example you'd have shutdown cooling or RHR. A-train would be the running train, but you'd also have a

backup train that could provide that function in case you lost the A-train. And so there's always two means of doing that.

It wasn't clear to us that that intent was captured by just a phrase of primary shutdown safety system. So, again, that's a clarification.

Dr. Ford might be interested in this one. This is the common cause failure and degradation mechanisms. We had a number of comments on Revision C dealing with this. And this is really being driven because of the only way to really invalidate the characterization risk sensitivity study is if you had some global failure that went across systems or affected multiple systems and you didn't have any kind of way of getting the early detection or early warning of that. So if it's not explicitly evaluated in the PRA, we would expect that those aspects of the treatment that are needed to take care of a specific degradation mechanism would carry through and those components would still be treated for that. So this is trying to capture that.

And right now Revision D references the ASME code case N-660 and also the risk-informed ISI code cases and topical reports, but it doesn't

explicitly address the need to identify SSCs that have degradation mechanisms that need to be treated, regardless of what their importance is. So we expect that that discussion needs to be added to NEI 00-04 in the next revision.

DR. FORD: This is not meant to be sarcastic, but in your phase "if not explicitly evaluated," you're going to say from known mechanisms. And, unfortunately, all the unpleasantness we've had over the last 40 years has been from unknown mechanisms; until they occurred we didn't know that they were going to occur, at least on the face of it.

MR. HARRISON: Right.

DR. FORD: Although in the laboratory we knew they were going to happen before they in fact occurred.

As you go forward on this, especially for the advanced reactors but also for the current reactors, how are you going to address or how is NEI going to address possible future degradation modes in a proactive sense? It's a question that's really important.

For instance, NEI have got a program right now looking at proactive materials

degradation. Will this be fed into this NEI 00-04?

MR. HARRISON: To be honest with you, I wouldn't think it would be directly. And I'm not a materials person. So I'd be shooting in the dark. I'm not really sure how that would fit in.

MR. REED: And I think your question is really on the RISC-3 treatment side. And so your question really goes to whether --

DR. FORD: It's RISC-3 I'm really worried about.

MR. REED: Right. You're really asking whether the requirements we had in 50.69(d)(2) are sufficient to capture future degradation mechanisms that might come up?

DR. FORD: Yes. The language you've got currently in (d)(2) is fairly high level and it's adequate, I believe. There's a question of how you actually produce the factors. And that's their problem. You've made it their problem since you're going to endorse 00-04 into the reg. guide for this particular code, or rule rather. I mean, you pass it on to NEI and I'd love to know how they're going to manage this and how they're going to decide whether they've done enough adequately to convince themselves and you ultimately they have done an

adequate job.

MR. REED: And I'd say that's something I can't respond to I guess in this presentation. It goes beyond my knowledge.

Is there any other -- so we'd have to get someone that knows the topic to be able to give you a better answer to that.

DR. FORD: Okay.

MR. REED: Okay.

MR. HARRISON: The tenth here is regulatory commitments. In Revision C there was a discussion on or in response to a statement on Revision C, Revision D took out or had a sentence in it that said that they were going to basically drop regulatory commitments associated with low safety significant components. But I think the point the staff is making that it's not easy. There might be some regulatory commitments that cannot be eliminated just without thinking. They may kill you in design requirements. If you were to eliminate them, you wouldn't be meeting the rule because you can't change the design requirements.

So this was just a recognition that NEI needs to go back and revise the paragraph that has that statement in it. And the licensee would

actually have to do an evaluation of their commitments to see which ones can be eliminated and which ones have to remain.

The last slide or the 11th slide here is just some miscellaneous issues that came up. Again, some of these are more wording.

One of the sensitivity on fire talked about manual suppression. It wasn't clear what was meant. So we just -- we're recommending that they say, explicitly set manual suppression at zero and do the sensitivity calc with that.

We also recognize that after doing the fire -- if they've got a fire CDF, they have to address those things that were screened out and the risk associated with that in doing the categorization.

There was also a definition for other external events like tornados of what was meant by safe shutdown path. I think when we talked to NEI there was a statement that they were really focused on the barriers. I wouldn't get that from reading the word "safe shutdown path." So there was need there for them to clarify that wording.

And then just, again, an editorial thing. They referred to CDF and LERF when they were

talking about NUMARC 91-06. And that's a qualitative evaluation. So you're not going to get CDF and LERF. You're going to get, you know, core damage and release. So they needed to just change some terminology.

And then lastly, just to conclude, I think in going through the issues that we've presented here, you see that we're converging. Revision D has provided a lot of clarification from Revision C. We understand more of what's going on within the process.

Our comments, there's relatively few technical issues. It's more of the practical, how do you implement it and what do you mean by this specific word. So that's really where we're going.

I hope in the next version of the guide that we can move to a point where we actually understand each other clearly enough to not to be able to have any objections. And the only thing that would be left would be just staff comments or staff positions. For example, the statement about more PRA, the better -- the wider, the broader the scope of the PRA analysis the more relief you can expect to get. That would be the type of staff position I would like to end up with within the reg.

guide.

CHAIRMAN APOSTOLAKIS: Which brings me to a question. Are you done with this?

MR. HARRISON: Yes.

CHAIRMAN APOSTOLAKIS: In your regulatory guide, draft of the regulatory guide there is an attachment, of course, a long attachment. On pages 11 and 12 the issue of guidance to the independent panel is discussed. And I think, again, echoing my comments earlier today, I'd like to see this structure so that it would reenforce the statement you just made, Donnie. In fact, you do. On page 12 you say at the beginning of the second full paragraph, for SSCs not modeled explicit in the PRA, the IDP could use the following guidance to determine blah, blah, blah, which is really consistent with what I was trying to advocate this morning.

But, it's not -- there are some of the questions that you have here or some of the statement would apply also to categorization that is based on PRA. In particular number ten, I think, comes back to Dr. Bonaca's beloved issue. You say failure of the SSC will result in unintentional release of radioactive material in excess of 10 CFR

Part 100 guidelines.

When you do a PRA and use the importance measures, you are focusing on CDF and LERF, not Part 100. So that could be something that applies also to the PRA based categorization, right? So I think -- and then, of course, again the issue of defense-in-depth in general in the previous page 11, you identify the five major functions.

MR. HARRISON: Right.

CHAIRMAN APOSTOLAKIS: I think having a more detailed or not really detailed discussion, but the clear statement when you have based on the PRA this is what is important in the defense-in-depth review, when not this is what's important. And there is certain issues that go beyond CDF and LERF and that you have to work about them. And that's late containment failure, Part 100.

And I think if you just rearrange this section and other few sentences here or there, that would be a really very nice section because it will send a clear message this is what you do in this case, this is what you do in that case. And you're halfway there.

MR. HARRISON: Yes. And I think some of what we had in comments in draft Revision C frankly

came from a lack of complete understanding of the process. I think once you have a better understanding of the function base --

CHAIRMAN APOSTOLAKIS: Yes.

MR. HARRISON: -- categorization that NEI follows, for example if you've got a high or a safety significant function and you determine this thing that's mild cannot effect that thing in any way, that function in anyway, you ask yourself why you asking these questions. They become mute.

CHAIRMAN APOSTOLAKIS: Yes.

MR. REED: So I think we're looking at that and, you know, going back to some first principles and thinking where are these questions really at, the principle, you know.

CHAIRMAN APOSTOLAKIS: Exactly. That's what I'm saying. And make clear that they understand that.

MR. HARRISON: Right. And when we met with NEI a couple of weeks ago, I think the comment was that these questions become mute for exactly what Tim just said.

CHAIRMAN APOSTOLAKIS: But some of them don't.

MR. HARRISON: Right. And what we

needed to do was maybe go back to the list and say which ones of these are not CDF and LERF questions and would be work pursuing and then getting with NEI to talk about those or to make sure. Because they had that list on their defense-in-depth of the different topics. And we can maybe try to merge our list, if you will, to come up with one list that makes sense.

MR. ROSEN: I've got one more question, and that's having to do with I think we all agree that the IDP, this is going to be very important in this process and make a lot of important decisions. And there's a very nice discussion in Revision D on page 53 and 54 of the IDP's panel make up and training. And clearly reading this I get the impression that the intent here is to have a fairly expert, in fact the word "expert" is used in several places, set of members for this panel.

But how will you measure, how will you decide that the people, the individual, on the panel are in fact expert? Do we have some standard in mind or what's your thinking?

MR. HARRISON: I don't think we have a standard.

CHAIRMAN APOSTOLAKIS: Are you going to

approve the panel?

MR. HARRISON: We'll be approving the process. And the panels may or may not be part of that.

MR. ROSEN: Well, the process is one that's reviewed, I would say, is the one that's in this NEI document, right?

MR. HARRISON: Right.

MR. ROSEN: And I'm simply reading from the document.

MR. HARRISON: Right.

MR. ROSEN: So I would say what's on page 53 and 54 on panel make up and training is part of a process. It says there's going to be five experts designated as members of the IDP with expertise, joint expertise, in the following fields. And it was plan ops, design engineering including safety analyses, systems engineering, licensing, PRA. Those are good things to have.

MR. HARRISON: Right.

MR. ROSEN: I agree. And there's some good words about process here.

But it seems to me that the success or failure of this thing will ultimately hinge on the quality on the people that are doing to that plant.

MR. HARRISON: Right.

MR. ROSEN: So you ought to have some standard in mind about who you'd say well that person's too junior for this or not junior enough. I mean, there have been standards in this industry for qualification training. Selection and training and qualification of people. It's natural for the NRC, even through INPO, for operators, for example, to have standards for selection, training and qualification. This is such an important area that I would think you would have some standards for selection, training and qualification of these people.

MR. HARRISON: Yes. And I'm going to ask a question of Dave Fisher. Yes, wake up.

In the ASME code case there's also a parallel to IDP makeup of the expert panel expertise. It's very similar to what's listed here, isn't it?

MR. REED: Before Dave jumps in, let me just start with the rule, just to remind the Committee in paragraph C does have high level requirements on the IDP. It says -- if I can find it. And I just lost it. It must be staffed with experts, plain knowledgeable members whose expertise

include that of DRA, safety analyses, plant operation and design, engineering and system engineering. So that's the high level requirement.

MR. ROSEN: That's what it says in the document. But I'm still wondering how you judge it.

DR. KRESS: Well, you take their résumé and look at it.

MR. HARRISON: Go ahead, Dave, take a shot at it.

MR. FISHER: I'm Dave Fisher, NRC staff.

There are some are very high, again, requirements in ASME OM case OM-3. But they're not much more detailed than what you have in front of you.

MR. ROSEN: Well, if someone says that they're going to be an expert and defines expertise as experience in plant knowledge, I would think that you would look for some evidence of plant knowledge, you know, and some evidence of experience. But during days of experience or three years of experience? I mean, don't you have any idea?

MR. FISHER: Well, clearly, and I've seen places where a person's called PRA expert when what it really meant was he managed the contact for the PRA contractor. Those aren't --

MR. ROSEN: And you're suggesting that's not expertise?

MR. FISHER: That's not a PRA expert.

MR. ROSEN: Okay. I think I agree with you.

Now how about systems engineering; what if the guy has just got through the system engineering class?

MR. FISHER: Yes, again, I would say we would obviously say that's not. So --

CHAIRMAN APOSTOLAKIS: Being serious here, though --

MR. ROSEN: Well, we're not kidding around here. This is serious stuff. These guys are going agree to the recategorization of the plant's components. And the people who did that originally for the design basis were very senior.

MR. FISHER: And the expectation I think here would be that they would be senior personnel.

CHAIRMAN APOSTOLAKIS: Suppose that the result of this process were -- is really flawed. What opportunities will you have to catch that? You have to wait until things start failing?

MR. HARRISON: Well no. On the conversation at the front end there's an opportunity

there for us to see that the process has flawed and see like if the PRA itself --

CHAIRMAN APOSTOLAKIS: Process but not the result. I mean, you're going to look at what they put in RISC-3, RISC-2 in a random way, perhaps, and say this doesn't strike me like it belongs to RISC-2? Is that what you're going to do? In other words, I'm trying to place what Mr. Rosen is saying in the performance-based approach. We're not going to regulate who is an expert on this and that, but we're going to look at the product. Now, if you tell me, though, that you're not going to look at the product, then we'll go back to his point and we'll regulate who becomes the member of the panel.

MR. REED: But I'll tell you that the rule right now is structured to review the categorization process one time. And it's not right now looking at lists of SSCs that would go into the boxes one, two, three and four as part of that process for approval.

MR. HARRISON: And so what you have, it would become an auditing or an inspection part of the process that would have to capture --

CHAIRMAN APOSTOLAKIS: But when you review the process you're going to make sure that

they have an IDP.

MR. REED: Right.

MR. HARRISON: Yes, they're required to have an IDP by the rule.

MR. ROSEN: But the rule is silent and so are you about the qualifications of those people.

MR. HARRISON: Other than they have to be expert knowledgeable, yes. You've got it.

So the reasonable thing to do would be we would ask them, you know, not necessarily who but where the qualifications for the people that are --

MR. ROSEN: And they're going to tell you you don't have any judgment. I think you just said it was more than having written a contract on PRA.

MR. REED: Yes, that would be a good starting criteria because I would be a PRA expert at that level. And that's scary.

MR. ROSEN: All right. So we know that. We got a four at least on the PRA guy. We have four more guys to go through. But at least we got a -- we got to have at least done more than written a contract for PRA model.

MR. HARRISON: But I think just to be reasonable that most of the plants already have --

well, most of the plants already have some --

MR. ROSEN: But you see, when I'm unreasonable you'll know it.

MR. HARRISON: Yes, I didn't mean that for you. I'm just saying from a standpoint of most of the plants already have some type of an expert panel set up when they've done any kind of a risk-informed --

CHAIRMAN APOSTOLAKIS: But there is a bigger issue here. I mean, we keep invoking Regulatory Guide 1.174, and that has a box on the left lower side, a program is in place to monitor the consequences of the change.

MR. HARRISON: Right.

CHAIRMAN APOSTOLAKIS: Do we have anything like that here?

MR. REED: Yes. There's paragraph E of this rule.

MR. ROSEN: I suggest it's --

CHAIRMAN APOSTOLAKIS: So what are you monitoring then?

MR. REED: We're monitoring the performance of this equipment and feeding that data back into the process.

MR. ROSEN: I suggest that's too late to

find out that the expert panel was not qualified and they made a bunch of decisions that --

MR. REED: I'm gathering that from your comment.

MR. ROSEN: -- resulted in the plant's performance being degraded. It's not enough. And I encourage to sort of get together, get your heads together and think about what it is you're going to write in the inspection model. Because you're going to put inspectors out in the field one of these days to check the boxes. And you're going to leave it up to people a whole lot less qualified than you are in this area to make judgments about the qualifications of these people. Give them something to hang their hates on is what I'm suggesting.

MR. HARRISON: No, and that's a good point. I'll take that away. At some point we need to figure what --

MR. REED: And I'm not sure what measuring stick you use. And I tell you, I'm a little weary of the NRC using that measuring stick to judge whose an expert and whose not. And if you have suggestion, I'm certain we're all ears.

DR. KRESS: That could get you in all kinds of trouble.

MR. REED: Yes, I know. But I understand the concept. It's a valid comment, but I'm not sure exactly how to --

CHAIRMAN APOSTOLAKIS: But is there any evidence -- I think Donnie address that. Is there any evidence that in some places they have expert panels that are below par?

MR. ROSEN: Well, I think it's too soon to tell, isn't it? I mean we don't have any --

CHAIRMAN APOSTOLAKIS: Well, they are using panels for other reasons.

MR. ROSEN: We don't have a lot of experience with 50.69 panels.

DR. KRESS: The maintenance rule.

MR. ROSEN: Well, yes. Well, that's not 50.69. And there's some parallels, there are some analogy, but 50.69 is going to be recategorizing the plant's components from a risk basis and adjusting what the plant staff does with respect to those. That's a pretty heavy responsibility. And I'm suggesting that you have more than just what's on page 53 and 54 here.

CHAIRMAN APOSTOLAKIS: Can they hire consultants?

MR. HARRISON: Sure.

CHAIRMAN APOSTOLAKIS: Or do they have to be plant people?

MR. HARRISON: No, if you've got the expertise, you would meet the criteria.

MR. ROSEN: As long as you have knowledge of the plant and knowledge of experience.

MR. HARRISON: Now, if you've never been to that plant and there's a PWR guy and he's going to a BWR.

MR. REED: But would I want the PRA expert to be -- yes, absolutely. So in some cases consultant would be very, very good thing. That could work both ways, of course.

MR. ROSEN: Well, I'm just suggesting that you establish some standards for your inspectors so they can make some uniform judgments about the qualifications of the people.

MR. HARRISON: I will tell you a story, though. Once I -- I'll tell you two stories.

I was once doing some PRA work and they wanted -- they had established qualifications. And I'd been doing PRA work for a while. I didn't take any of the classes that they had as part of the qualifications. I wasn't qualified.

MR. ROSEN: Probably so.

MR. HARRISON: But I was doing the PRA. So you have to be kind of careful -- we'll have to be careful with how we do that.

CHAIRMAN APOSTOLAKIS: It's very difficult to get metrics. Usually people say I've had 20 years of experience.

MR. ROSEN: I don't know, George --

CHAIRMAN APOSTOLAKIS: Maybe you've been wrong for 20 years. I don't know. You know, just experience is not -- I appreciate -- you are really walking a very fine line here.

MR. HARRISON: I agree.

CHAIRMAN APOSTOLAKIS: Especially in this era of performance-based regulatory approaches.

MR. ROSEN: It's not adequate to wait for bad performance in this case and to say therefore, you're not qualified.

CHAIRMAN APOSTOLAKIS: I had the core melt. Let's go back and change the policy.

MR. ROSEN: It's not -- as I said before, it's not unusual to establish selection regarding qualification requirements. Especially for important functions. I don't see why you're making a big deal of this. I just think it's a question of being reasonable, but also being a

little bit tough.

If Donnie Harrison hasn't taken the courses, then the question is why not. Maybe you ought to go take the class. You might even learn something.

MR. HARRISON: No. On that particular case I was asked -- I asked to take the class so I would be qualified.

MR. ROSEN: Sure.

MR. HARRISON: And I was a contractor at the time. I was told well I was the expert, why did I need the class.

MR. ROSEN: That's a wrong answer.

MR. HARRISON: I understand. But that paradox does happen.

MR. ROSEN: But you're making excuses rather than dealing with the issue.

MR. HARRISON: I think we need to take that back, though, and see if we can figure out what we would do with that. I'm not dismissing the comment. I think it's a valid comment. I'm just not sure how we're going to do that.

CHAIRMAN APOSTOLAKIS: Okay. Are there any other -- yes?

DR. BONACA: Since you raised the issue

of my sensitivity to Part 100. It's important that I explain why. I mean, I still believe that that's an important hole in it for two reasons.

One is that regulations shouldn't be arrogant, in my judgment, and instead we can be technical arrogant, you know. I really wouldn't want to be the one telling the people around these 103 plants that releases have nothing to do with safety. I mean, that's an issue. There's always been an issue there. And in my judgment some criteria could be used to instruct some sequences that have to do in fact with these particular areas of analyses and have additional criteria for that. Or at least as a minimum, explore that as a possibility. It hasn't been done. We recommended it.

And, again, in my judgment, you know, perception it's important and the way that the public views it.

Right now we have incoherent regulation because we have on one hand something which is still in our design basis. We're still protecting it, we're still defending it and yet we're doing other things. And I'm saying I'm all for it, but I think there should be some way of cleaning up our act and explaining, for example, why there isn't the

criteria there. And there may be good reasons, but I think we should communicate that. They should be part of the whole process. And the burden, really, is on the staff. It's not on the industry. I mean, clearly, this is regulation.

The other issue is the importance of coherence. I mean, here on one hand we have seen for 40 years the vendors spending enormous resources to develop properly -- for reactor protection systems, for example. Now, in my logic if I had a PRA with a detailed PRA analyses of the RPS, which many plants don't have but some do, I could simply say that since I have four redundancies, each one of them is not safety significant. And then maybe at that point I would begin to question the treatment -- lowering the treatment for something for which I have expanded so much focus and effort for so long. I mean, there is an imbalance there. Again, it's incoherence in the regulation. That has to be somewhat addressed in my judgment. And I think that's a piece missing.

And, again, I don't think the burden is with the industry. The burden is with the regulatory agency and regulation.

That's my thinking.

MR. REED: I think I understand. I mean, I keep coming back to -- a conversation like this happened this morning. That for what we're doing in 50.69, I'm not saying you already know, I'm saying again is we're only changing the treatment of this equipment. And we're only changing it after we're pretty confident it's low. And it's not coming out of the plant. And it's supposed to be maintained. The design base functional requirements are supposed to be maintained.

And a lot of effort has gone into that over four years, those RISC-3 treatment requirements, and a lot of attention has gone there just for that reason.

And I think we got to be confident that the categorization process knows what's safety significant and what's low. And I think it's what gets to the fundamental issue like on reactor protection. You brought up that example and I was like, wow. You know, reactor protection in my mind -- running around in my brain, but we've come out safety significant. But let the categorization process determine it.

DR. BONACA: I don't think so. I think if you do an analysis with PRA you'll find that

since you have four independent trains in every function, you would call each of them low safety significant is all. I mean, that's a possibility.

MR. REED: Yes. I understand.

MR. ROSEN: But, Mario, see that's exactly my point, too. That's why you need people who are properly selected, trained and qualified for the expert panel. Because they can hear the PRA guy come in and make that argument; it's no safety significant, it's four trains and say thank you very much. Now let's move on. It's safety significant. We'll leave it safety significant.

DR. BONACA: But it would have -- that all of them will act the same way. I'm only explaining a little but where I come from. I mean, we talk about a year and a half ago we had a presentation of coherence of the regulation, and we discussed this. And, in fact, the idea was yes it'll be effort. And we haven't seen any further progress on that.

CHAIRMAN APOSTOLAKIS: Well, maybe that's making progress and we're not aware of it. We haven't seen it, because we haven't asked, I guess. I don't know.

MR. SNODDERLY: No, no. I think Mr.

Gillespie said this morning that it has been put on the back burner to elevate the priority of 50.69 and 50.49. There's not much been work on the coherence in the last year since our last briefing.

MR. REED: That's accurate. I'm getting a nod from Stu.

CHAIRMAN APOSTOLAKIS: There is another question -- oh, sorry.

DR. BONACA: I am totally supportive of the process of risk-informing treatment. That goes beyond the issue of trying to make sure that we bring some coherence to the regulation. These are things that I believe probably are at the foundation of some of the discomfort that this some of this stuff had with this application.

CHAIRMAN APOSTOLAKIS: Continuing on your argument, Regulatory Guide 1.174 says that you can risk-inform something and specifically identify CDF and LERF, gives rules. IT says if you show the delta CDF and delta LERF are small, then you have not sacrificed defense-in-depth and so on, it's acceptable. It doesn't say, as far as I recall, that there may be other considerations that can come into -- when it says defense-in-depth it means with respect to core damage and LERF, right? Not a

general defense-in-depth against anything that comes to your mind. That's what the guide says.

So now we are risk-informing a very important regulations. And in addition to CDF and LERF, we are using now Part 100, we're using late containment failure and God knows what else. Is that consistent with 1.174 or are we changing now the rules of the game for risk-informing the regulations? That now it's not just for damage in the larger release but as the case may be, we may worry about other things. Because the original intent of the regulations was such-and-such-and-such.

So I'm wondering whether we are doing something that goes beyond the regulatory guide here?

MR. REED: I don't think so.

CHAIRMAN APOSTOLAKIS: You don't think so?

MR. REED: No.

CHAIRMAN APOSTOLAKIS: You don't worry about Part 100 when you consider 1.174, I don't think.

MR. REED: My perspective on this, and others can chime in, is that from the beginning

going back to 1999 we built this around the 1.174 concepts.

CHAIRMAN APOSTOLAKIS: Yes.

MR. REED: And I think it's built throughout it. I mean, I think the whole regulation is structured that way.

CHAIRMAN APOSTOLAKIS: No. Because you're now asking to look at late containment failure. In fact, in one place you say that it would be really nice to see a probabilistic calculation of that, although you don't require it. So, you know, you are really pushing now somewhere else.

MR. HARRISON: Yes. If I can say one thing, though, is Reg. Guide 1.174 was really looking at a license application. And I think one of the principles that's listed in Reg. Guide 1.174 is that you are still maintaining the regulation. You're still meeting the current regulation.

CHAIRMAN APOSTOLAKIS: Yes.

MR. HARRISON: Here we're kind of writing a new one. We're writing a new rule. So in doing that, we need to capture the things that aren't there now.

And, so, yes --

CHAIRMAN APOSTOLAKIS: That may be the

answer.

MR. HARRISON: My take is that we are going to be on Reg. Guide 1.174. It's a concept that we're following, but we're applying it with the recognition that we're writing a new rule and we need to make sure we capture the things that maybe it doesn't pick up for a license application.

CHAIRMAN APOSTOLAKIS: Any other comments? I will go around the table after these gentlemen step down. But do you have any questions addressed to them?

Thank you very much.

Why don't we go around the table and see what major messages you would like me to convey to the full Committee when we meet in a couple of weeks. Who wants to start? Peter, you seem to be ready.

DR. FORD: Well, I've really given voice to my concerns. So my main concern with RISC-3 components. The draft rule 10 CFR 50.69 in the (d)(2) clearly states the qualitative expectations of the staff with respect to treatment of the RISC-3 components and it talks specifically about environmental and the aging aspects.

The guidance as to how you're going to

meet those expectations in NEI 00-04 does not talk at all about materials degradation issues, and specifically how it's going to deal with proactive treatment of these, bearing in mind that we'll be looking at things in the future. It won't just be known degradation mechanisms.

There's no treatment of the procurement requirements, which is covered in the (d)(2) paragraph in the rule.

And there's no discussion about the adequacy risk-informed inspection plans for materials degradation.

Ad I'm concerned that although the rule itself seems to be adequate as far as RISC-3 is concerned, the treatment of RISC-3 components, the guidance is not there. And I'm puzzled as to how they're going to do this before June, which is when this thing is all going to go into the marketplace.

CHAIRMAN APOSTOLAKIS: Okay. Anything else?

DR. FORD: No.

CHAIRMAN APOSTOLAKIS: Tom?

DR. KRESS: Well, let me first give you what my basic bias is before I give my comments.

My bias is that I don't really think

special treatment requirements help very much in reducing risk. Therefore, if you have some sort of process where you're categorizing systems in terms of special treatment, almost any risk related process out to work, especially if they've got the safeguards in it like you're going to ask questions about defense-in-depth and you're going to have an expert panel that only generally puts things at a higher level and lower level that if they went forward with the process as is, I don't think the change in risk is one that I would worry much about. Okay. That's my bias.

Given that as a comment, I don't think this rule and guidance is a very good example of what I would call a good risk-informed regulation. It has some fundamental flaws in it.

Number one, a flaw that I wouldn't call a flaw, it's just I don't think it's a good regulatory principle to rely on the licensee to select an expert panel that's going to do your job for you. The guidance and everything's all right. I don't have real concerns about it. I just don't like the regulatory principle without some controls over by NRC or some more controls than I've seen.

I think the defense-in-depth

considerations are ill-posed and ill-defined. They're different for parts dealing with the PRA than they are for parts not dealing with PRA. And I think there are structural defense-in-depth issues that ought to be included. So I'm worried about the defense-in-depth parts of it.

The acceptance metric, I agree with Mario, they're just incomplete. Somehow you need to deal with the other things like late containment failure and inadvertent releases of 10 CFR type levels. You need to deal with things like rad protection.

I don't think we've yet seen any proper justification for the cut off values for the importance measures. I have a feeling that systems like this, a cut off value or a criteria for it needs to look at all the things that don't meet the criteria, that are below it or that they've screened out. And somehow I add up their values. But once again, either raw and CDF, neither of those represent the actual change in risk because, like I said before, special treatment doesn't change the reliability that much I don't think. And to ever really have a technically justifiable value for the cut off criteria, you really do have to have some

measure of the change in risk due to the special treatment. And there are some things out there, but I've never seen it drawn into this particular avenue yet to say "All right, if I use this value, then my change in risk is actually going to be this much."

Have they scoped it or bounded it by the values they use plus the sensitivity? Yes, probably. But I think it's an ad hoc type justification that I don't like. And, like I said before, I think LERF is a site characteristic and, you know, I'm still upset about we never use it as a site characteristic, it's a plant characteristic in this and all the 1.174.

I was of the opinion that for this type of process this would be a good place to ask for a high quality, full scope uncertainty PRA. I think they properly addressed the scope when they said those things that are not in the PRA are out of scope of the consideration. And so I think I would go ahead and buy off on that.

I still think four categories is ridiculous. We really only have two categories. Is it an SSC or not? All this other stuff is for past history and to be sure you don't lose history. But I don't like building history into regulations. I

still think there ought to just be two categories and you treat one of them one way and the other one the other way. It doesn't make a lot of sense to me otherwise.

Since I don't think this is a real risk significant issue, I wish there was some way we could avoid this expert panel stuff, but I guess there's not.

Well, that's basically my impressions. I don't know what we'll do with them or what we can do with them.

CHAIRMAN APOSTOLAKIS: All right. Steve?

MR. ROSEN: Yes. Thank you.

Well, obviously being a resident rationalist, I support having the special treatment rule. I think Revision D of NEI 00-04 does a good job of putting in place the structure for dealing with categorization in accordance with the special treatment rule.

I think also that the NRC staff has adequately handled a very large number of public comments and had to thread the needle in a couple of places, but I think by in large they've been fair about them and handled them properly.

And the only thing negative I can say about all of this, which I've already said, which is the IDP is very important to this process. Not just what it knows, but really what its attitudes are and how it translates those attitudes into the plant staff. And so putting in place a member qualifications definition either in NEI 00-04 or in the staff's TI, preferably in the NEI document, that takes into account the idea that this is going to be a very important panel in the plant and it does it more than just simply categorize. It advocates the use of risk information. It defends itself to the plant staff. It trains the plant staff by individual contacts or by training sessions, or by influencing the training program of the plant. It just has a lot of jobs in the plant to bring about a smooth implementation of this process. And that without fairly senior people on it I'm afraid there won't be an adequate implementation.

So I encourage the staff to think about and to the industry as well.

CHAIRMAN APOSTOLAKIS: Okay. Mario?

DR. BONACA: Well, first o fall, I think that NEI 00-04 Revision D is a good improvement. I think that a lot of the elements are there, and I am

totally in the agreement with the point of view that Tom is expressing that it's a safe thing to do, all-in-all. And I think it can be managed properly.

I do believe, as Steve says, that the IDP is critical, is of critical importance. And the way that they're going to deal with the issues, discuss them and address them do with the safety culture. It will drive the safety culture in the place. It will give the messages of what's important, what is not important, and provide also the understanding of where it goes. You know, a bad IDP could do the opposite, and so that's important. I believe that the elements for strength are in the guidance.

I share the concern with the cut off values for acceptance measures, not because I'm so much concerned because I really don't have sufficient understanding of the appropriateness of some of those values. And, you know, but we discussed one of them of the proposed 20 and I'm left with the question is well, I trust that 20 is okay. But you know there isn't specific basis. And maybe there is nothing else one can do, but that's an issue.

I have spoken enough about frequency

consequence. You know, that's really where new designs are going to go. They're not going to say that smaller releases are not important. They're going to design to something like that.

There has to be some way in which we can be more coherent. I already spoke enough about this issue of coherence. And certainly if we have the coherent criteria, then we'll have only two categories -- where it does it fit. Until we have different criteria you're going to have four, maybe some day we'll have eight. Who knows? You know, you can proliferate that depending on what you do, how you cut it across and now you have some other criteria. So, we're complicating life rather than simplifying in that sense. But again, I'm not going to kick that dead horse any further.

In general, again, I think that it's going in the right direction. I really believe that ultimately it will be beneficial rather than not, and so I'm supportive of it.

CHAIRMAN APOSTOLAKIS: Bill?

MR. SHACK: I think the categorization process seems to me robust. Just looking at the EPRI analysis on the parametric uncertainty I think addresses a number of questions we've been raising.

And I think people sort of felt they knew the answer, but I think it's kind of nice to see somebody actually work through it to come up with the details. So I'm left with the notion that the categorization process is robust. I guess I'm even comfortable enough with the notion of using the screening analyses rather the full scope of PRA. And, again, once you have confidence in the categorization then you feel a little bit more comfortable about the fact that you have some difficulty with defining the treatment requirements, perhaps as you would like to do them, but it seems to me that the proposals the staff has outlined for the rule, the paragraph (d)(2) seem adequate.

You know, clearly the IDP is important. I keep looking at this as the licensee has a very strong vested interest in this, so I really don't -- yes, we need qualifications in that but I just can't see them really taking the junior engineer just on the staff to do this job. So I'm probably less concerned about that than I am just ensuring that the guidance for the robust process is there. And I think it is. The Revision D is a big improvement over the initial ones we saw.

I probably would like to have seen some

more detailed guidance for the IPD. Somewhat going through some of the staff comments that they had for specific things the IDP could look at. I guess Doug True make a comment about the SAMGs and the EOPs and the fact that you are throwing everything but the kitchen sink at it at that point. But I still think that that's information that the IDP ought to look at it. Not necessarily that they ought to include everything that's referred to in the EOP and the SAMG, but I certainly think it's a piece of information that they ought to look at. And I think that's the one omission I see in the Revision D is that there is absolutely no reference to that as an information source.

CHAIRMAN APOSTOLAKIS: Okay. Well, I think I more or less expressed my views during the day. But I do agree with just about everything you gentlemen said.

But coming back to the point that Tom made, maybe precisely because this is not a regulation that's dealing with something that really has an impact on the risk, I agree with you. I have never thought that these special treatment requirements were really critical.

Then we should advantage of the effort

that is being put into it to actually address some major that would be important in another regulation. And in that spirit -- and public confidence, of course. In that spirit the issue of how do you handle defense-in-depth.

DR. KRESS: That was my basic comment.

CHAIRMAN APOSTOLAKIS: Yes. You had to be a structuralist, you have to give a reason in this category or that category. You want to be a rocket scientist, you have to give a reason.

DR. KRESS: This sets a precedent --

CHAIRMAN APOSTOLAKIS: Exactly. Exactly.

DR. KRESS: -- for other regulations that it may be more important.

CHAIRMAN APOSTOLAKIS: Because it sets a precedent. Precisely. And that's why I really wanted those slides 3, 4 and whatever that Doug and Tony presented earlier to be more realistic in their depiction of what the process is all about. But if you go the PRA route, there are certain benefits that you don't have if you go the other route. And the staff also in their regulatory guide maybe they can send a message directly. The IDP's job will be different with different questions and all this

stuff.

So I view this as a regulation that is really setting a precedent. And if we set the wrong precedent, then later on people will tell us but you approved that one.

I was very pleased with finding out that EPRI had done this work on parameter uncertainties and looked at the uncertainties and the importance measures and so on. That's great. As I said this morning, when we wrote a letter a year or a year and a half ago that said look we are not against approximations but just show that they are approximations, so give some arguments I think this is in the spirit of that. And I think this is great. This is really great.

And overall, I would say I'm very pleased with what I see.

DR. KRESS: But the question is are they through? Is this definitive?

CHAIRMAN APOSTOLAKIS: No. No. I think-

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DR. KRESS: You said you --

CHAIRMAN APOSTOLAKIS: Another thing that pleases me is that both Doug --

DR. KRESS: Yes. Yes. I really like

this style, but I'm not sure it's complete.

CHAIRMAN APOSTOLAKIS: No. nd thy seem to be receptive to comments. I mean, nobody tried to dismiss anything. I mean, they were arguing of course, but I don't remember Doug or Tony saying no we're not going to do that. So that's great. And given that they have the study that I'm extrapolating that they will think about it, at least. So in that respect I think we're doing okay.

I'm a little bit disturbed about this business of looking at late containment failure. Not that I am against it, but I would like to see a more explicit statement. Maybe what Donnie said. Deviating from 1.174 because that refers to changes in the licensing basis. Here is a new regulation. We have to worry about other things besides CDF and LERF. Because everybody thinks now that risk-informing the regulations means CDF and LERF. And this rule says otherwise.

MR. SHACK: But the regulatory framework brought the late containment. I mean, that's been in every staff approach to risk-informing it.

CHAIRMAN APOSTOLAKIS: Late containment failure?

CHAIRMAN APOSTOLAKIS: Yes.

DR. KRESS: Yes, but it's not just late containment failure because you have a set of frequencies associated with various possible events. And these events have consequences that are both health consequences and cost consequences. And in my view a coherent system would have a product of a frequency in terms of cost, and I'm talking about dollars there, that includes everything, as a subtle criteria that you want importance measures on and you would have acceptance criteria for these. And if you have high frequency events that have enough cost associated with them that you don't want it to happen within a certain level, you don't want it to happen. And that's what the regulations are intended to control. And, you know it's more than just CDF and LERF.

Now, some argument can be made that if you control CDF and LERF you probably may have controlled those others, but I don't think that argument has ever been shown. You know, it may be a valid argument, but it needs to be shown.

CHAIRMAN APOSTOLAKIS: Okay.

DR. BONACA: You know, I expressed before my main concern is about what people perceives they're protected. And we have told them

we will protect them. And I think that that's important that that's clear. But again, we saw it through the application from Exelon, for example. That came in with a frequency concept and I would believe that almost any plant we're going to see will have some kind of frequency --

CHAIRMAN APOSTOLAKIS: We tried that, though. We tried that. Went back to some time ago, 11-50. And what you see really is nothing until a severe accident occurs.

DR. BONACA: I understand.

CHAIRMAN APOSTOLAKIS: You really don't see anything.

DR. BONACA: And I'm not saying that that cannot be --

CHAIRMAN APOSTOLAKIS: So you really --

DR. BONACA: I think there has to be an effort to do some more categories otherwise you end up with four boxes.

CHAIRMAN APOSTOLAKIS: Yes. Well, and you gentlemen though should have said also that the term safety significant, nonsafety significant are in so many places that it becomes almost impractical to drop them now. You have to give them some credit for what they're doing.

DR. KRESS: That's why they're there. That's why they're there.

CHAIRMAN APOSTOLAKIS: Yes, that's why they're there. It's not that the staff and NEI --

DR. KRESS: That's why we have four categories.

CHAIRMAN APOSTOLAKIS: -- love four categories and not two. I mean, it's a pragmatic approach to --

DR. KRESS: Yes, we buy that.

CHAIRMAN APOSTOLAKIS: -- somebody told me.

MR. SHACK: In South Texas they have more.

CHAIRMAN APOSTOLAKIS: What?

MR. SHACK: In South Texas they have more.

CHAIRMAN APOSTOLAKIS: Yes. Right. Right. Because they have to be ahead of everybody.

MR. ROSEN: How many would you like? We could still have more.

CHAIRMAN APOSTOLAKIS: Yes. And if they find out that now these guys --

MR. ROSEN: If anybody sneaks up on us, they could put even more.

CHAIRMAN APOSTOLAKIS: I think this meeting has reached the point where it's not useful anymore.

Now we have this presentation by the ASME group, which is supposed to start at 5:00. If we don't violate any federal laws and if the speakers are willing to do so, I suppose we start a little earlier.

DR. KRESS: Good idea.

MR. ROWLEY: George, we can probably start earlier, except Ken's not here yet.

CHAIRMAN APOSTOLAKIS: When is he going to come? At 5:00?

MR. ROWLEY: He should be here shortly.

CHAIRMAN APOSTOLAKIS: IS he coming at 5:00?

MR. ROWLEY: He said he'd be here much earlier than 5:00.

CHAIRMAN APOSTOLAKIS: Okay. Why don't we say then that we will attempt to start in 20 minutes. And if he's not here, we'll postpone it again.

So that will be 5:05. Am I losing any members?

(Whereupon, at 4:15 p.m. a recess until

4:43 p.m.)

CHAIRMAN APOSTOLAKIS: We're back in session.

The next issue is different from the ones we've had today. It is on the status of risk-informed initiatives within the ASME Nuclear Codes and Standards, and it says here Ken Balkey, but I don't see him up there. Oh, there he is. Ken.

MR. BALKEY: I brought some friends with me.

CHAIRMAN APOSTOLAKIS: Okay. Would you introduce your friends, please, although we've met before some of you.

MR. BALKEY: We're going to let our Vice President of our Nuclear Codes and Standards do the introductions.

CHAIRMAN APOSTOLAKIS: Oh, okay. I'm sorry.

MR. ROWLEY: Well thank you. I just might say that in spite of the risk of Washington weather in February, we're having pretty nice weather outside as we walked over here from the Metro station. And kind of a little interesting aspect of risk in another venue.

Anyway, this afternoon thank you very

much for the opportunity to present the ASME efforts in our risk-inform initiative which has been going for quite some time, especially here late in the afternoon like this.

The Board has a strategic plan to manage our risk initiative. This has been going on for quite a while. And we planned to concentrate on these four aspects of our static plan this afternoon, for your information. And at the end of the presentation we will provide some time at the end for future actions.

We have had our board meeting here in Washington over the last two days, and today we brought over our Board Risk Management Task Group. And also I'd kind of like to recognize a couple of our ASME volunteers who happen to be in the audience here. I see Pat O'Regan from EPRI who is in our section 3 and section 11 effort. I see Stanley Levinson, who is our committee on nuclear risk management and Doug True. I know all of you know Doug.

It's been five or six years since the board briefed ACRS on our risk initiatives, and I'd like to just say I think we've done a fair amount in those intervening years.

Kevin Ennis is going to provide a little bit of information on the ASME organization.

MR. ENNIS: Okay. Well, as everyone in the room can see by the slide behind me, this shows a depiction of how ASME Nuclear Codes and Standards fits within the overall hierarchy of ASME codes and standards activities, which is quite extension.

Nuclear Codes and Standards, we address all aspects of mechanical equipment used in nuclear power plants from design through in-service inspection and in-service testing. This includes the Committee on Nuclear Risk Management, or CNRM, as you can see, that has developed the ASME PRA standard.

Now, within ASME codes and standards we have 3,000 volunteers that are active. And a subset of that Nuclear Codes and Standards, we are supported by approximately 1,000 of these engineers who, and I must stress, volunteer their time and expertise to produce nuclear codes and standards that address the needs of all our stakeholders. And since we are here in Washington, I want to make particular note that the NRC's an integral part of this Codes and Standards activities, and their representation certainly helps make sure that

Nuclear Codes and Standards addresses the concern for the regulatory body.

MR. ROWLEY: Now Ken Balkey, who is Chairman of our Risk Management Task Group will discuss our strategic plan.

MR. BALKEY: Okay. Thank you, Wes.

As you're well aware, in fact as I came into the room, I remember meeting with Dr. Kress, probably 15 years ago. And we had the first idea of using risk analysis for in-service inspection. Before we even started some research work. And that's how long it goes back. And then that research work lead to a number of codes and standards initiatives back in the early and mid '90s. And we did have, our Board on Nuclear and Standards did meet at that time as we were starting to develop several code cases, and you'll hear a little more about that, as well as the beginnings of the PRA standard.

But with that, when the Board of Nuclear Codes and Standards recognized the value of this technology, a decision was made by the Board. We could see that the Nuclear Regulatory Commission in its policy statements was looking to bring risk into the regulations. Well, we looked equally at the

same time of how we could bring risk into all of our codes and standards.

So with that, as Kevin Ennis kindly just showed a broad spectrum of applications everything from in-service inspection, to quality assurance to the development of a committee on nuclear risk management and the PRA standard itself.

In order to manage that, we made a decision at the board level that we had to have a plan that we could track both short term, long term initiatives. And we would review this on a very regular basis. So within that, we have the elements within the plan covering across all the applications as well as the PRA standards and not only looking today, but also looking at the needs of the future reactors that need to be engaged in this process as we look at the road.

We had our board meeting yesterday and we reviewed the plan. We updated it and it was approved by the Board, and you have a version here that's in your handout that goes through that.

What we decided in the interest of time would be we selected four topics that we thought would of greatest interest to you dealing with the PRA standards, dealing with what we've done to work

with the Nuclear Regulatory Commission and Nuclear Energy Institute on 50.69, some efforts on new reactors. And finally, very significant development, we have -- tomorrow and you're going to hear at the end is trying to work, set a coordinating committee with ASME, ANS and the NRC and the NEI and several other organizations to enhance the coordination of standards development activities.

All those elements are in the plan. What I'd like to do now is turn it back to Mr. Rowley and you're going to hear from individuals on those specific areas.

CHAIRMAN APOSTOLAKIS: So someone will address the 50.69?

MR. BALKEY: Yes. We have somebody for 50.69, the PRA standards.

CHAIRMAN APOSTOLAKIS: Okay.

MR. ROWLEY: So next Gil Zigler, who is Vice Chairman of our Committee on Nuclear Risk Management is going to discuss our risk management activity.

MR. ZIGLER: Well, it's a pleasure here. And it's a pleasure here and not talking about sumps. You haven't probably haven't seen me talk a lot about that just recently. So I'm going over

here talking about a complete different issue.

We at ASME recognized there was a need about six years ago to form some sort of a standard to get everybody back on board what would it entailed, what would be the requirements of the formation of a PRA that could be used for risk applications.

So this group was formed about six years ago. And about two years ago, two or three years ago we came by over here and sort of presented the draft version of where we were on the standard to this body.

In April of 2002 we issued finally the standard, after much discussions on it. And I think you're familiar with it.

Immediately following that Regulatory Guide 1.200 was issued and the group, the whole CNRMC basically focused our efforts then in attempting to address the issues that were brought up on Reg. Guide 1.200 and addendum A to the standard was issued. As soon as addendum A was issued or concurrently with that, there was a peer review that was done at San Onofre using the new standard with the addendum associated with it. And this was the first real trial use of the standard,

if you please. We had some issues that were brought associated with the clarifications with it, interpretation of the standard. And we are now in the process of forming addendum B to the PRA standard which we are addressing those addresses of clarifications and how to go about implementing or using the standard.

Parallel with that we had on the new initiatives that are coming up in the Committee on Nuclear Risk Management include, we have been tagged by Ken Balkey's organization to take a look at the necessary actions to respond and to evaluate the December 18th letter or Commission paper on the PRA quality issue on it.

We're embarking and very strongly working with this new coordinating committee that Ray will be talking about over here, ensuring that the PRA standards developed by all of the consensus organization have some sort of commonality on it.

And then on a more technical issue, one thing that we recognized during the development of the PRA standard is this whole issue of having a common thread on the numbers that should be used to quantify the PRA. And we are now embarking on an attempt to have a standard now that will come up

with some generic reliability number so that we can ensure across the board that consistency within the PRAs that will be issued. And if you do want to use the plant specific or site specific numbers, you're welcome to do it provided you have some justification.

So that gives you a glimpse of where we are on the committee of Nuclear Risk Management. Right now trying to ensure that the current standard that we have is usable, clear and we know to apply it.

CHAIRMAN APOSTOLAKIS: Is your new initiative on identification of actions to respond to the Commission's paper on PRA quality, is that initiative sponsored by the NRC or is it on your own--

MR. ZIGLER: On our own. We felt it was a significant paper. We have this lingering thing in the background of the PRA quality issue. And I hope the good doctor fully understands that we have to talk about two things. One is the quality issues on it and the other one is what is the PRA composed of. This is the total body that's inside of the PRA.

So those are two distinct issues that are different.

CHAIRMAN APOSTOLAKIS: But what would you say to someone, not me, but someone who might say you are the organization that issued the standard. If someone follows the standard, then you have a high quality PRA. So why do I need then additional initiative?

MR. ZIGLER: Well, the Commission paper that was issued has those multiple phases.

CHAIRMAN APOSTOLAKIS: The phases.

MR. ZIGLER: Right. And that is what -- we have some thoughts but I would like to reserve that up until we have further deliberations on it. As a consensus organization we have lots of deliberation going on about that.

CHAIRMAN APOSTOLAKIS: But again, the phase issue appears to me to be a policy issue. So what can a technical organization like ASME offer there? I mean, the Commission says this is what we want.

MR. BALKEY: In reviewing the paper and as we discuss in our task group to respond on it, the major item in here is that there's a timing in the Commission paper.

CHAIRMAN APOSTOLAKIS: Yes.

MR. BALKEY: We'd like to be at phase

three by 2008.

CHAIRMAN APOSTOLAKIS: Yes.

MR. BALKEY: And in that right now we do not cover all the modes and the full scope of applications within a nuclear power plant. The question is can ASME, and this is now our coordinating committee, can we develop standards that would be available in 2008 to meet phase three. So we have to be able to respond back. Is 2008 too ambitious or it's something we can meet.

MR. ZIGLER: It's the issue of completeness.

CHAIRMAN APOSTOLAKIS: So you're not really issuing a document that will tell the Commission your phased approach is not appropriate? You say --

MR. ZIGLER: No, no.

CHAIRMAN APOSTOLAKIS: -- if we follow what you're saying, we would need A, B, C and is it feasible?

MR. ZIGLER: Exactly. Exactly.

CHAIRMAN APOSTOLAKIS: Oh, okay. That's very different.

MR. ROWLEY: Okay. Next Craig Sellers, who is a member of Board Risk Management and Task

Group will be discussing our risk-informed applications.

MR. SELLERS: Okay. We were primarily going to focus on what we did to support 50.69, but I'm going to back up and go a little before that to say that ASME has been involved in risk-informed applications prior to the publication or proposing of 50.69.

This slide shows a number of section 11 risk-informed cases, both for in-service inspection and repair and replacement that currently exist.

The next slide shows OM code cases that address risk-informed in-service testing.

All these code cases are currently in use by the industry and don't necessarily need 50.69, but can be used in a 50.69 program.

When 50.69 was proposed, ASME recognized the benefit of active involvement in its preparation and in development. We had regular interface with the NRC and NEI during the whole process. NRC and NEI participated within ASME organizational activities. ASME volunteered to participate in NEI and NRC activities. The goal of all this is to assure that the ASME codes and standards documents comport with the guidance and regulation that's

coming out of the NRC and NEI.

We also provided formal comment on the proposed 50.69 rulemaking packages. And then we've got a number of ongoing application activities that are within ASME. Some are supporting the pilot plant activities and some may be.

That's it.

MR. ROWLEY: Okay. Next we're going to have Bryan Erler, who is Chairman of the Board Regulatory Endorsement Task Group will discuss some of our future reactor activities.

MR. ERLER: We are proceeding with a number of initiatives for getting ready to apply some of the risk-informed technology for future reactor design.

Outlined on the slide above shows some of the various steps that we are developing.

Essentially what we have done is we have established a research effort in order to pull together the material data, the failure mechanisms, loading probabilities. And we've funded the research in order to develop a load resistant factor designed approach for piping and piping supports and ASME components that you have so that we have the risk-informed design basis.

At the same time we are proceeding with adopting risk-informed classification system to apply to the design. Therefore, selection of the use for the component and the performance requirement, would we have the appropriate classification that would roll together with the design basis and be able to develop a risk-informed design for the components of the power plant.

This is a significant step going forward for the organization, because this would be a very useful tool to be able to get the kind of reliability that we desire in the new product for new products. And we see a couple of code cases coming out of these initiatives that are going on. And then essentially the step would then go to a code revision. An alternative code framework is what we're looking at, something like we perhaps have not seen before where we have life cycle process and system based codes dealing with the design everywhere from the material issues all the way to the in-service inspection, to the testing and performance experience and roll that into the design approach for the whole system design. So this is a substantial changed that we're talking long term, but the benefit of that certainly is going to be the

capability of getting our safety level built into the design up front.

DR. FORD: Excuse me. Are these future reactors, are they primarily the light water reactor base time types of reactors or are they gas cooled reactors?

MR. ERLER: Essentially right now the process is we're dealing with the light water, the future light water reactors. We're taking the data that we have from those PRAs, those systems. We're taking the data that we have from failure mechanism in piping and rolling that into the design basis to be used in the future. But the same logic as I was going to discuss on the next slide can also be used as the next new generation of reactors, the pebble bed and the gas cooled, as those systems are designed and we understand their risk and their behavior system, we can roll that into the same design approach.

MR. ROSEN: We had a discussion this morning, earlier today actually this afternoon, about 50.69. You may have heard parts of it. And the discussion we had touched on the subject of not having these four criteria, these boxes anymore where you have -- you know the four box approach.

And just having two boxes. Having risk significant and not risk significant and things that are risk significant would be treated with a safety related and things that are not risk significant would not be treated that way to simplify this business. Is that direction something that this process would support?

MR. ERLER: I think right now it's too early to judge. But, yes. I mean, obviously, the advantage of a design that gets very complicated when you're doing design going forward to have too many different boxes and too many systems, so it would be advantageous. But the issue of working our way through the classification is really something that we move forward on and then to see how the other boxes come out. I mean, I don't think we're going to jump ahead to the conclusion what our results are going to be at this stage.

MR. ENNIS: But, Steve, currently the code cases within ASME only recognize two classifications, how and low. So we do have a two box criterion within ASME.

MR. ROSEN: It would seem to me that if we had PRAs back when we started designing the current generation of plants, we would have come up

with two boxes, important and not important, that's safety related and not safety related.

MR. ENNIS: Right. Absolutely.

MR. ROSEN: Whatever we wanted to call them, but there'd only be two the four things which I see as an attempt to use the advantages of PRA but take into account pragmatically with the situation we find ourselves in with the regulations that are rife with references to safety related or not safety related.

So in the future, maybe five or ten years from now, however long it takes before somebody steps up to the bar and says they'd like to build a new reactor in this reactor, I don't know, but by that time I would open that your previous slide, the one that shows risk-informed design, a block that shows risk-informed design and direct use of plant PRA, that's the way to do business, I think. And I think that leads to two categories: What the designers think is important for safety and what they think is not important. And if they think it's a little important for safety, they ought to put it in a safety box. And there really ought to be nothing in between. And that would simplify the regulatory system.

So I think you're headed in the right direction.

DR. FORD: This seems to be a very, very challenging prospect. Do you have the data in order to come up with PRAs which take into account materials degradation -- time dependent material degradation phenomena? Do you have the data to take into account model uncertainties?

MR. ENNIS: There is a lot of -- Ken?

MR. BALKEY: Let me try to answer that.

The way we're doing it right now, we've actually done it in risk-informed ISI programs, is that rather than building the actual age degradation time dependent function and bringing that right into the PRA model would be a very significant step. So even in today's risk-informed ISI programs we do the failure probability estimate using such tools as probabilistic fracture mechanics where you can look at the uncertainties over time to -- you'll have an increase in failure probability over time. And we use that input coupled with the consequence results from the PRA to map it. That's the way it is right now. But in the future as we keep moving forward in enhancement of the PRAs, if I'm looking at ten years from now, the idea of bringing the time dependent

functions in would probably be a possibility.

I mean, if we look back where we were ten years ago, I think we've made great strides forward. And where we'll be ten years to the future, maybe we can get to that point.

MR. ERLER: We have the tools and the data. It's just a lot of work to deal with and a lot of effort.

MR. ROSEN: I think you made a very good point, Ken. And that is if we go back ten years from now, back to 1994 and ask ourselves would we have predicted the gains we've made between 1994 and 2004? I think the answer we would all come up is no. We wouldn't really be as far along with risk-informing and using PRA as we have come. And so it's probably not too much of a stretch to say that by ten years from now, hence we can do a lot better than we've done, than we're doing now.

The techniques are only to improve. More and more practitioners will become available. It will become even more deeply embedded in the regulatory framework and in the codes and standards. And I think there's a real likelihood we could do better, and even maybe work on the materials a little bit too. Get some age related degradation

mechanisms embodied in the PRA.

DR. FORD: Well, as you know, in your efforts for some ASME 11 and ASME 3 for fatigue that all carbon steels and alloys there's tremendous scatter in the data. And I keep thinking of this. And now you're going to go eventually to pebble bed reactors and different failure mechanisms. Is there the funding basis to get the data that you will require for doing this?

MR. BALKEY: That's a very point. I'd like to address it with two points.

First of all, one of the values in -- if I go back in my career we did a piping design in the early '70s. You knew there was uncertainty in the loading condition materials.

DR. FORD: Sure.

MR. BALKEY: And you just bounded it. And if you could show you met the stress, you said okay. But you knew you may have added in many more snobbers than probably were needed. But I was able to make the conditions.

What the probabilistic models have allowed us to do is instead of just putting a bound and then moving forward, we now can put the limits and the uncertainty around that data and say, well

given situations the failure probability is quite different for one case where there's a large uncertainty and now there is not. So I think we've made a lot of -- there is a lot of advantages to the probabilistic methods to address that item.

Regarding the data, what I'd like to do is Bryan Erler has been, actually, on our new Reactors Task Group that's been going around the world to see if we can engage the new reactor manufacturers in this process.

And to get back to Mr. Rosen's comment, I think the reason we have moved so much further than what any of us would have thought ten years, is the brain power that's been brought in. Right now we have every plant staff in this country does their PRA. It's not just the experts in firms outsides. We have the utilities doing it. We have many, many organizations around the world using these techniques and the more brain power we bring to it I think the advances will come.

MR. ERLER: Let me just add one other thing. If you go back to the one slide, Kevin, there is funding for that part. You know, we cannot depend the volunteers to do all of this work, and so it does take funding and we have gotten some

funding. And, obviously, it's important that we need more going forward. So, it's very key.

The other thing is, is there's a lot of stuff going on across the board. This is a very international effort. At our meeting yesterday at the Board our colleagues from Japan are doing a lot of work with regard to a safety balance of margin and dealing with the design basis, a system basis code they've called it. And that's good up front work that they're applying to their future reactors, some of it their fission work, too.

And so there's things going on around the world and some of it's all getting focused, really, at some of Ken's group and some of that really stimulates the success of the goal that we have in here in the end product.

So the strategic plan is the guidance. The issue is there's all kinds of ideas going on around the world that do come to the board meetings and I think that has stimulated a lot of chances for success.

Going to the next slide, the new reactors going forward, one of the things that's very clear to the Board; I mean ASME has been around for 125 years or whatever it is, but there is a need

for input in terms of understanding what the new reactors are looking like. What are the materials, what are the temperatures, what are the conditions that they have. And, quite frankly, the Board and the committee members don't know all the different reactors. And so we embarked on a whole series of work shops that we have going on going around the world. We've been to Pittsburgh with Westinghouse. We were with AECL up in Canada. We were in Johannesburg to meet with the pebble bed people. We have more scheduled with the GA, the gas cooled reactor, the GHTR. So we have a whole series of input we're collecting that we can then identify a matrix where the code needs to be, not just in risk based but in terms of materials and in terms of design requirement. And that effort is a significant task force that's a part, as Ken said, the new reactor task force. But all the new reactors are using risk-informed technology. I mean, they are proceeding with their design, you know, along with doing a PRA and evaluating the conditions and the safety margins as you're going along.

So it's the tools you have in place at this stage that you're going to roll into the detail design once you have the systems worked out.

So we want to have a code to be ready to be able to handle that when those reactors come on, whenever they do, a number of years from now.

I mean the initial new reactors are really going to use a combination of risk-informed as well as some of the deterministic -- as I see it, they're going to have some of the systems issues and certain performance requirement. And then they're going to use some of the design allowable stresses. So it's going to be a mixture at different stages, but you'll have the risk-informed knowledge in your design basis that you've established.

So I think we're going to be in a substantially different position going forward in terms of building in the safety into our design up front and knowing and quantifying what that number will be. And that's the advantage of the design approach for new reactors for risk-inform.

MR. ROWLEY: Next Ray Weidler the Board Vice Chairman will be discussing the Risk Coordination Committee.

MR. WEIDLER: Thank you, Wes.

First of all, I'd like to recognize Jim Mallay back here. Jim came in just a few minutes ago. He is Chairman of ANS' Standards Board. Did I

get that right?

ASME and ANS and NRC feel compelled for a need to coordinate the risk activity for the benefit of all the stakeholders. And therefore, we have agreed to propose a coordinating committee. The sponsors of the initial meeting will be ASME, ANS and the NRC.

The invitees to the meeting are our sister engineering organization such as IEEE, DOE and NEI.

The purpose, the objectives that we want to try to achieve, the big motherhood one is coordinate codes and standards activities related to risk management for nuclear activities. But the real key statement, I think is the next one that is to ensure that codes and standards associated with risk-management and their underlying principles are consistent and compatible.

There's a white paper in your package entitled "Proposed Standards Development Organization and Regulatory in the Industry Risk Management Coordinating Committee." I commend that for your reading at your convenience as it describes more in detail what I've just said in a very few words.

The first meeting is tomorrow morning from 9:00 to 1:00 at ASME's offices on L Street. And we invite anybody with interest, come down and give us their ideas.

We're really excited about this. I've been working on this idea about two and a half years, and Jim and I have batted this back and forth. And we're real excited about this.

Any questions?

MR. ROSEN: Well, I think the obvious question is one that I know has begun to be kicked around in the ANS, and that is are we ever going to have one standard?

MR. WEIDLER: I understand tomorrow there'll be a proposal made at this meeting for a one coordinated standard. Now, I can't sit here and tell you that that's going to happen. But I know we're going to get a proposal.

CHAIRMAN APOSTOLAKIS: One standard of what?

MR. ROSEN: For PRA? In other words, internal events, low power and shutdown, fire, seismic; the whole ball of wax? Standards of how to do a PRA that deals with all, LERF, the whole situation? When you need to do level three, when

you don't? I mean, basically addresses of being able to use quantitative techniques in risk management.

And right now, you know, I don't condemn what we've done and we set out to do is ASME set out to do the internal events job and ANS took on the external events job and low power and shutdown. Just a division of labor. All those parts needed to be done. But I think you've recognized, as I have, that at some point we either have to have some awfully complicated road map and a lot of coordination, which is kind of what we've got now, or else some kind of putting it altogether process.

MR. WEIDLER: That's one of the exact reasons we see the need to form this group is to address that issue. How we'll end up doing it, I can't -- I wish I had a crystal ball to show me, but I don't. So we'll start tomorrow to see what we can figure out.

We know what the industry wants.

MR. ROSEN: What is that?

MR. WEIDLER: One standard, I think, is what I've heard.

MR. ROSEN: Okay.

CHAIRMAN APOSTOLAKIS: Who is coming

from the NRC to the meeting?

MR. WEIDLER: No, it's not coming from the NRC. Oh, yes. Well, I've heard it from NRC.

MR. BALKEY: No, attendance tomorrow.

MR. ROWLEY: Who is coming from NRC?

MR. WEIDLER: Jean Imbro, Frank Churney. Mike Mayfield was going to come but he had to leave for India today. Mary Druin.

MR. BALKEY: Mary Druin was supposed to come, but unfortunately she's still out of the country as well, too.

CHAIRMAN APOSTOLAKIS: What happens today in India?

MR. ROSEN: I don't know how we're running this agency with Mary Druin and Mike Mayfield out of the country.

MR. ERLER: It's a challenge for the rest of the staff, yes.

MR. BALKEY: I'd like to add, as Mr. Rosen's pointed out the aspect of the multiple standards and the regulatory guides and the NEI guidance that it makes a challenge if a new person comes into an organization trying to understand all these different pieces. That's the one piece.

The other one is building on a new

reactor framework, if we want to move to a two boxed approach, it should be looked the way the organizations are lined up.

The current classification scheme that we use in our plants today, the class one, class two, class three were not from ASME. ANS has a standard on classification and we have Reg. Guide 1.26. Now at ASME we've done risk-informed safety classification work for our various applications, as Mr. Sellers explained in his overheads. If we want to move towards a risk-informed framework for the new plants, we have to coordinate activities between the societies and the NRC that we all agree on that framework. It can't be just ASME by itself or ANS by itself. And that's going to be another item when you look at the paperwork, that's embedded as an item that we've got to address as well, too, in a coordinated fashion.

MR. ROWLEY: In summary, the Board uses this risk management strategic plan to manage our risk activities,which are quite diverse. And the intention of being over here today is to really try to identify areas that we can be of assistance in the larger risk effort.

And, again, thank you for this

opportunity to brief you. And we're open to staying around as long as you want to answer questions.

CHAIRMAN APOSTOLAKIS: Any comments from the members?

MR. ROSEN: I do have one thought that I've kind of expressed, but maybe make it more explicit would be helpful.

I think you've alluded to the fact that there's been an enormous amount of brain power brought to the table in the last ten years that wasn't there, and I think that's a very good thought, very good point.

I hope when you go forward with this effort that you don't in anyway carve off parts of that brain power and get it behind the wheel pushing, too. Whatever you do, you need to energize that brain power and bring it even, even those people are members of AIChE. Who knows where they are in the society structure, as long as they're working on PRA they need to get behind the idea of ultimately heading in the direction of one standard, a two box effort. The idea being that PRA is a discipline, an engineering discipline just like mechanical engineering, just like electrical engineering, just like chemical engineering. It

needs to have a standard or a set of standards that universities can review and use to do teaching, that vendors can use. That everybody knows is out there and is part of the fabric of the way we do engineering in this country, and hopefully in the world. So you need to consider foreign inputs as well.

MR. ROWLEY: Well, that's exactly -- in fact, let me make two points there. One is that in our codes and standards effort in the ASME, we do not require the members of our committees to be ASME members because we recognize that lots of times the disciplines that we need for a particular standard might be electrical or nuclear, or whatever, you know. So we don't have that requirement. In fact, I alone didn't join the ASME until after I'd been in ASME Codes and Standards for eight years.

And the second thing I'd like to point out is that we use the acronym ASME International, kind of trade name, to demonstrate our thrust to be kind of a world leader in the codes and standards throughout the world. And we already have international organizations, people, project teams that help to bring ideas from other countries into both our nuclear and our non-nuclear codes and

standards efforts. Of course, it needs to be more, but we're working in that direction.

A good example is that boiler code meeting next week down in St. Petersburg, I know for a fact that we have three people from the PBMR project in South Africa coming up for the meetings to look at graphite materials and high temperature and so on, ISI.

CHAIRMAN APOSTOLAKIS: Very good. Michael?

MR. SNODDERLY: Just two questions. The first was when were briefed on NEI 00-04 it references code case N-66- for additional guidance. And I was wondering if you could just talk about the schedule for N-660. I saw you had a slide that talked about its ongoing activity. And I guess they're talking about Revision D being complete to support the draft final rule package by the end of June?

MR. ROWLEY: Ken, you'd probably be the best one to day that one.

MR. BALKEY: Sure.

Code case N-660 was developed as the first proposed rule language or the aspect of even just proposing rule back in 2000. And even though

we had our risk-informed ISI and IST cases, we made the effort to develop a code case for risk-informed repair replacement activities that would fit right in the thrust of the 50.69 effort. So we worked, and at that time we had several plants in the United States doing some early demonstration work supporting the 50.69 effort. Some of those plants also tested some very early wording and approach that we had laid out in N-660.

And the way a code case works is that we ended up -- we had a case and it was approved by the Board on Nuclear Codes and Standards about a year ago. It was actually two years ago. So we already have an approved code case. And the staff right now is evaluating do they endorse it in their Reg. Guide. 1.147.

But now that code case should be viewed as a -- it's a trial application. So we need some more plant evidence from applying the case. So now that the 50.69 effort has moved forward, the Wolf Creek Plant and I believe the Surrey plant are moving forward on applying NEI 00-04 and the guidance that was provided in the proposed rulemaking package and they're beginning applications for that. And within that they're

using Code case N-660 and N-662 which is the treatment part of it.

There's experience coming back from Wolf Creek and we're going to be discussing that, actually, at our code meeting on Monday, some feedback from first use on the approved case.

I would envision what will happen with N-660 is similar to what happened to ISI code cases. We got the code case out there so there was a framework for the initial trial applications. But as those plants did the work, there was feedback. Changes needed to be made. And we've since revised it.

So I would envision that we would be going down a path of revising N-660 as we gain this feedback from the first plants making use of the codes.

MR. ROSEN: You know, there's been some discussion here about the difficulty of treatment in 50.69. I didn't know, but I see now that you are working on standards for treatment for at least RISC-3 pumps and valves. It would be my hope that that standard could at least give some guidance. We would end up with less of this variability between plants if you do that job well, and it catches on.

MR. ZIGLER: Dr. Rosen, we've been dealing with this issue in the operation management committee for quite some time now. And what will happen with 50.69 is that 50.69 essentially descopes the RISC-3 category from application to the code. So then we have those bunch of components sitting out there that are RISC-3 and we felt that we should generate now a standard. It's not a code. And there's difference between a code and a standard.

So this standard would then provide the guidelines of what to do on the treatment side for the descoped components of the IST program.

MR. ROSEN: And not leave everybody to figure that out for themselves.

MR. ZIGLER: Exactly. Provide guidance on it.

MR. BALKEY: I also like to add when we developed Code case N-662, which is the treatment part of the repair replacement, very challenging effort. Because it wasn't such that, okay now if it's descoped out in the code that I can just walk over and use a B-31-1, which is the power piping code for all facilities. The reason is, is in RISC-3 you still have to provide assurance you're maintaining your design basis. Well, a plant that

descopes that's an ASME code designed plant, you have to be very careful in your repair replacements that you're still meeting the same intent of those design rules from the initial construction.

MR. ROSEN: So the tendency would be to try to get out from under the code for that descope stuff and lurch back and end up with all the same stuff we had before. And so you'll have to fight that tendency and try to strike a reasonable balance.

MR. BALKEY: Well the Code case N-662, we brought all the stakeholders around the table. The owners, the manufacturers and the Nuclear Regulatory Commission and tried to carve a path what's the way to do the repair replacement treatment, find an item that's in risk free.

MR. ROSEN: Without ending up back where we started.

MR. BALKEY: Exactly. Not just back where we started, but out of compliance with meeting the intent of assuring your original design basis and design function.

MR. ZIGLER: And from an operation and maintenance standpoint our goal for RISC-3 is not simply to say apply the current code. I mean,

that's NA. We are going to be trying to think of out-of-the-box on it for those components that are descoped. Perhaps there are other more applicable and appropriate in-service testing requirements associated with it.

MR. SNODDERLY: Thank you.

My last question was could you discuss some of the lessons learned that came out of your involvement with Reg. Guide 1.2 in endorsing the level one ASME standard? Because I would imagine as you begin to consider how you're going to respond to the Commission in their request for developing standards by 2008, obviously there are some things that have come out of that process; well maybe we can improve coordination, time of review, that type of thing? Is there anything you can talk about?

MR. BALKEY: And it's taking the question as we develop a PRA standard. Well, as we develop the standard, what a challenge --

MR. ZIGLER: Are they talking about the PRA standard?

MR. BALKEY: Yes.

MR. ZIGLER: Okay. I didn't understand why you were coming from and I was curious about it. You had me confused on it.

As you know, the PRA standard was a very, very hard thing to do. I mean, I think I in preparation for this, I was looking through the history of the PRA standard. I think I stopped at Revision 15 or Revision 15, something along that line. Because then we called draft A, B, C, D or whatever it is on it. It was very, very intensive.

Remember that we went from one single category to three categories, back to single category. At one time just having two categories. And we would up with the three categories on it.

I think that finally we now have a common body, a common set. And there was violent discussions going on in the start, was this standard going to be a how to or what did it. And the standard, in fact, is not a how to standard. It sets forth the requirements for the components of the PRA on it. So I think we are very, very much more mature on how the process is and what's going forth.

Stanley, would you like to make some comments on -- since you were there right in the trenches on this?

CHAIRMAN APOSTOLAKIS: When you comment on the Commission's phased approach, as we discussed

earlier, will you say anything about which category should be used?

MR. ZIGLER: No. We're not going to touch the category issue.

CHAIRMAN APOSTOLAKIS: Whenever it becomes interesting you say no.

MR. LEVINSON: I'm Stanley Levinson from Frametone AMP.

To skip into your question first, George, about commenting on the categories and stuff.

CHAIRMAN APOSTOLAKIS: Yes.

MR. LEVINSON: NEI through the risk application task force will be looking at what the NRC is doing is terms of plan and response to the SRM and we'll be making comments and input to the NRC as that goes on.

Different purpose from ASME in determining whether there will be codes or standards available in 2008, the industry is of course concerned about what this is going to mean to them in doing their risk-informed applications.

CHAIRMAN APOSTOLAKIS: Like me understand something here. Did the Commission issue a policy statement or an SRM? They issued a SRM for

the staff to investigate?

MR. SNODDERLY: They issued a policy statement and then they issued a SRM approving the policy statement. And within that SRM it said to provide the action plan, which is what we're going to be working on --

MR. LEVINSON: Chairman Diaz' letter, of I forget the date, and was voted on by the Commission to go forward with this four phased plan. And the SRM instructed the staff, my understanding, is to actually put together a plan. And the staff has committed to do this by the end of June, which is very ambitious. And, of course, the industry is interested in how this plan is going to develop and are going to provide input through NEI and probably the owners groups and other organizations. Different focus than what ASME has. So that's the answer to one of your questions.

And as far as the standard goes, I want to reiterate that -- and Dr. Rosen I think misspoke, but I'm sure it was an accident.

MR. ROSEN: It won't be the first time.

MR. LEVINSON: The standard, as Gil Zigler said is not a how to document. Whether it's the ASME standard or any of the ANS standards, these

standards are determined, the capability categories, all the PRA necessary to support different risk-informed applications. None of these standards were intended to be how tos. They were supposed to be standards so that both the industry and the NRC would know what needed to be in a PRA in order to support different applications.

As the level of applications have increased, of course, there is an expectation that the capability categories of the PRA have to increase with those applications. That's why we're seeing, for example, for 50.69 the expectation that a category two PRA is what's going to be used to support that application, for the most part.

And as Gil said, the process to put the standard together was very difficult. We gave ASME fits through the process because PRA does not fit your standard standard mold. This is a standard like any other standard ANS or ASME has ever put together before. The rules for determining what you need in a proper capability category for a PRA is a lot different than saying your vessel has to be of a certain thickness or, you know, it has to rupture at a certain pressure. This was totally different. We broke some of the molds in ASME when we were first

developing it.

The original standard had shall/should/mays in it, and we realized as we were developing the standard that we couldn't do it that way. And the standard ended up with action verbs, which has been adopted by ANS in an attempt to make it seamless.

The effort that's going to start tomorrow with this SDO coordinating committee and the proposal, Karl Fleming has written a proposal about a way to do an integrated standard which would cover all the factors that you talked about, Dr. Rosen.

CHAIRMAN APOSTOLAKIS: You're going to send us Fleming again?

MR. LEVINSON: Eventually. Anyways, just in the short that Karl put out has generated a lot of response in the industry. It's clear that there's not an identified one way to do this. That the scope is uncertain, the overlaps are uncertain. The SDO coordinating committee is going to have a lot of work in front of it. And then the people that are going to be responsible for actually doing the integration and coordination in terms of developing a single standard are going to have a lot

of technical challenges ahead of them.

And I'm sure at some point the ACRS will get involved in that, too.

CHAIRMAN APOSTOLAKIS: Thanks.

Any other comments from members, Mike, our guests, the public?

MR. MALLAY: I'm Jim Mallay.

As Ray introduced me, yes, I am Chairman of the ANS Standards Board, which is also Chairman of the Standards Committee for ANS.

We're looking forward to this coordinating committee. Ray and I have worked quite hard to put it together and put together the charter and that sort of thing. I'm pretty excited about it because, as Ray mentioned, one of the purposes of this coordinating committee was to make sure that we're consistent and compatible across the various standards. But more than that, our emphasis really is going to be on the user ability to apply these standards. We need to keep that in front of us, and that's one of our purposes is to make sure that it's user friendly, if you will.

We've talked a little bit here about a single standard. I want to caution to you that that will never happen. and let me explain that. There

will always a large suite of standards for the various applications. What we hope to be able to do is develop a standard that will provide a framework so that you know when to use the various elements. You know there's the various individual standards. That's really where we'd like to head, assuming we can do that logistically. And I think that would serve the purpose that you're after.

We also mentioned earlier about the issue of quality and not get into the middle of a debate on the use of that word, but one of the things the coordinating committee is going to take a look at is perhaps a more apt use of the word quality.

You had asked the question earlier about if we apply the ASME standard, does that have adequate quality. Well, yes, of course it does. But I think we need to define what we mean by quality so that we're all together on that issue also.

CHAIRMAN APOSTOLAKIS: If you need to define it, then you cannot apply the standard, right? If you apply the standard, you have adequate quality. But then you have to define quality. So how do you apply the standard?

MR. MALLAY: I think we just need to clarify --

CHAIRMAN APOSTOLAKIS: I understand.

MR. MALLAY: That's all I had, unless you had questions.

CHAIRMAN APOSTOLAKIS: Thank you very much.

Any other comments?

Well, thank you very much, gentlemen. This was very informative. We appreciate your coming down here. Good luck with your efforts. They are all noble.

And, Ken, I can't see you every weekend.

This Subcommittee meeting is adjourned.

(Whereupon, at 5:38 p.m the Subcommittee meeting was adjourned.)

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 Reliability & Probabilistic Risk Assessment Subcommittee Meeting

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Rebecca Silberman
Official Reporter
Neal R. Gross & Co., Inc.

NEI DRAFT 50.69 CATEGORIZATION PROCESS

Presented To:

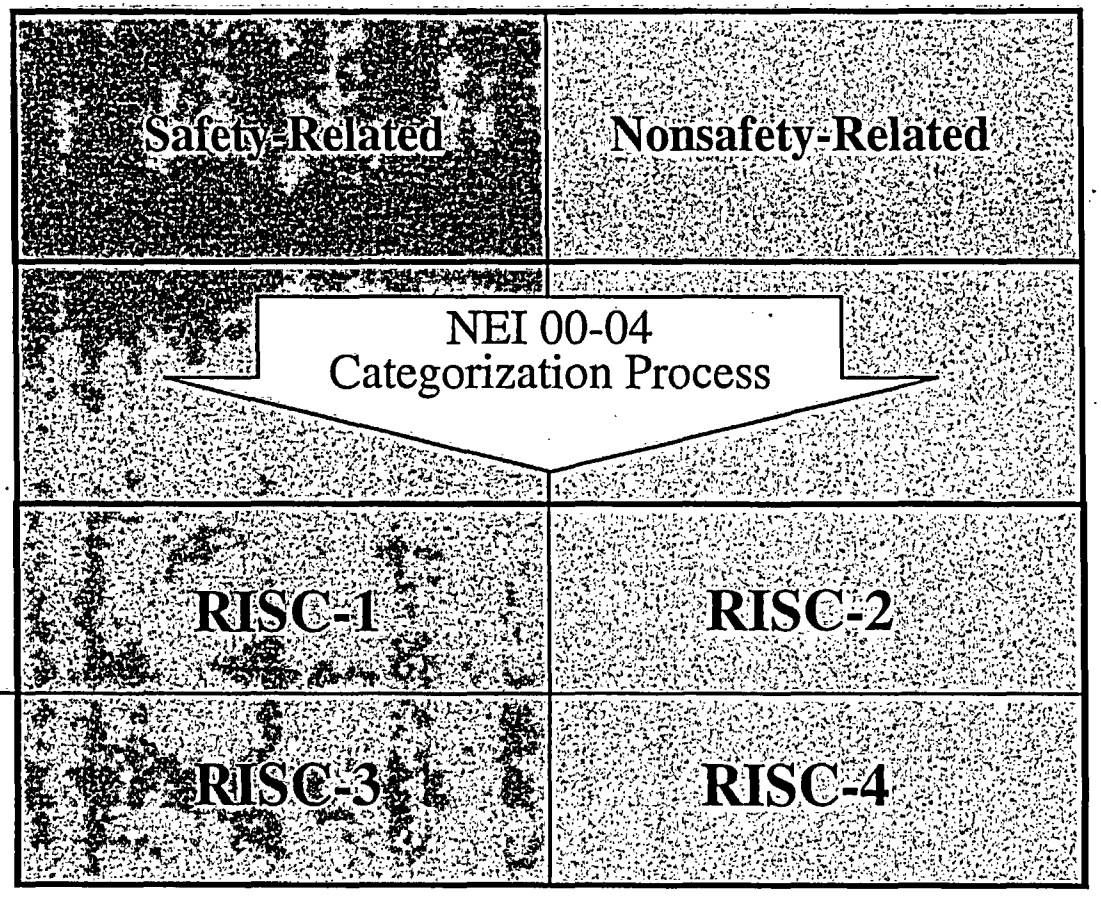
ACRS

NEI Option 2 Task Force

Doug True

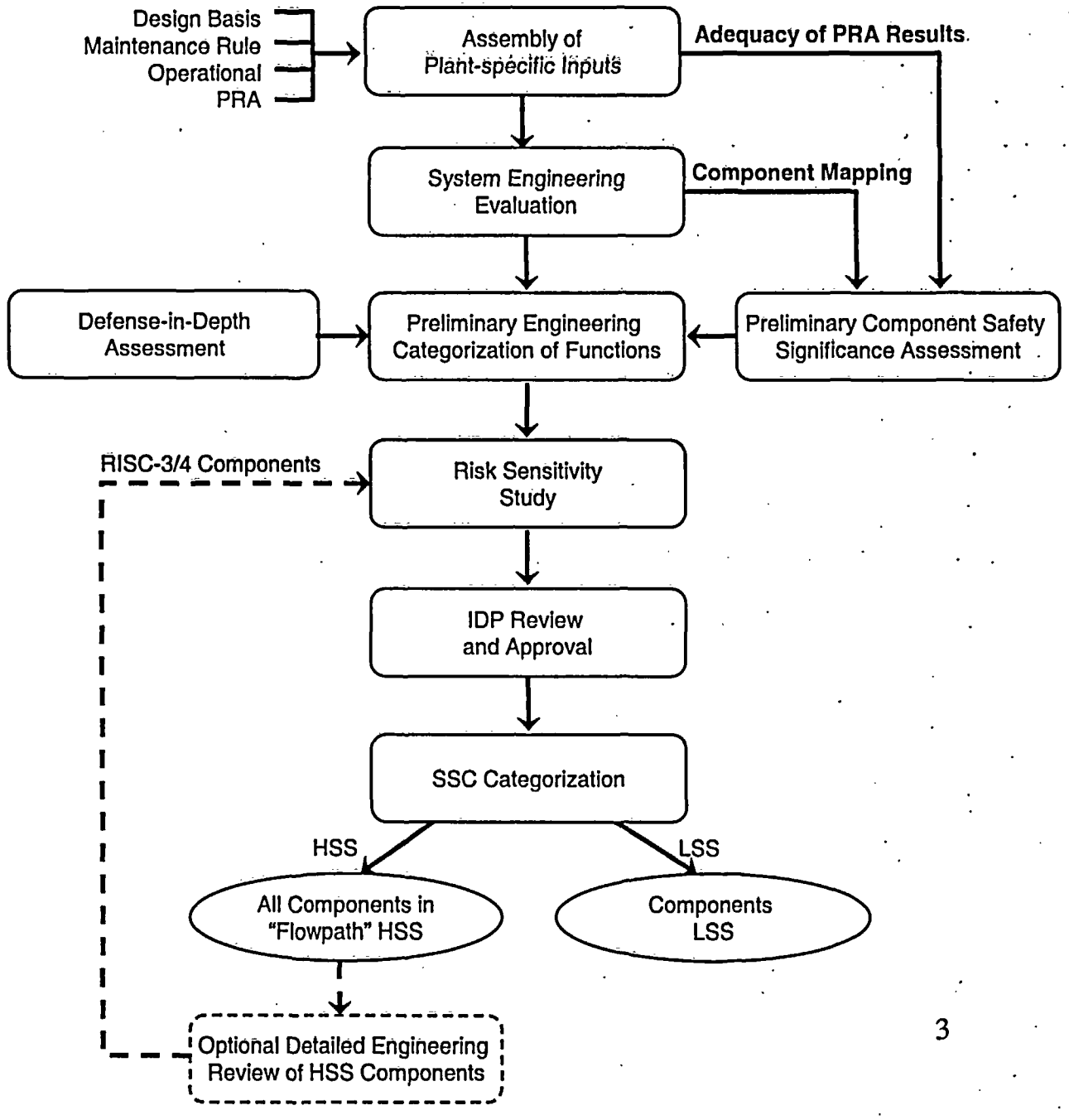
NEI

RISK-INFORMED SAFETY CATEGORIZATION

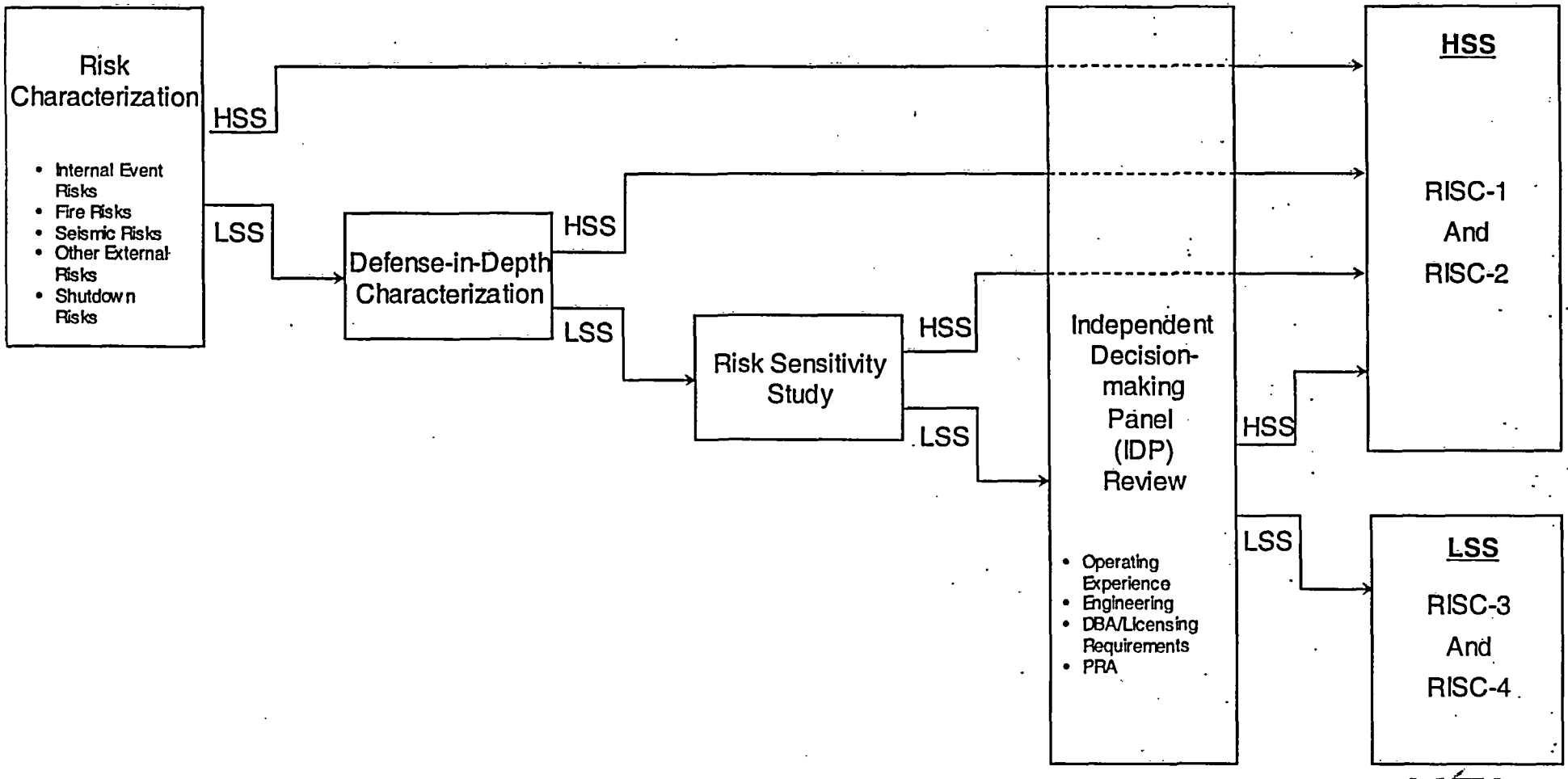


NEI

NEI 00-04 CATEGORIZATION PROCESS



OVERVIEW OF CATEGORIZATION APPROACH



NEI

RISK CHARACTERIZATION

Risk Source	Alternative Approaches	Scope of Safety Significant SSCs
Internal Events	PRA Required	Per PRA Risk Ranking
	Screening Approaches Not Allowed	n/a
Fire	Fire PRA	Per PRA Risk Ranking
	FIVE (Fire Induced Vulnerability Evaluation)	All SSCs Necessary to Maintain Low Risk
Seismic	Seismic PRA	Per PRA Risk Ranking
	SMA (Seismic Margins Analysis)	All SSCs Necessary to Maintain Low Risk
High Winds, External Floods, etc.	PRA	Per PRA Risk Ranking
	IPEEE Screening	All SSCs Necessary to Protect Against Hazard
Shutdown	Shutdown PRA	Per PRA Risk Ranking
	Shutdown Safety Plan	All SSCs Required to Support Shutdown Safety Plan

NEI

EXAMPLE APPLICATION OF IMPORTANCE MEASURES

COMPONENT FAILURE MODE	F-V	RAW	CCF RAW
1) Valve 'A' Fails to Open	0.002	1.7	n/a
2) Valve 'A' Fails to Remain Closed	0.00002	1.1	n/a
3) Valve 'A' In Maintenance (Closed)	0.0035	1.7	n/a
4) Common Cause Failure of Valves 'A', 'B' & 'C' to Open	0.004	n/a	54
	0.0007	n/a	5.6
5) Common Cause Failure of Valves 'A' & 'B' to Open	0.0006	n/a	4.9
6) Common Cause Failure of Valves 'A' & 'C' to Open			
Component Importance	0.01082 (sum)	1.7 (max)	54 (max)
Criteria	> 0.005	>2	>20
Candidate Safety Significant?	**Yes**	**No**	**Yes**

NEI

SENSITIVITY STUDIES

Recommended Sensitivity Studies - Internal Events -
• Increase all human error basic events to their 95th percentile value • Decrease all human error basic events to their 5th percentile value • Increase all component common cause events to their 95th percentile value • Decrease all component common cause events to their 5th percentile value • Set all maintenance unavailability terms to 0.0 • Any applicable sensitivity studies identified in the characterization of PRA adequacy

NEI

USE OF IMPORTANCE MEASURES

- **Importance measures are used to identify potentially significant system functions**
- **Importance measures useful as they measure a relative impact on CDF/LERF, thus focusing categorization on maintaining current level of safety**
- **Key limitations of importance measures are addressed in categorization process:**
  - Training of the IDP on interpretation of importance measures
  - Limitations of importance measures identified in Reg Guide 1.174 addressed in process

NEI

RG 1.174: LIMITATIONS OF IMPORTANCE MEASURES

RG 1.174 Issue	Manner Addressed
Truncation Limit	• Explicitly addressed in guidance
Risk Metric	• Importance measures for both CDF & LERF used • Separate consideration of hazards
Completeness	• Full scope of hazards addressed separately, then combined
Uncertainties	• Investigated in EPRI study
Impact of CCF	• F-V &/RAW of CCF events included in evaluation • Sensitivity studies required for CCF values
Recovery actions	• Sensitivity studies for HFEs
Not Good for Multiple Component	• Risk sensitivity study
Relationship to Risk Change	• Risk sensitivity study
SSCs not in solution (unmodeled)	• System function approach includes all SSCs that can impact function

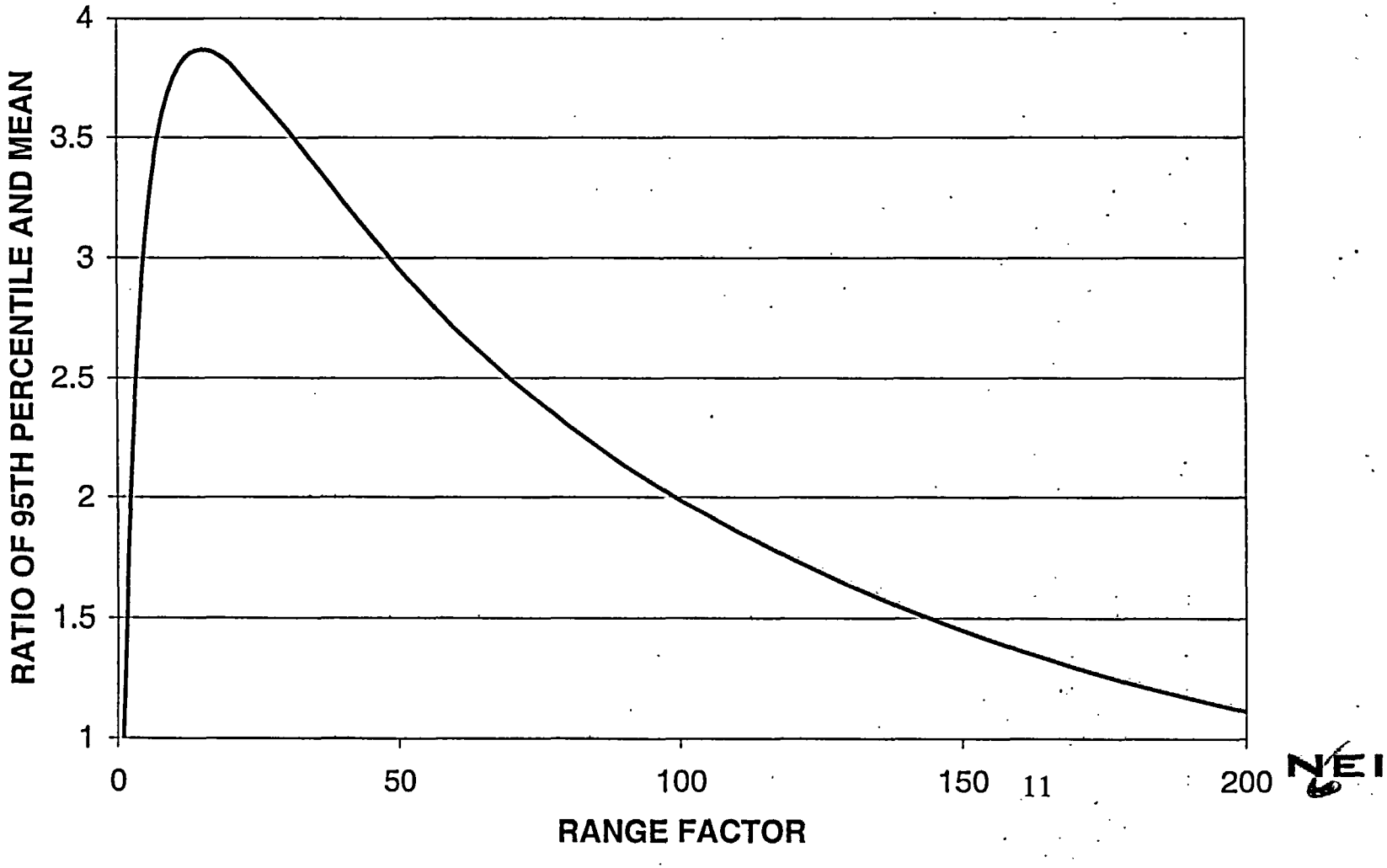
NEI

EPRI STUDY ON UNCERTAINTIES IN NEI 00-04 CATEGORIZATION PROCESS

- **Purpose:**
  Evaluate ACRS questions about the impact of uncertainties on the importance measures used in NEI 00-04 categorization process
- **Utilized same internal events PRA used in BWROG pilot**
- **Considered:**
  - General Evaluation Of Uncertainties
  - Point Estimate Results
  - Monte Carlo Results (Mean & Percentile)
  - Sensitivity Study Results

NEI

RATIO OF 95TH PERCENTILE TO MEAN VALUE FOR LOGNORMAL DISTRIBTUTION



SUMMARY OF CATEGORIZATION FINDINGS

SSC	FV or RAW	Safety Significance			
		Method #1	*Method #2*	*Method #3*	*Method #4*
		Point Estimate	True Mean	Uncertainty Distribution Propagation	Sensitivity Calculations[2]
Feedwater	RAW	LSS	LSS	LSS	LSS
	FV	SS	SS	SS	SS
	Integrated	SS	SS	SS	SS
RCIC	RAW	LSS	LSS	SS	SS
	FV	SS	SS	SS	SS
	Integrated	SS	SS	SS	SS
LPCS	RAW	LSS	LSS	LSS	LSS
	FV	LSS	LSS	LSS	LSS
	Integrated	LSS	LSS	LSS	LSS

NEI

KEY CONCLUSIONS FROM EPRI TR-1008905

- PRA codes calculate importance measures based on point estimate models
- The correlated means for the importance measures calculated from a Monte Carlo evaluation are higher than point estimates
- The correlation effect may have a influence on the calculation of the mean F-V value, especially for low F-V SSCs.
- However, the parametric correlation effect does not change the safety significance assessment
- The NEI 00-04 sensitivity studies encompass the correlation effect on the mean importance measures
- Either a formal parametric uncertainty assessment or a series of sensitivity studies provides equivalent results for use in the safety significance determination process

NEI

DEFENSE-IN-DEPTH ASSESSMENT

- **Addresses SSCs Categorized As RISC-3 in Risk Characterization**
- **Deterministic Rules/Questions Addresses Defense-in-Depth Relative to:**
  - Core Damage Prevention
  - Large Early Containment Failure
  - Long-term Containment Integrity
- **Indication That SSC is Necessary for Defense-in-Depth Categorizes it As RISC-1**

NEI

DEFENSE-IN-DEPTH MATRIX

Frequency	Design Basis Event	>3 diverse trains OR 2 redundant systems	1 train + 1 system with redundancy	2 diverse trains	1 redundant automatic system
>1 per 1-10 yr	Reactor Trip Loss of Condenser	LOW SAFETY SIGNIFICANCE CONFIRMED	POTENTIALLY SAFETY SIGNIFICANT		
1 per 10-10^2 yr	Loss of Offsite Power Total loss of Main FW Stuck open SRV (BWR) MSLB (outside cntmt) Loss of 1 SR AC Bus Loss of Instr/Cntrl Air				
1 per 10^2-10^3yr	SGTR Stuck Open PORV/SV RCP Seal LOCA MFLB MSLB Inside Loss of 1 SR DC bus				
<1 per 10^3 yr	LOCAs Other Design Basis Accidents				

NEI

DETERMINISTIC D-I-D QUESTIONS

Containment Bypass

- **Can the SSC initiate or isolate an ISLOCA event?**
- **Can the SSC isolate a faulted steam generator following a steam generator tube rupture event?**

Containment Isolation

- **Does the SSC support containment isolation for containment penetrations that are:**
  - >2" in diameter,
  - part of a system that is not considered closed as defined in GDC 57,
  - not normally closed or locked closed, and
  - not a part of a normally liquid filled system?

Early Hydrogen Burns

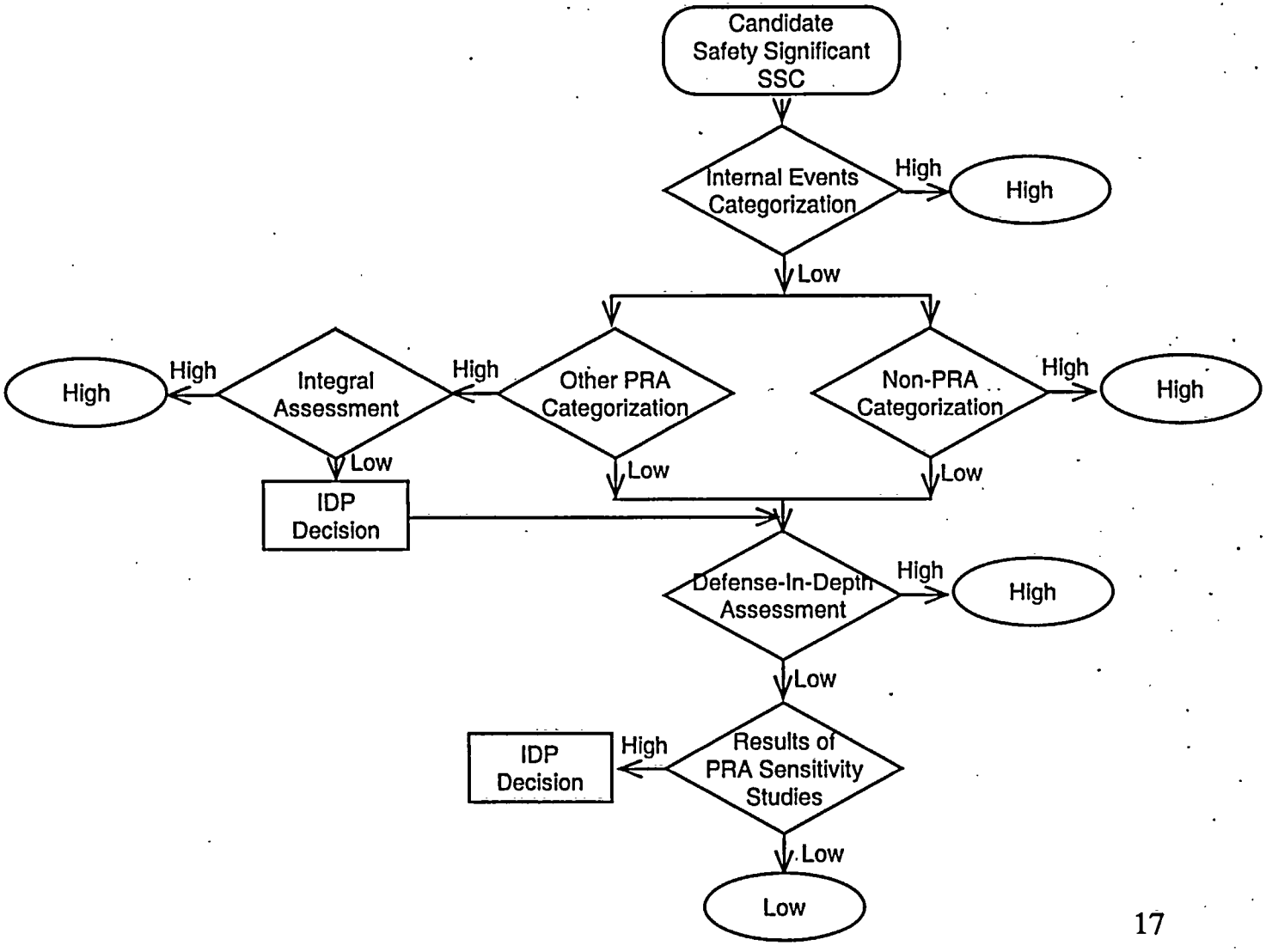
- **Does the SSC support operation of hydrogen igniters in ice condenser and Mark III containments?**

Long-term Containment Integrity

- **Does the SSC support a system function that is not considered in CDF and LERF, but would be the only means for preserving long-term containment integrity post-core damage (i.e., containment heat removal)?**

NEI

CATEGORIZATION FOR INPUT TO IDP



NEI

RISK SENSITIVITY STUDY

- Assesses Bounding Change in CDF/LERF Assuming a Simultaneous Decrease in Reliability of All LSS SSCs
- Factor of Increase Set By Determining Amount of Simultaneous Change Detectable in Corrective Action Programs
- Comparison to RG 1.174 CDF/LERF Guidelines

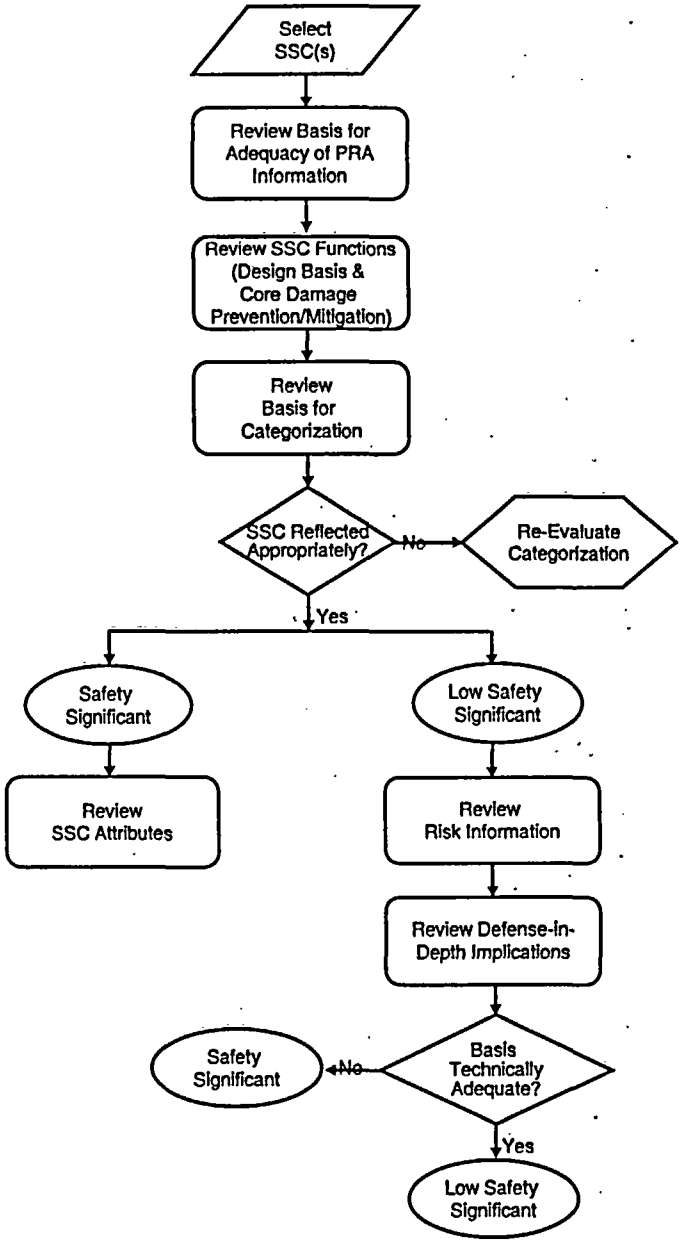
NEI

INTEGRATED DECISION-MAKING PANEL (IDP)

- **Confirms Technical Basis for Categorization (e.g., SSC functions, use, performance, etc.)**
  - The IDP may request re-assessment of categorization, if basis is found to be inadequate
- **Specific Review of LSS SSCs To Confirm Defense-in-Depth. May Move SSCs from LSS to HSS.**
- **Not Allowed to Move SSCs From HSS to LSS**

NEI

IDP REVIEW PROCESS



SUMMARY

- Rigorous Risk-informed Categorization Process
- Utilizes Strengths of PRA
- Addresses Limitations of PRA
- Allows Use of Non-PRA Analyses, But Standard for Safety Significance Applied Conservatively
- Believe NRC Staff's Major Issues on Categorization Have Been Resolved

NEI

United States
Nuclear Regulatory Commission

RISK-INFORMED PART 50 SPECIAL TREATMENT REQUIREMENTS PROPOSED SECTION 50.69

ACRS SUBCOMMITTEE ON RELIABILITY AND PROBABILISTIC RISK ASSESSMENT

FEBRUARY 19, 2004

Timothy Reed, Thomas Scarbrough
John Fair, Donald Harrison
Office of Nuclear Reactor Regulation
US Nuclear Regulatory Commission

BRIEFING OBJECTIVE

- To brief the Committee on the current status regarding the significant technical issues that must be addressed to publish a final 50.69 rule - specifically:

  1) Staff's efforts to address comments received on proposed §50.69

  2) Staff's review of NEI 00-04 draft revision D

- Focus of the discussion will be on the possible changes from proposed rule to final rule

BACKGROUND

- SECY-98-300 (12/98) proposed high level approaches ("options")
- SECY-99-256 (10/99) provided rulemaking plan and ANPR
- SECY-00-194 (9/00) provided preliminary views on ANPR comments and thoughts on regulatory approach
- South Texas exemption (8/01) approved (proof of concept for §50.69)
- SECY-02-0176 (9/30/02) provided proposed 50.69 to Commission
- Commission SRM - 3/28/03
- Proposed 50.69 published for comment - 5/16/03
- Public comment period closed - 8/30/03

ONGOING TASKS TO ISSUE 50.69

- Review/resolution of public comments
- Review of Draft Revision D of NEI 00-04 (and revision to DG-1121)
- WOG pilot examining 50.69 submittal and staff review
- Revision to rule package per public comment resolution/review of implementation guidance
- Review/concurrence process for final rulemaking process (meet with ACRS on final rulemaking package)
- Schedule - final rulemaking package due to the Commission 6/30/04

PUBLIC COMMENTS

- 26 sets of comments comprising approximately 250 comments
- Comments received from NEI, numerous industry groups, licensees, public interest groups, states, and nuclear organizations

OVERVIEW OF PUBLIC COMMENTS

- Comments reflected a wide range of views on many of the major issues associated with 50.69:
  - Divergent interpretations of the rule language and SOC
  - States and public interest groups recommend prior NRC review of SSC treatment while industry recommends no prior NRC review
  - Stakeholders generally support NRC inspection of 10 CFR 50.69 implementation
  - Industry does not support full scope PRA requirements while States and public interest groups recommend full scope PRA

STAFF PROPOSAL TO RESOLVE PUBLIC COMMENTS

- Clarify rule language
- Simplify SOC
- No prior NRC review of treatment
- At a sampling of plants inspect implementation of 10 CFR 50.69 per TI
- Conduct public workshop to discuss final rule

SPECIFIC ISSUES

1. RISC-3 Design Requirement for Fracture Toughness

   SOC noted that design requirements for fracture toughness continued to apply for replacement ASME components.

   Several industry commenters stated that SOC exceeded rule requirements. One commenter asserted that fracture toughness is not a design issue.

   Staff considers fracture toughness to be a design consideration.

   Intent of 10 CFR 50.69 is to remove special treatment requirements while maintaining design requirements.

   Staff plans to clarify in paragraph (b)(1) of the rule that fracture toughness requirements retained for RISC-3 SSCs.

2. Consistency of RISC-3 Categorization and Treatment

Industry comments indicate that licensees might not consider impact of treatment in categorization process.

South Texas asserts that sensitivity studies eliminate need to specifically consider SSC reliability changes due to treatment.

Westinghouse Owners Group states that cross-system common cause interactions are rarely modeled in PRAs.

Dominion Power indicates that degradation mechanisms resulting from treatment processes are typically not considered in PRAs.

Treatment practices must be consistent with categorization process assumptions and assessment of potential change in risk.

Staff plans to clarify in paragraph (d)(2) of the rule that RISC-3 treatment must be consistent with assumptions credited in categorization process.

3. Application of Voluntary Consensus Standards, Vendor Recommendations, and Operational Experience for RISC-3 SSCs

SOC references use of voluntary consensus standards as an effective means to establish treatment requirements. SECY-00-0194 noted an NRC-sponsored study found too much variation in industrial practices to conclude that such practices will provide reasonable confidence in SSC functionality.

Industry comments indicate that only industrial practices might be applied when implementing treatment requirements for RISC-3 SSCs.

ASME did not recommend adding a provision on voluntary consensus standards in rule because SOC provided adequate guidance for RISC-3 treatment.

Additional stakeholders raised concern that proposed rule was not adequate to maintain plant safety.

3. Application of Voluntary Consensus Standards cont'

Staff plans to clarify in SOC supporting paragraph (d)(2) that industrial practices might not satisfy rule requirements regarding implementation of processes that provide reasonable confidence in RISC-3 design basis capability.

4. RISC-3 Design Control Attributes

SOC listed several attributes that should be considered as part of design control process in light of only high-level requirements in rule.

Importance of design control reflected in South Texas exemption which maintains Appendix B design control.

NEI suggested a focused list of design control attributes be substituted in 10 CFR 50.69, including selection of suitable materials; verification of design adequacy, and control of design changes.

With simplification of SOC, it may be appropriate to clarify design control attributes in rule.

Staff plans to clarify design control attributes for RISC-3 SSCs in paragraph (d)(2) of the rule to include the NEI suggestion plus the control of installation.

5. RISC-3 Design Capability for Environmental and Seismic Conditions

RISC-3 SSCs will be exempt from special treatment requirements for qualification methods for environmental conditions and effects, and seismic conditions.

RISC-3 SSCs must be capable of performing their safety-related functions under applicable environmental conditions and effects, and seismic conditions.

Some licensees interpret rule as requiring no evaluations of environmental and seismic capability.

NEI states that environmental or seismic requirements for RISC-3 SSCs in 10 CFR 50.69 should be deleted.

NUGEQ states that 10 CFR 50.69 exempts RISC-3 electrical equipment from aging issues, and that rule does not require establishment of design life.

5. RISC-3 Design Capability Cont'

Staff plans to clarify in rule that licensees must develop and implement documented treatment processes. The staff is not planning to revise design basis language.

6. RISC-3 Corrective Action to Preclude Repetition

NEI recommended revision of rule to address significant conditions adverse to quality such that measures are taken to provide reasonable confidence that cause of condition is determined and corrective action taken to preclude repetition.

New Jersey and NIRS raised concerns regarding apparent lack of consideration of common-cause issues for RISC-3 SSCs.

Staff plans to accept the NEI comment and clarify in paragraph (d)(2) of the rule that measures must be taken for significant conditions adverse to quality for RISC-3 SSCs.

7. Operating Experience Feedback

Commission requested comments on how operational experience should be considered in the rulemaking.

UCS states that relevant operating experience suggests that regulatory oversight of equipment credited with lowering risk should be increased.

Industry commenters believe that ongoing opportunities for sharing experience from existing industry and regulatory programs provide substantial data source for licensees in categorizing SSCs, and recognizing impacts and performance changes.

Staff plans to clarify in paragraph (e)(1) of the rule that licensees must feed back plant operational experience (e.g., corrective action) into processes.

8. Use of Seismic Experience Data

Several industry commenters stated that SOC might create additional burden on plants licensed prior to implementation of Appendix A to 10 CFR Part 100.

SOC needs to clarify that 10 CFR 50.69 will not change seismic design basis for USI A-46 plants, or impose additional seismic requirements.

Industry commenters also raised concerns regarding SOC discussion on use of seismic experience data.

Rule does not change seismic design requirements for RISC-3 SSCs.

Part 100 licensees must comply with technical requirements of Part 100 and have adequate technical bases to conclude that SSCs will perform safety-related functions under seismic design-basis conditions, which includes number and magnitude of earthquake events specified for SSC design.

8. Use of Seismic Experience Data Cont'

Staff plans to clarify in SOC that 10 CFR 50.69 will not change seismic design basis for USI A-46 plants, or impose additional seismic requirements for those plants.

9. NRC Review of Planned Treatment and Inspection of Implementation

Commission requested comments on NRC review of RISC-3 treatment processes, and whether changes are needed in inspection program.

New Jersey recommends that NRC review planned 10 CFR 50.69 treatment programs.

UCS states that NRC should review treatment and also inspect its implementation.

BWROG asserts that licensees should develop 10 CFR 50.69 processes based on rule requirements with routine NRC inspection verifying acceptable compliance.

NEI states that existing NRC inspection and enforcement process addresses all affected functional areas.

9. NRC Review of Planned Treatment and Inspection of Implementation Cont'

A sampling of plants will be initially inspected per TI. The ROP is a performance-based and risk-informed program and overall will remain sensitive to conditions that could significantly increase risk.

10. PRA Scope Requirements

Industry commenters do not believe that 10 CFR 50.69 should be dependent on full scope PRA.

Illinois Emergency Management Agency recommends full scope PRA for 10 CFR 50.69 implementation.

New Jersey recommends that NRC review licensee PRAs in depth periodically.

UCS states that rulemaking should not proceed when PRAs require adjustments as indicated in its submittal.

Conference of Radiation Control Program Directors recommends that PRAs be updated and submitted for NRC review.

Staff plans to continue to require Level 1, full power, peer-reviewed PRA for application of 10 CFR 50.69 with prior NRC review of categorization process and concludes this is consistent with the Commission SRM on PRA quality.

11. Crediting SSCs as Part of Selective Implementation

When a licensee selects a system for categorization and categorizes SSCs as "RISC-3" it means other SSCs must be RISC-1 and RISC-2.

What must a licensee do for these "credited" SSCs?

What must the NRC staff review in the PRA to support approval of the categorization process?

The staff plans to clarify the SOC that licensees must maintain credited SSCs (per paragraph (e) and (d)(1)) and that the staff will need to perform a broad review to support categorization approval.

12. 50.46a(b) SCOPED INTO 50.69

Certain provisions within the old § 50.44 were previously identified as containing STRs

The proposed rule noted this situation and indicated that the final rule may "scope-in" these provisions

Head vent requirements from old 50.44 were simply relocated to 50.46a(b) as part of the effort to risk-inform 50.44

The requirements impose Appendix B requirements on reactor vessel head vents

The staff plans to add the Appendix B portion of 50.46a(b) to the list of special treatment requirements within the scope of 50.69.

United States
Nuclear Regulatory Commission

STAFF PERSPECTIVES ON REVISION D OF NEI 00-04, "10 CFR 50.69 SSC CATEGORIZATION GUIDELINE"

ACRS SUBCOMMITTEE ON RELIABILITY AND PROBABILISTIC RISK ASSESSMENT

FEBRUARY 19, 2004

Donald Harrison
Office of Nuclear Reactor Regulation
US Nuclear Regulatory Commission

BRIEFING OBJECTIVE

- To brief the Committee on the current status regarding the technical issues that must be addressed to publish a regulatory guide to endorse NEI 00-04 in support of 10 CFR 50.69 rulemaking - specifically:

  1) Resolution of staff comments on draft Revision C

  2) Review of NEI 00-04 draft Revision D

  3) Remaining issues that need to be addressed/clarified

- Focus of discussion will be on remaining issues and areas where Revision D differs from the staff positions provided on Revision C

Note that the staff met with NEI/Industry on February 5, 2004 to discuss Revision D and their resolution of the staff comments on Revision C

SPECIFIC ISSUES

1. Quality Attributes of Analyses
(Comments A, E6, & E11)

Staff recommended guidance be developed to address expected quality attributes of the external events PRA and non-PRA type analyses for this application

Revision D provides some quality guidance (§ 3.3), but leaves the quality justification up to the licensee for their plant-specific application (i.e., no application-specific guidance for external events PRA and non-PRA type analyses)

Staff accepts the Revision D approach, recognizing this will put the burden on the licensee to justify and the staff to verify the quality of the PRA analyses and other risk information used for this application

The Revision D approach limits the scope of application if non-PRA type analyses are used

2. The Factor Used to Represent the Reduction in Treatment (Comments B, E18-1, & E18-2)

Staff recommended a method be developed to determine the factor to use in the risk sensitivity study and guidance be developed to ensure by corrective action program the risk sensitivity study remains valid

Staff also recommended a method be developed when non-PRA type analyses are used to demonstrate impacts are acceptably small

Revision D provides some guidance on performing the risk sensitivity study (§ 8), but the linkage to the corrective action program is not explicit, though NEI has stated the intent was that the factor would be within what could be detected within the corrective action program

---

Staff expects additional guidance to be provided in the subsequent revision of NEI 00-04 to describe how the factor used in the risk sensitivity study is derived to be within detectability of the corrective action program and how this program will collect and analyze the data

The Revision D approach limits the scope of application if non-PRA type analyses are used

3. Limitations of Types of Analyses Used (Comments C & E11)

Staff stated that current state-of-the-art PRA methods are available to quantitatively address the full spectrum of potential events and the full range of plant operating modes for this application

Staff also stated that the degree of relief that can be expected under 10 CFR 50.69 will be commensurate with the type of analyses used

Revision D recognizes the limitation in relief imposed if non-PRA type analyses are used (§ 3.2)

Staff accepts the Revision D approach, in that it limits the scope of application, and thus relief provided, if non-PRA type analyses are used

4. Uncertainty Considerations, Integral Assessment, & Sensitivity Studies (Comments D, E5-3, E8-2, E8-4, E17-1, & E17-2)

Staff noted potentially large differences in the levels of uncertainty in the modeling and data for the PRA models for various types of events (i.e., internal, fires, seismic, etc.) and thus, recommended that the most conservative categorization should be used, considering the various types of events and associated sensitivity studies individually

Revision D contains additional guidance (§ 7 and 9), but does not explicitly discuss uncertainty considerations, though a number of sensitivity studies are part of the categorization process

Revision D allows an integral assessment (§ 5.6 & 7) of the various types of events, with results of the individual sensitivity studies also provided to the IDP for consideration

---

Staff expects uncertainties to be addressed in the risk sensitivity assessment, consistent with RG 1.174 § 2.2.5

Staff accepts the Revision D approach to integral assessment since the use of non-PRA type analyses limits the scope of application

5. Prevents or Mitigates Core Damage Figure 5-1 Interpretation (Comment E8-1)

Staff stated that the phrase could be mis-interpreted in such a way to not include consideration of containment systems and suggested changing it to "prevents or mitigates severe accidents"

Revision D does not change the phrase in Figure 5-1, though the supporting text (§ 5) is broader as it refers to severe accidents and NEI has stated that the intent was to include containment systems

---

Staff accepts Revision D approach that allows screening out SSCs that have no role in prevention or mitigation of severe accidents, but expects the terminology in Figure 5-1 to be clarified in the subsequent revision of NEI 00-04

6. Relevant Failure Modes Interpretation (Comment E9-2)

Staff indicated that the phrase "relevant failure modes" was open to interpretation and thus, all failure modes of the SSC identified in the PRA should be considered in the importance evaluation

Revision D maintains the phrase (§ 5.1), and NEI has stated its intent was to allow exclusion of failure modes that might be in the PRA that are not directly related to the component's performance

NEI has indicated that they will clarify (or delete) this phrase in a subsequent revision

---

Staff expects the intent of this phrase to be clarified or deleted in the subsequent revision of NEI 00-04

7. **Safety Significant Attributes Interpretation (Comment E9-3)**

Staff was not sure of the intent and implications of the discussion of using the component failure mode or dominant failure mode in the identification of safety significant attributes

Revision D still discusses (§ 5.1) the identification of safety significant attributes, but does not explicitly how this identification is to be used, though NEI has stated the intent was to assure that the factors that influence the risk significance of RISC-1 and RISC-2 SSCs are identified and controlled

---

Staff expects the intent of this identification to be explicitly discussed in the subsequent revision of NEI 00-04

8. Primary Shutdown Safety System Interpretation (Comment E13)

Staff stated that it was not sure use of the NUMARC 91-06 guidance would result in conservative categorization results as described and thus, indicated that any (not just the primary) SSCs identified in the plant-specific Outage Risk Management Guideline should be considered safety significant

Revision D (§ 5.5) clarifies the attributes of the primary shutdown system and the conditions for designating SSCs safety significant for shutdown conditions

NEI further clarified that the Outage Risk Management Guideline may identify numerous means of meeting the guidelines for shutdown safety identified in NUMARC 91-06 and stated their intention for the phrase primary shutdown safety system to include the typical running shutdown safety means as well as an alternative means

---

Staff accepts the Revision D approach, but expects the identification of the primary shutdown safety system to be clarified in the subsequent revision of NEI 00-04

9. Common Cause Failure and Degradation Mechanisms (Comment E18-4, E18-5, & E18-6)

The risk sensitivity study could realistically only be invalidated if extensive cross-system common cause failures could occur without early detection/warning, thus the Staff included in 10 CFR 50.69 the need for licensees to identify potential common cause interaction susceptibility, including cross-system interactions and potential impacts from known degradation mechanisms

If not explicitly evaluated, Staff expects those aspects of treatment necessary to prevent SSC degradation or failure from known mechanisms would be identified and such treatment aspects retained

Revision D does not address this area directly beyond reference to ASME Code Case N-660 and RI-ISI code cases and topical reports and NEI has indicated that they may provide additional guidance on this area in future revisions of NEI 00-04

Staff expects in the subsequent revision of NEI 00-04 to address how their process identifies/tags SSCs susceptible to known degradation mechanisms

10. Regulatory Commitments
(Comment E23-2)

In response to a statement in NEI 00-04 Revision C on addressing changes to NRC commitments, the Staff stated that a licensee needed to establish under what conditions they would notify NRC of changes in categorization and/or resulting treatment

Revision D (§ 11.1) does not reference NEI 99-04, but states that any regulatory commitments associated with the special treatment requirements for SSCs categorized as RISC-3 would no longer be applicable and may be dropped at the license's discretion

---

Staff expects licensees to evaluate the RISC-3 SSC regulatory commitments to ensure they can be eliminated since some commitments may relate to design issues, which if eliminated would result in noncompliance with 10 CFR 50.69

Staff expects this discussion to be corrected in the subsequent revision of NEI 00-04

11. Miscellaneous

Change manual suppression fire sensitivity study wording

Fire CDF must address contribution from screened fire areas

Clarify meaning of "safe shutdown path" for other external events

Change NUMARC 91-06 approach CDF/LERF terminology

CONCLUSIONS

- NEI 00-04 Revision D is an improvement
- Staff and NEI are converging on approach
  1) Relatively few technical issues remain
  2) Issues can be resolved by providing additional clarifications and/or more specific guidance
- Providing these additional clarifications/guidance to Revision D could result in no objections from the staff; with the Regulatory Guide providing only some general staff positions and staff interpretations

Status of Risk-Informed Initiatives in ASME Nuclear Code and Standards

Advisory Committee on Reactor Safeguards
Meeting of the Subcommittee on
Reliability and Probabilistic Risk Assessment

American Society of Mechanical Engineers

Rockville, Maryland - February 19, 2004

1

Status of Risk-Informed Initiatives in ASME Nuclear Code & Standards

AGENDA

- Introductions and Purpose of Briefing
- ASME Consensus Codes & Standards Organization
- ASME Board on Nuclear Codes and Standards Risk Management Strategic Plan
  - PRA Standards Development
  - Efforts to Support 10 CFR 50.69 Initiative
  - Initiatives to Develop Framework for New Reactors
  - Proposed Nuclear Risk Management Coordinating Committee
- Summary

2

Status of Risk-Informed Initiatives in ASME Nuclear Code & Standards

INTRODUCTION – PARTICIPATING ASME MEMBERS

- Wes Rowley – Vice-President, Nuclear Codes & Standards and Chair, Board on Nuclear Codes & Standards
- Ray Weidler – Vice-Chair, Board on Nuclear Codes & Standards
- Kevin Ennis – ASME Director, Nuclear Codes & Standards
- Ken Balkey – Chair, ASME BNCS Risk Management Task Group
- Bryan Erler – Chair, ASME BNCS Task Group Regulatory Endorsement
- Craig Sellers – Member, ASME Operations & Maintenance Committee
- Gil Zigler – Member BNCS, Vice-Chair, Committee on Nuclear Risk Management

3

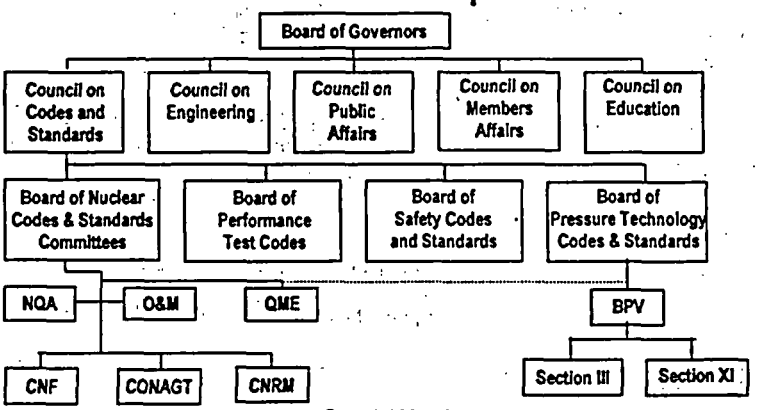
Status of Risk-Informed Initiatives in ASME Nuclear Code & Standards

PURPOSE OF BRIEFING

- To Provide Status and Overview of Key Risk-Informed Initiatives Within ASME Nuclear Codes & Standards to Support Both Operating and New Reactors
- To Define Any Appropriate Actions or Impacts Related to Corresponding Regulatory Developments

4

ASME Organization Chart for Nuclear Codes and Standards Development



Over 3,000 volunteers
Participate in this process

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ASME BNCS Risk Management Strategic Plan

MISSION

Factor risk, as well as performance, into all ASME Nuclear Codes and Standards, as appropriate, to further ensure, on a worldwide basis, that they protect public health and safety and meet the needs of users

ACTION PLAN

Identify and track short term (1-2 year) and long term (3+ year) risk-informed initiatives within the Committee on Board Operations and across all BNCS Committees

PRA STANDARDS DEVELOPMENT

Identify needs to enhance or develop PRA Standards to support applications defined in the action plan

UPDATES

Plan is updated and approved at each BNCS meeting (~4 months) and is then placed on the ASME website for public access

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ASME PRA Standards Developments

PRA STANDARD DEVELOPMENTS

- ASME RA-S-2002, "*Standard For Probabilistic Risk Assessment For Nuclear Power Plant Applications,*" published April 2002
- Addendum A to ASME PRA Standard issued in Dec. 2003 to address NRC clarifications in RG-1.200
- ASME PRA Standard used in plant-specific PRA peer review at San Onofre in June 2003; Project Team drafting Addendum B to PRA Standard to address issues that arose in using the standard

NEW INITIATIVES

- Identify actions necessary to respond to the December 18, 2003 Commission paper on PRA Quality
- Work with proposed Nuclear Risk Management Coordinating Committee
- Investigate development of reliability data base to support the PRA Standard

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ASME Section XI Risk-Informed Code Cases

ASME SECTION XI - INSERVICE INSPECTION (ISI) AND REPAIR/REPLACEMENT OF PRESSURE-RETAINING ITEMS			
CODE CASE	CONTENT	CLASSIFICATION	TREATMENT
N-577	Risk-Informed ISI for Class 1, 2, or 3 Piping - Method A	Yes	Yes
N-578	Risk-Informed ISI for Class 1, 2, or 3 Piping - Method B	Yes	Yes
N-660	Risk-Informed Safety Classification for Use in Risk-Informed Repair/Replacement	Yes	No
N-662	Alternative Repair/Replacement Requirements for Items Classified w/RI Processes	No	Yes

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ASME O&M Risk-Informed Code Cases

ASME OPERATIONS & MAINTENANCE - INSERVICE TESTING OF PUMPS, VALVES, & MECHANICAL EQUIPMENT			
CODE CASE	CONTENT	CLASSIFICATION	TREATMENT
OMN-3 Revision 1	Requirements for Safety Significance Categorization of Components Using Risk Insights for IST of LWR Power Plants	Yes	No
OMN-4	Requirements for Applying Risk Insights for IST of Check Valves of LWR Power Plants	No	Yes
OMN-7	Requirements for Applying Risk Insights for IST of Pumps of LWR Power Plants	No	Yes
OMN-10	Requirements for Safety Significance Categorization of Snubbers Using Risk Insights and Testing Strategies for IST	Yes	Yes
OMN-11	Risk-Informed Inservice Testing of Motor-Operated Pumps (Used in Conjunction with Code Case OMN-1)	No	Yes
OMN-12	Alternate Requirements for IST Using Risk Insights for Pneumatically and Hydraulically Operated Valve Assemblies	No	Yes

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ASME Efforts to Support 10 CFR 50.69 Initiative

- Regular interface with NRC and NEI
- ASME formal positions on §50.69 package
- On-going application activities
  - ASME Section XI Code Cases N-660 and N-662 for risk-informed repair / replacement
  - ASME O&M Committee proposed Standard for treatment of RISC-3 pumps and valves

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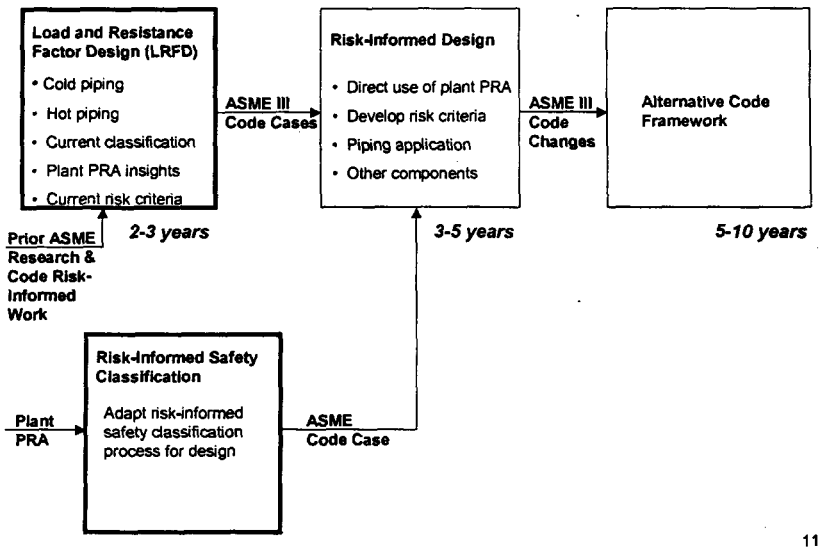
Initiatives to Develop Framework for Future Reactors



Initiatives to Develop Code Requirements for New Reactors

- ASME is in the process of holding a series of work shops with new reactor suppliers to determine their needs
- New reactors use risk-informed technology to support design efforts
- Initial new reactor plants will use a combination of risk-informed system performance requirements and ASME design, fabrication and inspection rules

Proposed Nuclear Risk Management Coordinating Committee

MEMBERS

- ASME, ANS and NRC have proposed to form committee
- Committee would also include DOE, NEI, and interested standards developing organizations, such as IEEE, ASTM, NFPA, and AISC

PURPOSE AND OBJECTIVES

- Coordinate codes and standards activities related to risk management for current and new nuclear power plants, nuclear facilities, and the transportation and storage of nuclear material
- Ensure that codes and standards associated with risk management, and their underlying principles, are consistent and compatible

CURRENT ACTIONS

- White paper drafted and issued for review; Defines need for Committee and potential short term and long term initiatives
- Inaugural meeting to be held Feb. 20, 2004 at ASME Offices in Wash, DC

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Summary

- ASME BNCS has developed a Risk Management Strategic Plan to bring risk technology into the development of consensus standards that are beneficial to its users
- ASME efforts to risk-inform nuclear Codes & Standards requirements, where appropriate, can be correlated with the NRC 10 CFR Part 50.69 Proposed Rule
- ASME is working with NRC, DOE, industry, and other Standards Development Organizations to coordinate codes & standards activities related to risk management such as PRA Standards, an appropriate framework to support new reactors, and other initiatives
- Interface with the ACRS on these developments in the future, as appropriate

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Reliability Engineering and System Safety 38 (1992) 3–26

The strengths and limitations of PSA: where we stand

Dennis Bley, Stan Kaplan & David Johnson

PLG, Inc., 4590 MacArthur Boulevard, Newport Beach, California 92660, USA

Despite increasing maturity in probabilistic safety assessment (PSA) methods, there are several problems that create discomfort among decision makers. These include the use of expert opinions, the assessment of human reliability, and the impact of organizational factors. These problems are all manifestations of the larger problem of uncertainty in the real world and how that uncertainty is presented within the context of the PSA.

Examples are presented to show how these issues have been addressed in a few existing PSA studies. The expert opinion issue is reframed as a representation of the gathering and evaluating of expert evidence. Uncertainty in physical models is approached by applying expert evidence to judging the likelihood of alternative models. Confidence in human reliability modeling can only be achieved if substantial effort is dedicated to qualitatively describing the scenario for analysis: the history of plant states and human intervention, as well as the ensemble of cues, training, and applicable experience. Organizational factors are structured as the key underlying dependency linking human reliability and equipment availability. Examples of other major sources of uncertainty—equipment aging, design and construction errors, common cause failures, plant area heatup, and shutdown events—are presented. The continuous thread through all the examples is that identifying and treating uncertainty explicitly is the key to generating confidence in PSA among decision makers.

PSA is shown to provide a language for quantifying uncertainty, a clear exposition of plant safety, and a flexible tool for managing safety. The framework that is PSA is, by its very nature, robust and able to provide the ability to address the identified problems.

1 INTRODUCTION

This seminar was organized around the observation that despite increasing maturity in probabilistic safety assessment (PSA) methods, there are several problems that create discomfort among decision makers. These include the use of expert opinions, the assessment of human reliability, and the assessment of organizational factors.

In addition, there have been claims of serious problems with PSA, sometimes raised from within the PSA community itself. For example, in his widely respected book on human error,[1] Reason makes a sweeping criticism:

> even in its purely engineering application... [PSA] has been criticized on a number of counts... [including that] only conditional probabilities should be used.... However, this conditionality is rarely recognized, and independence of events has normally been assumed. In short, PSAs have neglected the possibility of common mode failures, something that is considerably enhanced by the presence of human beings....

and Paté-Cornell, in a paper on the organizational aspects of reliability management,[2] states that:

> PRA... does not go beyond the basic component failures... [and] does not account... for the effect of organizational mechanisms on the probability of... [operator error and component failure] basic events.

We see this discomfort with PSA as emanating from the single, deeper issue of uncertainty. The relation-

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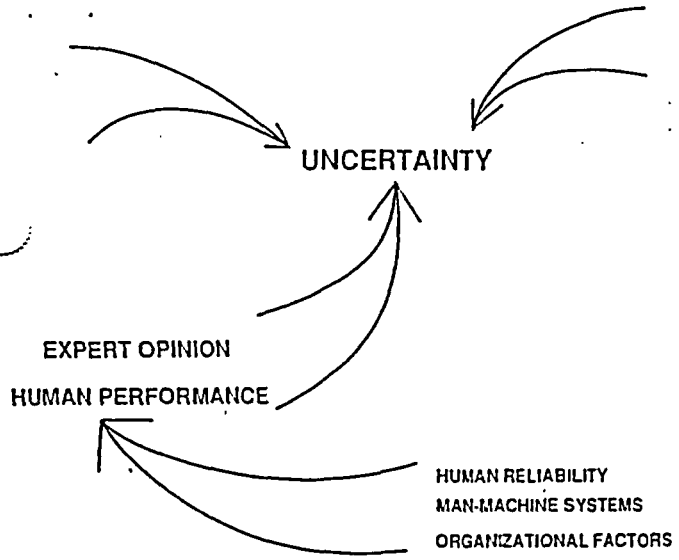


Fig. 1. Organizational framework.

ships among the key issues are sketched in Fig. 1. Human reliability, man–machine systems, and organizational factors are all part of human performance. Human performance and expert opinion represent problems that create discomfort among decision makers. The reason, we suspect, is because they are all sources of substantial uncertainty, and people are not particularly comfortable with uncertainty. Moreover, these are not the only issues burdened by large uncertainties. There are others: uncertainty in the models used to represent the physical aspects of safety assessment; uncertainty with respect to the impact of aging on power plant equipment; uncertainty with respect to defects introduced during manufacturing, design, or installation; uncertainty in the frequency of occurrence of interfacing systems loss of coolant accidents (LOCA); and uncertainty in environmental effects such as the effects of adverse (or just different) environments on equipment, the effects of fires and floods, and the impact of room heatup.

Our purpose in this paper is to present examples in which many of these issues have been addressed in existing PSA applications. Such examples can alleviate the discomfort and should counteract the negative hyperbole. While there will always be room for improvement in methods and while many of the examples are not routinely part of the common practice, there is substantial indication that today's results are meaningful and that methods are available for addressing the most significant concerns.

The remaining sections of the paper address:

- communication and the language of PSA;
- expert opinion and expert knowledge;
- model uncertainty;
- uncertainties with respect to aging, design and construction errors, human performance, etc.

The paper closes with a numeration of the strengths of PSA to place the issue of uncertainty in perspective.

2 THE LANGUAGE OF PSA

Another way to look at the issues addressed in this paper is to consider them all as problems in communications. These communications are both internal, within the PSA project, and external in the communication of PSA analysis and results to people outside the process. Making that process understood and conveying clarity in the expression of uncertainty are the keys to building an effective risk management program, which, after all, is the underlying purpose for performing PSA.

PSA is more than a set of tools for analyzing large systems and calculating a risk parameter. It is a process for understanding the safety status of a facility, identifying contributions of people and specific equipment to safety problems, and evaluating potential improvements. At a deeper level, PSA is really a language for addressing uncertainty in all engineering applications. Our structure for all of PSA is shown schematically in Fig. 2 as the set of triplets, $\{S_i, \ell_i, X_i\}$, where S_i describes a particular scenario, ℓ_i is the frequency of that scenario, and X_i is the consequence.

PSA, then, is building the complete list of triplets; i.e. the set of all S_i, ℓ_i, and X_i: $\langle\{S_i, \ell_i, X_i\}\rangle$. Identifying the full set of triplets requires the analyst to structure the scenarios in a way that is complete and is organized to facilitate the analysis. Structuring the scenarios is both an engineering art requiring experience and a nice sense of analysis, and a process drawing on the techniques of logic modeling and traditional engineering and scientific mechanistic calculations.

No matter how finely we partition the space of scenarios, it is important to recognize that each scenario really represents a group of similar

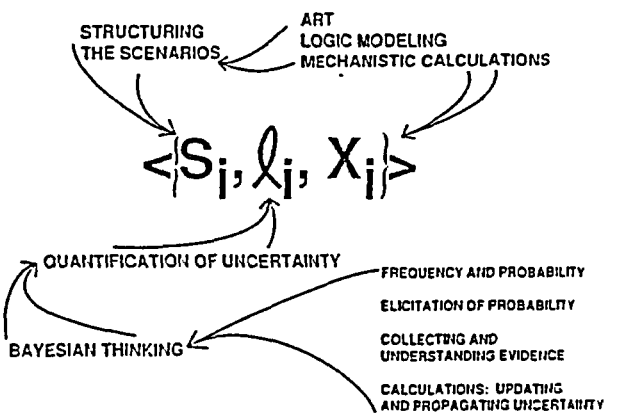


Fig. 2. The language of PSA.

subscenarios. All members of each group must lead to the same consequence. If not, the group should be broken into smaller subgroups until that is the case. The calculation of the frequency of each scenario must be based on considering all possible members of the group; i.e. all possible conditions that might exist under each scenario. The calculation of the consequences, the X_i, relies on traditional, mechanistic calculations from the engineering disciplines but is distinguished in that consequences from many more cases are calculated than in other approaches. The mechanistic calculations include thermal–hydraulic calculations, electric circuit analysis, neutronic calculations, chemical process analysis, and so on. The logic modeling required to structure the scenarios traditionally draws on fault trees and event trees, but other approaches, including digraphs and Markov models, are often used. In some cases, other tools that bridge the gap between logic and mechanistic calculations, such as simulation models, are especially appropriate.

Under the formulation already described, we incorporate the ideas of uncertainty into our calculation of the frequency for each individual scenario group. In addressing the uncertainty of frequency, it is important to adopt a coherent and consistent approach. The Bayesian model[3–6] provides just such an approach, and under its umbrella, we address the issues of frequency and probability, elicitation of probability, collection and understanding of evidence, and calculations.

Clarity of thought regarding the difference between what we call frequency and probability provides a philosophical framework for understanding a consistent treatment of uncertainty. The two concepts are often confused in the literature of probability, both being called probability. Let us say here that frequency is simply the result of an experiment, be it a real experiment or a gedanken experiment in which we simply count the number of times the event in question occurs out of the total number of possible trials or expired time. Probability, then, represents our state of knowledge about the real world frequency. In the literature, what we are calling probability has gone under various names, including subjective probability, state of knowledge probability, and prevision.[7,8] Probability, as a measure of what is in our heads rather than a property of the physical world, is a measure of what we know and what we do not know—our complete state of knowledge.

If probability is a personal state of knowledge, how then do we determine probabilities to use in PSAs? Let us consider two cases. In the first case, our state of knowledge comes directly from information that has been collected for other applications; for example, we have collected a wide range of equipment failure data from a variety of power plants around the world. From these collected data, we have existing curves showing the plant-to-plant variability of, say, the failure rate from motor-operated valves. This plant-to-plant variability curve shows the variation in frequency of failure as we move from plant to plant in a large population. When we now ask, 'What is the probability of failure of motor-operated valves at a new plant?' our probability distribution for the failure rate is numerically identical to the plant-to-plant variability curve or the frequency variability curve.

In other cases, no such plant-to-plant variability curve is available. Therefore, we must elicit the probability from the best experts available to our work. How one obtains the information from the experts and builds a probability distribution is the subject of the following section, which addresses one of the key issues raised for the seminar: expert opinion. Elicitation of probability is something that is often not done in PSAs or not done well. The reasons it is not done well have been documented by Hogarth[9] and others, and include biases built into the human thinking process such as anchoring, overconfidence, and selective interpretation of new data. Careful techniques must be used to avoid these problems.

The last two elements in determining the probability of frequency of each scenario—collecting and understanding the evidence, and calculations using Bayes' theorem for updating probability distributions and propagating uncertainty—are now fairly well established and have been covered in other papers and reports (for example, Refs 10 and 11).

The structured language of PSA provides a powerful model for addressing safety and uncertainty involved in all engineered facilities. It provides a framework for organizing a wide variety of standard mathematical and engineering models to address safety issues directly. We will describe applications from our own practice in which specific issues and types of uncertainty have been addressed. However, it is important to distinguish between specific applications and general practice. While many of the topics raised here have been addressed in one or more PSAs, they have not all become part of the general practice, neither throughout industry nor within our own firm.

3 USING THE KNOWLEDGE OF EXPERTS: EXPERT OPINION

One of the criticisms often leveled at PSA, and one of the reasons some people have little confidence in it, is that PSA results often rely, in part, on the opinions of experts. The PSA analyst's answer to this criticism is that the purpose of PSA is to support decision making, that decisions are always made under uncertainty, and that decisions are going to be made

with or without the support of PSA. Therefore, they argue, when so-called 'objective' or 'statistical' evidence is available, they use it; however, when it is not, expert opinion is better than nothing.

This answer does not satisfy the critics, however. They recognize that expert opinion may be all we have, but they are not convinced that we are using that information with the proper caution. They suspect that we are believing and trusting the experts' opinions far more than we should, and they cite reams of cases in which the greatest experts in a field pronounced opinions that were subsequently proven to be totally wrong.

The questions of how to use expert opinion and of how to combine the opinions of different experts have generated much literature, and much debate, and there is little agreement on it even today. We are not going to answer these questions either. Rather, we are going to suggest that the way to address these issues is to bypass them by asking a different question. What makes experts 'expert', we believe, is not their opinions but their knowledge, experience, experiments, etc.; in short, their evidence. We suggest therefore that instead of asking the experts for their opinions, we ask them for their evidence.

We call this the 'expert information' approach, in contrast to the usual 'expert opinion' approach. In the next sections, we shall discuss in more detail the difference between these two approaches.

3.1 The expert opinion approach

Suppose that, in our PSA model of a specific plant, we have a certain 'elemental parameter,' λ. This parameter is elemental in that it is not expressed in terms of any other parameters in the PSA. It itself must be entered as a basic input parameter. So, for the PSA, the question that must be answered is, 'What is the numerical value of the parameter λ?' We seek to answer this question by putting it to the experts.

In the usual expert opinion approach[6,12-17] to eliciting and combining expert opinion in PSA, the problem is formulated in one of the following two ways:

1. Let $\lambda_1 \ldots \lambda_n$ be the point estimates of this parameter given by n different experts. Let $E_p = \{\lambda_i\}$ stand for this set of n point estimates. What shall we take as $p(\lambda \mid E_p)$, the probability curve representing our state of knowledge about λ, given the evidence E_p?
2. Let $p_i(\lambda)$ be the probability curve expressing the full state of knowledge of the ith expert, and let $E_f = \{p_i(\lambda)\}$ stand for this set of n probability curves. How do we combine these into $p(\lambda \mid E_f)$, the curve expressing our state of knowledge about λ, given E_f?

In formulation 1, the individual estimates, λ_i, are regarded as 'data'. The problem then becomes structurally identical with an everyday problem of experimental science: namely, given n different measurements of the quantity λ, what is our final state of confidence about its true value? Formulation 2 attempts to get more information out of each expert and thus is a bit of a stretch on the everyday problem. Nevertheless, in both formulations, the approach is that of an experimenter; we put the question, 'How much is λ?' to nature (the experts), and we regard the answers, λ_i or $p_i(\lambda)$, as the resulting data. The problem for the analyst then centers around the determination of 'weights', w_i, of some kind[18] with which to combine the several answers.

3.2 The expert information approach

In the expert information approach, we do not ask the experts directly for their opinion about λ. Instead, we ask them what experience and information they have that are relevant to the value of λ. The PSA analyst, serving as facilitator, then leads the group in combining the different kinds of information and evidence into a consensus state-of-knowledge curve.

The motivation behind this approach is the thought that, while the experts from whom we are eliciting information presumably have much knowledge in their particular domains, they usually are not trained or experienced in the use of probability as a language with which to express a state of confidence or state of knowledge (see note 1). The latter subject is the expertise of the PSA analyst. In addition, issues of bias and honesty[12,15] conscious or unconscious, arise when the experts are asked to give λ_i, or $p_i(\lambda)$. These issues are bypassed if we go to the root, so to speak, and ask the experts for their evidence rather than for their opinions.

Let E_i be the total body of evidence given by the ith expert. E_i should then constitute everything the expert knows that is relevant to λ. It is what makes the expert an expert. The idea of the expert information approach therefore is to elicit from the experts what they known best, E_i, and let the PSA analyst take the

Table 1. Comparison of three formulations

Formulation	Question	Form of answer
1	What is your best estimate for λ?	λ_i
2	What is your state of confidence about the value of λ?	$p_i(\lambda)$
3	What evidence and information do you have relevant to the value of λ?	E_i

lead in codifying this knowledge into the form required by PSA.

To do this, the PSA analyst first establishes a 'total', or 'consensus', body of evidence, E_T. This is the body of evidence that all of the experts agree to after reviewing and discussing each other's E_i. The analyst then guides the group of experts to a consensus probability curve, $p_c(\lambda \mid E_T)$, on which they all agree.

The expert information approach can thus be viewed as a formulation 3, which stands (see Table 1) as a natural progression in relation to formulations 1 and 2 above.

3.3 The elicitation process

In the expert information approach, the elicitation process typically would proceed as follows:

1. First, gather the experts, if possible, in one room. We have found that groups of 5–10 can be handled nicely.
2. Explain thoroughly the context of the problem and make sure that everyone understands exactly what the definition of the parameter λ is. In other words, we have to make sure that everyone understands the philosophy and purpose of the PSA being done, the 'risk model' that is being used in the PSA, and the precise role and meaning of the parameter λ in this model. Much interchange should be encouraged at this point. This step must be well done or there will be confusion later, and the participation of the experts will be halfhearted.
3. After the meaning of λ is clear, the analyst/facilitator then puts to the group the question: 'What evidence do we have that is relevant to the numerical value of this parameter?'
4. In the ensuing discussion, the analyst guides the group to clarity and agreement on the meaning of each item of evidence. The analyst writes these down in his notes and on the blackboard.
5. When this step is done, there is on the blackboard a complete list of understood and agreed-upon evidence items: $E_1, E_2, \ldots E_m$. The analyst needs to make sure here that the experts (and the analyst too) are satisfied that this list captures the total experience and information of the group. This total list is what we referred to above as E_T.
6. When this is done, the analyst then asks: 'What probability curve, against λ, expresses this list of evidence?' We designated this probability curve above as $p_c(\lambda \mid E_T)$.
7. The important point to recognize here is that the question of item 6, although put to the group, really falls within the domain of the PSA analyst, not the subject matter experts. These experts have already contributed their knowledge in the form of E_T. The representation, or mapping of E_T into $p_c(\lambda \mid E_T)$, is an operation in logical inference, governed by Bayes' theorem, in which the PSA analyst is, or should be, expert.

   In principle, then, the PSA analyst sets forth $p_c(\lambda \mid E_T)$. In practice, to ensure that the evidence E_T has been interpreted correctly, the analyst seeks to have the experts understand and agree with the mapping operation. In practice, then, the analyst guides the group to a consensus curve that the group adopts as $p_c(\lambda \mid E_T)$.
8. In the course of reaching this consensus, the analyst may need to explain the use of probability curves as expressions of states of confidence, as distinct from their use in a 'frequentist' sense. This extends to explaining and enforcing the tight logical connection, through Bayes' theorem, of the probability curve to the list of evidence items that it represents.
9. If, at this point, there is difficulty in reaching consensus, then, inspired by Jaynes (see note 2), the analyst may want to guide the group back to item 4 and to clear up any remaining differences in interpretation of the E_i.

   If this cannot be done within the time and patience available, if differences in interpretation remain, then it is useful to emphasize that $p_c(\lambda \mid E_T)$ reflects the state of confidence of the group as a whole. Individual experts may have their own curves, $p_j(\lambda \mid E_T)$, reflecting different interpretations of E_T. In this case, the group, as a group, has large uncertainty, and this would be reflected in a broad $p_c(\lambda \mid E_T)$. Thus, although an individual's curve, $p_j(\lambda \mid E_T)$, differ from $p_c(\lambda \mid E_T)$, nevertheless, each individual agrees that $p_c(\lambda \mid E_T)$ does reflect the group's state of knowledge and is therefore the curve on which the decision should be based.

   In other words, they agree to disagree, and they agree that the decision maker must take account of the fact that the experts are disagreeing.
10. Steps 1 through 9 are repeated for all of the parameters that are to be estimated, and the session is concluded. The analyst then prepares a draft document, a section of the PSA, that sets forth the consensus probability curves, the evidence items on which they were based, and the reasoning connecting them. It also calculates the effects of these curves on other downstream parameters in the PSA. This draft document is circulated to the experts who were

present at the elicitation session and to other experts who are qualified to comment.

11. These experts and reviewers can now individually reflect on what has been done, have second thoughts, make comments and corrections, add new evidence items or clarifications of previous items, etc. In this way, we soften some of the potential problems with interacting group processes and gain some of the benefits of Delphi and nominal processes.[24,25]

In light of this new input evidence, the analyst revises his draft and recirculates it. If necessary, the experts are convened for a second session, and the process is repeated until convergence.

This process has many benefits besides the production of final curves, $p_c(\lambda \mid E_T)$, on which to base decisions. During the course of obtaining these curves, much by-product value is obtained. For one, the experts are forced to become explicit about their evidence, E_i. Each expert learns what the experience and information of the others are.

In the course of becoming explicit, each item of evidence is thoroughly discussed, examined, challenged, and compared for consistency with the other items of evidence; interpretations are debated; semantics are clarified; and fine distinctions are drawn. Previous misunderstandings and professional disagreements between experts will often be resolved during this step. If this phase is managed well, the group will come to an agreed-upon information base, E_T, which can be documented and circulated. This, in itself, is a very useful result.

Furthermore, since this is a PSA, the parameters λ will be related directly or indirectly to the likelihood of occurrence of risk scenarios ϕ_i.[26] So, during the discussion, while the group is focusing on a specific scenario, ideas for ways in which to eliminate this scenario or to make it less likely will flash around the room. Someone will say, 'If that's an area of concern, we can do such and such or change this and that'. This idea will spark further ideas, and soon we have definite proposals for changing design and procedures to reduce risk.

Needless to say, the expert opinion 'problem' is never going to be 'solved' by any single mechanical or cookbook-type procedure. The expert information approach should be viewed as one more tool in the toolbox. Used with skill, we find that, in our experience, it works well.

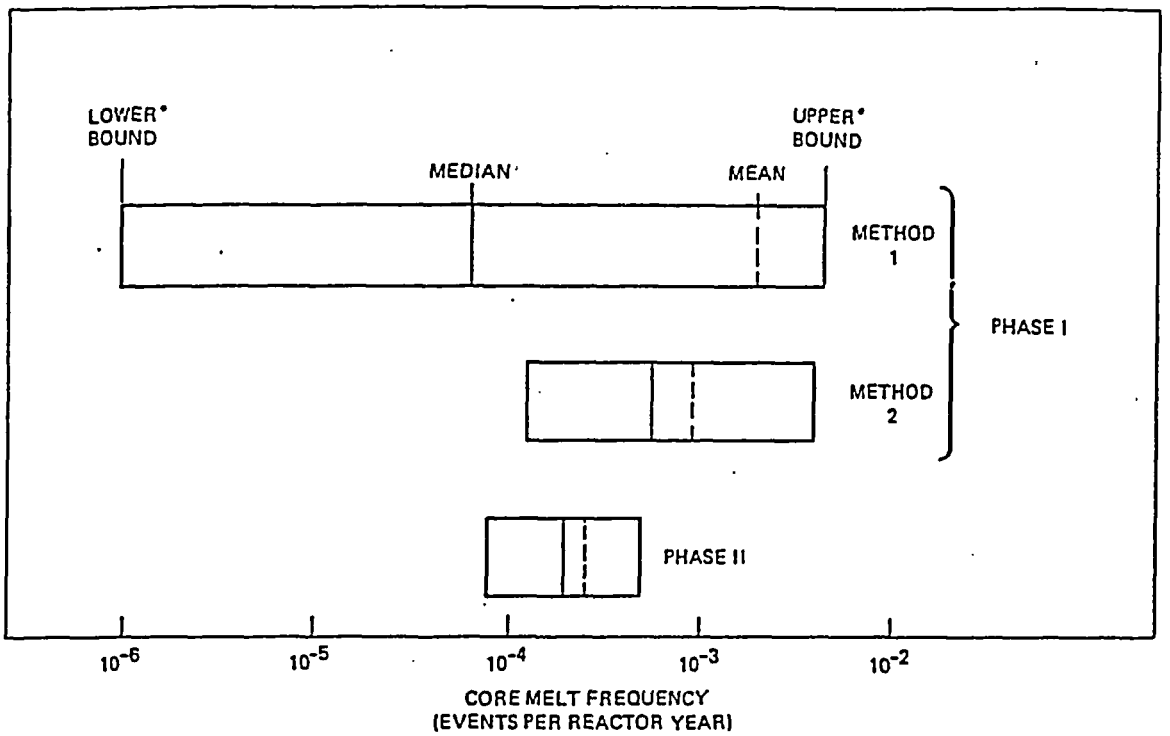
4 MODEL UNCERTAINTY

Despite attempts to be complete and to use realistic, physical models in PSA, matters of time, budget, and the current state of physical knowledge combine to guarantee substantial uncertainty in the PSA model. The usual approach has been to select conservative models or best estimate models based on the PSA analyst's judgment of reasonableness of each approach.

Rigor, honesty, and lack of clarity about what conservatism means call for a better treatment of modeling uncertainty. The earliest attempts to incorporate model uncertainties into our PSAs began with an effort to better manage large PSA projects. The first studies in the United States (for example, WASH-1400, Oyster Creek, Zion, and Indian Point) were large multi-year projects. A great deal of money, effort, and time had been invested in each of these studies before even preliminary results were available. One and one-half to two years often passed with no results and, in the end, for many of the studies, it was determined that too much attention had been paid, too much effort expended in modeling issues that ended up having little importance to risk. With the beginning of the Seabrook PSA, we organized a multi-phased approach to the analysis to control these factors. This approach forced us to consider model uncertainty.

The Phase 1 Seabrook model[27] was to be a 'smart PSA' in which a small group of about four analysts tried to understand the plant very thoroughly by immersing themselves in plant documents and visiting the site for about 3–4 months. During that time, they built very detailed event sequence models that were to be retained throughout the entire study. To quantify those models, they attempted rough-cut quantified systems analysis. When the results were produced, it was necessary to allow for conservatisms in the Phase 1 model and somehow to account for what was left out. The primary conservatisms involved uncertainty in the reactor coolant pump seal LOCA timing and lack of models for operator recovery possibilities. Two methods were attempted for incorporating the full range of uncertainty in the results of the Phase 1 study.

The first method was quite simple and involved fitting a lognormal distribution to upper and lower bounds. The upper bound was selected by using the point estimate from the Phase 1 results with no additional credits applied. The judgment of the PSA team was that there was likely to be some balance between the improvements possible by adding additional recovery actions to the model and the effect of including those scenarios that were left out (given the possibility that some of those, although not expected to be risk-significant, might be important). The lower bound was set quite subjectively as an estimate of the lower bound attainable with a modern light water reactor. The results for method 1 are shown in Fig. 3 and spans a wide frequency range from about 1×10^{-6} per year to about 3×10^{-3} per year.



* LOWER AND UPPER BOUNDS CORRESPOND, RESPECTIVELY, *WITH 5TH AND 95TH PERCENTILES OF THE UNCERTAINTY* DISTRIBUTIONS.

Fig. 3. Comparison of core melt frequency obtained in Phase 1 and Phase 2.

In method 2, we attempted to be more precise by propagating uncertainties through the simplified systems analyses, by specifically allowing for initiating events that were left out of the scoping study (especially the external events), and by applying credit for recovery. The results of method 2 are also shown in Fig. 3, where we see that the final Phase 2 results were reasonably centered under the curve provided by method 1 and skewed to the lower side of the more narrow distribution assessed using method 2.[11]

The highly judgmental approach used in method 1 seems to better provide the kind of uncertainty bounds desirable in the first-cut analysis, while method 2 substantially understated the uncertainty on the low side. The postmortem analysis indicated that method 2 suffered from the impact of dependencies that were not properly addressed and from conservatisms in the reactor coolant pump seal LOCA model. The Phase 1 seal LOCA model assumed the seals would fail in about 30 minutes with no cooling, and was instrumental in stimulating the owners group effort to understand the properties of seal LOCA. The most encouraging aspect of this first two-phase analysis was that, in fact, the top sequences in the Phase 1 model were similar to the top sequences in the final complete analysis, and, at least using judgment, it was possible to bracket the range of the final results quite nicely.

Two years later, in 1985, the similar phased approach was applied to the South Texas Project PSA, Phase 1 being called a scoping study.[28] This time, a more rigorous approach to considering the model uncertainties was developed. Two particular models were most heavily influencing the risk results in the scoping study, and from careful review of the plant, appeared to be of the issues that would be important throughout a more detailed review as well. These were reactor coolant pump seal LOCA timing and HVAC success criteria. To address these issues, the analysis team hypothesized several different possible states of the real world and judgmentally assigned probabilities to each of these cases being the true state.

For reactor coolant pump seal LOCA timing, two cases were selected: seal rupture within 2 hours and seal rupture within 16 hours. The two cases were weighted as follows:

- 22% for the 2-hour case
- 78% for the 16-hour case

For the HVAC success criteria, there were four separate issues. The first was whether a smoke purge mode would be effective in cooling equipment in the plant; the second was the exact chiller capacity that would be required to avoid equipment failures; the third was the number of fan trains that would be

required; and the fourth was the dependence of AC power on HVAC; i.e. how likely it is that, given a loss of cooling, the AC power would also be lost. Fourteen separate assumption sets were developed and assigned probabilities through a structured process. The results this rigorous propagation of uncertainty in model parameters was a wide band of uncertainty in the results.

Core damage frequency results spanned well over an order of magnitude just due to differences in the various assumptions on success criteria. The most likely success criteria led to a middle range of values, and several unlikely, but plausible, cases led to very significantly higher core damage frequency. At that point, PSA results were available based on models containing a high degree of uncertainty. It was decided that because of the significance of this uncertainty, much more detailed room heatup calculations should be performed under a variety of conditions of HVAC system operation. The results of the final Phase 2 PSA had much less uncertainty because these factors were carefully evaluated using standard engineering analysis.[29]

One to two years later, in the 1986–1987 time frame, the Diablo Canyon PSA was also performed with a phased approach and accounted for the impact of model uncertainties in each of its phases. At the conclusion of the scoping study, the model uncertainties with the greatest potential impact on core damage frequency were three: (A) the timing of actor coolant pump seal LOCA associated with loss of component cooling water; (B) the low-end seismic fragility curves for piping and DC electrical components; and (C) the impact of seismically-induced relay chatter. In Fig. 4, we show the change in mean core damage frequency associated with all combinations of the alternative assumptions listed on the figure. Each of these is weighted by the probability assigned by the PSA group of each of the alternative assumptions being the true state of the world:

- A1 (0·20) versus A2 (0·80)—ability to recover CCW promptly
- B1 (0·05) versus B2 (0·95)—seismic fragilities
- C1 (0·87) versus C2 (0·13)—impact of relay chatter

The associated mean values and their probabilities are shown for the total integrated risk result. The result shifts by almost an order of magnitude, depending on the results of the model uncertainties. The maximum value is near 1×10^{-3}, and the most likely value is near 2×10^{-4}. While the results were very useful, the picture presented in Fig. 4 offers a confusing view to the uninitiated. Thus far, we have not succeeded in designing a clear way to display the results of such a model uncertainty analysis.

The scoping study focused the work for the completion phase of the risk assessment and, in Fig. 5, we show the residual uncertainties following the first complete quantification of the full Phase 2 model. At this point, substantial new work had been done to clarify the assumptions on piping and DC electrical fragilities; however, a complete understanding of

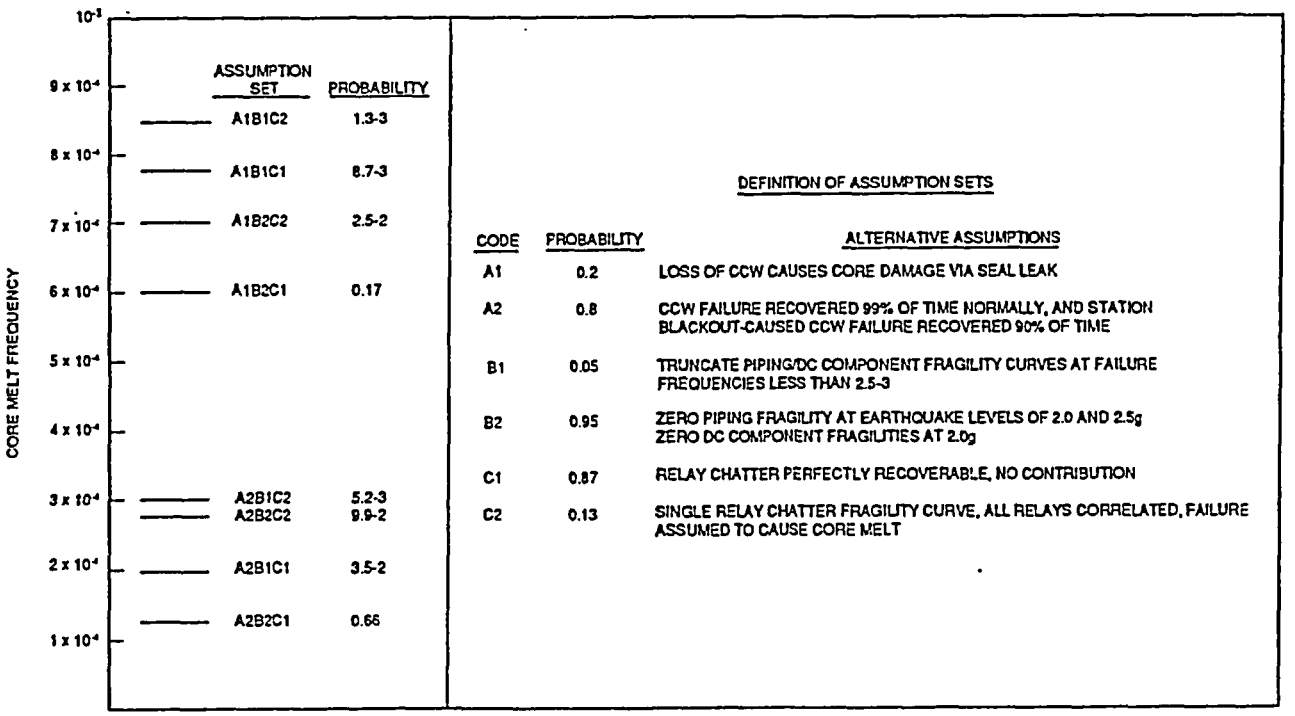


Fig. 4. Scoping study model uncertainty results.

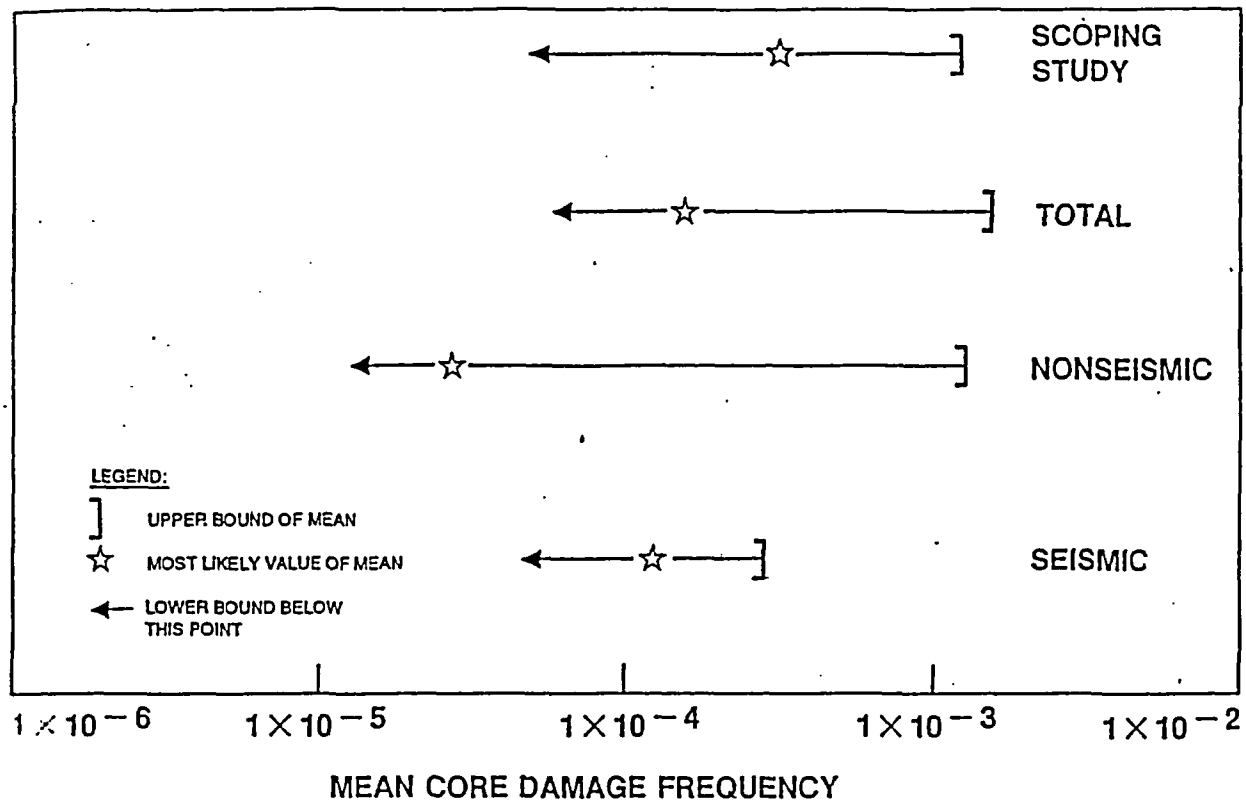


Fig. 5. Model uncertainty at first complete quantification of the full PSA model.

reactor coolant pump seal timing and relay chatter was not yet in place. In addition, further uncertainty associated with the electrical power system was determined during the full-scale work. This was associated with the failure rate for the diesel fuel oil transfer pumps that were required to start at frequent intervals during the running of the diesels. Figure 5 presents an unusual view of PSA results: it shows the uncertainty in the expected value of the PSA results dependent on the impact of understanding the model uncertainties.

The Phase 2 results led the utility to address the model uncertainty in several ways. For relay chatter, a more thorough, detailed analysis was done to greatly reduce the uncertainty in the results. For the reactor coolant pump seal LOCA-related events, two complementary approaches were taken. Seal LOCA scenarios emanating from loss of component cooling water alone were addressed by bypassing the issue of uncertainty in seal LOCA timing. An alternative path for cooling the plant charging pumps was installed, thereby providing a recovery mechanism before seal damage could occur. For those scenarios emanating from blackout conditions—and these were both seismic and nonseismic—the issue was again bypassed by providing for alternatives in ensuring the continued availability of AC power. The plant was modified so that the diesel fuel oil transfer pumps would not be required to undergo multiple starts, and the capability was added for moving fuel oil with a portable pump. In addition, for the seismic loss of power scenarios, an improved method for bypassing potential seismic damage in the switchyard was provided at the plant. Thus, the final results moved very close to the most likely values shown in Fig. 5 through the reduction of uncertainties in the model by additional analysis or bypassing those uncertainties through plant modifications.

We note that, more recently, in the *NUREG-1150* analyses of the U.S. Nuclear Regulatory Commission (NRC), a number of issues associated with model uncertainty were addressed through probability elicitation of expert panels convened for this purpose.[30,31]

5 COMPONENT AGING

PSA studies have generally not addressed uncertainties associated with the issue of equipment aging. Concern that aging equipment might lead to increasing risk has led to more thorough examination of the aging issue. A Bayesian methodology developed for the NRC has been fully implemented in a PC computer code called DORIAN. It permits the analyst to specify several alternative, hypothesized 'aging models' (i.e. possible trends) along with a prior probability distribution indicating the subjective

probability that the analyst assigns to each trend. The hypothesized aging trends can be of arbitrary form and can reflect either deterioration or improvement over time. For example, the analyst can specify linear or exponential aging trends, 'bathtub' curves, or other arbitrary functions. This capability allows the analyst to model realistic aging scenarios; i.e. mechanistic, structural models for equipment aging.[32]

Data on actual component failure rates or outage durations over time are used to 'update' these prior probabilities and to determine the posterior probability associated with each aging model; i.e. the probability that each model is correct in the light of the observed data, rather than a priori.

In the model, our state of knowledge about the failure rate λ is expressed in terms of an initial failure rate, $\lambda(0)$, and a series of multipliers describing how the failure rate changes as a function of time, $A(t)$, each of which is characterized by a discrete probability distribution. Thus, according to our prior distributions, the failure rate λ at time t will be equal to the product $\lambda_i(0)A_j(t)$ with probability $P(i, j)$. For simplicity, we assume that each aging model $A_j(t)$ is piecewise constant, taking on a different value every year. Our plant-specific evidence is therefore given by

$$E_1 = \{\langle k_1, e_1\rangle, \langle k_2, e_2\rangle, \ldots, \langle k_T, e_T\rangle\} \quad (1)$$

where we have observed k_t failures in year t, for each year $t = 1, 2, 3, \ldots, T$, and our total 'observation time' or 'exposure' during year t is equal to e_t.

The probability that the true value of $\lambda(t)$ is equal $\lambda_i(0)A_j(t)$, given the evidence E_1, can now be specified by Bayes' theorem

$$p(i, j \mid E_1) = \frac{P(i, j)P(E_1 \mid i, j)}{\sum_{i,j} P(i, j)P(E_1 \mid i, j)} \quad (2)$$

where the likelihood function, $p(E_1 \mid i, j)$—the likelihood of observing the evidence E_1 if the function $\lambda(t)$ is equal to $\lambda_i(0)A_j(t)$—is specified as

$$p(E_1 \mid i, j) = \prod_{t=1}^{T} \frac{[\lambda_i(0)A_j(t)e_t]^{k_t} e^{-\lambda_i(0)A_j(t)e_t}}{k_t!} \quad (3)$$

The Bayesian aging model has been applied to historical data from a boiling water reactor plant with 17 years of operating experience. With the assistance of the utility company, plant-specific data were collected on the failure and maintenance histories of components in two systems. No evidence of rapid aging was observed. However, the posterior distributions for some components showed a slight tendency towards increasing failure rates, and others showed a slight trend toward improvement. Most exhibited posterior distributions with the bulk of the probability around the zero aging hypothesis and substantial uncertainty associated with projections far into the future.

As an example, 15 motor-operated valves were analyzed. Over the 17-year period, 9 failures were distributed among the valves. For this case involving a reasonably good fit of the data within the prior distribution for λ_0, the evidence provided by 17 years of experience suggests a slightly increasing mean failure rate. The posterior mean for A is 2·0. The median value of A remains quite close to 1·00 so that it can be concluded that we are approximately as confident that these valves will improve as degrade. Specifically, the probability of $A > 1{\cdot}0$ is about 54%.

A recent paper[33] provides more detail on the method along with several examples. One of those applies the technique to forecasting the steam generator tube plugging rates for a pressurized water reactor (PWR) that had already sleeved its tubes using a leak-limiting mechanical roll. The aging model offers a wide range of applications.

6 DESIGN, MANUFACTURING, AND INSTALLATION DEFECTS AND UNCERTAINTIES

The possibility of design and construction (D&C) errors is a potential source of risk in nuclear power stations, as it is in chemical plants, aerospace facilities, and all other technological ventures. Although some have worried that failure to account explicitly for such errors is a serious gap in most PSA studies, the case for this point of view has not been convincing. It is clear that D&C errors are implicitly included in the failure rates of equipment modeled in PSAs. Therefore, D&C errors are only of concern if they lead to systematic errors in risk calculation due to dependent effects. Specifically, D&C errors could have impacts beyond those generally modeled if they could lead to rapidly escalating failure rates due to common wearout, unexpectedly correlated failures due to untested environmental conditions, or unexpected weaknesses under accident stresses. Qualification testing, acceptance testing, in-service inspections, and maintenance programs combine to minimize the likelihood of such conditions. However, uncertainties in installed capacities and possible loads must be considered.

Three examples of explicit modeling of D&C errors and uncertainties are provided here. The first represents a general search for high-impact D&C errors at one commercial nuclear plant. It extended the pioneering work described in Refs 34–37. The second considers the impact of potential manufacturing flaws in fuel plates for a very high heat flux research reactor. This represents a case in which a single structural failure could have serious effects. The third examines how uncertainties in strength and accident loads can combine to cause failure of passive

components that should survive under best estimate conditions. The results indicate that, under normal operating conditions and anticipated abnormal environments, the contribution of D&C errors is generally well covered by their implicit inclusion in independent equipment failure rates and the uncertainty in seismic fragility calculations. Special attention is warranted for unusual designs and for severe accident conditions.

6.1 Application—an operating commercial nuclear plant

The following analysis of D&C errors was performed for a commercial nuclear power plant in the United States. The study was never published. In contemplating the totality of possible design and construction errors, we observe that the same type of error (e.g. misplacement of reinforcing rods) can be made at different locations (e.g. different structures) in the plant. This suggests that it may be useful, as a basic structuring idea, to consider the space of possible design and construction errors as a two-dimensional space formed by the coordinate axes: 'kind of error' and 'location of error'.

In line with this idea, then, we embody the coordinate axes in the form of a table, as shown in Fig. 6. With this table, we have ruled our space into a coordinate grid. Each box in the grid represents a particular subcategory of error; i.e. a scenario. We can then denote the *i, j*th grid box as the scenario $s_{i,j}$, meaning the *i*th type error made in the *j*th location.

Observe that on each axis, vertical and horizontal, a taxonomy may be erected. For example on the location axis, 'turbine building' could be a major category. This category could be subdivided into various locations and sublocations within the turbine building. Thus, we can think of ourselves as laying first a coarse gridwork over the error space and then, as we discover interesting grid boxes, 'turning up the microscope' to establish finer and finer gridworks within that box, thus identifying the main risk contributors with greater and greater specificity and detail.

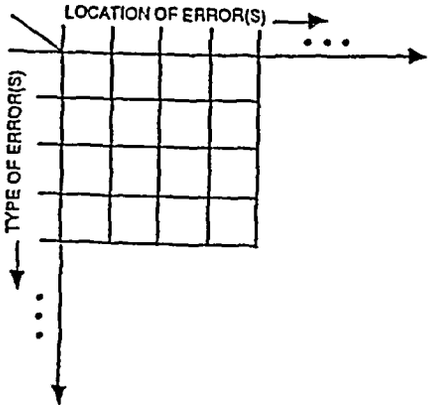


Fig. 6. The error space table (a two-dimensional structuring of the error space).

When the table is first laid out, any box that might conceivably contribute to risk is marked. The marked boxes are then filtered in successive passes, as follows. The first pass filters out those boxes representing design/construction errors that are already included in the PSA. The second pass filters those that obviously contribute no risk on the basis of either likelihood or potential consequence. The arguments supporting these filterings should be carefully documented, box by box, for they are an important part of the risk analysis.

Those boxes (scenarios) that survive the filtering will have to have their likelihoods and consequences quantified. For this purpose, we note that these errors will all be 'latent' in the sense that they have not been discovered in the ordinary course of testing or operation. The error, having been made, just sits there inactive until some unusual stress or demand (e.g. earthquake) makes it noticeable (see note 3).

A latent design or construction error can contribute to risk in one of only two possible ways. Either it will change the frequency of an existing scenario already included in the PSA or it itself will somehow introduce a new scenario.

Most of the errors will be of the first category. For example, misplaced concrete or wrong anchor bolts may affect the fragility of structures and equipment, thus changing the frequency of plant damage due to earthquake-initiated scenarios. Similarly a valve designed without regard to the pressure differential that it would experience in a plant transient scenario will fail more frequently during that scenario. The failure rate or 'unavailability' of the valve here plays a role exactly analogous to that of fragility in seismic scenarios.

Before continuing, note that failure rate data already include some failures due to D&C errors. Likewise, seismic fragility curves may include some judgmental conservatism or allowance for the possibility of D&C errors. The following discussion assumes that no allowance for D&C errors exists in those parameters for clarity in the discussion of effects. Thus, we can say, in general, that the impact of D&C errors is to increase the fragilities (unavailabilities) of plant equipment and structures. Most D&C errors show up by impacting the split fractions in the existing event trees. To include these errors in the PSA therefore requires modifying the split fractions and reassembling the calculations. If any such errors are found that produce their own scenarios, then these scenarios will simply be added into the PSA result.

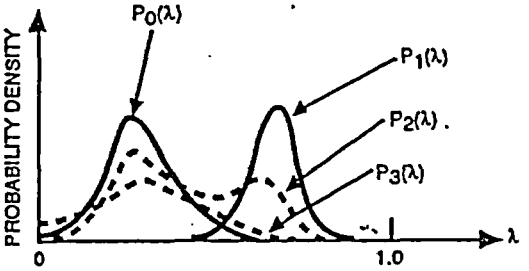


Fig. 7. Probability curves for the fragility unavailability parameter λ, with and without design or construction error.

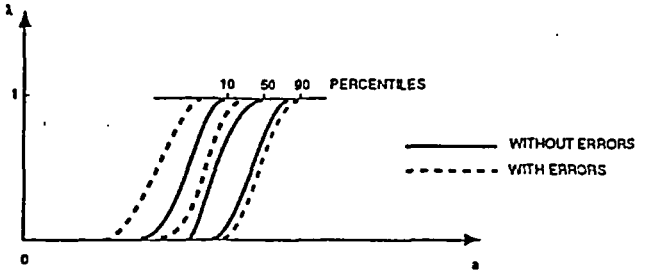


Fig. 8. Fragility family with and without inclusion of design and construction errors.

It may be worthwhile here to add a note on exactly how the possibility of design or construction errors would enter our calculations. For this purpose, consider a typical fragility or unavailability type parameter, λ. Suppose that, having assumed no design or construction error, we have expressed our knowledge about the value of λ with a probability curve in our usual way, obtaining curve P_0 in Fig. 7.

Now, suppose we are considering a specific design or construction error, E. If this error were definitely known to be present in our specific plant, our probability curve would shift to something like curve P_1 (see note 4). We can interpret $P_1(\lambda)$ as the conditional probability, given that the error E has occurred. That is

$$P_1(\lambda) = P(\lambda \mid E)$$

Similarly, $P_0(\lambda)$ may be understood as the conditional probability

$$P_0(\lambda) = P(\lambda \mid \bar{E})$$

given, $\bar{E}$, that the error has not occurred. Now, if our confidence that the error has not occurred is denoted $P(\bar{E})$, then

$$P(E) = 1 - P(\bar{E})$$

and our new state of confidence about λ is

$$P_2 = P(\bar{E})P(\lambda \mid \bar{E}) + P(E)P(\lambda \mid E)$$
$$= P(\bar{E})P_0(\lambda) + [1 - P(\bar{E})]P_1(\lambda)$$

$P_2(\lambda)$ thus is just a linear combination of the curves, P_0 and P_1, and might look something like that shown in Fig. 7.

If we now consider that E represents not a single specific error but a class of design or construction errors, some of which will have greater and some lesser effects on λ, then our final state of confidence becomes a linear combination over the whole class

$$P_3(\lambda) = P(\bar{E})P_0(\lambda) + \int P(E)P(\lambda \mid E)\, dE$$

The appearance of $P_3(\lambda)$ in this case would typically be as shown in Fig. 7. Observe that P_3 is broadened, compared with P_0, on both the left and right, reflecting the fact that design or construction errors can sometimes be in such a direction as to make the structure or equipment stronger or more reliable.

A similar discussion applies to fragility curves, which may be thought of as curves of λ versus some 'hazard intensity parameter' (a). In this case, the inclusion of design and construction errors would broaden the fragility family, typically as in Fig. 8.

The error space table (errors versus locations) described earlier was constructed by first building a detailed list of errors identified in an extensive review of the technical literature of computer databases, informal discussions with the NRC, and provided from the judgment and experience of the error assessment team. This long catalog of what might go wrong was reorganized and grouped into a list of 25 particular error types that were additionally grouped into six categories: concrete structures, structural steel, piping and equipment, electrical cabling, corrosion, and instrumentation and control. The table format was completed by identifying 66 specific locations throughout the plant that were categorized within 11 general plant areas such as containment, intake structure, auxiliary building, turbine building, etc. The table was filled in following the filtering process described earlier. The first screening step identified 513 possible error locations out of the 1650 possible locations on the table. The error investigation team assigned these to the following five categories:

1. already in the PSA—185 (36%);
2. affects only the seismic fragility—230 (45%);
3. no effect on risk—41 (8%);
4. could affect the frequency of core damage—39 (8%);
5. no impact on core damage but could affect the release—18 (3%).

The error assessment team, which consisted of structural engineers, reliability engineers, chemical engineers, a design and construction manager, mathematician/probabilist, nuclear engineers, and systems engineers, examined all of the errors in each of their locations. As shown above, they determined that 185 were already incorporated into the PSA analysis and that 41 had no effect on risk. The other

287 errors in categories 2, 4, and 5 were examined to evaluate their potential impact on risk. Of those that affected only the fragility, the team judged that the impact on the complete fragility curves, including uncertainty, was minimal. For the 57 potential errors in groups 4 and 5, the assessment team made bounding estimates of the potential risk and compared that with the risk in the existing study. None of the errors appeared to offer substantial impact on the existing PSA results.

The analysis of D&C errors provided significant insight. First, many of the postulated design and construction errors are already included implicitly in the plant PSA mode. Although final, definitive, numerical risks for D&C errors cannot be claimed to have been developed through this study, enough insight has been obtained, we think, to support the belief that D&C errors do not contribute significantly to the general levels of numerical risk results obtained in the plant PSA.

6.2 Application—a research reactor

A more recent study considered the effect on safety of fuel manufacturing and installation defects for a government-operated research reactor.[38] For this application, we applied a new technique. The approach taken is shown schematically in Fig. 9 where we present a conceptual model leading from causes through chains of events during the manufacturing, design, and installation processes up until installation in the plant. What we have is an upstream tree working from causes to the final installation that, in turn, corresponds to the downstream tree of normal PSA from the time of installation onward looking at degradation and random failures.

The research reactor uses highly enriched, narrowly spaced fuel. Fuel elements are composed of many individual plates, each 50 mm thick and separated by 50-mm-wide cooling channels. Because of the high heat flux in this reactor, minor interruptions in heat transfer are postulated to lead to rapid deterioration and fuel damage. The fabrication of a fuel plate starts with a 'sandwich' configuration made up of a shaped U_2O_8–Al powder mixture between two aluminum plates. This sandwich is then alternately annealed and rolled until the final piece dimensions are achieved and the plate components form one integral piece.

A list of 20 possible material-related mechanisms that might affect performance was developed. This list was eventually narrowed to a few specific plausible mechanisms: nonbonds (i.e. defects associated with the annealing process); inhomogeneities (i.e. defects associated with the fuel shaping); lateral cracks of fuel plates; and undetected welding failures of the fuel assembly. The model was, essentially, an event tree representing the quality control process, which includes alpha detection, gamma transmission, and X-ray. If flaws were identified, the technician was to make notations on the paperwork associated with the fuel but the fuel would stay in the process until later. Errors made in the paperwork could conceivably result in potentially defective fuel remaining in the process. To quantify the event trees, we relied on the expert knowledge of a man associated with the reactor who followed the fuel QC for the past 25 years. Working with the facility from the design stage, he was familiar with the full spectrum of operation and problems at the manufacturing plant. In his experience, it was not uncommon to find some of these problems on the order of once per manufacturing run of 24 plates and others were never seen but could not be outlawed. The result of the analysis was that 28 scenarios contributed less than 1% each to the total core damage frequency of about 3×10^{-4} per year. The two largest contributions came in sequence 5 (a nonbond defect), which contributed $1{\cdot}4 \times 10^{-5}$ (5%), and sequence 22 (a lateral defect), which contributed another $3{\cdot}7 \times 10^{-6}$ (1%) per year.

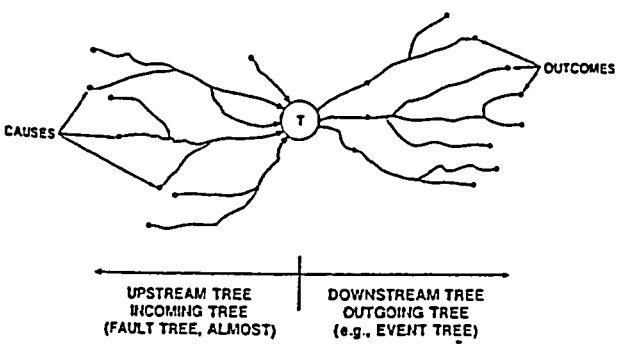


Fig. 9. Conceptual model for modeling pre-operational defects.

6.3 Application—uncertainties in strength and load in passive equipment and structures

Application of PSA techniques in structural analyses has allowed engineers to address the issue of uncertainty in structural mechanics quantitatively, in a consistent fashion. The most common applications to date in nuclear power plant PSAs address the response of the containment structure to elevated pressure. In fact, such applications represent only a fraction of potential PSA applications. The basic approach outlined below would also benefit the stress–strength response analysis of passive components experiencing stress; for example, overpressure scenarios due to an anticipated transient without scram or interfacing system LOCAs that expose system components to unexpectedly high pressure.

The basic concepts surrounding the application of PSA techniques are illustrated by considering the containment response to pressure spikes. The basic problems are outlined in Fig. 10. The discussion that follows is summarized from Fleming[39] where the method for estimating containment failure is also fully described. The goal of the analysis is to assess the likelihood of various containment failure modes (event B in Fig. 10) in response to a severe accident (event A). In the absence of uncertainty, the likelihood of containment failure is determined by the frequency of occurrence of sequence 2 in the event tree. Uncertainty in the estimation of the frequency of severe core damage $[F(A)]$ and of the frequency of containment failure after core damage $[F(B \mid A)]$ is quantified with the use of probability distributions that describe the probability that various levels of frequency are the true values.

Previous PSAs have shown that core damage frequency and the frequency associated with its constituent plant damage states are best characterized by continuous probability distributions. However, a

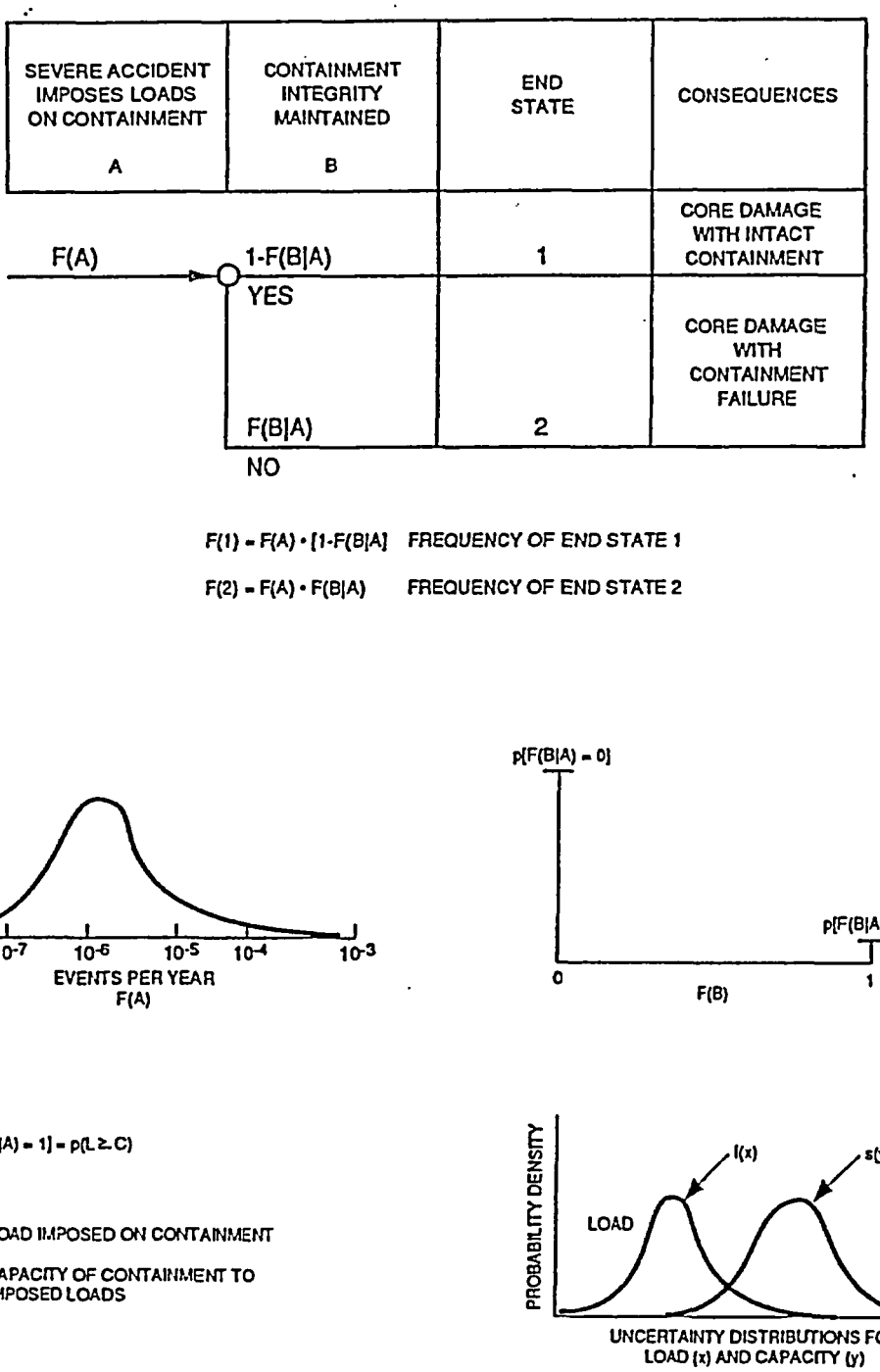


Fig. 10. Basic concepts of containment failure probability estimation for pressure spike case (from Ref. 39).

discrete distribution with possible frequency values of 0 and 1 often best describes the state of knowledge regarding most containment event tree split fractions such as those that apply to containment overpressure failure. In other words, if all underlying uncertainties in predicting containment failure were resolved, the containment response could be predicted deterministically; i.e. the only possible values of $F(B \mid A)$ are 0 and 1. The basic approach to estimating the probability of containment failure (i.e. the value of $P\{F(B \mid A) = 1\}$) is to assign uncertainty/probability distributions to the imposed load (L) (i.e. the magnitude of the pressure spike) and the containment pressure capacity (C), and then to compute

$$P\{F(B \mid A) = 1\} = P\{L \geq C\} \quad (4)$$

Since the only other outcome is $F(B \mid A) = 0$, it follows that

$$P\{F(B \mid A) = 0\} = 1 - P\{L \geq C\} \quad (5)$$

Methods for computing $P\{L \geq C\}$ are well established and are often referred to as the 'stress–strength interference theory'. If the probability distributions for the load and strength are given by $l(y)$ and $s(x)$, respectively, this theory states that

$$P\{L \geq C\} = \int_0^\infty s(x)\left[\int_x^\infty l(y)\,dy\right]dx \quad (6)$$

i.e. at each value of pressure capacity, x, the condition of failure is met for all values of load $\geq x$.

When the functions in eqn (6) facilitate closed form integration, the value of $P\{L \geq C\}$ can be determined analytically. Otherwise, numerical integration or Monte Carlo solution schemes can be employed.

A number of issues complicate the above basic approach to determining containment failure split fractions in actual application. These issues include the need to address:

- Two basic types of pressure loading situations in different scenarios: gradually and continuously increasing pressure with time, and pressure spikes at various points in time.
- Two or more failure modes that could occur, each having a distinct probability distribution for the pressure of failure occurrence.
- Two basic types of failure modes: a gross failure or catastrophic failure of the containment, leading to a large opening in the containment boundary, and a leakage-type failure mode, in which the size of the hole is small and potentially expands and contracts to limit the magnitude of internal pressure. The competition between these types of failure modes during slow pressure transients leads to the possibility of a 'leak before break' containment failure in which the occurrence of a leak happens to prevent further pressure rise and, thus, the possibility of a break at a greater pressure.
- Two possible relationships between failure modes, including independent and dependent cases. In the independent case, both the occurrence and the state of knowledge on the frequency of occurrence of two or more failure modes are independent. In the dependent case, the state of knowledge between two or more failure modes is dependent, even though the occurrence is independent. Dependence between two or more failure modes influences the appropriate method for combining failure mode distributions in the estimation of containment failure probability.
- In addition to the need to address pressure loads and pressure capacities, there is also a temperature effect to consider. In continuously increasing pressure transients, there may also be a significant increase in temperature that may impact the material properties of the structure that determine pressure capacity.

In general, a containment can be subject to any number of failure modes, some of which are of the leak type, and the rest are catastrophic breaks. In addition, any particular subset of the failure modes may be dependent and can occur during scenarios in which pressure is continuously increasing as well as during scenarios in which discrete pressure pulses occur at various times during the scenario. Finally, the pressure capacity of any failure mode may also be dependent on temperature. Modern PSA techniques have proven to be successful in addressing the challenges of these complicating factors.

7 HUMAN PERFORMANCE

Human performance is a broad heading under which we will consider both the modeling of human reliability and the modeling of what might underlie human reliability—the organizational factors at a facility.

In performing more than 30 plant-specific PSAs, we have tried many alternative techniques for modeling human reliability; for example, the Swain & Guttman approach outlined in the human reliability handbook,[40] the Swain & Bell approach known as THERP,[41] the HCR approach sponsored by EPRI,[42] and Embrey's success likelihood index method (SLIM)[43] and modifications of it.[44] In these studies, we have worked both with and without psychologists as part of the human reliability team.

All of the analyses after the first two or three involved substantial input from plant operators and looked at human response under detailed scenario definitions. The question of organizational factors

affecting human reliability was considered in all these studies, but only the approach using the SLIM formalism identified them explicitly.

All of the approaches seemed to provide reasonable answers, and, in fact, it has been our opinion that the choice of a specific human reliability analysis (HRA) technique is not the first-order issue. The clarity of the scenario is what must come first and unfortunately is what is often neglected. By this, we mean a careful qualitative definition of the complete scenario leading up to operator intervention; that is, all of the successes and failures of equipment, the time sequencing of plant events, and the previous history of operator involvement are crucial to defining the situation the operators face at any given time. It is not reasonable to address a question such as 'What is the likelihood that the operators initiate bleed and feed cooling?' The operator situation must be defined in terms of all the events that have led up to the point where bleed and feed cooling would be called upon. What is really required is a recognition of all dependencies. That is vital; again, such dependencies are too often neglected.

Beyond clarifying the situation and the dependencies involved, it may be that there are some cases for which judgments alone or simple models of operator performance are not sufficient.[45,46] An integrated dynamic model may be a much better approach for some specific cases. For example, in a paper given earlier at SMiRT 11, we provided an example of a class of problems involving dynamic interactions among phenomena, plant response, and operator crew actions.[47] In that example, we considered fires that occur within the control room in which the phenomena involve fire growth processes; that is, sequential damage and spurious actuations due to the fires and their smoky hot environments. During the same time, the plant is automatically responding to fire-initiated signals, starting and stopping equipment, and changing its state. Finally, the operating crew is carrying out actions in response to both the fire phenomena and the changes in plant state. Therefore, the operators must play plant control against fire control. The detailed timing of the ensuing scenarios can vary substantially, depending on operator response to any particular issue. This certainly seems to be a case where dynamic modeling could provide insights not obtainable in other ways.

Let us turn our attention now to the organizational factors that affect equipment reliability and operator performance. It was an early hope that these organizational factors were implicitly included in the plant-specific data. We have already noted that some human reliability analysis approaches, such as SLIM, allow accounting for organizational factors through performance-shaping factor evaluation. However, it is certainly time to question whether we have been successful in picking up the true impact of these organizational factors.

It is easy to get a feeling for corporate culture. The prevailing philosophy in a particular organization is progressive or reactive; rigid or flexible; inquisitive or defensive. That sense of the organization comes through when you visit the plant, talk to the operating and maintenance staff, and talk to the engineering and management staffs. What is much more difficult is to assess the quantitative impact of that culture and to convince the utility that the quantitative impact is, in fact, the reasonable result of conditions at its facility. It is our opinion that none of the current attempts to quantify these organized factors have fully succeeded. However, we note that some interesting taxonomies have been suggested in the high-level models that have been offered.

A brief look at two of the models provides a convincing case that failure to account properly for organizational factors may dramatically underestimate the risk from facilities. We look at the models by Wu *et al.*,[48,49] and by Paté-Cornell & Bea.[2] The model of Wu *et al.*, begins with the NOMAC structure of Fig. 11 that had been developed by the NRC[50] to show the influence of management on risk. Here we see how the management safety culture can directly affect safety knowledge, attitude, performance goals, and communications, and how those four factors combine to influence operations and maintenance procedures, quality control, operations, and maintenance.

What Wu *et al.*, have done is to show how these four factors then directly influence the key parameters affecting average unavailability, q_{av}, of equipment in terms of failure rates, repair times, and maintenance unavailabilities. The importance of this model is that we now see the parameters of average unavailability (the quantity of interest in PSA calculations) as correlated variables. The correlation comes through these organizational factors that have impacts felt throughout the plant and that create interdependencies among the unavailabilities for equipment. In a way, this is very much akin to the common cause failure problems,[51] and, in fact, the common cause failures are, in many cases, a subset of these management and organizational factors. Therefore, it appears that any model that fails to examine the organizational factors is guaranteed to underestimate the overall risk by an undetermined amount.

Paté-Cornell & Bea state, 'When a systems failure is studied a posteriori, it is often pointed out that what resulted in a technical failure was actually rooted in a structural or functional failure of the organization'. The Challenger and TMI accidents are good examples.

In their analysis, Paté-Cornell & Bea break up the problem into two categories: cognitive problems and incentive problems, as shown in Fig. 12. Cognitive

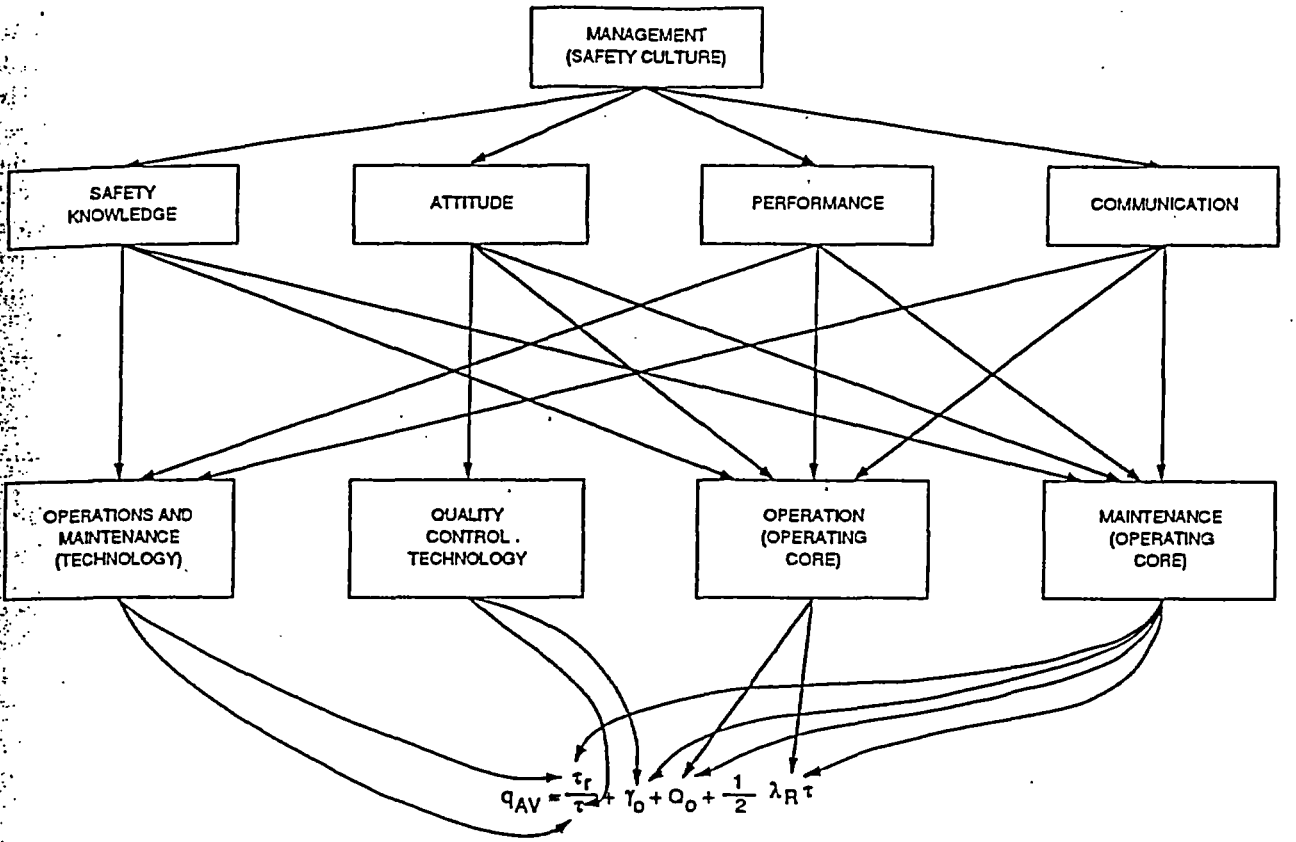


Fig. 11. Impact of management quality on one component system q_{AV}'s.

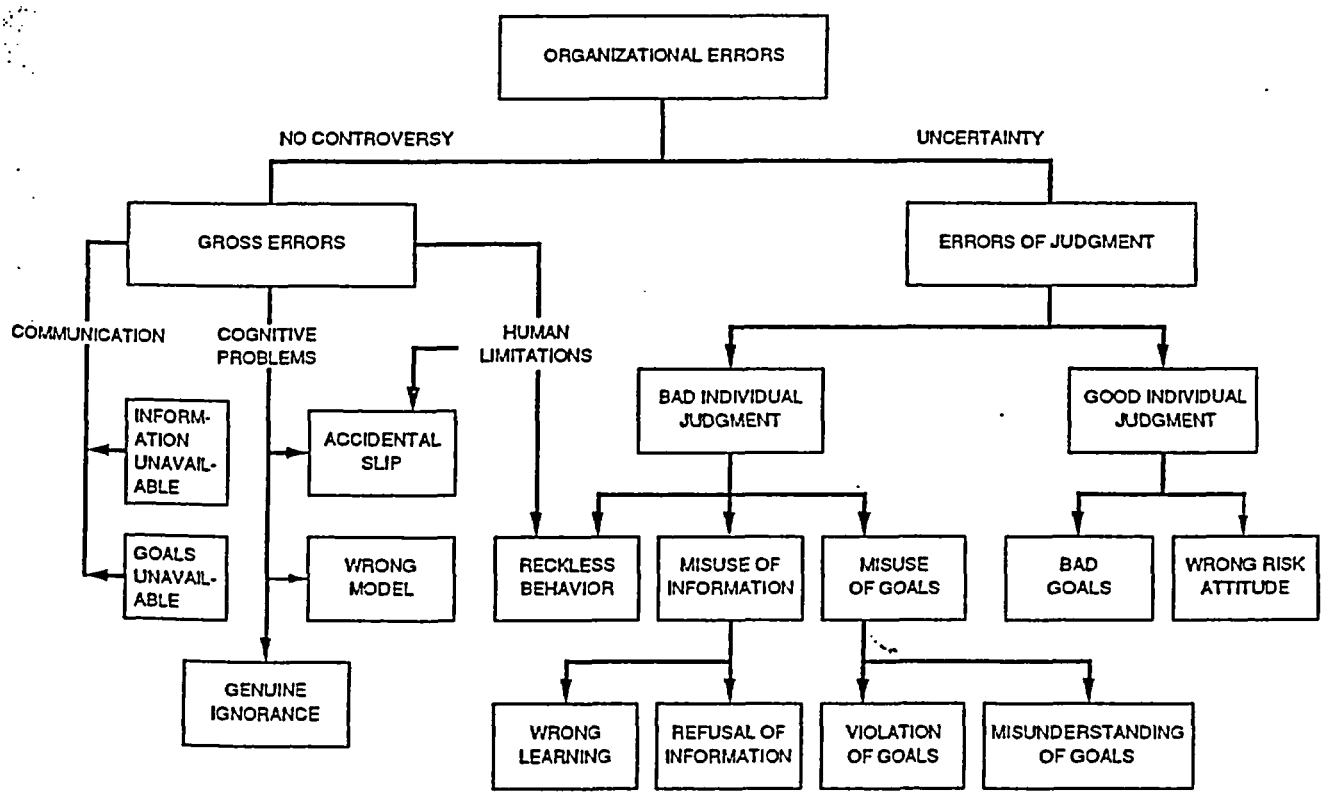


Fig. 12. A taxonomy of organizational errors.

problems are identified as those due to ignorance, poor communications, or misinterpretation of information. The incentive problems are those due to conflicts of goals and preferences between individuals and corporate management. Consider the culture of the organization. What is its willingness to take calculated risks? What is its reward structure? How does it consider operational performance versus safety? Does it deny uncertainties where they exist?

Using the framework suggested by Wu and Paté-Cornell, we can now address real problems quantitatively. We can manage the risks due to them and account for these dependent factors. However, we must use care in that we do not introduce a form of double counting into our overall PSA analysis. What we mean by that is that most of these failures are already imbedded in the data or equipment failure rate, frequency of maintenance, maintenance outage time, and human error reliability; e.g. SLIM modeling of corporate culture. What we need is something like the beta factor idea used in common cause analysis to break up those parameters of our model into independent factors and common (or dependent) factors linked through the organizational factors.

We need to improve the learning process of individuals in organizations, the scheduling process, the use of probability and management processes, feedback mechanisms, and design review. What we think is a reasonable approach for attempting the application of organizational factor analysis is one that follows four steps.

1. *Preliminary PSA.* Identify key subsystems or elements of the systems reliability.
2. *Process Analysis.* Identify potential problems in design construction or operation.
3. *Organizational Analysis.* Identify how organization and incentive aspects can observe, recognize, communicate, and correct problems in a timely manner.
4. *Detailed PSA.* Determine the impact of residual errors on systems.

While we have not yet performed a detailed application following these steps, we are becoming more and more convinced of the necessity for examining the dependent organizational factors that can affect all aspects of plant risk.

8 COMPLETENESS

The final source of uncertainty that we will discuss is the issue of completeness. In all of our PSAs, we express the opinion that we try to be complete; however, we know many areas where that goal has not been met. We believe that the safety significance of those events that are not modeled is generally small compared with existing PSA results. Continuing review of new operating events, the results of new experiments, the implications of extensions to analytical methods, and a growing body of expert review and comment increases confidence in the adequacy of completeness in PSA. Several areas remain of concern, and three examples are discussed below: common cause failure, room heatup and thermal fragility, and risk during shutdown conditions.

PSAs have analyzed intrasystem common cause failure in great detail, looking at common cause failures within a single system. The same depth of examination has not been applied to common cause failures across systems (intersystem common cause failures) or to dependent links among maintenance actions. Some of the latter do show up in the common cause database for intrasystem common cause failure. This whole class of events is really a subset of the dependencies that exist due to organizational factors existing at the plant.

Room heatup has been examined in great detail in a few PSAs (see, for example, Refs 29 and 52). What has been found is that most plants have not done detailed calculation of room heatup conditions, when all ventilation has failed. Typically, only design basis single failures have been examined, and the systems have been designed to provide complete capability under such failures. When the PSA examines the likelihood of failures of ventilation systems, we need to examine how fast the rooms can heat up and at what point the problems begin to develop.

In our firm, detailed room heatup calculations have been performed for at least three power plants, and those plants were selected based on their having fairly small rooms that have the capability to heat up in a short period of time. In a few of these cases, the HVAC contributions to risk are substantial. However, at this point in time, inclusion of ventilation failures has not become a standard part of all PSA programs.

Turning now to shutdown PSA, recent analyses have shown the shutdown events can, in fact, be more important than originally believed.[53–55] In WASH-1400 and in other early PSAs, it was believed that safe conditions existed during shutdown because the plant was cooled down, was not at power, and long times would be available to handle any accidents. However, this 'safe shutdown condition' is offset by the existence of degraded plant configurations and a more relaxed set of technical specifications. Lack of emergency procedures and guidelines for classifying emergency action levels for shutdown conditions also have a tendency to make these events more risk significant than those from power operating conditions.

Our first detailed look at shutdown risk was performed in the early 1980s for EPRI NSAC. At that time, we observed that, whereas full-power PSA looks at interruptions to a normal plant operating in a

steady state mode, a plant in cold shutdown actually moves through a process in which the plant conditions are changing over time. Figure 13 shows schematically the model that was developed for examining risk in a shutdown PWR.

Six procedure event trees were developed to define the maneuvers applied to the shutdown PWR.

- Tree 1 takes the plant from hot shutdown conditions to cold shutdown solid conditions;
- Tree 2 drains the plant for refueling or maintenance;
- Tree 3 shows the step required to refill the refueling area for refueling;
- Tree 4 defines the activities for draining the cavity after refueling;
- Tree 5 considers the activities in refilling the reactor coolant system after refueling or maintenance;
- Tree 6 takes the plant from solid cold shutdown to hot with a steam bubble in the pressurizer.

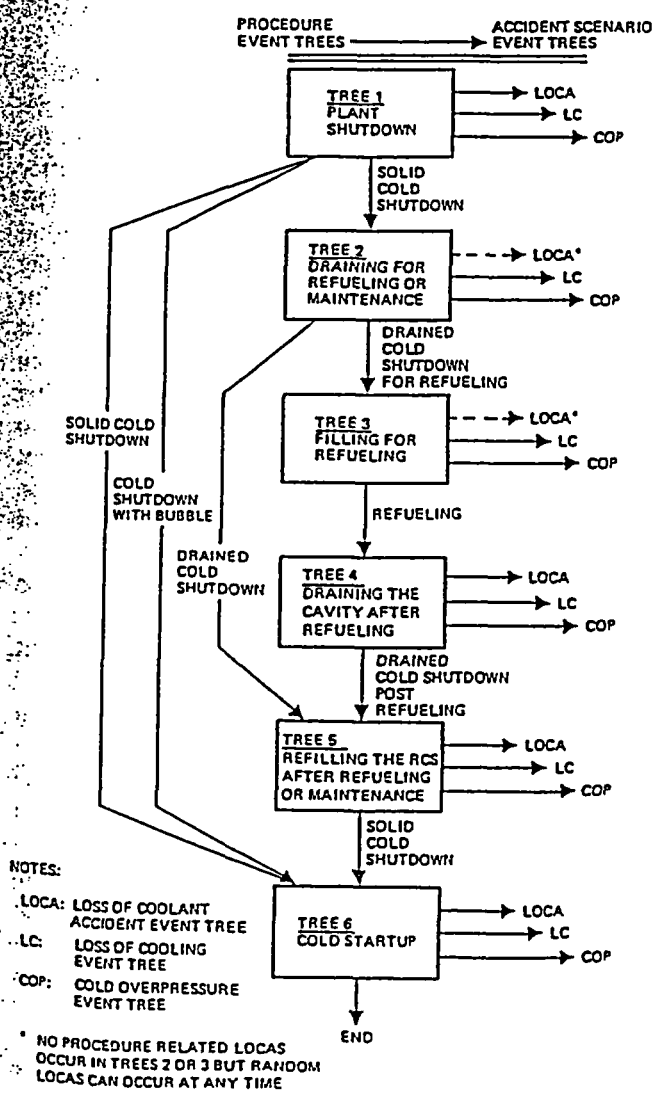


Fig. 13. Event tree map for cold shutdown activities at a nuclear power plant.

Various combinations of the six procedural event trees define the various cold shutdown processes. Trees 1 and 6 alone define those cases for solid cold shutdown or cold shutdown with a bubble in the pressurizer. Trees 1, 2, 5, and 6 define the activities for drained cold shutdown outages such as working on a steam generator. The whole set is used to consider refueling outages. During each of the procedure trees, random events can cause loss of coolant accidents, loss of cooling (either loss of flow or loss of heat removal), and cold overpressure events. Reactivity events were also considered. In addition, the human activities in carrying out the procedures of the processes can themselves lead to these conditions. For example, in draining the plant for maintenance, the operators can overdrain and lead to cavitation of the RHR pumps and loss of cooling events.

The model that was developed, then, was a full set of procedure event trees that coupled to accident scenario event trees looking much like those for power operation.

The results of this study were interesting in that we found that the risk during shutdown had wide uncertainty, while its most likely value was nearly an order of magnitude lower than the risk at power. However, there was a small chance (i.e. a long tail on the probability distribution) that it could be as high. The great uncertainty is associated with the timing of plant thermal–hydraulic conditions and large numbers of dependent human actions that occur during the procedure event trees and in response to an accident during shutdown when automatic systems are not available. More recently, the Seabrook and French shutdown PSAs have shown similar possibilities for high risk during shutdown conditions.

9 OVERVIEW OF PSA STRENGTHS

While we have dwelt on the weaknesses and areas of uncertainty in current PSAs, we have, in fact, mentioned a great many of its strengths as well. By far the most important strength of the PSA model, as we consider it, is the generality and richness of the basic PSA model, as was shown in Fig. 1, which serves as a framework for bringing all available information to bear on the questions of risk.

We note especially that the large uncertainties we discussed are not inherent in PSA but are inherent in the real world. What PSA does is make explicit and quantify these uncertainties and display them in full view to ourselves and to others. This general framework is a complete view of how to answer questions about risk and how to bring all available knowledge, analyses, and experiments to bear on these questions.

A major strength of PSA is the maturity of many of

the methods for looking at the risk from plants and for including and quantifying dependent effects that are often the major contributors to risk in well-designed, highly reliable systems. Large amounts of data have been collected and are available for use in these PSAs, and methods for eliciting expert information and applying it to the questions of interest have become viable.

PSA provides the perfect venue for bringing together interdisciplinary participation and review. In fact, it is essential in a well-constructed PSA that experts in all areas of the technology—operations, thermal-hydraulics, neutronics, physics, and human performance—be brought together to ensure that the best possible information is used in the analyses.

The true strength of PSA comes from its use as a safety management tool. The only reasons for doing PSA are to understand what the risks are and to do something about them. PSA provides information on the risks and their sources, which allows managers and engineers to suggest alternatives for improving safety and calculate their effectiveness.

The key question that arises once the basic PSA model is quantified is, What can be done? It is helpful to break what can be done into its component parts. On the one hand, we can consider experiments and modeling improvements (that is, improving our knowledge), and on the other hand, we can consider modifications.

The modeling improvements involve engineering analysis, man–machine interaction modeling, and event sequence analysis. The types of engineering analysis that are often involved are detailed calculations of room heatup, equipment thermal fragility, and thermal-hydraulics. In many cases, the initial PSA work is done with expert opinion, and then the most significant areas are followed up with more detailed engineering analysis. The modeling of man–machine interaction considers the interactions of operators with current and alternative alarms, indications, and controls. Finally, the event sequence analysis, the heart of PSA, would allow us to look at the impacts of detailed sequence timing and possible recovery activities. Modifications can be considered that would involve procedures, the man–machine interface, and other hardware.

It is important to look at all these areas of what can be done—both improved modeling or experiments (i.e. improving knowledge) and actually changing the plant. The best approach depends on the details of the situation and is really a cost–benefit consideration. If we have great uncertainty, then acquiring new knowledge often makes the most sense. However, in some cases, we find there are low-cost ways to avoid the issue of uncertainty. For example, at Diablo Canyon, reactor coolant pump seal LOCAs associated with loss of component cooling water appeared to be a major contributor. However, there are substantial uncertainties in how fast the associated charging pumps would fail with loss of cooling water and how soon the reactor coolant pump seals would degrade and begin to leak at substantial rates following the loss of charging; i.e. seal injection. Much research has been done already, and it is not clear that spending even an enormous amount of money studying this problem further would do much to improve our knowledge of the risk. However, for Diablo Canyon, making a simple modification, one of providing a hose connection to bring fire-main water to the charging pump cooling boxes, provided a low-cost path for maintaining charging and protecting the reactor cooling pumps. This approach completely avoids dealing any further with the issues of uncertainty in the reactor coolant pump seal performance for the loss of cooling water scenarios.

Our final point in dealing with the use of PSA has to do with the use of PSA as a communications tool—as a way to allow managers and engineers to talk with each other and understand where risks arise and what to do about them.

In a recent project for the U.S. Department of Energy (DOE) at the Savannah River Site (SRS), we feel we made some real gains in finding a method for presenting risk results in a form that better communicates to engineers and managers.[56] The DOE SRS elected to develop a new top-down presentation format for the existing K-reactor PSA. Despite the availability of the PSA, its widespread use for evaluating the safety of the K-reactor for restart purposes was hampered by the mystique surrounding the traditional presentation of models and results. The DOE desired a format that could speak clearly to engineers, scientists, and managers who have not directly participated in the PSA and who might not be intimately familiar with the design and operation of the SRS reactors.

To improve the utility of SRS PSA results to managers and regulators, a simplified tabular presentation was developed. In this table, various plant conditions (PSA plant initiating events) are listed along with their frequencies, the capabilities of the plant (hardware and human actions) to mitigate each condition, and the likelihood of success. To add clarity, more detailed information was imbedded in linked backup flow charts and tables; for example, Fig. 14. Note that Fig. 14 is a flow chart display of the same kinds of information that had been listed in the table. However, there is additional text in the clear presentation of the relationships among systems providing plant capability. The shadowed boxes in the figure indicate that a deeper level of detail is available. For example, box 2.3 is expanded to explain the functions of the system, its associated startup test procedures, and technical specifications. Again,

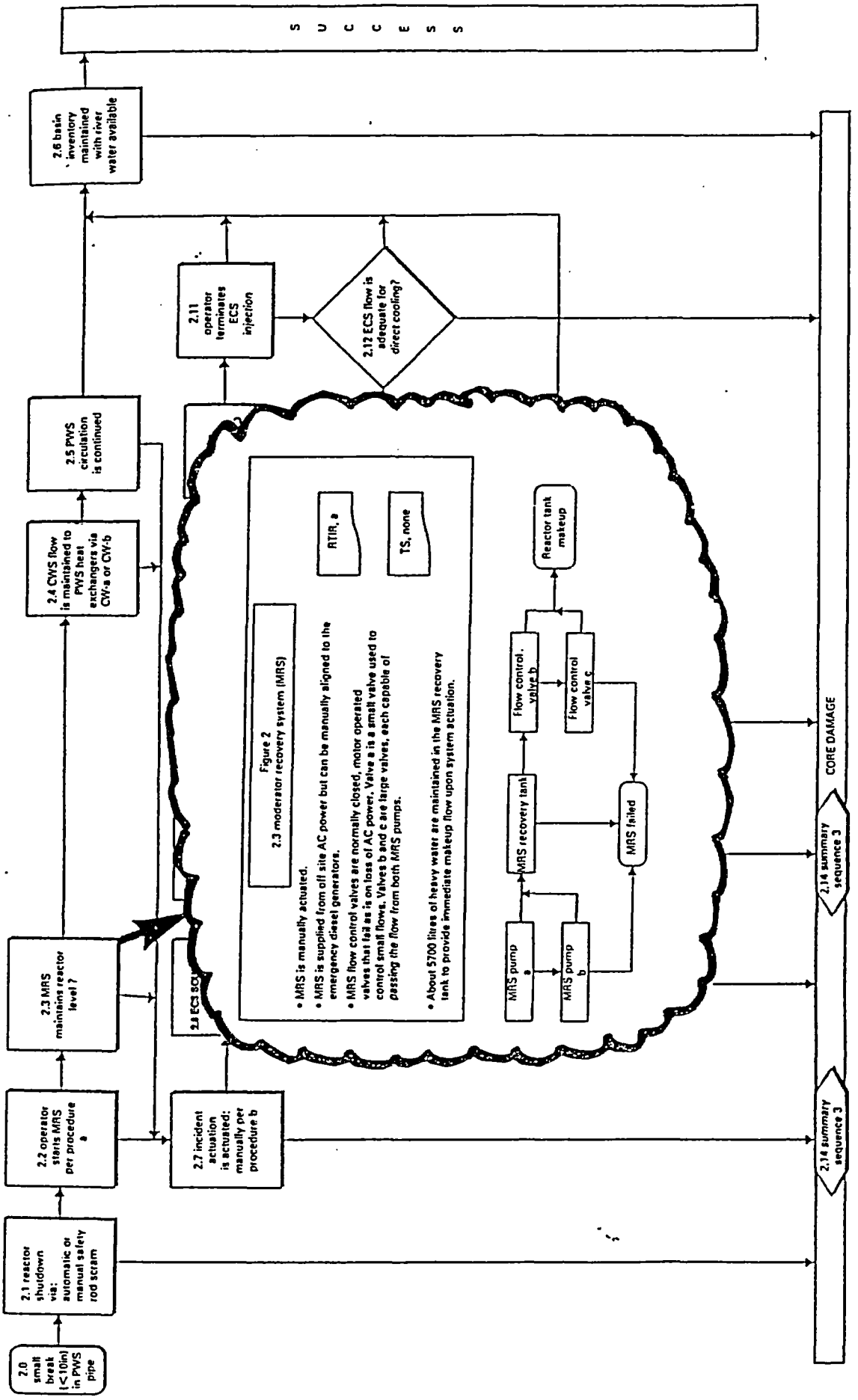


Fig. 14. Risk communication—information flow chart.

shaded boxes at this level are expanded even further on additional levels.

This multitiered approach permitted immediate access to summary risk results in an explanation of plant capabilities and vulnerabilities with respect to specific initiating events and is readily understood by most engineers. The actual documents are color coded to identify key issues such as human actions, dominant sequences, etc.

The new format for presenting risk results served as the focal point for the use of the PSA as a management tool by a broad group of facility managers and regulators. Representatives from nearly all DOE and Westinghouse SRS reactor startup organizations—engineering, operations, training, etc.—have now directly used the PSA models and results to benchmark existing startup programs and to evaluate the significance of open issues.

The SRS models have been used to provide a redundant check on plant safety and to evaluate the startup test program, emergency procedures, technical specifications, and training. They served as the basis for personnel from all site technical departments to discuss safety in a common format. Additional uses for the models have been planned.

Others have already identified how risk results can be used for improved communications with the public and outside organizations.[57,58]

10 CONCLUSIONS

The basic value of PSA is to provide:

- a language for quantifying uncertainty;
- a structured view of plant dependencies and interactions;
- a rational integrated view of plant response in terms of consequences, their likelihood, and the responsible contributing factors;
- a flexible tool for managing plant safety.

PSA provides the only integrated way to balance influences from design, construction, and operation in terms of their impacts on safety. It provides the coordinated basis for ordering the importance of human actions and various component failures with respect to their impacts on plant safety. It calls for cooperation among design, manufacturing, and operations to optimize safety while minimizing costs. That promise may appear as a challenge to the traditional independent, serial interfaces of industry. Care, diplomacy, and competence are required of PSA organizations and are essential if the promise is to be realized.

We note that there are weaknesses in all PSA applications. However, we also note that many examples of successful modeling of many of these weak areas exist within the current PSA literature. It is only that these approaches have not become general practices. Interdisciplinary participation and review within the Bayesian framework for addressing uncertainty can enhance and validate PSAs.[59,60] There are many examples in which this approach has been taken; unfortunately, there are many examples in which this extra effort has not been applied.

It is worth a final note to point out that the bulk of this paper has discussed the weaknesses or areas of greatest uncertainty in PSA. We need to remind ourselves to beware of overstressing the weaknesses in PSA. In fact, the methodology is sound, the overall framework is complete, and the question really comes down to one of addressing the cost and benefits; i.e. how much is it worth to narrow the remaining uncertainties? In some cases, it may be very valuable; in others, it will not be.

NOTES

1. This is referred to in the literature as the issue of calibration.[19,20] In the language of Winkler & Murphy,[21] the experts are 'substantively good' but may not be 'normatively good'. See also Tversky & Kahneman.[22] We note that a short seminar or training session is not sufficient to make our experts normatively good.
2. Jaynes observes that, as scientists, we relish those occasions when the evidence is inconsistent with our prior judgments. At such times, we are forced to gather new information, and our knowledge can take a great step forward.[23]
3. Another way such errors might manifest is through early aging or wearout and therefore premature failure of the equipment.
4. If the nature of the design or construction error were such that, by itself, it ensured the failure of the equipment, the curve P_1 would be a delta function spike over the value $\lambda = 1$.

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PSA '89

THE EUROPEAN BENCHMARK EXERCISE ON HUMAN RELIABILITY ANALYSIS

A. Poucet
Commission of the European Communities
Joint Research Centre, Systems Engineering and Reliability Division
21020 Ispra (Va), Italy
+ 32 332 789604

ABSTRACT

The Joint Research Centre of the European Commission has organised a Human Factors Reliability Benchmark Exercise (HF-RBE) with the aim of assessing the state of the art in human reliability modelling and assessment in a PSA framework. Fifteen teams from eleven countries, representative of the parties involved in PSA studies, participated in the HF-RBE.
The HF-RBE was organised in two reference study cases: one on the analysis of routine functional Test & Maintenance (T&M) procedures and one on the analysis of operator response during an operational transient. This paper analyses the results of the HF-RBE on a comparative basis. The aim of this analysis was to compare the procedures, modelling techniques and quantification methods used, to obtain insight in the causes and magnitude of the variability observed in the results and to get an understanding of the current state of the art in the field, identifying the limitations that are still inherent to the different approaches.

INTRODUCTION

The Joint Research Centre of the European Commission has launched a series of Reliability Benchmark Exercises (RBE's) with the aim of achieving an understanding of the state of the art of reliability analysis, of assessing the nature and importance of uncertainties involved and of reaching agreement on common analysis procedures[1,2,3]. The Human Factors Reliability Benchmark Exercise (HF-RBE) [4] was the third in this series. The main aims of the HF-RBE were to:

1. compare the various procedures and approaches used to identify human failure possibilities and mechanisms;
2. compare the modelling techniques and the quantification methods and data used to estimate human failure probabilities;
3. assess the degree of consistency in the results and the advantages and limitations of the various techniques used to obtain the results;

Fifteen teams from eleven countries (8 E.C. member countries plus U.S., Sweden and Finland) participated in the HF-RBE. They represented industry (vendors, architect-engineers), utilities, licensing organisations and research institutes.

ORGANISATION OF THE HF-RBE

On the basis of a reference plant, the Grohnde NPP of KWU design, a common set of problems to be analysed by all participating teams was defined.
Since the Grohnde NPP was already taken as a reference plant for a previous benchmark exercise on common cause failure[3] and a certain amount of documentation had already been prepared by KWU, it was agreed that the hardware aspects of the HF-RBE should refer to the same systems considered in this earlier exercise, namely: the systems that can be used to feed the steam generators in case of loss of preferred power. These systems consist of a two train start-up and shut-down system and a four train emergency feedwater system (EFWS) (see fig. 1).
It was further agreed that the HF-RBE should basically address the following issues:

1. the analysis of routine functional Test & Maintenance procedures: with the aim of assessing the probability of test induced failures, the probability of failures to remain unrevealed and the potential to initiate transients because of errors performed in the test. This

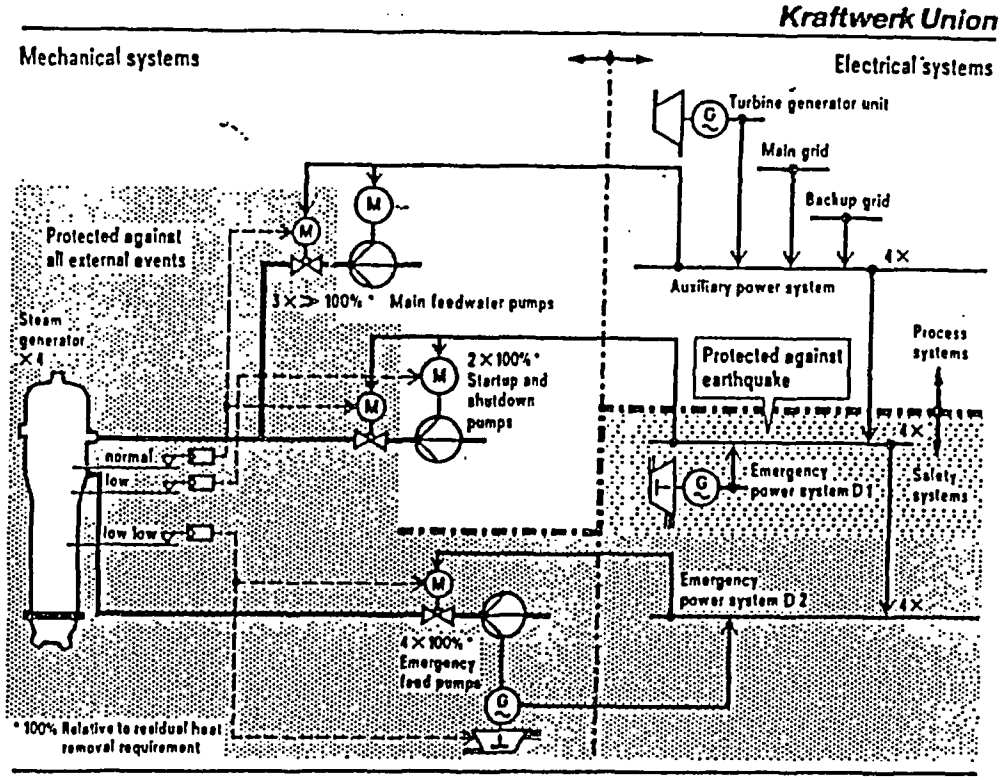

Fig. 1 NPP Grohnde: possible modes of steam generator feed (survey).

study case addressed the more conventional problem of analysing human errors during execution of written procedures;

2. the analysis of human actions during an operational transient: with the aim of assessing the probability that the operators will correctly diagnose the malfunctions and take proper corrective action. This study case involved more challenging issues such as the analysis of human errors in diagnosis and in selection of response strategy, and a dynamic situation in which timing and time constraint play a role.

These two basic issues were considered in the selection of two study cases: a T&M study case and an Operational transient study case.

MODELLING APPROACHES USED

The modelling has the aim of providing a logic structure for describing the success and failure actions involved in a human error related event. This allows the analyst to understand the event and to quantify it in the successive quantification phase. The logic models used were fault trees (FT's) and event trees (ET's). The latter model covers also Operator Action Trees (OAT's) and expanded operator action trees (EOAT's). Because of its sequential nature, the ET approach was found to have some advantages in modelling the sequence of tasks in a procedure. Therefore the ET approach is indicated if one is interested in modelling the spectrum of possible outcomes from various human errors in performing the procedure. It also appeared that the ET approach allows easier modelling of dependency and recovery. The fault tree approach seems more natural if the starting point is one particular event (e.g. misposition of component) for which the (human error related) causes have to be modelled. One team used as alternative to logic model construction and quantification, a direct simulation method, MAPPS[5,6] . MAPPS is a task-oriented, computer-based model for simulating maintenance activities. It includes environmental, motivational, task and organisational variables which influence personnel performance reliability. The input consists of general information about the task (procedure) and personnel, and information about each subtask (step in the procedure).

QUANTIFICATION METHODS USED

The main methods used by the participants for quantifying the human interactions as they appeared in the models are summarised below.

The Technique for Human Error Rate Prediction (THERP) and the approach described in the Swain handbook[7] was used by all participants and, hence, can be considered as reference method in this field. Since the THERP approach is sufficiently well known, no further details are given.

The Success Likelihood Index Methodology (SLIM)[8] is a method for obtaining a structured judgement about error probabilities in both proceduralised and cognitive tasks. The method is based on the assumption that expert assessors are able to evaluate the relative importance (weight) of different performance shaping factors (PSF's) in determining the likelihood of error in the situation being assessed. For a specific task to be analysed, the PSF's are given a numerical rating. These rating are then combined with the weight of the PSF's to obtain a numerical index called Success Likelihood Index (SLI). The SLI is converted in a human error probability (HEP) by calibrating the SLI scale using at least two tasks with known HEP's (anchor points). SLIM has been implemented using a computer program (MAUD: multi attribute utility decomposition) that runs on microcomputers.

The Human Cognitive Reliability model[9] is a parametric model for calculating a time dependent operator non-response probability in a task involving a certain type j of cognitive processing (either rule based, skill based or knowledge based). The following formula is used:

$$P_j(t) = exp - \left[\frac{\left(\frac{t}{T_{\frac{1}{2}}}\right) - C_{\gamma j}}{C\eta_j}\right]^{\beta_j}$$

in which: $T_{1/2}$ is the median time to perform the task corrected by a performance shaping factor K_j; β_j is a shape parameter of the HCR model correlation for type j of cognitive processing; $C\gamma_j$ is a time delay parameter as fraction of $T_{1/2}$ for type j of cognitive processing; $C\eta_j$ a scale parameter as fraction of $T_{1/2}$ for type j of cognitive processing; Dependency between tasks in a procedure is not quantified as is the case with THERP.

In addition to these methods, some participants used alternative methods like the TESEO method[10], the HEART method[11] and Absolute Probability Judgement (APJ)[12].

DESCRIPTION OF THE TEST & MAINTENANCE STUDY CASE

The Test and Maintenance study case was based on the analysis of routine test procedures: a procedure for testing the correct alignment of an isolation valve and a steam generator level control valve during cut-in and shut-off of the emergency feedwater system by the reactor protection system and a procedure for performing a minimum flow test on an emergency feedwater pump train.

The information provided to perform the analysis of the three tests consisted of the system description, a translation of the actual test procedures, a video film showing the actual performance of the test procedures and answers

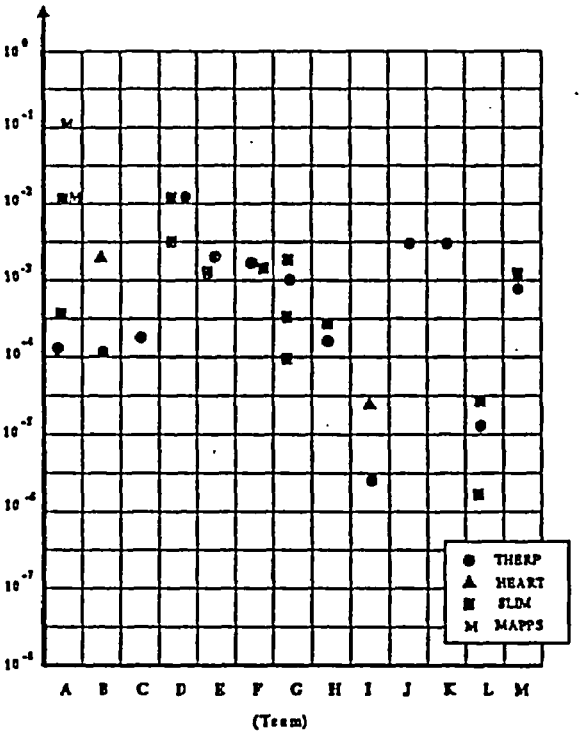

Fig. 2 T&M phase 2: results for misalignment event.

to specific questions asked by the participants. Most participants found the information adequate and a good substitute for a plant visit in all respects except one: the lack of information on the psychological environment and individual attitudes of the operators. This latter information can only be obtained via a direct interview with the operating staff of the plant.

The work plan of the T&M study case included three phases:

1. In a first phase the procedures were analysed in order to identify the human failure mechanisms which could lead to transient initiation, to test induced unavailability and to failures remaining undetected. The identified human errors were modelled and their occurrence probability estimated. It turned out that, although there was qualitative agreement on the most important human failure mechanisms, a detailed comparison of the modelling and quantification results was very difficult because of the large variability in assumptions and definition of the specific human errors.
2. In order to analyse the team to team variability in modelling and quantification, it was decided to perform a second phase in which the scope was restricted to the minimum flow test and to the analysis of a commonly agreed and well defined set of events. These events were identified in the first phase and were judged to

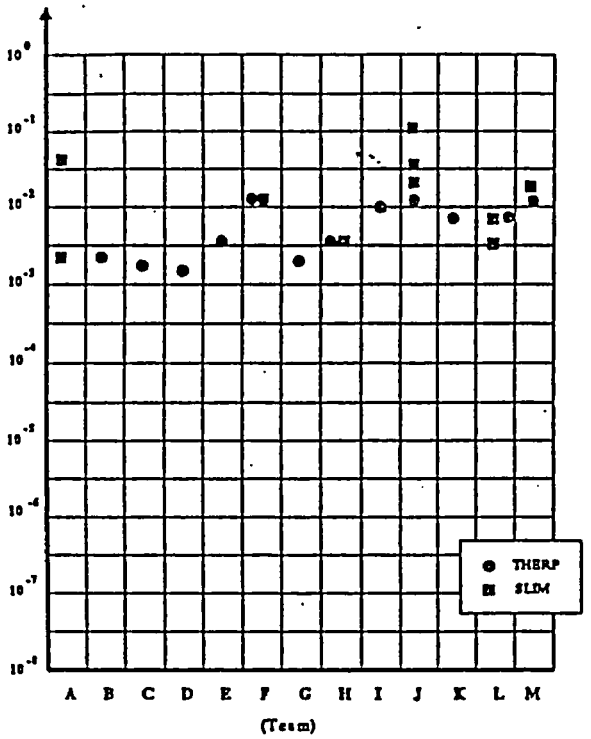

Fig. 3 T&M phase 3: results for misalignment event.

be representative for the type of problems dealt with in the T&M study case. The events were related to:

a. the non detection of various failure modes in a three way check valve;
b. misconfiguration of a EFWS train because manual valves were left in a wrong position after completing the test.

3. In order to ferret out the variability due to mere quantification, it was decided to repeat the calculation for event b above on the basis of a commonly agreed decomposition and common model.

Quantitative results of the second and third phase are represented in fig. 2 and 3. Figure 2 gives the probability estimates for the failure to configure the EFWS train correctly as calculated in the second phase. Figure 3 gives the estimates for the same event but obtained on the basis of the common decompositioning and modelling as performed in the third phase.

The first phase of the T&M study case has shown that, for routine procedure tasks, it is possible to obtain reliable qualitative results in terms of identified key human interactions and error mechanisms and in terms of importance ranking of these error mechanisms. This is especially true for the analyses performed with the aim to identify mechanisms leading to system unavailability (test induced failure) and leading to unrevealed hardware failures ing present in the system (test inefficiency). Indeed, analyses the sequence of subtasks and actions as in the procedure is closely followed, determining procedural step the possible errors and the effect on the system.

Qualitative analysis with the aim to identify ror related mechanisms that can induce transients has to be more difficult first because the analyst has to also extraneous acts (acting on another system and second because the analyst has to determine of errors, not only on the system under study other systems and on the plant. This requires a extensive documentation in terms of the control out (not only for the system involved but also for whose control panels are in similar areas) and the the plant to assumed erroneous actions. Many have therefore performed only a limited scope transient initiation, considering only omission, commission errors related to the tasks in the test and related to the components in the system

The T&M case also showed that it is very obtain reliable quantitative estimates even for events related to routine procedural actions.. The the second and third phase of the T&M study a large analyst to analyst variability, and it backtrace the origins of this variability.

It is our belief that the major contributor to ability is due to differences in *decomposition and* These differences originate mainly from the sues:

1. Different assumptions, used explicitly during the modelling, concerning the tasks(s) to be modelled, the task possible redundancy at the level of presence of independent cues by which could identify some malfunctioning).
2. Different levels of decomposition. itative analysis, the task to be analysed posed (breakdown) into a number of tions. During the modelling phase, some teractions are further decomposed or some of interactions are lumped together in order a model that can be quantified.
3. Different recovery mechanisms considered blished model. The recovery mechanisms with the assumtions made concerning the pervisor or QC personnel. They are also the analysis scope. Indeed, recovery possibil exist across procedural steps or tasks: i.e. cedural step or task may provide cues identify faults made in an earlier proced task.

Different dependency structures between interactions included in the model.

It was noticed that a very detailed decomposition may have some face value but may fail to represent the reality: it can give the analyst a false feeling of completeness but fail to represent the real important error and recovery mechanisms or dependency structures. This latter effects may explain why the T&M results indicate a shift towards lower error probability estimates as the level of decomposition is longer/higher (cfr. the results obtained in a more holistic way with SLIM as opposed to those obtained with THERP). Indeed one could expect the opposite since the more detailed the model, the more error mechanisms explicitly included.

As a general rule, it was recommended to limit the breakdown to a level upon which experimental data are still available. Otherwise there is no way of checking whether some important contributors have not been overlooked. It became obvious that the classical procedure used in systems reliability analysis, i.e to decompose the system into a model of its constituing elements, does not work in human reliability assessment because of the difficulty to identify and model the subtle internal feedback and feed forward loops and other dependencies in human behaviour which make single actions so context dependent.

The mere *data assignment* task (in this case using the THERP data base or the SLIM approach) was shown to lead to a maximum spread of about a factor of 10. This spread is introduced because the analyst has to apply some judgment in the selection of the appropriate basic human error probabilities or anchor points, and in the adaptation of these probabilites to the situational characteristics of his case. Concerning the data assignment methods, THERP, SLIM and (to a lesser extent because of its relative newness) HEART were the most widely used for obtaining human error probability estimates.

THERP (especially in its short ASEP version[13]) is still regarded as the standard tool for estimating human error probabilities in routine procedural tasks. The method is easy to use and allows in principle to quantify dependency and recovery. THERP allows qualitative judgment about the situational characteristics of the task analysed to be incorporated in the error probability estimates through the use of Performance Shaping Factors (PSF's). However, it was shown that in some cases it was difficult to accomodate for all PSF's which were regarded as important. Some PSF's which were given high importance ranking in the SLIM application (SLIM puts much more emphasis on PSF's than THERP) are not explicitly considered in THERP. In many cases, THERP yielded the most optimistic results (lowest error probability estimates).

The SLIM approach provides a structured way for identifying and ranking the most important PSF's, and hence for getting qualitative insight in the tsak analysed. The fact that SLIM is rather oriented towards a holistic analysis and does not require fine decomposition of human interactions can be regarded as an advantage given the difficulties in decomposition and modelling that became apparent during the exercise.
However, SLIM results were shown to be extremely (too?) dependent on data used as reference points for calibration. When no good reference data are available, application of SLIM is not indicated. The results of the T&M case show that there is a good agreement between the estimates obtained by a same team using THERP and SLIM. However, it is our belief that the sensitivity of SLIM to the anchor point probabilities and the fact that those probabilities were, either explicitly or implicitly, taken from the THERP data base, create strong dependency between the SLIM and THERP results.
A problem with SLIM may be that it cannot handle interactions or dependences between different PSF's: e.g. high motivation may compensate for low quality of the man-machine interface. Therefore, the weighting given to PSF's should not be assessed independently of the rating given to (other) PSF's. Moreover, the fact that it is recommended to give to a PSF the same weight for different actions (i.e. to perform the weighting per task and not per action) is arguable.

Finally, a remark must be made on the analysis of routine tasks in a PSA context. Concerning unrevealed failures, it must be recognised that such failures do not only arise from imperfect test performance but also from a badly designed test procedure. This latter problem was not tackled in this exercise. However, imperfect test performance or test procedures seem not to have a critical influence on system reliability, as their influence is conditional to a hardware failure and has as effect a increase in the time to recover the hardware failure. Concerning test induced failures, it can be argued that the component failure rates used in systems reliability analysis usually include contributions from such human errors performed during test and maintenance. However, detailed analysis of both types of failure may be necessary in order to account for dependencies between redundant components of a system.

THE OPERATIONAL-TRANSIENT STUDY CASE

The analysis of the dynamics of man-machine interactions and of the cognitive behaviour (e.g. during diagnosis of malfunctions) are important issues that were not addressed in the test and maintenance study case. Therefore, a second study case was defined, in which the response of an operator team to an operational transient was to be analysed.
The following scenario was defined for the transient:

1. loss of outside power leading to reactor scram and turbine trip;
2. the first level diesel power supply system (D1) is requested to start but 2 of the 4 diesels generators fail to start disabling the start-up and shutdown feedwater pumps;
3. because of the power loss on the busbars linked to the two failed D1 diesels, after about 14 seconds 2 of the 4 diesel generators (D2) of the emergency feedwater system are requested to start and to supply power to the busbars;
4. since there is no feedwater supply, the S.G. level continues to drop and after 18 minutes the steam generator (S.G.) level reaches the low-low level causing all four emergency feedwater trains to receive the cut-in command; this causes the 2 remaining D2 diesels to start and the isolation valves at the output of all four emergency feedwater trains to open;
5. because of a common cause failure, the four isolation valves open only partially thus causing a reduced feedwater flow;
6. if no action is undertaken, the S.G. level will continue to drop and will reach a dangerously low level after about 40 minutes.

The scenario has some interesting features:
- a diagnosis of the incident taking place has to be made by the operators and a choice must be made between alternative strategies to prevent the steam generators from drying-out.
- there is a time constraint: the operators have about 1 hour to undertake action before the S.G. level drops below the dangerous 1 m level.
- the actions to be undertaken involve different members of the shift staff, at different physical locations.

The problem presented to the participants was to model the operator response in the given scenario and to assess the probability that the operator team would not cope with the incident and fail to restore the EFWS (in casu open the gate valves manually).

The documentation provided included, besides the already distributed descriptions of the systems, control panels etc., a complete description of the scenario and of the actions the operators would have to perform and a videotape in which the scenario was "played" in the control room and which showed the correct course of actions to be taken.

The overall quantitative results of the operational transient study case are summarised in figure 4. As can be seen from this figure, the overall spread in the results is considerable. Even if the extreme values are not included, the results differ by more than two orders of magnitude.

The breakdown of the sequence into different actions and the modelling of the actions involving lumping identified actions together or decomposing some actions into even more detail, showed considerable differences from team to team. These differences are believed to have had some impact on the quantitative results. However, it seems that for this particular application, the different assumptions made for quantification had a larger impact on the final probability estimates than the differences in the breakdown.

When looking at results obtained by a same team, the spread is still considerable. First of all, the different single quantification methods seem to give quite different results. In almost all cases, the results obtained with THERP (as a separate method) are lower than the ones obtained with HCR: typically an order of magnitude difference is observed between a same teams results obtained with THERP and HCR. This seems to indicate that the nominal diagnosis model in THERP (which gives also a time reliability correlation) is, in this case where most teams considered 'knowledge based' behaviour for the diagnosis of the failed gate valves, far more optimistic than the HCR correlation.

The results obtained with HCR show the largest team to team variability, larger than for the THERP results. The HCR method was found to be very sensitive to assumptions related to the median time to perform some action and the behaviour type of the action. This considerations tend to inforce the belief that the different assumptions, made by different teams, for median time needed to perform an action, for behaviour type, and for PSF's, are major contributors to the spread observed. It was concluded that very good median response time data (e.g. from simulator experiments) have to be available in order to be able to apply HCR.

Problems were encountered in the application of the HCR method to a sequence of actions under a given shared time constraint.
One approach is to apply HCR to the lumped sequence of actions. But if the various actions are lumped together into a compound action (as advised in the HCR description) there is a problem for estimating the median time needed to carry out the compound action. Simply summing up the mean times of the single actions yields results which may be too optimistic. In any case this approach will not work if the different actions are of different type (skill, rule o

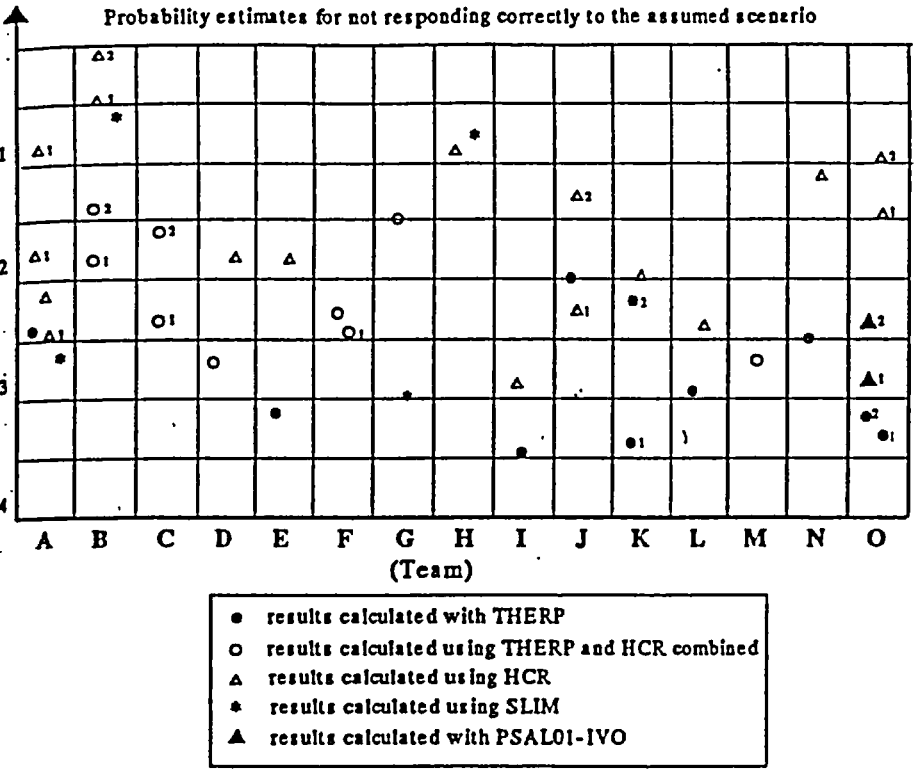

Fig. 4 Operational transient study case: summary of results.

knowledge based).

Another approach is to apply HCR to the single actions, but then there is a problem in how to subdivide the total sequence time window.

In order to overcome these problems and to give credit to the fact that the shared time constraint implies dependency between consecutive actions (if one allows more time for a first action, and hence increase its success likelihood, less time remains for a second actions, which then will see its success likelihood decreasing) a new approach was proposed during the HF-RBE[14]. The approach consists in applying a convolution integral in order to establish the mean response failure probability over a sequence of actions. The application of this approach to a sequence of two consecutive events yields a more conservative estimate than the application of HCR on both actions lumped together using the sum of their median response times.

Irrespective of the approach taken, it seemed to be difficult to apply HCR on routine manual interventions in which omission,selection and commission errors could occur (this is one reason for the extreme results obtained by team B in their HCR calculation). Therefore, some teams preferred to use THERP and HCR in an integrated way, HCR for more cognitive tasks and THERP for manual interventions or routine tasks. Those teams apparently had less difficulties in estimating the median times for their HCR calculations as they were to be assessed for better defined events (diagnosis, recognition of plant state...). From fig. 4, it can be observed that the results obtained by these teams agree rather well (they fall roughly within the 5.0E-3 to 5.0E-2 range).

Considering the results within a same team, the SLIM results always agree quite well with the results obtained by other methods, but this could be due to the calibration anchor points used. As already pointed out during the discussion of the Test and Maintenance results, this calibration has a large impact on the values obtained.

CONCLUSIONS

The HF-RBE certainly provided insigths and hints that could help to come to more universally accepted approaches for assessing human reliability in the PSA context. However, it has also illustrated that the problems linked with human reliability analysis are much greater than those in systems analysis. The typical approach used in systems analysis, i.e. to use decomposition, collect data on the component level and integrate those data again in a system model, does not work for analysing complex human interactions. Man is not a machine and a complex interaction cannot easily

be decomposed and modelled deterministically into a structure of elementary actions without loosing subtle feedback, feedforward and other dependency mechanisms. Human behaviour is extremely context dependent and only recently some important factors such as organisational framework and "safety culture" have been recognised. The incorporation of such dependencies into quantitative models, if ever possible and desirable, is not for tomorrow.

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