ORIGINAL ACRS-3121

OFFICIAL TRANSCRIPT OF PROCEEDINGS

NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Title: RELIABILITY AND PROBABILISTIC RISK ASSESSMENT

TRO4 (ACRS)
RETURN ORIGINAL
TO BJWHITE
M/S T-2E26
415-7130
THANKS!

Work Order No.: NRC-1376

LOCATION: Rockville, MD

DATE: Wednesday, June 28, 2000

PAGES: 1 - 206

ANN RILEY & ASSOCIATES, LTD.
1025 Connecticut Ave.,NW, Suite 1014
Washington, D.C. 20036
(202) 842-0034

DISCLAIMER

UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

JUNE 28, 2000

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, taken on June 28, 2000, as reported herein, is a record of the discussions recorded at the meeting held on the above date.

This transcript had not been reviewed, corrected and edited and it may contain inaccuracies.

UNITED STATES OF AMERICA

NCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

***

RELIABILITY AND PROBABILISTIC RISK ASSESSMENT

Nuclear Regulatory Commission
Room T-2B3
Two White Flint North
11545 Rockville Pike
Rockville, Maryland

Wednesday, June 28, 2000

The committee met, pursuant to notice, at 8:30 a.m.

MEMBERS PRESENT:

HOMAS KRESS, ACRS Member

JOHN D. SIEBER, ACRS Member

MARIO V. BONACA, ACRS Member

ROBERT E. UHRIG, ACR Member

WILLIAM J. SHACK, ACRS Member

PARTICIPANTS:

NOEL F. DUDLEY, ACRS Staff

HOWARD J. LARSON, ACRS/ACNW Staff

JOHN T. LARKINS, Executive Director, ACRS

MICHAEL T. MARKLEY, ACRS Staff

GERRY EISENBERG, ASME Project Team

SID BERNSEN, ASME Project Team

KARL FLEMING, ASME Project Team

RON SIMARD, Chair, ASME Project Team

RICK HILL, GE Nuclear Energy

BARRY SLOANE, Westinghouse

RAY SCHNEIDER, Westinghouse

MARY DROUIN, NRC, Office of Research

IAN WALL, Consultant, EPRI

BOB BUDNITZ, ASME Project Team (via speakerphone)

BRUCE MROWCA, Baltimore Gas & Electric

C O N T E N T S

P R O C E E D I N G S

[8:30 a.m.]

CHAIRMAN APOSTOLAKIS: The meeting will now come to order. This is the first day of the meeting of the ACRS Subcommittee on Reliability and Probabilistic Risk Assessment. I am George Apostolakis, Chairman of the Subcommittee.

ACRS members in attendance are Mario Bonaca, Thomas Kress, William Shack, Jack Sieber and Robert Uhrig.

The purpose of this meeting is to discuss the proposed final ASME standard for probably risk assessment for nuclear power plant applications.

Tomorrow the subcommittee will discuss the status of risk-informed revisions to 10 CFR Part 50, including proposed revision to 10 CFR 50.44 concerning combustible gas control systems, issues in the Nuclear Energy Institute letter dated January 19, 2000, Option 3, and public comments related to the advance notice of proposed rulemaking on 10 CFR 50.69 and Appendix T, Option 2.

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

Michael T. Markley is the cognizant ACRS staff engineer 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 May 16, 2000.

A transcript of the meeting is being kept and will be made available, as stated in the Federal Register notice. It is requested that speakers first identify themselves 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. However, Mr. Robert Christie of Performance Technology, Incorporated, has requested time to make a presentation during tomorrow's session concerning proposed revision to 10 CFR 50.44.

We will now proceed with the meeting and I call upon Mr. Gerry Eisenberg of ASME to begin.

MR. EISENBERG: Thank you. I am Gerry Eisenberg, Director of Nuclear Codes and Standards at ASME, and I want to thank the subcommittee for this opportunity to brief the committee as well as to receive direct and early feedback on our proposed ASME PRA standard. I think this feedback is a very important part of our process.

With me at the table here, all the way to my right, is Karl Fleming, a member of our Project Team and

Standards Committee; Sidney Bernsen, who is the Chairman of our Standards Committee; and Ron Simard, who is Chairman of our Project Team. Also, supporting Project Team members Rick Hill, Barry Sloane, Ray Schneider and Ian Wall.

With that, I would like to turn it over to Dr. Bernsen.

MR. BERNSEN: Good morning. My name is Sid Bernsen. As Gerry said, I am Chair of the Committee on Nuclear Risk Management, the Standards Committee that is responsible for approving the standard and maintaining it.

We have a few visuals and they are also in a handout. It was prepared for both the workshop that we held yesterday and for this meeting today. I don't intend to cover in detail all of the slides, but they are for your information.

The first, just to review where we have been and we are finally -- we are happy we are finally back here again to talk to you. We are using the ASME redesign process which involves using a project team of experts to develop the document, publish it for early public and comment, and then it will be approved by our committee, which is a balanced committee without any dominance in any sector, and the work is overseen by the Board of Codes & Standards. And we intend for the standard to be recognized as an American National Standard, we are going to submit it

to ANSI for approval.

The current status, historically, as you know, we issued draft 10 for comment in the spring of '99. We received 49 responses and well over 2,000 general and specific comments and suggestions. This project team has worked intensively to address the comments. I am not aware of any effort in standards that involved as much as time investment on the part of the people. The NRC, the industry have all participated heavily in this thing. Project team members have worked extremely hard to address the comments.

Our draft 12, which is the one in your handouts, was issued for comment June 14th, and with it is included a white paper that summarizes where we have been and where we have come to.

Just briefly again, the scope and purpose of the standard, it covers a Level I PRA analysis of internal events at power, excluding fire, and a limited Level II, sufficient for LERF evaluation. It is developed to support risk-informed applications, including, of course, those within the ASME Codes & Standards framework, the inservice inspection, inservice testing, and others underway. And it is developed to support the use of existing PRAs, which, as we get into our discussion, is something to keep in mind.

It provides a process for determining the ability of a PRA to support an application and it provides options

for augmenting the PRA either by adding to it or by supplementary analysis to handle those cases where the PRA has weaknesses and deficiencies.

Projected schedule, perhaps a bit optimistic, but we are going to work toward it. August 14th, the comment period ends. The project team will work to disposition the comments and we hope by early October it will go to the committee for approval, and that particular package will include responses to the substantive comments. We will probably go for a parallel public review at that time, the formal public review.

Then the votes from the committee are due back in a month. The team will work to resolve the comments. And if we are successful, the whole package can go to ASME Board of Codes & Standards for their concurrence before the end of the year. And the ANSI process may take a month or so more.

The purpose of this review, and, as you know, we held a workshop yesterday where we introduced this to a number of members of the industry and public, is primarily we want to make sure that we have resolved your specific comments, your meaning in the case, obviously, ACRS sent a lot of comments through the staff. And we have tried to address them, but we really need the feedback from you on how well we have done, the acceptability of other changes we have made in response to other comments.

Recommendations for the future. This is a living document. We are probably going to have to defer a number of the comments and recommendations for future consideration, so long as we come up with a standard now that is adequately comprehensive and usable. And we hope that the comments will be supported with a basis, justification and proposed wording.

The only other thing I would like to mention is we do have a number of representatives of the project team here today. They are participating as individual experts. Their comments don't necessarily represent the position of the committee or ASME. Obviously, we haven't formally approved the standard, and, therefore, we don't have an ASME position on the standard, but I think you will hear from people who are quite knowledgeable and, in a few cases, we may even expose some still areas that need resolution, where there are some differences of opinion and approach.

And we certainly welcome your interest, which we know has been continuing, and the input that you have provided to us. So, with that, I am going to turn the meeting over to Ron Simard, who will discuss in more detail the comments and what we have come to. Thank you.

MR. SIMARD: Good morning. I am Ron Simard. I would like to acknowledge two more Project Team members who have joined us since Sid made his introduction, Frank Rahn

and Mary Drouin.

Gerry, I would like to skip right to the slide that summarizes the comments that we got on Rev. 10, because what I would like to do is set the stage for Karl Fleming's presentation and the more detailed discussion that I expect we will get into about the approach we have taken in Rev. 12.

But let me try to help you understand what was behind our rationale for the approach in Rev. 12. As Sid said, we got a substantial number of written comments at the end of the comment period on Rev. 12, and I am holding this up. This is a two-sided copy. And in addition to the comments that you see here that were submitted in writing, we had discussions at a public workshop held shortly after Rev. 10 was released, and at a number of key industry meetings throughout the year. And what you see on this viewgraph is my attempt to summarize what were the very strong and clear messages that came through in all these various discussions.

There was a very strong sense that Rev. 10, was it was written, was too prescriptive, and it didn't allow the flexibility needed to apply it to a variety of risk-informed applications. One thing that we heard throughout the year was that somebody had counted the number of "shall" statements that were in the standard, and I am not going to

propagate that number by repeating it here, but there was perceived to be a large number of "shalls."

Now, there were a number of concerns with that, and I think one concern that really bothered us the most is that they said the large number of shalls made it very difficult to use with the process that we had laid out in this standard for our risk-informed application. And the related remark in the second bullet here is that we needed to do more to allow users to distinguish among the grades of application, given that there is, you know, a pretty broad spectrum of applications that require different levels of PRA capability. And again, another related comment in the third bullet is that the applications that we are trying to support today are applications that involve the wide mix of PRAs. I think you all are familiar with the variety of PRAs that are out there today.

And finally, there is a considerable amount of work that has gone on in parallel with us developing this standard to assess the quality of PRAs, and that is through the industry certification process, which I understand you are going to talk about tomorrow. But as we were working to develop our standard, the guidelines for that process were being developed, and visits were being carried out. I am not quite sure where we stand today, but I have heard that by the time -- well, certainly, by the time this standard is

out, most of the plants today will have had one of these visits.

So, again, a very strong comment came through in the written comments, in the workshop, in the discussions throughout the year, that these visits were providing a lot of good insights. And they also represented a significant commitment of resources, and we needed, where possible, to acknowledge that and allow a user to make use of any insights from a previous peer review in the way that we structured the peer review requirements in our standard.

And finally, although it is not on there, there were also a number of comments that were favorable with respect to Rev. 10. A number of commenters felt that, despite the various comments that I just said about the lack of flexibility and difficulty in applying the requirements in Rev. 10 to the process, that, in fact, there was some good stuff in there. There were some very -- some characterizations of a PRA that really made sense and were worth maintaining.

So, this is what we have tried to do in our approach to Rev. 12. I won't get into too much detail in the interest of time, knowing that Karl is going to cover the approach that we have taken to recognizing different categories of application and restructuring.

But I would like to point out a couple of other

differences that you will notice between Rev. 12 and Rev. 10. There is a fair amount of restructuring. For example, we had what we would proposed as a mandatory appendix to Rev. 10 of the standard, that had a database to be used for generic data. And it was decided by the Committee on Nuclear Risk Management that the standard is not the right vehicle for that, but they have taken that on for consideration in the future, whether or not it would be appropriate for them to issue a separate standard on that.

Another thing that we have tried to do is we have tried to emphasize that, really, the heart of this standard is the process we have laid out for using the standard in a risk-informed application. So, cosmetically, we have moved that process from the bank of the standard now to the very first thing that you see once you have read the definitions. And second, we have tried to make that standard more usable.

The other thing that we have tried to do, again, responding to those comments that we talked about earlier, is we have tried to link the requirements for the various aspects of a PRA in our standard to corresponding criteria in that industry certification process where we could make the linkage. So, where we could see that one of the requirements in our standard was equivalent to a criterion that was being used in the cert process, we explicitly recognized that.

When Karl -- if Karl goes into the viewgraphs he has got, for example, of one of the tables of requirements in Rev. 12, you will see in the leftmost column, there is a unique identifier for each requirement. And where we can identify a corresponding criterion in the cert process, there is also -- that number is there.

The other thing that you will notice is that where we have retained a Rev. 10 requirement, we have also put in the number of the subsection where that requirement appeared in Rev. 10. Only for this review and only to assist you as you compare what you are looking at today with what was in Rev. 10. Those numbers will come out when it is published.

The only thing that I might do -- Gerry, would you put up the last viewgraph, the flow chart, please?

This is something that Karl is not going into in detail, and that we wouldn't expect to be -- I want to make sure that we hit it now before we get into the way we have structured the requirements. I want to emphasize the importance of the process again.

This slide summarizes some of the main points of the process as we have laid it out in Rev. 12. We emphasize, for example, that the process is -- that the requirements in the standard, for example, apply only to a PRA that is going to be used in this process. So, the requirements in Section 4 apply only to a PRA that is going

to be used in Section 3. They are not meant to describe a PRA that is going to be used outside that context.

MR. EISENBERG: You might point out that it is the last one. They are looking for it.

MR. SIMARD: In case you are having the trouble finding the slide that is up there now, it should be the last slide that is in the handout with my name on the front. You got it?

The other thing is that in the second bullet, we have added a statement to say that we -- the process intended to be used with a PRA, that has had a peer review, that meets the requirements of Section 6 of the standard.

A third point that I think came up again yesterday, we had some useful feedback yesterday, I think maybe we need to emphasize this a little bit more, is that in the process we go through the various aspects of the PRA requirement by requirement, as opposed to saying the entire PRA has this level of capability. In certification language, we don't say this is a Grade 2 PRA or a Grade 3 PRA.

And finally, it is only those aspects of a PRA that you need for the application that you are considering that would have to meet the capability level that we lay out in our standard.

DR. BONACA: I would like to just make a comment

for the record, because we discussed this yesterday at the workshop. I still have an issue or a concern with the presumption that there is in Box A, that one can say this is my problem and this, all I need to do is to develop this primitive model and that is good enough, because, as I mentioned yesterday, I have seen it hundreds of times and that we use PRAs for so many years.

The PRAs always surprised us with findings about dependencies that we did not understand when we were trying to address a problem. PRAs always surprised the specialists, they surprised the electrical engineers or the mechanical engineers about things that they had not imagined, and most of them were in the description of the support systems.

And I am saying that I don't think it is a major issue, however, I feel that the standard right now, it doesn't provide any warning to this kind of issue, at least in the forward where the distinction is being made in the process. There have to be some forewarning that says that changes proposed to be addressed with a Category I type of capability should be very limited. I mean there is a message somewhere here, but it is not very well communicated. And this point of the importance of the dependencies that cannot be intuitively understood up front has to be presented. That is a judgment I have. And I

present yesterday, Karl. And, you know, anybody who has used extensively PRA always gets these kind of findings and surprises.

CHAIRMAN APOSTOLAKIS: So, how would you change Box A?

DR. BONACA: I would not, maybe not change Box A, but in the text where you have a description, in fact, of how the steps are being done, there has to be a very clear warning that there is always a risk in limiting your projection of a model that you may miss something there.

MR. SIMARD: Thank you. That is useful comment.

DR. BONACA: And I can verbalize it and put it down in writing and send it to you as a comment, I think.

CHAIRMAN APOSTOLAKIS: Yes. I think I would appreciate it.

DR. KRESS: Would it be useful, Mario, to say -- say, you have identified your issue as a Category 1 type PRA need, to use that Category I PRA in an iterative fashion to verify that, sure enough, it was a Category I? Or is that lifting yourself up by your bootstraps too much?

DR. BONACA: Well, I guess what I am trying to say here is that if I had the Category I that I tailored to address my issue, and then I did the same evaluation with a Category III, for some changes, Category III will tell me something different than Category I.

DR. KRESS: Tell you something too much different than Category I.

CHAIRMAN APOSTOLAKIS: It is really Box C that you comment is addressed --

DR. KRESS: Yes, determining.

CHAIRMAN APOSTOLAKIS: It determines the category. That is where the warning should be.

DR. BONACA: It maybe ought to go there. Yeah.

CHAIRMAN APOSTOLAKIS: Determine the category of application.

DR. BONACA: Okay.

CHAIRMAN APOSTOLAKIS: That is I, II, or III, Roman I, II or III.

DR. BONACA: Okay.

CHAIRMAN APOSTOLAKIS: Mario is questioning whether Category I is always sufficient, even when you think it is.

DR. BONACA: Or that if you upfront can make a decision.

DR. SHACK: I think it is really Box A he is talking about, it is always Box 2, that you have somehow identified the problem and you have limited it already upfront.

CHAIRMAN APOSTOLAKIS: Then how about Box 5? That is where you determine the category. 2 and 5 are related, I

suppose.

DR. BONACA: No, this is in the choice of the specific requirements, the set of requirements they are going through. The first assessment up there is how large -- how well is my model supposed to be in order to address this specific question.

CHAIRMAN APOSTOLAKIS: I think we are going to have a discussion of the categories when Karl gets up there, the appropriate slides. So let's say that we note the comment.

I think Mr. Bernsen wanted to say something.

MR. BERNSEN: I was just going to say that perhaps we do have something, I think it is in the quantification area, where we say, when you are all done, you have got to review this for reasonableness. And it may be that it would be better to consider as an option, when you get done doing the application, look back and see that you have had a reasonable --

DR. BONACA: But if you look at the quantification, I mean you have statements like, you know, for Category I, you may want to check that the truncation total does not exceed the CDF from the rest. I mean you may want to do that.

MR. BERNSEN: That type of thing, right.

DR. BONACA: This is so loose that, you know,

there is not really a verification that you are making. You know, if I go through those requirements on the quantification, they don't give you any --

MR. BERNSEN: What I am saying, a similar thing at the end of the application, when you have done it and you have your results, then you need to sit back and look at it and say, what have I done, is it reasonable?

DR. BONACA: I just, the last testimony, my main concern is that if there is a presumption in this, and people in good faith may think, and probably they are thinking today, that they have very limited model and they can do the world with it, because there is sufficient description But the fact is I can tell -- I mean anybody who uses the PRA, how many times the PRA provides surprises to the deterministic people, because it provides dependencies that they don't understand upfront, so.

MR. SIMARD: Well, I think at this point what I will do is, I think at this point I will end and let Karl start walking us through the way the requirements are structured in more detail. And then that will help to give us specific examples before us that we can talk about.

CHAIRMAN APOSTOLAKIS: Good idea.

MR. SIMARD: I will just note one thing, if we have any comments in particular about the Level II LERF analysis, all the sections, the nine elements of the PRA

that we describe in our standard were assigned to various members of the team with one team member as the lead. In the case of the Level II LERF analysis, the team lead was Ray Schneider, who, unfortunately, has a conflict and will have to leave here around 10:00. So, if we have additional comments beyond that, I think other team members can help, but it might be good, if there is anything really substantive, to try to involve Ray if we can.

CHAIRMAN APOSTOLAKIS: Perhaps after Mr. Fleming gives us an overall view of the methodology, we can jump into LERF and make sure that the comments are covered. Now, who is this Mr. Fleming?

MR. FLEMING: My name is Karl Fleming and I am --

CHAIRMAN APOSTOLAKIS: The committee is not familiar with you.

MR. FLEMING: I am a member of the Project Team working on the standard.

CHAIRMAN APOSTOLAKIS: Okay.

MR. FLEMING: I would like to begin my presentation with a few comments on Mario's concern, because I think it is a valid concern. But there are a couple of comments I want to make that could perhaps mitigate the impact of your comment.

On one, I think one part of your comment indicates, and I agree with this wholeheartedly, there is a

critical mass for a PRA, that before we can even put the PRA label on something called a PRA, it has to meet some minimum qualifications. And it is certainly our intention that the Category I requirements capture that, and if there are some specific problems or limitations with our requirements that don't get us to that critical mass, we certainly are anxious to get that feedback.

But another reflection I want to make is Ron indicated there has been, you know, more than half of the plant PSAs have been subjected to this industry certification peer review process. I have participated on about 10 of them myself. And I don't think there is a Category I -- I mean I doubt, I haven't seen all of them, but, based on my evidence, I would doubt if there is a full Category I PRA out there.

I think every PRA out there has many elements that would classify as Category II and some Category III. And I think the concept of the block diagram that we have shown earlier is to try to clarify that a given PRA may have an outstanding accident sequence model for transients and LOCAs, but may be very weak for ATWS or very weak for station blackout. So, there may be specific areas of the PSA that are Category I or maybe not even Category I, but other aspects of their PRA and systems and data treatment that may be very good.

So the block diagram is meant to clarify that, for some applications, what -- the current PSA, with its weakness and strengths, could be adequate for a given application, and to advance the concept that perhaps one can use the PSA today and incrementally, you know, build on its capabilities without having to invest huge resources to bring the whole PRA up to some level before they can begin to apply it.

CHAIRMAN APOSTOLAKIS: Speaking of resources, Karl, you are very experienced with these things, given that most units have an IPE now, what do you think the cost would be, roughly, for the utilities to upgrade those to a good Level II PRA and then a good Level III PRA? What are these huge resources we are talking about all the time?

Is it $10 million or half a million dollars?

MR. FLEMING: I would say that if there is an example of a PSA that went to the minimum, might be requirements and not much further, and did not update it and so forth and needed to do risk-informed applications, I would say that the typical cost upgrade, if they just sort of purchased the services from a consultant company, may be one million dollars to update the Level I PSA, and perhaps half a million for the Level II.

CHAIRMAN APOSTOLAKIS: So with a million and a half, they would have a very good LEVEL II PRA?

MR. FLEMING: Right.

CHAIRMAN APOSTOLAKIS: And the would not need to agonize over Category I, II, III, and all these things?

MR. FLEMING: Right.

CHAIRMAN APOSTOLAKIS: So I'm a little puzzled here. Where are these limitations in resources and so on? It seems to me a million and a half, considering the benefits that the utilities will have from the PRAs, is nothing.

And yet we hear all the time that there are limited resources, that we have to develop standards that recognize that you don't need a good PRA for all applications, and debate it.

You know, we spend a million and a half debating when you need a PRA, instead of spending it doing a good one.

Now, Mr. Sieber, I think, has something to say.

MR. SIEBER: Well, my comment is that in the context of budgeting for a nuclear power plant, a million dollars is something. And it takes at least two people, full-time, to keep the PRA up, and that adds to your employment list.

And so it's not inconsequential.

CHAIRMAN APOSTOLAKIS: It is no inconsequential, but I think we're spending that much money arguing about

quality and arguing about -- instead of just doing it. Of course, this has nothing to do with the ASME standard which is facing reality, of course.

But I was just wondering why we have all these things. But anyway, you answered my question.

MR. FLEMING: I think that whatever the resources are and whoever wants to decide to allocate those resources, it's also a legitimate consideration to optimally allocate those resources so that you're adding the resources in the parts of the PSA that you need to apply today, so don't necessarily have to go out and put a bit chunk of resources in at once.

CHAIRMAN APOSTOLAKIS: It seems to me that the Revised Oversight Process has sent a clear message that this Agency is serious about risk-informing the regulations.

MR. FLEMING: Right.

CHAIRMAN APOSTOLAKIS: So whether the utilities want to spend a million dollars now, or drag their feet and spend it three years from now, I think it's coming.

MR. FLEMING: Right.

CHAIRMAN APOSTOLAKIS: And the Staff was authorized recently to request risk information from the licensees, even if they choose not to submit risk information. So now you tell me what those signs are.

MR. SIEBER: Right.

DR. BONACA: I would like to add just one more thing, Mr. Chairman, which is --

CHAIRMAN APOSTOLAKIS: George, for you.

DR. BONACA: I totally agree with your statement that I don't know of any PRA out there that is just a Category I. But also, I would like to remake the statement that I made yesterday that if there was one Category I PRA, it would be a dog. I mean, I would be really something that you would not want to use for anything.

And then we have a standard, however, that would allow for a PRA to be that poor, because it doesn't say here that only some aspects should be Category I, and others shouldn't be.

CHAIRMAN APOSTOLAKIS: If you remember yesterday, we discussed something that I believe the gentleman from ASME agreed that if you think in terms of Regulatory Guide 1.174, and you remember the almost white lower left-hand side corner, then as you move towards the boundary, it becomes darker and darker.

Category II, I believe we said, really would apply to the nearly-white area. As you moved to the darker areas, then you enter Category III, which I think is a very good description of the categories. I mean, that really cleared it up for me.

And the other important thing, Mario, which is

relevant to your question, is that there is no room for Category I there. In the context of 1.174, I don't see a Category I playing a role.

DR. BONACA: You're right. I'm not saying that. I'm only saying that when I look at the standard, I have always had an expectation that standards are the standards, which is, you know, I have something I can look up to, and I know I can do something with that standard.

And so, I'm a little bit troubled by -- and I recognize, totally, the point that you are making, about only looking at certain attributes.

But, taken in a vacuum, you could think about, you know, these are Category I and what could I do with that? And the issue -- and the answer is, you can do much with it, which is a very poor --

CHAIRMAN APOSTOLAKIS: Karl, you remember many years ago, in order to streamline the PRA, there was a Phase I where people used rough point estimates, looking at other similar PRAs, PRAs for similar plants.

And they came up with a list of dominant sequences before they started doing a more detailed analysis.

Now, as I recall, that list was pretty good. I mean, a detailed analysis did not really upset the order that you got.

Would you say that that kind of a crude ranking

would be a Category I application?

MR. FLEMING: Well, I think that it would. I think the main difference might be some of the documentation requirements.

Those limited-scope, Phase I PRAs that you're talking about, their primary purpose was to optimize the resources for the full PRA.

CHAIRMAN APOSTOLAKIS: Right.

MR. FLEMING: And I don't recall many important decisions being made.

CHAIRMAN APOSTOLAKIS: No, no.

MR. FLEMING: On the basis of that.

CHAIRMAN APOSTOLAKIS: I agree.

MR. FLEMING: It was a way to risk-inform the PRA itself.

CHAIRMAN APOSTOLAKIS: But the results, though, were fairly robust.

MR. FLEMING: Yes, if experienced people are doing the PRA, they are capable of coming up with dominant sequences very quickly, with maybe ten percent of the resources of the PRA.

DR. KRESS: George, with respect to your categorization, linked to the white to dark, the problem I have with that is that white-to-dark space has -- is in a plane at which you have to have the absolute value of the

CDF already, and the absolute value of the LERF.

That means you have to have a Category III to determine those numbers, before you even enter into that space.

CHAIRMAN APOSTOLAKIS: If you want to be a purist, that's correct.

DR. KRESS: Yes, well, I am a purist.

CHAIRMAN APOSTOLAKIS: There are situations, I think, where you have an idea that you are really way down there.

Some of the newer plants are highly redundant, they produce numbers like ten to the minus six. Now, you might say that if you don't have a complete PRA, that number could be as high as ten to the minus five.

But you're still --

DR. KRESS: You still could estimate.

CHAIRMAN APOSTOLAKIS: -- in that region, so I mean, at least trying to tie it to the decisionmaking process, helps, I think. But, again, you can never draw a line and say Category II to the left and III to the right.

We have a request?

MR. SCHNEIDER: Yes, Ray Schneider, Westinghouse.

One of the issues with the Category I is that if you view that some PSAs will have Category I elements where they were intended to be conservative in the modeling, tried

to give a higher estimate of CDF, which tried to give a higher estimate of LERF, and in those cases, you can make decisions within certain regions, as long as you're making the decision based on a well-focused assessment, and you understand what the limitations of the PSA is, and that you understand the uncertainty bounds are with respect to the uncertainties.

And so if you are on the high end, you can make reasonable assumptions, so that while we're not -- the standard isn't purporting to say you should have -- anyone should have a Category I PSA, but Category I PSAs could have Category I elements within them that -- where certain assessments can be made, and made quite effectively and quite robustly.

DR. BONACA: I understand.

MR. RAHN: Mr. Chairman?

CHAIRMAN APOSTOLAKIS: Yes.

MR. RAHN: Frank Rahn, a member of the Project Team.

I know it's hard to believe, but there are potentially some ramifications that are non-regulatory in nature, where we don't even need to, for instance, consider a Category II, but where a Category I may be well sufficient to make a decision.

Again, the purpose of a PRA is a guide to your

thinking, and there are applications, as example, making insurance decisions, which are based on some insights in PRA where we've used this, things like trip meters which may be economic decisions.

So the ASME is not only serving, if you will, the regulatory applications, but a whole spectrum of other applications where a Category I application may be sufficient.

MR. SIMARD: Karl, are you done?

CHAIRMAN APOSTOLAKIS: No, we are discussing Categories without -- I suggest going directly to the categories.

MR. EISENBERG: Show me which one.

MR. FLEMING: The next one, actually.

CHAIRMAN APOSTOLAKIS: Either the second or the third.

MR. FLEMING: In the effort that we went through to prepare this draft, we were attempting to meet several objectives, one of which was to retain the technical resources that had been set forth in Draft 10, and also to try to match up the requirements to the certification process.

We spent quite a bit of time in the last six months, working on the definition of the application categories, because the detailed supporting requirements are

all specified in terms of three different application categories.

We came up with three categories that match the top three categories of the industry's peer review and certification process.

We go in there, recognizing that a given PRA will have to be examined for their capabilities with respect to the details of the PRA. Individual elements and individual parts of the PRA within an element may fall into different categories, and with that recognition, we'd like to be able to provide a set of tools for the utility to use, so that they can find the appropriate applications to support the requirements.

We might move to the next slide, please. A little bit on the definition: I think George's descriptions were provided some good insights.

The Category I applications, we define in terms of decisions that are normally made based on deterministic analyses. And if you had a PRA, you could supplement those deterministic insights with PRA insights.

But these are applications that refer to actions that the utility has to do anyway, with or without a PRA, and with the availability of the PRA resources, can provide additional insights.

Category II was intended to line up with risk-

informed applications, the minimum applications that might be required to support a risk-informed application in which you need a balanced set of PRA insights and deterministic analyses.

Category III applications get up into the area where in Reg 1.174, you need to increase management attention, where the decision more heavily hinges on the validity and absolute values of the PSA.

DR. KRESS: Let me ask another question: I like to think in terms of uncertainty. And it seems to me like you could link each category to the degree to which you need to know the uncertainty.

For example, Category I looks to me like you need to know the uncertainty, because the application is of such a nature that you cover it otherwise with the deterministic analysis.

Category II, you probably need to know something about the uncertainty, but you can probably do it with a sensitivity-type analysis.

MR. FLEMING: Right.

DR. KRESS: Category III looks to me like it needs a full uncertainty analysis. Is that a good way to look at these?

MR. FLEMING: Yes. There are several different attributes of the PRA that we have looked at across these

application categories.

And uncertainty is one of those. In fact, we'll go on to Slide Number 4 where we identified the differentiation across these categories with respect to the expectations for uncertainties.

In Category I, there certainly is a need to appreciate the sources of uncertainty and the general concepts of uncertainty that are behind the PSA results.

In the Category II, there is an expectation that you can understand uncertainties well enough to be able to identify your CDF and LERF estimates with mean values.

That means you have to think adequately through your uncertainties to be able to say that the point estimates you're calculating are reasonable estimates of the mean value.

And then finally, in Category III, a full quantification of the epistemic and alliatory uncertainties is expected, which is consistent with Reg Guide 1.174 expectations.

DR. KRESS: I should have looked ahead to see your slide.

MR. FLEMING: Yes. So that is one of the dimensions. Another dimension is the extent to which the decisions may impact the licensing basis with respect to safety-related systems, structures, and components.

And as Frank Rahn mentioned, there may be applications in which the utility might want to make some changes to the balance of plant to reduce the -- to improve the reliability of the plant, in which case, it does not have to apply to the NRC for these types of decisions, and may have somewhat less requirements to document the PSA so that a regulatory body can participate in the peer review process.

CHAIRMAN APOSTOLAKIS: Now, again, this is something that came up yesterday. When we discuss these things, I think it's important to always bear in mind what the purpose of this is in the standard.

In other words, I don't think anyone will come to the NRC and say, well, this is a Category II issue, and that's why I did it this way; don't ask me any questions.

The staff will say, well, excuse me, but here are 100 questions. So that's not the intended use.

The intended use is before they come here, to think about the issues. What would be required? So there is a contribution to the general, I would say, elevation of the state of the art to a certain level.

So the licensee will know in advance, what kinds of things are really expected of the PRA. So when they come here, they will be prepared.

So in that sense, I'm fairly comfortable with

this, because it recognizes, you know, reality.

I mean, we can argue about the words and put in 1.174 references and so on, but I -- but if the intent was, I mean, to have somebody come and say, gee, the standard says Category II, and you are asking questions about Category III, well, excuse me, then I'm against it.

But the Staff will always be free to ask the questions that they feel are appropriate to ask.

So, that's fine with me. If the licensee wants to think that it's Category I and come here and be surprised, well, that's one more surprise for Mario here.

PRAs surprise people in a lot of ways. So, I'm happy with the -- I mean, not the details, but the whole idea.

DR. BONACA: I didn't not express an opposition to the way that the standard is being -- I believe, however, that there is need for -- I think, in the text, you know, the presentation, I think, is clearer than the text.

There is a need to translate some of this into the text, so there is a clearer understanding of the limitations of PRA Category I, and, therefore, you don't stray from this approach.

CHAIRMAN APOSTOLAKIS: In the context of what I just said, of helping the licensee understand what is happening here, so that he won't be surprised before the

Staff, that would be a very valuable thing to do.

DR. BONACA: Yes.

MR. FLEMING: The other thing that came out in our presentation yesterday, and I think we got some feedback that we could improve our presentation of this in the text.

And that is that there is also an expectation that in terms of the scope of coverage of these requirements, in terms of the dominant and risk-significant accident sequences.

And in this slide we bring out the expectation that for Category I applications, we have a set of requirements, and we expect those requirements would capture the critical mass issues before we could put the label of PRA on the product.

But we impose the requirements on the treatment of the dominant sequences. And so, for example, there may be some requirements that have to be applied to the dominant sequences that are not important for the non-dominant parts of the accident sequences.

When we go into Categories II and III, we have to extend the application of these supporting requirements to all the risk-significant sequences. And if we go up into this area of increased management scrutiny, we may have to go beyond the risk-significant sequences to some of the even less important sequences, to the extent that that may impact

the decision.

So, that's another characteristic of these requirements, and one of the feedback discussions we had yesterday is that we probably need to work on a definition of what we're talking about when we use these terms, dominant, and risk-significance.

We did not include those in the actual definitions section, and I think we got some feedback that we would be well advised to add that.

If we can skip the next slide, so, working sort of from a top-down fashion, we, of course, then have the elements, the nine elements of the PSA, and these are the same nine elements that we used in Draft 10.

And they are very typical of what you would see in the breakdown: Initiating Events, Sequence Development, Systems Analysis, Data Analysis, and so forth.

There are nine of these that cover the scope for internal events, including internal flooding, but not including internal fires.

If you look at these attributes, the attributes call out the concepts of dominant versus risk-significant accident sequences, and the other concept that's clearly differentiated across these three columns is that conservatism is tolerated, if you will, more completely -- more freely in the Category I applications, whereas it's not

really tolerated in the risk-significant arena for the Category II and III applications.

And anytime that we permit or provide the opportunity to meet requirements with conservative assumptions, we have the caveat that the conservatisms do not distort the ability to make risk screening applications that you would need in a Category I.

The basic Category I type of applications are applications in which you just want to make course screening of elements of your PSA into very course risk categories, so that conservatism would be permitted, only to the extent that it does not distort that kind of application.

So that's -- these attributes provide the logic for how we tried to come up with a differentiation, when appropriate, for the supporting requirements for each of the categories.

CHAIRMAN APOSTOLAKIS: Under Data Analysis, it says realistic quantification of mean values.

MR. FLEMING: Right.

CHAIRMAN APOSTOLAKIS: Many PRA type analysis -- a lot of people take a point estimate, and they say, well, this is a mean value.

That's not what you mean here. You have to alert people to the fact that the mean is not the same as somebody's best estimate.

MR. FLEMING: That's right. The concept for data and quantification is that point estimates, which could be conservative estimates, as long as they don't distort the risk profile, are accepted for Category I.

Mean point estimates are expected for Category II, and that means that you have to carry through your uncertainty analysis to a sufficient extent to be able to show, demonstrate that you have mean values.

CHAIRMAN APOSTOLAKIS: That's stated somewhere? It should be clarified.

MR. FLEMING: We certainly intended it to be.

CHAIRMAN APOSTOLAKIS: Yes. I don't remember seeing that.

DR. KRESS: That's the mean value of only the alliatory uncertainty?

MR. FLEMING: Alliatory and --

CHAIRMAN APOSTOLAKIS: Epistemic uncertainties, as well. I think it is really epistemic.

DR. KRESS: Yes. That's only the --

CHAIRMAN APOSTOLAKIS: The failure rate is epistemic.

DR. KRESS: Yes.

MR. FLEMING: Whatever epistemic uncertainties that are included in the model.

CHAIRMAN APOSTOLAKIS: Yes, the human error rates.

MR. FLEMING: Yes, the human error rates, and --

CHAIRMAN APOSTOLAKIS: So that's a key point, and I think that maybe we can look for a place to make sure --

DR. KRESS: Both of those things need clarification.

MR. FLEMING: For example, that would require some kind of uncertainty analysis be done at the data level, but not necessarily propagated all the way through to CDF and LERF.

CHAIRMAN APOSTOLAKIS: But when you propagate mean values, in some instances, as you know, the variance plays a role.

MR. FLEMING: Right.

CHAIRMAN APOSTOLAKIS: I think people will find it easier to just do a Monte Carlo simulation. That is at least numerical, you know. Just do it.

MR. FLEMING: And that may be, in fact, the case.

CHAIRMAN APOSTOLAKIS: I wonder whether we can, before Karl moves on to discussing requirements, maybe we can start with the LERF, the very last one, Level II analysis, and make sure we cover it before the expert leaves? How about that? Is that okay?

MR. FLEMING: Sure.

CHAIRMAN APOSTOLAKIS: Unless there is something --

MR. FLEMING: Sure.

CHAIRMAN APOSTOLAKIS: Do you have any viewgraphs on this subject?

MR. SCHNEIDER: No. I was just basically going to take questions from the Committee, but I would want to put something in overview in terms of what was done with the LERF section.

The intent was not to be a full Level II PSA, but to look at the LERF surrogate that the NRC's been using for regulatory review. And the three categories in --

The words probably don't specifically state the way it was structured, but the three categories, Category I, was generally intended to be the conservative estimate of LERF, using bounding assumptions, where bounding assumptions would be -- would provide acceptable results in sufficient margin.

As you move it to the Categories, you will get increased resolution and increased precision. You include more information, more phenomena, and more information on the -- more details on the quantification.

So as you go from Category I, II, and III, what you should be getting is a more refined prediction of LERF, generally moving down.

The expectation is that Category I estimates should not under-predict LERF.

Okay, I guess with that as an overview, I'll take questions.

DR. KRESS: Well, I had a couple of questions, mostly -- I thought that was a fairly good section of the standards, but I had some questions that I think are mostly just of a clarification nature.

On page 126 of my version of the document, in the Category III applications, you say in the bottom box there, you say you include a requirement that the effects of in-vessel melt retention ought to be included.

And I wonder why you felt it necessary to actually spell that out. Is that at all applicable to any operating plants we have?

MR. SCHNEIDER: There are several C-plants that have the ability to be bottom-flooded, and some of them have credited a certain proportion in their detail Level IIs, more or less a certain proportion of the events wouldn't necessarily go to failure, because they could flood all the way up to the nozzles.

So, there's a -- we have integral lower heads, so, as a result of the design differences, at least for the plants that I'm familiar with, it is a consideration that has shown up in PSAs, and could result in certain events that would have gone into failure/not going to failure.

DR. KRESS: My understanding is that they all go

to failure if you include the uncertainties, and the size of the vessels and the power levels are such that none of them really can take much credit for in-vessel retention.

I would rethink whether or not I wanted to have that called out, specifically, there. But maybe I'm wrong there.

MR. SCHNEIDER: I believe that most of them can, and the analyses depend on -- there is, I guess, the probabilistic assessment that a certain fraction of them, under -- I guess there were two issues.

One was a delayed injection into the RCS, coupled with a flooding of the external would give you a high probability of recovery.

And that wouldn't be recovery in another high-pressure event or another event that progressed slightly differently. That's why it says level of precision that's moving.

What's happening is that you're reducing your LERF probability.

DR. KRESS: My feelings are that the uncertainties are so large in that that it probably is not useful.

MR. SCHNEIDER: Understood.

DR. KRESS: Likewise, on page 128, in defining a large early release it says that the analyst may consider mitigating factors, such as played out and deposition of

fission products released from the fuel and the release pathway characteristics.

I certainly again with that but unfortunately nowhere in the standards do you mention any standards for fission product release modeling that I can see at all because you are dealing mostly with LERF, which doesn't really involve the modelling of fission product release, but if you are going to take credit for mitigating issues, then you have to know something about the timing of the release. You have to know something about the species. You have to know something about the aerosol characteristics which depend on those things, so when you say they may take credit for it, you don't go the next step and say but if you do you will have to meet certain standards in your fission product release model, so this is more just a comment than a question.

MR. SCHNEIDER: Good point.

DR. KRESS: And I guess I had one other. This is a clarification question.

On Table 4.49 on the dominant contributors to be considered in LERF, I was a little bit interested in why under hydrogen combustion for example you included Mark 1s and Mark 2s, which I thought were inerted and why you didn't include large dries because in combination with other loads hydrogen combustion could be the straw that puts you over

the brink so I was just wondering why the check marks, how the check marks came about in that table?

MR. SCHNEIDER: For the large dries, the Level II analyses and the experiments that have been followed up, that have been used to support this is that the DCH and hydrogen combustion really aren't concurrent. They do occur displaced in time and while if you add the two together would put you above the brink, they probability that they will be there as a dominant contributor hasn't shown out to be in practice, in experiments.

I think that is why we didn't put the check box there for that and why we kept it but we did keep it for the DCH induced failure with a certain probability, but when you start adding the DCD in hydrogen the probability would be a lot lower.

Also, a lot of the analyses that are actually being done often when they do the DCH add to it, consider the hydrogen combustion in conjunction with the DCH as well, so this is really for the hydrogen combustion independent of the high pressure melt ejection.

DR. KRESS: Okay, and they detect the Mark 1s and Mark 2?

MR. SCHNEIDER: I'll turn that over to Rick Hill.

MR. HILL: This is Rick Hill, GE, and a member of the project team.

Hydrogen combustion is listed for Mark 1, Mark 2 even though they are inerted plants. They are oxygen controlled plants and there are scenarios where you could de-inert of have oxygen in the containment and we feel that that is a question of Level II modeling that should take place even though obviously the risks are very low.

DR. KRESS: Okay, it wasn't screened out on low probability?

MR. HILL: Right.

DR. KRESS: Okay. A similar question on this table. Why did you feel like you could exclude steam explosions from consideration in large dries and ice condensers?

MR. SCHNEIDER: It goes pretty much back to what the existing Level IIs tend to show is that the steam explosion phenomenon is, once officially uncertain and low probability, that for a LERF assessment it just was over-dominated by all the other processes.

The main issues in terms of releases to the public pragmatically are where you have the loss of containment isolations above ground typically and it would be loss of containment isolation, the IS LOCA and the steam generator tube rupture.

To a much lower extent you have the probabilistic potential that you can fail containment due to the high

pressure.

The steam explosions typically occur in the lower portions of the cavity. You would have to fail the containment in a way that would affect the above-ground releases and it was just felt to be a much lower probability event that would be more than covered by the others as long as you are not doing a detailed Level II.

DR. KRESS: So you are relying on the risk insights --

MR. SCHNEIDER: From the Level IIs that were done --

DR. KRESS: -- from the Level IIs that were done by the IPEs.

I suspect that that might be a risky thing to rely on for this. I am not sure I would want to exclude steam explosions, at least I don't think the explosion itself is going to damage the containment.

We are dealing with containment here --

MR. SCHNEIDER: Right.

DR. KRESS: -- but I think there is a high probability it can add pressure to an already pressurized containment and might ought to be considered for looking at.

MR. SCHNEIDER: Well, we have looked at that issue and that is not the driver.

You can vaporize a lot of the water but the

robustness of the containments are such that you are not going to, pragmatically you are not going to have enough water in the containment to take that to a containment failure condition, but we could look at that and reconsider and check the numbers out.

DR. KRESS: Okay. Well, that is the extent of the questions I had. Do you have some?

CHAIRMAN APOSTOLAKIS: I have one or two, but maybe it is because of my ignorance of the subject.

I have always been mystified by the definition of large early release, so I was looking for a definition.

So on page 8 it says that large early release is the rapid, unscrubbed release of airborne fission products from the containment to the environment occurring before the effective implementation of offsite emergency response and protective actions.

Then on page 128 it says you define LERF consistent with the definition given on page 8, Section 2, but then it goes on and elaborates a little bit on early -- which means, early refers to a timeframe -- prior to effective evacuation of the inhabitants of the exclusionary area boundary.

My question is why are we avoiding giving a time, a rough time? I have heard in the past before three hours, but I don't know. Is it before any effective implementation

of offsite emergency response? I wonder if that is a scientific definition -- early.

What if the emergency response measures fail and they are delayed? Well, then early release is anything that is released before that? There has to be some time --

MR. SCHNEIDER: For most of the transients if you look at what contributes to LERF, it mostly isn't an issue. It comes because like if you have loss of containment isolation it is core damage events that occur and have an early core damage failure.

CHAIRMAN APOSTOLAKIS: Early?

MR. SCHNEIDER: Yes, and so you are generally talking the first several hours, so when you initially get to this, you are dealing with 4 to 8 and then that depends on how quickly they can get the information out to the public, how much population they have around the site.

For example, in Arizona, it's not going to be that bad. They know everyone's phone number, but in other areas it may take longer for evacuation so to but a rule on the time was -- we didn't feel comfortable doing an exact, precise time, but the issues that you have to consider are about how rapidly is the staff going to be able to recognize they are undergoing a core damage state, how quickly can the information get out, and when do they expect the releases to be felt given the event? For example, steam generator

ruptures may occur very late in time.

What this does is gives them the flexibility to say not all steam generator tube ruptures have to be considered large early if you can keep the core covered for 12 to 15 to 18 hours, but if you have a steam generator tube rupture that rapidly progresses to failure with an open MSSV, then that would be an early release, so --

CHAIRMAN APOSTOLAKIS: I guess my question is why is the condition of early or late, why does it depend on the evacuation and not on some physical characteristics of the accident?

MR. SCHNEIDER: The QHO was the original --

CHAIRMAN APOSTOLAKIS: The unscrubbed --

MR. SCHNEIDER: Because you go back to the original definition of what was trying to be accomplished maybe five to eight years ago when you had the Qualitative Health Objective, and that was basically to limit the number of fatalities, to put it into a certain level -- to make it consistent with the rest of the industry, and what they did is they made a surrogate and the surrogate was LERF.

So you have taken away now a lot of the features that went into what the QHO was but the QHO included evacuation, sheltering and all of those features so the LERF retained some of that flexibility without the clear definition of how it affects the population and so you need

to define something and if you put a defining time for certain plants that may not be an appropriate timeframe, so we're allowing them the flexibility to adjudge their emergency planning procedures that match up against the various events and then determine whether they would class a specific steam generator tube rupture as a large, early or a delayed.

Otherwise you may end up in situations where you have later releases that because of some issue associated with the transient that may have prevented them from alerting the public might really be classified as a large but if we put -- an early, but if we put a short timeframe involved that would just automatically throw it out and if by the same token if you put a long timeframe you probably are including too many events, especially for the plants with low population area.

So we did allow some flexibility. It mainly will affect issues like steam generator tube rupture and some of the high pressure melt events. They have to justify how they are binning it.

DR. KRESS: I think when NRC, and I may be interpreting them incorrectly, but when they went to the LERF what their intention was to do was to more or less separate outside issues from design issues and do it in such a way that the LERF would cover essentially most of the

sites.

CHAIRMAN APOSTOLAKIS: Right.

DR. KRESS: And now we seem to be going away from that and going back and saying now we have to -- if you are going to do a LERF that is site specific, you have got to have Level III PRA, which we are not dealing with in here at all. We have no standards for Level III. We don't discussion fission product standards and I think it is a mistake to in this particular standard to go wawy from NRC's intended use where the LERF that we have is related to plant accident issues, like George says.

I think you do need some sort of tighter definition of large and early release that relates to actually the timing of the accident that would be site-independent, frankly, and that is a problem I had with it too.

CHAIRMAN APOSTOLAKIS: The definition seems to depend on site characteristics in emergency --

DR. KRESS: Yes, but those fall into Level III categories and you have no standards for Level III, so I think you have a bit of a problem with that.

CHAIRMAN APOSTOLAKIS: Please.

MR. FLEMING: There was also some industry perspective on the definition of LERF that we put into the EPRI PSA Applications Guide, and we offered a definition in

the PSA Applications Guide which is consistent with this definition but it was a little bit different.

The philosophy from the industry perspective was to expand the range of risk informed applications to be able to consider some of the containment systems that might be involved in the applications, and we came up with a definition of LERF in the EPRI PSA Applications Guide which was based on the philosophy of capturing all the risk of early health effects and we used the definition that was based on the assumption that Seabrook, the Seabrook Level III PSA, which had a vast inventory of Level III analyses, and also the Staff had pretty much concluded that Seabrook had one of the more limiting sites with respect to the emergency plan, we came up with a definition in the Applications Guide, which I believe was earlier was something like within four hours of vessel breach, which for Seabrook was the time it took to clear out the EPZ based on their site specific emergency plan, and that was part of the definition for quite awhile.

We dropped the hour definition in recognition of the fact that some plants may be able to clear out their EPZ in two hours or one hour and if they have site-specific analyses to be able to tighten up their definition of LERF and not use the conservative definition for Seabrook they would have that option.

But the philosophy was to provide a surrogate for a Level III PRA that would expand the range of applications beyond what CDF could look at without dragging in all the issues that we have difficulty -- rebed cooling and basemat melt-through -- and just take a subset of the Level II issues into the risk-informed arena.

CHAIRMAN APOSTOLAKIS: I appreciate the effort but the problem I see with that is that somebody may declare their plant as capable of evacuating within 2 hours without -- and then that is buried somewhere there and that may be significantly uncertain.

DR. KRESS: You say how do you know that, whether you did Level III, how good is your Level III.

CHAIRMAN APOSTOLAKIS: And to base a quantity that plays such an important role in decisionmaking on these kinds of assumptions makes me a little uneasy.

I would rather have a definition that depends on the design, as Tom said, and the accident characteristics, at least to have some bounds and give maybe some flexibility because perhaps Karl's point is an important one that you can't really ignore the fact that they may have very good evacuation plans, but limit the impact of that. Perhaps that would be a better way of doing it, because what if someone says we can do it in an hour, and that is a sentence there somewhere there in a three volume PRA and, you know,

the whole calculation of LERF depends on that --

DR. KRESS: Depends on that --

CHAIRMAN APOSTOLAKIS: -- and it would be very hard to touch it.

I would feel better if there were some recognition, some acknowledgement that these issues are important because I fully appreciate the arguments you made.

Now there is also a page 128 user definition of LERF that captures the contributions to the risk of early health effects, but it seems to me that that has been stated several times. It is just a matter of editorial cleaning up, I think.

I think a lot of the discussion in 128 on the right-hand column is very repetitive. That's your business.

MR. SCHNEIDER: Okay. I will take that into consideration.

CHAIRMAN APOSTOLAKIS: Maybe we should start using fuzzy sets, you know -- so dead set against them, but now I see those definitions.

[Laughter.]

CHAIRMAN APOSTOLAKIS: Are you guys willing to develop a standard for fuzzy PRA? Say no.

Okay. Are we done with LERF? Well, back to Mr. Fleming.

MR. FLEMING: Thank you.

CHAIRMAN APOSTOLAKIS: I really hate to work for an hour and a half without a break.

DR. KRESS: Yes, me too.

CHAIRMAN APOSTOLAKIS: Is our Federal employee objecting to taking a break now? Okay. We will take a break now for -- oh, well. How do we define a break without using a clock? What about 15 minutes.

[Recess.]

CHAIRMAN APOSTOLAKIS: Okay. Back to session. Karl?

MR. FLEMING: Karl Fleming from the project team.

Before I return to Section 4, I wanted to make a comment. The cost estimates I provided earlier were for time and materials and not a fixed price contract.

[Laughter.]

MR. FLEMING: Getting back to Section 4, one of the comments that we wrestled with from Draft 10 was that somebody counted up 900 and some odd requirements that had the work "shall" and we were trying to avoid a frankly silly exercise where we sit down and negotiate how many "shalls" could be sent to "shoulds" or "mays" or whatever and it didn't seem to be a very useful exercise, so what we decided to do as part of our effort for Rev. 12 was to back up to, say, 20,000 feet and from the point of view of people who are competent to perform peer reviews and people who have

lots of experience in PSAs is to boil down these requirements into a set of irreducible high level requirements that point to basic attributes of a PRA that we are all aware of.

These would be attributes such as the completeness of the PRA, treatment of dependencies, the degree of realism in the assumptions and the success criteria, the degree of fidelity with the plant and the PRA model, and how well it reflects the as-built, as-operated, and design change plant and so forth and go across each of the nine elements of the PRA and come up with high level requirements phrased in "shall" language that everybody would agree have to be present and form the critical mass of what is needed for the product that we are going to put the PRA label on, whether it is Category I, II or III.

One of the tasks that we laid out here, and I will walk through some examples of those in a few minutes for accident sequences, is to capture the essence of the requirements in these high level requirements that typically are a number in the range of maybe four or six high level requirements for each of the nine elements, and we used this as a starting point for organizing and defining the detailed supporting requirements.

Many of these high level requirements are actually in Draft 10 but they may be difficult to find because it was

presented in sort of a textual format and we wanted to bring them out and make them very clear and explicit in this version.

The concept is that each of these high level requirements would apply to all three application categories, but the extent and the context in which you would apply them would be different depending on the characteristics that I mentioned in the earlier presentation.

With this kind of a concept what I would like to do is actually walk through some of the high level requirements for accident sequences.x

DR. BONACA: So you are in Chapter 4?

MR. FLEMING: Yes, we are in Chapter 4.

CHAIRMAN APOSTOLAKIS: I was wondering whether the members had any comments on the definitions and the risk assessment application process that are Chapters 2 and 3.

DR. BONACA: The Definitions section, you mean?

CHAIRMAN APOSTOLAKIS: Yes. I just got a comment from Mr. Barton, who could not be here today. On page 10, unavailability is defined as follows -- the fraction of time that a test or maintenance activity disables a system or component, also the average unreliability of a system or component over a defined period of time.

His comment is the word "unreliability" is not

defined, so there should be a definition of unreliability as well.

That brings me to another comments, which is a favorite of mine. This definition I recognize is one that the industry has been using for a long time, the fraction of time that a test or maintenance activity disables a system.

It is not consistent with the definition in reliability theory, which is that the component or system is unavailable due to any reason at Time T, and this has been an issue before in other contexts.

What was the last time we had an appendix with a definition and I didn't like it there either? The maintenance rule.

It seems to me that if one decides to go with this definition of unavailability then one would have to have in the expressions for the probability of the thing not responding --

MR. BUDNITZ: [By Telephone] This is Bob Budnitz --

CHAIRMAN APOSTOLAKIS: Okay. We know who you are.

MR. BUDNITZ: Oh. I know who you are too.

CHAIRMAN APOSTOLAKIS: Can you see us?

MR. BUDNITZ: I cannot see you. I am only on a phone. Are you more gorgeous than usual?

DR. KRESS: Yes. The answer is yes.

CHAIRMAN APOSTOLAKIS: Okay, we can hear you very well, Bob.

MR. BUDNITZ: Look, I have to be out of here at a quarter after, which is just over an hour from now.

CHAIRMAN APOSTOLAKIS: Okay, don't worry. We will be done by then.

DR. KRESS: Do you have some comments you want to make, Bob?

MR. BUDNITZ: You mean upfront?

DR. KRESS: Yes.

MR. BUDNITZ: Where are you in the agenda?

CHAIRMAN APOSTOLAKIS: We are talking about definitions. We finished LERF.

I will give you a few minutes to catch up, okay?

MR. BUDNITZ: Yes. I thought I was on because when you come to expert judgment I am the one.

CHAIRMAN APOSTOLAKIS: We will make sure we do this before you have to go.

MR. BUDNITZ: Okay.

MR. SIMARD: Expert judgment as well as any questions about initiating events -- Bob and Steve in that area.

CHAIRMAN APOSTOLAKIS: Initiating events is coming up.

So as I was saying, if we adopt this definition,

which the industry seems to be comfortable with, then there has to be an extra term, probably of failure on demand.

I am not sure that we have that in the expressions.

Now if you go to standard mathematical books on reliability, unavailability includes that so I don't know what the resolution should be.

At some point we have to make sure we have one definition.

I think the industry refers to the latter, the probability of failure on demand is unreliability, which again conflicts with the mathematical definition which says it is the probability of not performing in a period of time, so I don't know.

Do the members have any suggestions? Should we try to change the way the industry uses these terms?

DR. BONACA: Well, for me, not including other reasons why a system or component is unavailable, it just doesn't make any sense.

CHAIRMAN APOSTOLAKIS: They may include it in the calculations. I don't know.

DR. BONACA: I understand that.

CHAIRMAN APOSTOLAKIS: The definitions should include it, in my view --

DR. BONACA: -- should include it.

CHAIRMAN APOSTOLAKIS: Okay, so we will probably make a comment to that effect and the committee will have to decide.

Now speaking of definitions, I also have a question, but maybe we can wait until -- the human error. The definition of latent human error, do you want to do it now or when we talk about human errors?

MR. FLEMING: As you wish.

CHAIRMAN APOSTOLAKIS: Well, it says here on page 8 a human error typically by mispositioning or miscalibrating a component that if not detected or corrected predisposes the affected component to failure when demanded.

This is a very limited definition of the latent error, and I would recommend that you use Jim Reason's definition of latent conditions and latent, which is any human action before the actual active error takes place and not just mispositioning or miscalibrating.

Any other comments from the members on the definitions?

DR. BONACA: I would like to provide one.

On page 5 on the definition of accident class there is a use of the word "severe" accidents, and I believe that is a little bit of a narrow connotation there, somewhat confusing. I would certainly prefer to see a grouping of accidents that by severe accidents we indicate very specific

ones but you include the category of transients that are not necessarily ending up in a severe accident.

Now on the issue of accident consequences, here is it more of a -- you know, in regulatory space is meant only doses. I mean is meant only radiological release, and I am not sure that you may not want to look at that definition there if it creates an unintended conflict, a confusion.

This I am just raising as a question and would let the ASME decide what is the proper approach.

At the bottom of page 5, "available time" specifically talks about time from which an indication is given that human action is needed to where the action was performed to "avert" -- first of all, the word "avert" -- but core damage I think again is a very narrow definition there.

I don't think it is intended only that sense of available time. I think there are actions that prevent other events, not only core damage and again it is very narrow to focus on core damage -- maybe to where the action was to be performed to achieve success, whatever that means. You could let it be in the analysis.

The definition on page 6 on containment analysis needs work. There is some editorial problem there -- no, that's okay -- definition of extended events on page 6, again there is always this pointing may lead to core damage

or larger releases, but really you are looking at extended events in a broader sense -- and again that reference to core damage early release I don't think that is necessary in the context of the definition.

CHAIRMAN APOSTOLAKIS: Well, for extended events though that is really what you worry about. Isn't it? I mean if you have an earthquake or --

DR. BONACA: Yes. I am talking about there extended events is initiating event originating outside -- I mean you may conclude in the analysis they will lead you to that. You are still defining certain external events.

For example, I could have conceivably a typical external event for a PRA that you always analyze that in that particular plant will not lead to CDF or LERF.

It would still be --

CHAIRMAN APOSTOLAKIS: But the concern is that it might. That is why you analyze it.

DR. BONACA: Yes, but if you look at the definition -- may lead.

CHAIRMAN APOSTOLAKIS: May lead to the part of external events?

MR. FLEMING: Internal events. It's in the scope.

DR. BONACA: Page 7 on the harsh environment, there is a reference to appropriate for design basis or beyond design basis accidents.

I would rather a definition that does not include -- not narrow that much. Again, a environment -- as a result of the postulated accident condition.

I mean, there are some others one, and I don't want to spend any more time. I will provide them.

CHAIRMAN APOSTOLAKIS: Sure. We'll have an appendix.

DR. BONACA: Again, the word, unavailability on page 10, mirrors the comments we had.

MR. BERNSEN: Let me just ask one question. We would like, wherever possible, to use existing definitions, definitions that have been published, if they're at all consistent with our intent. So that if you have some alternative definitions that have been published, if you could cite the reference or whatever for them, that would be very helpful.

CHAIRMAN APOSTOLAKIS: Sure. We will probably have appendix to our letter with the detailed comments, maybe line-by-line. I don't know.

One last comment on the definitions which may involve Bob Budnitz. On page 6, there is a definition of expert solicitation.

First of all, I would suggest that you change it to expert opinion elicitation. It's not the elicitation that's expert; it's the opinion.

And second, it says a formal highly structured and documented process. Now, if you go to the actual section on expert opinion, there is allowance for less than highly structured processes.

So, it seems to me that it's overly restrictive to define it as a highly-structured process. Above, when you use the technical integrator, the technical integrator, then the process is not necessarily highly structured.

It's highly structured when you go to the full treatment that the technical facilitator, integrator, demands.

And I think that in Section 6, you make -- I'm sorry, 4.6, you make that point well. So it seems to me this definition here should delete -- maybe you can say a structured formal approach, rather than highly structured.

MR. BUDNITZ: Which definition are you looking at?

CHAIRMAN APOSTOLAKIS: Expert elicitation on page 6. Okay?

MR. BUDNITZ: Yes, you can just take the "highly" out of there. I understand that point. It's a good point.

CHAIRMAN APOSTOLAKIS: Or maybe completely highly structured and say a formal and documented process, and you differentiate in 4.6, regarding the various levels.

MR. BUDNITZ: It's got to be structured, George.

CHAIRMAN APOSTOLAKIS: Okay. Can you have a

formal process that's not structured?

DR. KRESS: Yes.

CHAIRMAN APOSTOLAKIS: Okay. My expert in English tells me yes. I will not question it. I have questioned it in the past and have regretted it.

MR. BERNSEN: I would observe that this is a formal process.

CHAIRMAN APOSTOLAKIS: But it's not structured.

[Laughter.]

CHAIRMAN APOSTOLAKIS: Thank you very much, Mr. Bernsen.

DR. KRESS: I had a couple of items on the definitions.

CHAIRMAN APOSTOLAKIS: Sure.

DR. KRESS: Most of mine were covered by Mario, but on page 6, the definition of core damage frequency, I wonder why the shied away from the usual connotation that's per year instead of per unit time, although, you could define it anyway you want to, but it's usually in the use of CDF and LERF, it's always per year, per reactor year.

CHAIRMAN APOSTOLAKIS: Actually, in the text somewhere they say that it's not per reactor year; that's it's per calendar year. That was a question I wanted to ask, why-- because you're considering all modes of operation, so even if the reactor --

But if the reactor is in cold shutdown, do you really care? I mean, the definition is somewhere, and let me see if I can find it.

[Pause.]

You're saying it in the text, but --

DR. KRESS: If Dana were here, he's say, yes, I care.

CHAIRMAN APOSTOLAKIS: Yes, I what?

DR. KRESS: If Dana were here, he's say, yes, I care, to your question.

CHAIRMAN APOSTOLAKIS: I think there is an inconsistency between the definition and the text. Karl?

MR. FLEMING: Yes, with respect to the -- I believe that in the technical requirements for quantifying initiating event frequencies, for example, you'll see the need for expressing units in terms of calendar year.

That's just to clarify that the alternative might be to calculate it per reactor operating year, and then you're going to be coming up with units that may be inconsistent with the criteria, you know, all the safety goals and core damage objectives, and so forth, really are calendar year.

There has actually been some confusion out there in the industry about what calculations should be performed.

DR. KRESS: Okay, the other question I had was on

common-cause failure. I thought that defining it in terms of a short period is a good idea, but it leave me wanting a little bit more in terms of what is meant by short.

It has something to do with whether the two failures are close enough in time that they actually impact the sequence somehow.

And so somebody needs to add a little more of a definition of "short" in there that I thought it could be expanded on.

DR. BONACA: I think it's a very good comment. For example, you may have oftentimes a -- mode failure is caused by a replacement, say, of a component with a different material that will lead to the failure later on.

Many of them are latent, and then may develop themselves in a long time.

DR. KRESS: You to have a certain probability that's going to impact the sequence.

DR. BONACA: That's right. So that's a good requirement to clarify that.

CHAIRMAN APOSTOLAKIS: Karl, do you plan to spend any time on initiating events? I would like to finish initiating events and expert judgments, so that Bob can be off the line.

MR. FLEMING: Fine. If you have questions, I did not prepare.

CHAIRMAN APOSTOLAKIS: Okay, let's finish first.

DR. BONACA: I just have one more comment, unfortunately, on -- a question, actually. That's why I'm raising it, on the definition on page 9, under PRA Upgrade.

It says the incorporation into the PRA models of a new methodology that has not been previously peer-reviewed. I assume that if I incorporate it into my model, a new methodology, whether or not it was peer-reviewed, it would be an upgrade of my PRA.

MR. FLEMING: Yes.

DR. BONACA: Unless I misunderstand what you meant.

DR. KRESS: It doesn't matter whether it's peer-reviewed or not.

DR. BONACA: That's right.

DR. KRESS: It's still an upgrade.

DR. BONACA: May I'm missing something.

MR. BERNSEN: We could let Rick answer that, but I think the intent here is that this is a definition that's unique to the standard, and, in particular, to the peer review section where we're talking about what changes in the PRA need to have a peer review.

So it's kind of -- it's unique to the standard, and that's why the differentiation. Is that right, Rick?

MR. HILL: Well, actually, I don't think I'd have

a problem with taking out the, "that has not been previously peer-reviewed."

Yes, it is unique to the standard, but the context of what an upgrade is, is a change in methodology, rather than just a change in time phasing like data or something like that.

I also think that this has not previously been peer-reviewed, might skew the definition to somebody thinking, well, this particular methodology has been reviewed someplace else, so, therefore, it's acceptable here, without thinking about the application of that methodology.

MR. WALL: Mr. Bonaca, I'd like to draw your attention -- sorry, this is E.M. Wall, a team member.

Mr. Bonaca, I'd like to draw your attention to page 136, configuration control, Section 5, and Subsection 5.4.

We used these two definitions to distinguish an upgrade from maintenance. For a maintenance, we kind of even have kind of an internal review. It's for very minor things.

An upgrade is a major thing which will require some incremental peer review, pursuant to Section 6.

DR. BONACA: I understand, but still, I mean, I may decide to upgrade by adding seismic or fire, okay? And

I'm going to use a PRA methodology which has been previously reviewed. I'm asking somebody to put it in.

That's a major upgrade of the PRA. And so I would call it an upgrade, irrespective of whether or not that methodology has been peer-reviewed.

MR. SIMARD: We'll look at that. It sounds like we ought to delete that phrase and just end the sentence after new methodology.

DR. BONACA: I don't want to belabor it, I'm just pointing out that it is something to look at. Thank you.

MR. SIMARD: Okay.

CHAIRMAN APOSTOLAKIS: Are we ready to move on to initiating events? Since Carl Doesn't have any -- maybe you can put up the viewgraph you have which is the -- no, it's on page 21, where it talks about --

MR. BUDNITZ: George?

CHAIRMAN APOSTOLAKIS: Yes?

MR. BUDNITZ: In the sequence of the text expert opinion. comes first.

CHAIRMAN APOSTOLAKIS: Really?

MR. EISENBERG: No, it doesn't.

MR. BUDNITZ: Doesn't it?

CHAIRMAN APOSTOLAKIS: It's on --

MR. BUDNITZ: It's 4.6. I apologize.

CHAIRMAN APOSTOLAKIS: It's page 135.

MR. BUDNITZ: Of course.

CHAIRMAN APOSTOLAKIS: Are there any comments on initiating events from the members?

[No response.]

MR. BUDNITZ: Well, that was easy.

DR. SHACK: My one comment is sort of really just that it does apply that there is an awful lot of detail that was in the Draft 10 that disappeared from the Draft 12. I mean, that's common to the whole thing, and it's this philosophy, perhaps --

I mean, typical ASME standards are fairly prescriptive, and they provide a lot of detail. You know, I've heard references here that the philosophy here is to provide sort of a high level guidance to the peer review panel who are assumed to be knowledgeable.

And you've omitted a great deal of detail that is in other guidance documents like NUREG 1602, which was another attempt to sort of set up guidance for PRA, or the Draft 10 version.

And haven't you really lost something here in omitting these details?

MR. BUDNITZ: Well, about initiating events -- this is Bob Budnitz from 3,000 miles away -- about initiating events -- and I believe that this was something that was true all the way through --

Remember -- and it's very important for you to understand that the whole standard is telling the analyst or the analyst team what to do and not how to do it. What to do, and not how to do it.

Now, in the course of reviewing Rev 10, there was some stuff in there that told them how to do it, and I, like the others, took that out. Actually, I didn't have to take a lot of it out; it was taken out in the intermediate thing you never saw called Rev 11.

When a subset of our group took Rev 10, they made the major, major changes of going to three columns of requirements, and integrating the NRC certification requirements with what had been there before to make a larger list and straightening things out, a whole lot of detail was taken out that was of the character of how to do that.

And that was true here, too, however, I don't think that, unless you find one -- and I'd be, of course, eager to know -- I don't think there was any what-to-do's that we lost in the course of taking out a lot of that how-to-do.

So although it comes up here in initiating events, it's really a question of philosophy for the whole thing. It just happens to come up here, first, I suppose.

CHAIRMAN APOSTOLAKIS: Karl?

MR. FLEMING: Yes, to amplify on what Bob just said, if you go back to Rev 10, on the Section 3, I guess it was, that had the detailed requirements, the entire content of all the requirements for initiating events was on page.

All the other material that you found in Rev 10 on initiating events and other issues like that, was back in the Appendix, which was in the form of guidance and things like that.

So, actually, if you look at the detailed requirements we have in initiating events in Rev 12, there is actually more here. There is more because we have integrated in additional requirements that were in the certification process that were not in Draft 10.

MR. BUDNITZ: But either that one -- it was really one that had pages, Karl, you're right.

Even there, there was some stuff that was how to do it, that I then went through and took out, in the spirit of what we were trying to do with the whole thing.

You see, if there are five different ways to accomplish a certain thing, we made a decision up front that it was erroneous for us to prescribe one of them.

Now, by the way, if they're all equipment -- and no one had ever done a PRA in this area -- it might be useful to prescribe and have everybody do it the same way.

But, in fact, we've got 100-odd PRAs out there,

that all did it different ways. And you don't want anyone of them to say, gee, you did it incorrectly, because you didn't do it the way we told them how to do it.

So, if you're reacting to that, I believe your observation is completely correct, and we did it on purpose.

CHAIRMAN APOSTOLAKIS: There is some inconsistency. I agree with you, Bob, that this is a broader issue than just initiating events.

MR. BUDNITZ: Oh, of course.

CHAIRMAN APOSTOLAKIS: And I was planning to bring it up when we discuss human reliability analysis, and expert judgement.

In other words, in some instances, you give more detailed guidance in the form of references, and in others, you don't.

MR. BUDNITZ: Well, I --

CHAIRMAN APOSTOLAKIS: It's a matter of being consistent.

MR. BUDNITZ: Well, without arguing the case, it is -- if you can point out places where we can give references that provide a good example of how one goes about it, why, those are very valuable.

CHAIRMAN APOSTOLAKIS: I mean, I realize that this particular standard is not really a procedures guide. It doesn't really give you methods.

MR. BUDNITZ: Quite the opposite.

CHAIRMAN APOSTOLAKIS: You stayed away from it, and, in fact, one of the criticisms, as you told us earlier, was that you were too prescriptive in Rev 10.

So, the least we can do then is, when we discuss HRA, and expert judgment, is to make sure that there we eliminate the more specific advice that is given, which is inconsistent with the other chapters.

Anything else in initiators?

DR. KRESS: I had one, George.

CHAIRMAN APOSTOLAKIS: Sure.

DR. KRESS: On page 33, Table 4.4-1(d), under Item 1(e)-D14, we talk about that the frequencies need to be weighted by the fraction of time the plant is at power. I think that needs to be made a little more clear that the weighting goes in the denominator instead of the numerator. It may be clear to everybody else.

MR. BUDNITZ: By the way, this is exactly the place where the adjustment is made to the difference between a reactor year and a calendar year.

DR. KRESS: That's right.

MR. BUDNITZ: That's exactly the point that we spoke about this about five minutes ago?

DR. KRESS: That's it.

MR. BUDNITZ: This is the only place it's done.

This is the only place where frequency comes in, in quite this way, right?

DR. KRESS: That's right, and that's why I thought it need to be made a little clearer as to what you're doing here.

MR. BUDNITZ: Well, explain -- no sweat. What wording would you --

DR. KRESS: Well --

MR. BUDNITZ: You're going to tell them to do the arithmetic right, or something?

DR. KRESS: Well, that's basically that's it.

CHAIRMAN APOSTOLAKIS: We do that in the introduction.

DR. KRESS: If it's clear to everybody, okay.

MR. BUDNITZ: If it isn't clear --

DR. KRESS: It was clear enough to me, but I wasn't sure it would be clear to everybody.

I have another sort of comment on page 25 where we're introduced to key safety functions, which I thought was --

MR. BUDNITZ: Which requirement?

DR. KRESS: This is high level requirements for initiating event analyses on page 25 of my version. At the footnote, we're introduced to key safety functions.

I like that. I liked the list that they have

there, but the problem I have with it is, I hated to see that relegated only to a footnote. I wish there was a section in there talking about key safety functions and the role they play here.

In fact, you see this footnote showing up with multiple tables, all along through here. I thought that if you could take care of it up front, and not have to repeat it every time, it might help the readability a little bit.

But somehow I thought this was too-important a concept just to relegate to a footnote, and that was the only comment there.

CHAIRMAN APOSTOLAKIS: Can you give me an example of a safety function that is not a key safety function? If I look the way you define them, it seems to me that you covered everything, reactivity control, core heat removal, reactor coolant inventory control, reactor coolant heat removal and containment bypass integrity.

MR. BUDNITZ: Oh, I suppose you'll find -- I imagine that if I told you that the Center for Disease Control in Atlanta concentrated on key diseases, I could probably come up with some minor diseases they don't concentrate on. I bet there are some.

CHAIRMAN APOSTOLAKIS: No, I'm not sure.

MR. BUDNITZ: Maybe not. Control --

CHAIRMAN APOSTOLAKIS: What you have listed here -

-

MR. BUDNITZ: Inventory, that's pretty much the whole thing.

CHAIRMAN APOSTOLAKIS: It is pretty high level, and it sounds like it's all-inclusive, so they are really safety functions, so there isn't such a thing as a key safety function.

I mean, the moment you talk about core heat removal, reactor coolant inventory control and reactor coolant heat removal --

DR. KRESS: Where would you put flooding the cavity in that?

CHAIRMAN APOSTOLAKIS: Is that a safety function?

DR. KRESS: I consider it one. Where would you put operation of the sprays?

CHAIRMAN APOSTOLAKIS: I would say if you deleted the word, bypass, and you said containment integrity, then all these things are included there.

DR. KRESS: But they didn't. They had containment bypass integrity.

CHAIRMAN APOSTOLAKIS: Just because of the word, bypass, we define a new class of safety function?

MR. BUDNITZ: No, no, these aren't those. These are functional initiating event categories or categories that affect these things.

DR. KRESS: Oh, you're talking about initiating events.

CHAIRMAN APOSTOLAKIS: I think the word, key, is redundant here. I mean, you really have to try very hard to find something that doesn't belong there.

MR. BUDNITZ: Well, going once, going twice, it's out. It also has the phrase, are the minimum set -- well, these include, at a minimum, X, Y, and Z, so you're right, there is the freedom to throw something else in there; do you see it?

DR. KRESS: You're right.

CHAIRMAN APOSTOLAKIS: Anyway, we don't want to make a big deal out of it.

MR. BUDNITZ: Are you taking notes about these things, because I'm not.

MR. SIMARD: Yes, we're taking notes and we're also going to get a copy of the transcript.

CHAIRMAN APOSTOLAKIS: There is a transcript.

MR. BUDNITZ: Enough said; it's done, okay?

CHAIRMAN APOSTOLAKIS: Anything else on initiators?

[No response.]

CHAIRMAN APOSTOLAKIS: From the members?

[No response.]

CHAIRMAN APOSTOLAKIS: One quick question on page

26 under Transients in the bottom box: And this is now a requirement that applies to all three categories.

MR. BUDNITZ: Which requirement are you in?

CHAIRMAN APOSTOLAKIS: This is Table 4.4-1(a), page 26, 331, 331-B, transients, loss of offsite power and manual shutdowns. Are these the only transients we're looking at?

MR. SIMARD: Well, we do say that the following list is not intended to be all-inclusive.

CHAIRMAN APOSTOLAKIS: I mean, automatic shutdowns for some reason are not a transient?

DR. KRESS: They generally are categorized as transients.

CHAIRMAN APOSTOLAKIS: Why do we distinguish? Why the word, manual? Should it be just shutdowns?

MR. SIMARD: Absolutely.

CHAIRMAN APOSTOLAKIS: Bob?

MR. BUDNITZ: I can't remember why that's there.

CHAIRMAN APOSTOLAKIS: Well, maybe you guys can think about it.

DR. SHACK: That's really one of the things that really got stripped down compared to Version 10. There was a much longer list and much more detailed thing in 10 than there is in 12.

MR. BUDNITZ: Yes. It should say manual and

automatic, just to flesh it out.

CHAIRMAN APOSTOLAKIS: Yes.

MR. BUDNITZ: I don't argue that for a moment.

CHAIRMAN APOSTOLAKIS: Especially since these things are now part of the performance indicators, right?

MR. BUDNITZ: That isn't relevant to us. We're doing a PRA.

CHAIRMAN APOSTOLAKIS: To support risk-informed oversight.

MR. BUDNITZ: In part.

CHAIRMAN APOSTOLAKIS: Why am I arguing with you, Bob. Maybe now we can go back to Mr. Fleming. You plan to talk about accident sequence analysis?

MR. FLEMING: Yes.

CHAIRMAN APOSTOLAKIS: Good. I don't know, but how do we handle this expert judgment? Should we do it now so that Bob can --

MR. FLEMING: It's your call.

CHAIRMAN APOSTOLAKIS: Okay, let's do expert judgment. That is on page 155, as I recall. One of the comments of the Committee was time -- was too detailed and focused on one approach.

MR. BUDNITZ: Well, it's fair to say that the original version 18 months ago was ten times as long.

CHAIRMAN APOSTOLAKIS: Yes. The first comment,

Bob, is --

MR. BUDNITZ: With a whole lot of detail that's just gone, including a long appendix that's gone.

CHAIRMAN APOSTOLAKIS: Yes. Unlike other chapters -- we're coming back to the earlier comment about consistency and so on.

You are giving two references here. Other chapters, or most of them stay away from providing references.

MR. BUDNITZ: But you notice that they're permissive, may be used to meet the requirements in the --

CHAIRMAN APOSTOLAKIS: But you know, the moment you say "may be" in a standard, I mean, that's --

MR. BUDNITZ: No, "may" is a crucial word that is used in standards to indicate a permissive that is not required.

CHAIRMAN APOSTOLAKIS: Right, but then --

MR. BUDNITZ: Other approaches may also be used.

CHAIRMAN APOSTOLAKIS: But then the question is why these two? For example, the second one would seem to me to apply to high level waste repositories. It's from the NMSS Branch of the NRC, and it says in the title, in the high level radioactive waste program.

Why does this belong in a reactor standards?

MR. BUDNITZ: Because it's a method.

CHAIRMAN APOSTOLAKIS: It's a method? I thought they just reviewed existing methods?

MR. BUDNITZ: Well --

CHAIRMAN APOSTOLAKIS: The first reference is a method, but the second one really was a review to state the Branch position and I'm not sure that this helps anybody here.

And then the big question you're going to get is, why are you ignoring NUREG 1150? If you are going to put a Branch technical position on high level radioactive waste repositories, you are -- you are not citing the major study that involved expert judgments sponsored by the Nuclear Regulatory Commission.

MR. BUDNITZ: George, you might know the answer to that.

CHAIRMAN APOSTOLAKIS: I know.

MR. BUDNITZ: That was written by Apostolakis and Budnitz and a bunch of other people. If you don't know that, George and I were the authors of 6372.

The answer, George, is that in 6372, after a lot of thinking, we rejected some of the methodology used in 1150.

CHAIRMAN APOSTOLAKIS: But we never really look at what the staff did in NMSS, and I'm pretty sure if we reviewed that, we would have some comments as well.

My point is that the moment you start putting references, you get these questions. You know, why didn't you include this guide? Why didn't you include that guide? Why do you have this fellow?

I would say it would be probably best to not have any references at all. Now, that severely limits the ability of the user to really do something, but it would be consistent with the rest --

Or, just take out the second reference, which I think is irrelevant here, and put two or three more. I'm sure you're going to get this comment about NUREG 1150.

I mean, they went through a major exercise there. They spent a lot of the Agency's money, and now we are not even citing them.

MR. BUDNITZ: On 1150, I'm prepared to write a rebuttal if anybody says that, and I assume that you will review and tell me I was right about it.

You remember what they didn't do that was right.

CHAIRMAN APOSTOLAKIS: But since you are allowing, Bob, a graded approach to the use of expert judgment --

MR. BUDNITZ: Sure.

CHAIRMAN APOSTOLAKIS: Surely there is a role for 1150 somewhere there? I mean, in Category II issue, for example, I mean, we're even allowing the technical integrator to do it internally to the company, you know,

without even going to outside experts.

In that sense, there must be a role for 1150 somewhere. I mean, I am on your side when you say that in the full treatment, the first reference we have here goes beyond 1150. And now it just occurred to me, can we comment on things that we have co-authored?

MR. BUDNITZ: Well, I am on the phone with you so we can do what we want. You just stated on the record that you and I co-authored that, so everybody understands.

CHAIRMAN APOSTOLAKIS: There is Mr. Markley here who has some views.

MR. MARKLEY: Well, George, to the extent that you can, you should avoid discussing your own work.

CHAIRMAN APOSTOLAKIS: What I am doing here, Mike, is I am staying away from the technical content.

MR. MARKLEY: You can state the facts.

CHAIRMAN APOSTOLAKIS: I am just stating that there are other references that I think belong.

DR. KRESS: Right.

MR. MARKLEY: There is nothing wrong with that.

DR. KRESS: You can provide clarifications, and to the extent that you are not supporting the reference, you can actually add to the discussion.

CHAIRMAN APOSTOLAKIS: Sure. And I think it is evidence from our exchange with Bob that we are not really

getting into the details. My point is that since you decided to cite the reference, and I think that is appropriate here, because it is not easy to find these things, it seems to me you have to cite a few more for completeness. And especially since your write-up, the text, does allow for different approaches that involve different levels of sophistication, if you will. That is all the comment I have to make here.

DR. KRESS: But when you start adding more references you always have the completeness problem.

CHAIRMAN APOSTOLAKIS: Well, yeah, but I mean there are two or three major, like 1150, I mean, for heaven's sake, it introduced the formal use of expert judgment to the nuclear safety business. There were lots of little papers here and there, some of them mine, but 1150 really pulled the whole thing together.

DR. KRESS: But there is a whole science out there on expert elicitation.

CHAIRMAN APOSTOLAKIS: Sure.

DR. KRESS: With books and texts, and where do you stop?

CHAIRMAN APOSTOLAKIS: But what I am saying is we should limit ourselves to things that have been used in the nuclear business, especially the ones -- I don't know that the industry has supported any major studies in this area,

but the NRC certainly has. There was another one later on Level III.

DR. KRESS: Level III.

CHAIRMAN APOSTOLAKIS: Which was in collaboration with the European Union.

MR. BERNSEN: George, we will certain consider the comment.

One of the other observations I would make is that we have talked to Bob about the fact that there was a lot of valuable material in the earlier drafts that shouldn't be lost. And I believe he is committed to write a paper which might be suitable for reference in this issue or some subsequent issue of our standard. We felt that a technical paper would be more useful for that type of information perhaps than a standard.

CHAIRMAN APOSTOLAKIS: That's fine. But, again, looking at the standard alone, since there are no references in other places.

MR. BERNSEN: Understood. And we will certainly consider that.

CHAIRMAN APOSTOLAKIS: Jack?

MR. SIEBER: I was just thinking that that is a good idea to write a supplementary paper, because I think that then becomes the tutorial for the application of the standard, and without it, I think there is something

missing.

MR. BUDNITZ: Well, on the other end, I said I would do that, but it hasn't been done yet, and it certainly isn't going to get into this edition of the standard, you know, because, obviously, you know how long these things take.

George, by the way, so here is George -- George is talking about this, and without about arguing about conflicts, George, offline, let's have a conversation about what other references might be appropriate here, and I will give it some thought.

CHAIRMAN APOSTOLAKIS: Sure.

MR. BUDNITZ: And, by the way, just to broaden this, I can call up and have discussions with two or three other members of our team, there were seven authors there, like Peter Morris and so on, and see if I can pull together an improved little list.

CHAIRMAN APOSTOLAKIS: Yeah, I am not talking about, you know, 35 references. I am talking about --

MR. BUDNITZ: Certainly. You are talking about two or three more.

CHAIRMAN APOSTOLAKIS: Two or three key, major references, you know, that included nuclear related issues.

One or two more comments. I think, Bob, you undertook a very difficult task here trying to give guidance

as to when to use, you know, the facilitator approach or the technical integrator, and there is a series of four bullets on page 135. I would suggest, I mean I understood what you meant here, but, you know, I have spent three years with you working on this, earlier on the standard says that examples will be used to clarify things. In fact, in Section 4.4 on requirements, there is a series of examples. I would suggest that on this Section 4.6, you give a few examples of what you mean by certain things.

For example, are there any Level I issues that would require a TFI treatment, or would the technical integrator treatment would be good enough? The one that comes to mind from 1150 is the coolant pump seal LOCA, where there is model uncertainty. Would that be a good example? And maybe that one can be handled by the utility itself, since you allow them to do that, by a technical integrator. Then, as you move on to Level II, I suspect for some of these issues, one would have to do a more rigorous expert judgment elicitation process, you know, so people will get a better idea.

I am afraid that this is not clear now, unless you really have read some of the citations. And especially when you say, on page 135, 4.6.3, "The PRA analysis team may elect to resolve a technical issue using their own expert judgment or the judgment of others within their

organization." Now, if I were a utility person, I would say this is great, we can resolve all the issues internally. Maybe we will call up one or two consultants to make sure we are not doing anything really bad, and then I would not read the rest.

Why should I worry about uncertainties are large and significant judgments of outside technical experts are useful? I mean since you allow me to resolve technical issues within my organization, I would probably do that.

MR. BUDNITZ: Yes, but read the next sentence. I will read the sentence you read, "The PRA analysis team may elect to resolve a technical issue using their own expert judgment or --" Right. But the next sentence, "The PRA analysis team shall use outside experts when the needed expertise on the commission is not available inside."

CHAIRMAN APOSTOLAKIS: Well, I understand that, and that again --

MR. BUDNITZ: And then there is a "should" which is sort of in between. It says maybe you have the experts, there is a "should" which is in between. You got it, but there are other reasons why you want to go outside.

CHAIRMAN APOSTOLAKIS: But, again, I mean then it comes down to deciding whether I have the expertise or not, which, of course, --

MR. BUDNITZ: Yes, but that is always discussion

that is left up to the analyst team. Nobody but the analyst team could ever make that call. I think that is intrinsic to this game.

CHAIRMAN APOSTOLAKIS: But all I am saying is --

MR. BUDNITZ: Do you agree with that?

CHAIRMAN APOSTOLAKIS: A few -- no, I agree. But a few examples, I mean not 10, but two or three.

MR. BUDNITZ: I can cite some examples.

CHAIRMAN APOSTOLAKIS: Of issues.

MR. BUDNITZ: The way I can cite it is I can cite two or three reports which cover issues.

CHAIRMAN APOSTOLAKIS: Yeah.

MR. BUDNITZ: In other words, the analyst who is trying to figure out what the hell is what, could go to that coolant pump seal example, or they could go to, for example, full elicitation at Yucca Mountain for seismic hazard or something, to see the whole big, gory thing.

CHAIRMAN APOSTOLAKIS: Well, this is actually a good example, or 1150. I mean in Level II analysis, there are all sorts of issues that require expert judgment, right.

MR. BUDNITZ: Right.

CHAIRMAN APOSTOLAKIS: Although I don't know if you would limit yourself to LERF, or whether there is the same number of issues. But, certainly, if you do the traditional Level II, with the release of --

DR. KRESS: There are a lot less issues if you do it to LERF.

CHAIRMAN APOSTOLAKIS: A lot less. But the question that would come to my mind would be, if I were a utility executive, why can't I go to NUREG-1150? They did all this analysis, maybe I can take their results, use my expertise in my facility, maybe hire a consultant, and maybe adopt those results to my plant. So I don't have to go through this expert elicitation process and all that. I mean do you allow that reality here, which I suspect a lot of people would find very attractive?

MR. BUDNITZ: Well, of course.

CHAIRMAN APOSTOLAKIS: Because the idea of going through a NUREG-1150, it is just out of the question for a private company to do. I mean it is okay for a federal agency that wants to gain insight and so on.

MR. BUDNITZ: By the way, of course, it is not only allowed, it is explicitly -- it is expected, I suppose. But they do have to get by their peer reviewers.

CHAIRMAN APOSTOLAKIS: That's right. And all I am saying is by giving two or three specific examples, like I just did, I think you will make this section much easier for people to understand and implement.

Also, you don't emphasize enough this community perspective, which, for a private company, may not be

relevant. Remember when we were doing this other thing, a very important concern for a federal agency that is looking at broader issues is what is the community of experts' view or a spectrum of views on a particular issue? Because this is a federal agency, they have to regulate 103 units. But if I am one utility with one or two plants, I probably don't care about the community of experts, do I? I mean I really worry about what applies to my facility. Although, of course, there I can have the community's views. So, I would suggest that this become clearer.

MR. BUDNITZ: Well, it is right there, the last paragraph of 4.6.4, probably this whole thing is only, you know, half, two-thirds of a page. Read it.

"The utility shall be responsible for aggregating the judgments so as to develop the composite distribution of the informed technical community."

CHAIRMAN APOSTOLAKIS: Yeah, but what I am saying is that this is not sufficient to bring up the issue of the community view. Maybe you can emphasize it a little more. I mean every word here, every sentence is loaded with meaning.

MR. BUDNITZ: You and I know that this was 100 pages turned into three-quarters of a page.

CHAIRMAN APOSTOLAKIS: I know. I know. So, maybe by using a few examples, you can make it a little clearer

and that is all I have. And maybe thinking again about the issue of references, either eliminate all of them or add two or three more.

MR. BUDNITZ: I see your point.

CHAIRMAN APOSTOLAKIS: Yeah. Are there any -- I guess the issue of expert opinion elicitation does not arise when you do a Category I. I mean it really has to be Category III, right

MR. BUDNITZ: Well, I mean if you are just having a couple of experts in, which is not only allowed, it is probably the most common thing.

CHAIRMAN APOSTOLAKIS: A Category II perhaps. But Category I, which is --

MR. BUDNITZ: I mean, you know, you have a couple of experts in, you still have got to follow this, you just do it in a certain way. Right?

CHAIRMAN APOSTOLAKIS: That's right. I think it is so short that it probably will not be of great use to people, but I don't expect individual utilities to really resort to expert judgment elicitation to a large degree anyway. I mean this is more like a federal kind of activity.

Any other members have any comments on this particular issue?

[No response.]

CHAIRMAN APOSTOLAKIS: Well, I guess we are done with Bob. Bob, do you have any comments?

MR. BUDNITZ: Yes. I am not sure, and my colleagues are sitting around the table there, how much more here -- well, you know, we cut this way down on purpose because there didn't seem any middle ground between something that was real short and the whole big banana, which didn't make sense, it was out of context. That thing that was in the first thing was out of context, it was as long as the rest of the standard practically.

CHAIRMAN APOSTOLAKIS: Yeah.

MR. BUDNITZ: I suppose, you know, 25 percent more doesn't place it too much out of -- you know, doesn't screw up the balance

CHAIRMAN APOSTOLAKIS: Yeah.

MR. BUDNITZ: And I will see what I can do. Maybe it is only just a sentence here and there.

CHAIRMAN APOSTOLAKIS: Okay. Have you thought about eliminating the whole section, or is that out of the question?

MR. BUDNITZ: Of course we did. I didn't think eliminating it made sense because without some guidance, you leave it wide open.

CHAIRMAN APOSTOLAKIS: Okay.

MR. BUDNITZ: I mean you do want to say things

like look at the last one. You do want to tell them who is responsible. You do want to tell them that they have go to identify the issue and that they shall go outside. You do want to tell them they shall go outside when they don't have the needed expertise, I think, don't you?

CHAIRMAN APOSTOLAKIS: Yeah. Mario.

DR. BONACA: Just I want to make sure before Bob goes, I want to pick up again on something we talked about before.

CHAIRMAN APOSTOLAKIS: Okay. Are we done with expert judgment? I think we are done.

MR. BERNSEN: Just let me make an observation with regard to this. I mean our primary purpose here is we are responding to comments received.

MR. BUDNITZ: Yes.

MR. BERNSEN: And in that context, I don't recall any comment that said, take it out. I do think we had comments that said it seemed to be over-weighted in terms of the total approach in the standard. And yet, obviously, you want to recognize that this is a part of the process and must be considered. The user is obligated to address, and the peer review team has the opportunity to evaluate. So, I don't think we should take it out.

And, obviously, your comments on the examples and detail and references are quite appropriate. But we did not

get any suggestion that said delete it

CHAIRMAN APOSTOLAKIS: And you are not getting one now either. I am not suggesting that.

MR. BERNSEN: Right.

CHAIRMAN APOSTOLAKIS: I just asked a question whether you have considered it.

I think this kind of exercise is really foreign to most utility practitioners. I don't think they will go through this thing, unless somebody is about to shut down their facility and there is a major seismic issue, and then it is a different story. But in their routine application of PRA, I doubt it very much. But I agree with you, there should be some guidance.

So let's go on to the other issue that Dr. Bonaca has.

DR. BONACA: Yeah, I just had -- I wanted to pick up on the issue, Bob, of what you described before, that is, from Rev. 10 to Rev. 12, you really took out how to do it.

MR. BUDNITZ: Well, that is not fair. And the others in the room can elaborate. Sprinkled throughout all of this text are how to do it, you know, at different levels. Because sometimes you couldn't describe what to do without telling them how. You know, there has to be a flavor of that or it can be sterile in some places.

But where there were five ways to do something for

sure, it was erroneous to tell them how to do one of those, you see.

DR. BONACA: Yeah. And I don't disagree with the approach you have taken.

MR. BUDNITZ: Do people around the table agree with me, my team members there?

DR. BONACA: Well, let me finish my question.

MR. BUDNITZ: Yeah.

DR. BONACA: At least I don't disagree that you should do that. I am only considering some cases not always to do one thing are equal, I mean some of them leave behind some problems. And, you know, I have heard time and time again from PRA practitioners, you know, a discussion about the method, because if you follow a certain method, then you have to do something else later on to back up some possible shortcoming in the approach. And I think the original version we reviewed, Rev. 10 had some of those elements inside that

Now, I am not saying Rev. 12 doesn't have it, because I haven't performed that kind of evaluation. I only see that, you know, I am just concerned that -- it seems to me, okay that a lot of the burden now has been placed on the back of the peer review process, that is supposed to make sure that all this possible, you know, pitfalls in the kind of approach you use are being dealt with. Am I correct or

not? I don't know. That is a question.

MR. BUDNITZ: Does anybody else want to try to answer that, too? I don't know where the burden is. The burden is always on the analyst to do it right, and for the peer reviewers to check, isn't it?

DR. BONACA: Well, I mean --

MR. BUDNITZ: It is just like a running a reactor, the burden is on the reactor operator to run the reactor. The NRC can't.

DR. BONACA: Let me explain to you why I have got a problem, okay.

MR. BUDNITZ: No, I understand.

DR. BONACA: No, no, no. No, let me just finish. I have got a problem because you keep saying that this standard applies to -- as a standard is going to be used by the power plants and there is a full process here that, in fact, describes, you know, the utility use of this. And, in fact, the peer review process is also very focused on utility use. Most of these utility people did not perform the PRAs. PRAs were performed by, in a lot of cases, by specialists who were not participated in the peer review process, who are not parties to this. And so those kind of capabilities are not being applied in this review process. That is why I am raising it. That is the only reason.

I would have no problem if all this is going to be

administered by, you know, top, experienced industry practitioners. This is going to be applied individual utilities, typically, with one or two PRA people, that is the whole staff they got, plus a lot of other people in their expert panel, and that is why I am raising these questions.

And there may be an excellent answer. I just said it seems to me that there has been a significant shift, and maybe it is not significant, but some shift of responsibility to the peer review process.

CHAIRMAN APOSTOLAKIS: Well, I think the issue you are raising, Mario, is really much bigger, and it comes back to the earlier discussion we had on whether this is a procedures guide or a high level guidance document. It seems to me it is inevitable that this will happen, what you just described, because they have to stay away from actually prescribing methods. In fact, even the previous version, Rev. 10, that we saw was criticized as being overly prescriptive.

And I have a comment, for example, on the common cause failure part here that lists five methods, and without any qualification, and I think one of them should not really be there at all. So, you know, unless you are an expert in that field, unless you are Karl Fleming, you will not really know which method to use.

DR. BONACA: And I want to point out, --

CHAIRMAN APOSTOLAKIS: I would rather eliminate all five.

DR. BONACA: -- George, in fact, I didn't disagree that this could be done. And I am not not supportive of this. I am only making a statement that, in my judgment, I see some shifting of the role to the review process, or the peer process, which, in fact, you have. And maybe we will talk about the peer process, review process later.

CHAIRMAN APOSTOLAKIS: We will. But I think you see that in many, many applications like Option 2 and so on. And it is inevitable. When you really don't trust the numbers or the models to guide you to a decision, you have to rely on the judgment of people. And this is what is happening here, too. It may be in a different context, but it is the same thing.

DR. BONACA: Yes.

MR. BUDNITZ: Mario, let me talk about how this standard differs from most standards that ASME puts out. And I will tell you that I just had this exact same comment. I am chairing the group that is writing, under the American Nuclear Society, the seismic external hazards piece. And we had a meeting of our oversight committee just last week and it came up, the exact same question.

One of our committee members objected strongly to

what we had written because it wasn't prescriptive enough. And I will just read you an example, but I am going to read it from initiating events. If you have initiating events, the first high level requirement says, I will read it to you, "The initiating event analysis shall provide a reasonably complete and appropriately group treatment of initiating event categories." Okay.

Now, let's focus on the word "reasonably." Shall provide a reasonably complete treatment of the stuff. Right. Now, and the same thing came up in the seismic PRA, but it is generic throughout here. The person said, what do you mean by reasonably complete? I mean, you know, when you are telling people how to design, how to do a calculation of the stress on a piece of metal, you don't talk about reasonably complete, you give them a method.

And we had this discussion, and, of course, everybody understands in PRA that if we ever said the word "all" or "complete," it is death. There is no "all" and there is no "complete" in PRA, because you have to screen things out that are unimportant compared to other things. So, you have to use the word "reasonably." And then you come -- what is reasonably complete? Well, the analyst has to make that call, and the peer reviewers have to agree with it. You are stuck with that, there is no way around that, Mario and the rest of you, in my view. And I hope everybody

in the room will nod at what I am saying.

It is that sort of judgment that in the end -- that is why this standard, this whole area is different than most ASME standards or ANS standards that one writes in other areas.

DR. BONACA: And, Bob, I totally agree with you, I understand it. I am only --

MR. BUDNITZ: So it is dilemma that we are in from the start.

DR. BONACA: Yeah. But this sets certain parts in my mind about the peer review.

MR. BUDNITZ: Of course.

DR. BONACA: I know that when I was still -- and I knew we had the peer reviews of a number of PRAs, and I am going back in my memory to see what the qualification of the people were. Just because -- and probably they were adequate. I am only saying that I didn't even think about the peer review when I was reviewing Rev. 10, and maybe that was my problem, but now I am thinking about it more thoroughly.

CHAIRMAN APOSTOLAKIS: Okay. Any other comments? I'm sorry.

MR. BERNSEN: Just one. I did look at the changes from 10 to 12 fairly thoroughly in the initiating event area. And substantially, most of 10 is there. A lot of the

narrative stuff may have been deleted, but the what requirements by and large remain. In the initiating event area, there wasn't that much change.

MR. BUDNITZ: Wait, wait, wait. There was no requirement in Rev. 10 that isn't here.

MR. BERNSEN: What I mean is, and Bob did the same thing independently, so --

MR. BUDNITZ: There is absolutely no requirement that is missing.

MR. BERNSEN: Right. Okay. I guess I stand corrected. That is true. And so, I don't think there is a major change, in fact, from -- going from 10 to 12 for this particular element.

DR. BONACA: No, I am only mentioning that in some cases there were examples. Remember, you can use this approach or you can use that approach. And if you use this, you should be doing also this and this and that. There was that part.

MR. BERNSEN: That was kind of -- it was in 10 as well.

DR. SHACK: It sort of comes back to George's question. You know, if you look at (a)(4) in 12 versus the list in 3.3.1.1 of 10, there really is a great deal of difference in the list. You know, you get the transients and the LOCAs in (a)(4) and you have a much more descriptive

sort of thing in 3.3.1.1. And the question is why just these, you know? You know, should you have dropped them all, or, you know, included them all. And it is, you know, it is another one of those things. Where do you stop? And it is just curious, I guess is the answer.

MR. BUDNITZ: Well, that is a hard call. If you are looking 1(e)(a)(4), which is 3.3.1.

DR. SHACK: Yeah.

MR. BUDNITZ: Well, it says at the bottom this is not intended to be all inclusive. So, you know, it was a shot, okay.

DR. SHACK: Well, the other list wasn't all inclusive either.

MR. BUDNITZ: Right. Right.

DR. SHACK: You know, there is no all inclusive list.

MR. BUDNITZ: Right. That is what I said three minutes ago.

DR. SHACK: Right. And, you know, the question is, where do you stop when you give the example list? The one in (a)(4) seems awfully abbreviated, I guess is sort of my just general gut reaction. And why give such an abbreviated list, you know, versus what was in the 8, the 10?

MR. BERNSEN: It is distributed to other elements.

In other words, if you go back to 1(e)(b)(3), so on and so on, it is distributed. It is still there, but it has been redistributed.

MR. FLEMING: I think it is a valid comment, but the discussion that resulted in the solution that we adopted in Rev. 12 was the following, that as you go from a general list or a larger list to the appropriate list for a particular plant, one ends up with the unavoidable conclusion that the appropriate set of initiating events is plant-specific. So, we worked on the requirements, the supporting requirements, put a lot of emphasis on needing to resolve the dependencies, the plant-specific details and so forth, to come up with the appropriate list before you are done.

The more we worked with more detailed lists, the more we got arguments about, well, this is more of a PWR list and not a BWR list, and it doesn't belong in my plant, and so forth, so I think we all agree that one needs a detailed list of initiating events to support the PRA but putting a -- we did not want to promote the concept of using a standard list of initiating events.

That is why we did it the way we did it.

MR. BUDNITZ: Yes, Karl. We could, for example, have taken the, what? -- 12 or so things on this list, we could have made this 62, but then you might convey the

flavor to the initiated that if you do all those 62 you are done, and that is exactly the wrong flavor.

CHAIRMAN APOSTOLAKIS: I think we have exhausted the subject and it is a broader comment and --

DR. BONACA: Yes, we have.

CHAIRMAN APOSTOLAKIS: Anything else?

[No response.]

CHAIRMAN APOSTOLAKIS: Okay, Bob. Thank you very much.

MR. BUDNITZ: Okay. I'll ring off.

CHAIRMAN APOSTOLAKIS: Okay, bye bye.

MR. BUDNITZ: Thank you.

CHAIRMAN APOSTOLAKIS: And maybe we can also take a short break until maybe just before -- until 11:18.

[Recess.]

CHAIRMAN APOSTOLAKIS: Back in session. I don't have a quorum.

MR. MARKLEY: Your quorum -- 13 --

CHAIRMAN APOSTOLAKIS: All right. Okay, back to Mr. Fleming.

MR. FLEMING: What I wanted to do at this point if it is convenient for the committee is to go through some of the details of the accident sequence element to bring out some additional aspects of the structuring of Rev. 12 of the standard and make some key points that we haven't really

stressed up to now.

In addition to the three column, three category approach, which is of course where the detailed supporting requirements are listed, the other feature of this draft of the standard was the derivation of high level requirements for each of the elements.

These high level requirements I believe are very important, a very important enhancement to the standard from the following perspectives that I will get into.

The process we used to develop them was to start with the basic attributes of a PSA -- completeness, dependencies, fidelity -- those types of issues and look at those in the context of the particular objectives for each element, which are also listed for each of the elements in the standard and come up with an irreducible set, minimum set of requirements for a PRA, for any category of application that would have to be met.

This for example, the slide I have up here right now, is on page 38, which is the high level requirements for accident sequence analysis.

MR. EISENBERG: Page 39.

MR. FLEMING: Okay, it may be on page 39 in your copy.

Table 4.4.2 -- this is the style in which we presented all of the requirements for each of the nine

elements in the standard.

What we have done is developed from a high level perspective really the fundamental requirements that have to be met.

On these requirements we worked very hard, and I think the degree of consensus that the project team and the other industry groups that peer reviewed and provided input to this process, the degree of consensus that was reached at this level is much stronger than actually was a reality at the functional requirement level.

I, for one, my own personal opinion is that if a peer review team consisted of appropriately experienced and competent practitioners in PRA they could take these high level requirements and go in and perform a very good, sound peer review process to determine the quality of the PRA.

We wrote these down for several reasons, one of which is to show the context and logic for all the supporting requirements.

To the extent that people have optional approaches to do common cause, data, whatever, and to the extent that someone may not have exactly followed some of the supporting requirement tables that we have, the judgment, the yardstick on which you should judge the adequacy of an alternative approach would be with respect to these high level requirements.

I wanted to mention these, because this is a very key addition to what we had in Draft 10. While many of these concepts were in Draft 10, they were kind of buried in the textual presentation and we brought them out as very, very explicit requirements.

The detailed requirements are then organized by each of these high level requirements.

I might just pick a page of these for accident sequence definition. As you go into the specific supporting requirements for accident sequence, and this happens to be several pages in, for Requirement B, which shows you the style in which we have presented all these supporting requirements, we have carried down into these detailed requirements -- at the top of the table a reminder of what functional requirement we are supporting.

This particular page happens to be Functional Requirement B on plant-specific CDF and LERF quantification; the accident sequence analysis shall provide a sequence definition structure that is capable of supporting a plant-specific quantification of CDF and LERF by the Level I-II interface.

That is the functional requirement that all of these particular detailed requirements refer to.

The second thing that we remind people of is that as we apply the high level requirement and the supporting

requirements we are applying them against the attributes that are the column headings in these tables, where we repeat the particular attributes for this element, which provides the scope of applicability of each of the detailed requirements.

As you read these particular -- these are the same ones I showed in a previous table -- a common theme here is that Category 1 is focused on the dominant sequences and contributors to core damage frequency and large early release, whereas Categories 2 and 3 have to be extended to the risk significant accident sequences and contributors.

In recognition of the fact that some Category 3 applications may have to go beyond risk significant accident sequence contributors we dropped that caveat with -- you know, it is sort of an implicit way of saying something more than the risk significant and accident sequences.

Then as you go down into the specific requirements -- now we are into the very, very details of the supporting guidelines, one thing that you will see here is that for some elements like initiating events and accident sequence definition, for example, these elements are so fundamental to the overall structure of a PRA that you won't see a great deal of delineation of specific requirements coming across the columns.

The example that I threw up here, in most cases

what you will see in this differentiation is a permission of the application of conservative models in Category 1 and a lack of tolerance of conservative models in Categories 2 and 3.

Then based on the judgment of the project team, there is in some cases a softening of the language, the action statements that we are using that are specifying the detailed supporting requirements.

The choice of the verbs was considered very carefully but using the judgment of the project team as to whether something ought to be included in the model or whether it should just be considered in the model, and that is another example of differentiation.

When you get into other elements like data analysis and quantification and HRA you will see quite a bit more differentiation of detailed requirements across the three columns, and the classic example is what we were talking about earlier is that we go from point estimates, mean values, to full uncertainty quantification, as one particular type of example.

But then finally we end up for all of the elements, and if I am right -- I'll get the particular pages -- the particular requirements for documentation.

In general you will find, and this just happens to be the table on page 51, which may be 52 in your package,

you will generally find the documentation requirements to be common across all three elements.

The practical reason for this is that in order for a peer review team to even determine what category of application the PRA can support it is necessary to have that document so we can measure what is in there, so you tend to see particular aspects of that.

The other thing that we tried to avoid and we debated at length in the preparation of this draft of the standard, we tried to avoid having let me say "buzzwords" like "shall" or "should" or "may" trigger some kind of an automatic documentation requirement, so what we tried to do is for each element to have very specific documentation requirements for that element that is in the judgment of the project team is necessary and sufficient for a peer review team to come in, read that documentation, determine the category of application that that element is capable of supporting, and whether it meets the intent of the requirements.

You will see a very, very specific long list here. In fact, I think if you look at these documentation requirements you will see that by and large they include the documentation requirements that were in Rev. 10 as well as additional documentation requirements we had in the standard.

So that is -- you know, the purpose of this part of the presentation was to just walk you through a little bit more of the structure to point out the role of the high level requirements and the way in which we'd carried down the high level requirements and the attributes for each of the three categories, so that each time one is reading a specific requirement in the tables, they can provide the context, they can grasp the context of that requirement and what it was intended to achieve in interpreting how far to implement it.

Those represent some of the structural changes and enhancements that we tried to put into this draft of the standard, again exclusively motivated by the comments that we received on Draft 10 to make the standard easier to use for a range of applications.

That pretty much concludes what I planned to formally present as far as the standard, so if you have any other comments --

CHAIRMAN APOSTOLAKIS: It appears to me that Category 1 is really separate from the other two and the distinction between Categories 2 and 3 is really a very fine one.

If you look at the various requirements you are imposing, usually you ally both of them to Categories 2 and 3, with some exceptions.

Perhaps -- I think this is a very important issue. Maybe the subcommittee can debate it a little bit. The categories are discussed on pages 3 and 4 of the standard in terms of examples.

In Category 2, give examples, typical applications, risk informed prioritization of GL96-05, periodic valve verification testing requirements, risk informed inservice testing, risk monitoring applications, quality assurance, and tech spec modifications, it appears that most of these, if not all, really rely on importance measures to rank SSCs, don't they?

Then if you go to Category 3, you also have PRA products are used to prioritize and rank SSCs with respect to safety significance. Well, if that is the case, then why when I do a GQA I have to prioritize, rank SSCs, so which category does that belong to?

On the one hand, you are telling us this is Category 2 but then in Category 3 you say that when I rank SSCs I have to do a Category 3 analysis.

This issue came up yesterday in the other meeting. I guess there is an implicit assumption here that the importance measures are fairly insensitive to a full Category 3 treatment, that you can get a reasonable ranking without going to the details of Category 3, which is an untested assumption, and perhaps somebody ought to test

that.

Maybe for RAW that is valid because you make such drastic assumptions, although the remaining is still, you know, sensitive. I mean you set a component down but the rest of the stuff is at their nominal values.

I don't know that what you have here on pages 3 and 4 is the best description of what the categories are and whether -- I mean there is no statement here regarding the degree of confidence that one has to have in the PRA results and how that degree of confidence really dictates how sophisticated your analysis should be, but isn't that really what it comes down to?

MR. FLEMING: Yes, that is very important --

CHAIRMAN APOSTOLAKIS: And that is related of course to approaching the forbidden region in the diagrams of 1.174, increased management attention, that the Staff uses.

I wonder whether these kinds of thoughts can be reflected on these, that what really matters is the degree of confidence that is required in the calculations to support the application and then you go on to the examples and so on.

DR. SHACK: The one that struck me as funny here was the A4 Category 1, where --

CHAIRMAN APOSTOLAKIS: Yews.

DR. SHACK: -- in A4 you are looking in combinations that may be rather unusual and different, and yet it is often in the category where you think you are almost looking at the generic PRA and that just struck me as a kind of an unusual way for that.

I would have characterized the A4 applications as somewhat different, where you are really looking for some unexpected, surprising interactions.

CHAIRMAN APOSTOLAKIS: Which comes back to Mario's surprise. Karl?

MR. FLEMING: Yes. I think the particular -- sorry, I lost my fuzzy there -- back to fuzzy sets.

I think that is a good comment. I think the reason why something like A4 was placed in Category 1 in this document is based on the fact that A4 is a rule that was imposed on utilities and of course the utilities were expected to use their existing PSAs, whatever their existing PSAs, they had to implement that rule, but there was really no requirement at least from a regulatory perspective that they employ the kind of elevation of a PRA, which would be expected, like, say, a Reg Guide 1.74 application, so I think that is sort of the motivation for putting it down there.

It was a rule that they had to fulfill anyway and there was not a formal requirement by the NRC that you have

to do a quality -- you have to upgrade to a certain level of quality of PRA before you can implement the rule, so I think from a technical standpoint your point is well-taken.

MR. SIMARD: We have had a number of comments these are not good examples and we need to revisit them.

One example though that seemed to resonate at the workshop yesterday, Karl, maybe you could summarize the discussion about how given that you have a Generic Letter 88-10 MOV testing program, the distinction between Categories 1 and 2?

MR. FLEMING: Right. Yes, we had a very good discussion on this and I think it did provide us with some good insights on how we can improve the discussion on these pages in response to George's earlier comment.

For example, Generic Letter 89-10, we would take the position that use of the PRA to apply risk ranking quantifications to your MOV list just for the purpose of deciding which ones you are going to test first in fulfilling the 89-10 requirements without impacting the scope of the valves in 89-10 would be a Category 1 application, but if you wanted to say that, hey, we only wanted -- we are going to exclude certain requirements from scope and now we are actually bending or modifying or proposing a relaxation of the rule on a plant-specific

basis, now we are talking more of a risk-informed application a la 89-10 in which we would actually have to quantify the risk impact of the part of the rule that we weren't planning to fulfill.

While the risk ranking might have been a useful prioritization, we would have had to elevate this to a risk-significant determination to show that the delta risk associated with modifying how we are going to apply the rule is justified, so that would be how we would make those particular distinctions.

DR. BONACA: I would like at some point to go back to the Category 1 --

CHAIRMAN APOSTOLAKIS: Well, this is the point. This is the time.

Go ahead.

DR. BONACA: Well, it seems to me that one fundamental requirement I believe is that the PRA must be commensurate with the change that it supports. That is a fundamental element of the whole standard here.

It seems to me that there is a prejudging by saying that Category 1 specifically addresses SSC risk significant determination for the maintenance rule and A4. There is a prejudgment here.

Will it be true that the utility still has a responsibility to assess his own PRA, determining in fact

for example that the component is described and all that kind of stuff, and look at the dependencies and if, in fact, dependencies are not, then maybe he has to upgrade the whole system.

Now the concept is within the standard. I understand that, okay? -- but by reading this under Category 1 it seems there is almost a prejudgment that anything that meets Category 1 it will be adequate for doing this support of the maintenance rule.

Do you feel that it is supportable this way, particularly for the issue of dependencies, which were sallow at times, as we discussed before, because in the application of the maintenance rule that is exactly what is happening out there.

There are very at times innocuous pieces of equipment which are removed from service. They appear to be innocuous. They may be in the air system. They may be, you know, systems which are not safety grade typically.

MR. FLEMING: Right. There is one aspect of your comment, Dr. Bonaca, that was not intended by the project team, and that is the treatment of dependencies.

I believe that, and we will have to go back and check this, but I believe that in the phrasing of the requirements for treatment of dependencies which would show up in a number of places including initiating event,

sequence definitions, systems analysis, probably quantification and LERF, but as you go through and look at the detailed requirements I don't believe that we let the PRA staff off the hook, so to speak, in treatment of dependencies with the exception that we may permit a conservative treatment of dependencies for some of the Category 1 applications.

I don't think that we really intend to avoid the need to find all the system interaction and functional dependencies and common cause dependencies and so forth even for a Category 1 application.

I think in our upgrade of these pages for the final draft that we would consider in light of these comments, I don't think that we intend to make these assignments of applications on an exclusive basis in the way in which it is arrange in the standard right here and right now.

There may indeed be an A4 -- applications of A4 that in the way in which they are implemented at a particular plant really call for a Category 2 or 3 of PRA.

DR. BONACA: I guess what makes me uncomfortable is singling out the maintenance rule and A4 as a specific application in Category 1, when I do believe that the configurations you may end up with by pulling out equipment out of service at power, it would be more challenging than

other changes more formal that you are making, in part also because for more formal changes you do have a more thorough process. They have more time --

MR. FLEMING: Right.

DR. BONACA: -- and other things, so I think you have to be -- I don't know, this just seems to single out maintenance rule and A4 as a less challenging situation and I don't think it is.

MR. FLEMING: There is one other important caveat that perhaps we haven't been too clear on, and that is that it makes A4 a particularly interesting example to discuss because this standard and these requirements are really only covering the annual average CDF, LERF part of the PRA.

All of these new issues that come into play for the time-dependent risk monitoring applications that differentiate above those different -- this standard does not really go into that. It is really outside the scope of our standard, and I think for that reason maybe A4 would not be a very good example.

CHAIRMAN APOSTOLAKIS: But you have an example under Category 2, risk monitoring application. That is not part of the standard?

MR. FLEMING: I am saying that when you look at the technical requirements for initiating events and accident sequence and so forth, we really do not go into the

additional requirements that you would have to have in there to do risk monitoring applications.

For example, time dependent initiating events -- the details of what is in the standard right now don't go into the additional technical issues that come into play when you do time dependent risk monitoring in applications.

MR. SIMARD: Well, I think it was a good idea to put these examples in because it has brought out some really good discussion here, but I think what I am hearing is that we need to go back and reconsider whether we have any examples at all, because of Dr. Bonaca's point about prejudging the outcome.

The other thing I am hearing from the past day and a half is that we need to go back and make even clearer our expectations here that, first of all, experience with the certification process shows that as you look at the various subelements of a PRA you will find for every PRA -- I think every PRA that has been looked at some of the subelements are grades 2, some are grades 3, some are even grades 4, so we have found the spread among existing PRAs that would roughly correspond to the three categories.

Second, we need to make clear that what we are talking about now does not describe the PRA, it describes the attributes of an application. And for a specific application, our intent is to go through the PRA subelement-

by-subelement, and for a particular subelement determine what level of capability that application calls for.

So, I think we need to do a better job of reinforcing the point that this does not describe the PRA. We are not giving an overall grade, for example, to the PRA.

DR. BONACA: I wanted to just point out, first of all, I really want to be reasonable. But let me give you an example of what my concern would be. My concern would be I have a very simple PRA and I am going to take out of service two safety systems. Okay. And my PRA recognizes them, pull out one and two. Then I have some component in a support system is not safety related. Nobody recognizes the safety role to it, so, therefore, we take it out of service because it doesn't fall into the maintenance rule listing or anything like that. And we know that there are dependencies out there.

Okay. Now, typically, the operations people are pretty smart. At times, they don't see it. We are all human. And so that is the scenario under which, you know, the maintenance rule still has a lot of experience to -- you know, as far as online maintenance to be developed, and so it is not such an easy application. So, anyway, it is just a comment.

CHAIRMAN APOSTOLAKIS: I would like to come back to what Mr. Simard just said. You said that you look at

what PRAs are out there and they roughly correspond to one of the three categories. It seems to me that this should not be a criterion for defining the categories, because you should go one step beyond that and ask yourself, has the NRC staff, or have these PRAs of the various categories been actually used in some of these applications successfully?

Because it is true perhaps -- no, I am sure it is, that there are Category I PRAs out there, but have they actually been used in risk significance determination for the maintenance rule? And has the NRC staff said this is good enough? That should be the criterion, because the fact that the PRAs exist out there independently of their use in the decision-making process really doesn't tell us very much. So, I wonder whether that is the case, whether anybody came here with an IPE that was what we call now Category I, they submitted an application and the staff said, this is good enough.

MR. FLEMING: In the effort that went into the original development of the industry peer review certification process that was originally sponsored by the Boiling Water Reactors Owners Group, now all the Owners Groups have picked up on a variation of this process, the information that existed at that time with respect to different plants' successes and failures with risk-informed applications was taken into account in the definition of

these. These categories were originally defined in the certification process.

And as a matter of fact, the great success that the South Texas project had provided many of the examples for the checklist that were developed to differentiate, at least with respect to some elements, the category -- what is now the Category III applications, for example. So that, the information that did exist with respect to the track record of PRAs using the decision-making process, went into the original definition of these categories.

CHAIRMAN APOSTOLAKIS: The question is whether the staff now accepted these applications. And South Texas perhaps is not the best example because they have a very good PRA. Level III, right?

MR. FLEMING: Right.

CHAIRMAN APOSTOLAKIS: A Category III. So they can support the arguments that they may want to make using a very good PRA. But I think that should be really a good test, because just because there are PRAs out there that are of the three categories doesn't really mean very much unless they have been tested in a real risk-informed decision-making environment, which means the NRC staff has reviewed them and said, yeah, for this application, this is good enough. And I don't know of any case where the staff did not actually go to Category III and raise questions.

Now, that may be temporary because we are all learning, but --

MR. FLEMING: But, again, at the time these categories were initially defined, there was quite a large database of experiences at South Texas and other plants with risk-informed applications that had a track record of success that provided an information base on which to define these categories.

CHAIRMAN APOSTOLAKIS: In other words, has anyone used the Category I IPE to satisfy the (a)(4) requirements?

MR. FLEMING: Well, the definition of that category was defined to capture those activities which the industry was, in general, using, but was not subjected to an additional special peer review process of their PRA to verify the application.

CHAIRMAN APOSTOLAKIS: The reason why I think this is very important is because it is my understanding that there is a Presidential directive that all federal agencies should use national standards to the maximum degree possible, correct?

MR. MARKLEY: OMB Circular A-119.

CHAIRMAN APOSTOLAKIS: There you are. So, one possible misuse of this might be that, you know, if it becomes a national standard, a licensee may come to the staff and say, you know, you are not following the OMB

directive because you have to follow the standard, and the standard says that for (a)(4), I can use a Category I analysis. So, now we are really changing the process. Instead of establishing the categories based on a mutual interaction between the staff and the industry, now we are trying to impose on the staff certain limitations as to what they can ask and what they can expect.

So, I think this is a very critical point here when it comes to the categories.

DR. BONACA: Because I think it is important to note, also, regarding the online maintenance, utilities who are making -- who were doing online maintenance before, at times they were performing evaluation with their IPEs or PRAs, many of them. So there has been a backfitting and they have been using whatever they had. And so, I don't think we want to, you know, make the standard endorse this necessarily, force this on the NRC, an acceptance of a process.

CHAIRMAN APOSTOLAKIS: Yeah, I mean it should not impose limitations on what the NRC staff may want to do.

MR. SIMARD: Can you help me understand your concern? Because if we eliminate any pre-judgment, if we eliminate the statement that this particular application fits Category I and so forth, all we are doing is -- and, again, we are not talking about Category I PRAs. This part

of the standard we are talking about describes the application, not the PRA. So, all we are doing is recognizing that given applications may require PRA subelements of varying capability, that for a particular application, you may need a fairly robust treatment, in one area of your PRA, and the way you have treated other elements of your PRA may not be as important.

So, all we are doing is setting in place a framework without committing the NRC staff to any judgments with respect to a given application. All we are doing, if we eliminate the examples here, is saying, for applications that have the following categories, here is an appropriate level of PRA.

Now, it is our intent that it is up to the NRC staff to make the judgment of particular applications.

DR. BONACA: If you are leaving out the examples, I thought I would agree with you. I have no problem at all. The only issue here, in my eyes, was, by de facto, you had established that the capabilities necessary to support (a)(4) maintenance rule are less than the capability to rank, you know, risk prioritizing and less than others.

MR. SIMARD: Yeah, no.

DR. BONACA: That is really a prevarication of the process. The process --

CHAIRMAN APOSTOLAKIS: As long as the NRC staff

doesn't get its hands tied because of the OMB directive --

DR. KRESS: They are already standard.

CHAIRMAN APOSTOLAKIS: I'm sorry?

DR. KRESS: Go ahead.

CHAIRMAN APOSTOLAKIS: And they actually judge and say, well, gee, that is what this says, but we really believe you ought to do this and this and that to satisfy (a)(4), then I don't have a problem. Yes?

MR. BERNSEN: George, I think this discussion was very useful. We need to take it back and consider it, because there is no way that this standard is going to put out the concept that we are making decisions on where you apply it in regulatory space. These were intended to be examples of typical current usage. And apparently it is not clear. And I think as the discussion proceeded, it isn't clear. We need to reconsider that.

Now, what Karl presented yesterday in the workshop describing the attributes of the different categories was very useful. And, you know, it pointed out that, you know, for the Category I, we are talking about cases wehre you are using the PRA to support deterministic and you are not changing licensing bases and things of this sort, and so on.

We need to go back and focus on that, and take another look at this. And if these are not good examples of current usage, we need to take them out. And we make it

clear that this is -- we are not prescribing them. The standard does not prescribe them, that is done by the regulator. We are sensitive to that, so that is a good discussion.

CHAIRMAN APOSTOLAKIS: I think Section 1.5, pages 3 and 4, should be revisited with that point of view.

MR. BERNSEN: Right.

CHAIRMAN APOSTOLAKIS: You know, this is a very sensitive issue. Maybe in the paragraph, the second paragraph that talks about the boundaries between the categories and so on, bring up the issue of degree of confidence and so on.

MR. BERNSEN: Right.

CHAIRMAN APOSTOLAKIS: But the introductory paragraph perhaps should make it clear as to what these typical applications are intended to -- the message they are intended to convey, and that in no way are binding somebody. I don't know if you can say.

MR. SIMARD: Exactly.

CHAIRMAN APOSTOLAKIS: Because I think this particular section, you know, is very critical in how the categories will be viewed later on, because you don't want, again, to have people say, gee, it was Category II, and the OMB says you have follow it, and all of a sudden the NRC staff is on the defensive why they are violating an OMB

directive and they don't follow a national standard, you know.

DR. BONACA: The other interesting thing is that one could contend that in order to evaluate two or three different components simultaneously, you need quite an advanced degree sophistication, you know, and so you want to look at it, too. Okay. I just added that.

CHAIRMAN APOSTOLAKIS: Okay. Any other comments and categories? Yes.

MR. FLEMING: I wanted to clarify one thing that one of my colleagues on the project team wanted me to point out, and there is a lot of confusion, I think, or opportunities for confusion when one compares these three categories in our standard to the categories that were originally defined in the industry certification process.

These categories here refer to the industry Categories II, III and IV, and whereas I in the industry certification process was the IPE level. So, I just wanted to make a clarification here, is that this Category I is already raising the bar, I think to a significant extent above what was expected for the IPEs. So, I just wanted to clarify that point. Category II is further up the bar.

MR. BERNSEN: I don't know, we may revisit this again, but it is appropriate to bring it up at this stage. We felt that it was useful to have the three categories in

our standard because it does reflect current usage, and it does recognize that there different grades for the various elements and supporting requirements. And we are looking for feedback on that, what your reaction is to that, because it is an important concept of the standard.

CHAIRMAN APOSTOLAKIS: On this particular subject, any comments from the NRC staff?

[No response.]

CHAIRMAN APOSTOLAKIS: Public?

[No response.]

CHAIRMAN APOSTOLAKIS: I guess -- Karl, do you have any more viewgraphs?

MR. FLEMING: No, that is all.

CHAIRMAN APOSTOLAKIS: I have comments on the HRA and data analysis. I don't know, Jack, do you have anything on the accident quantification?

DR. BONACA: On the quantification, yeah.

CHAIRMAN APOSTOLAKIS: You do.

DR. BONACA: Yeah.

CHAIRMAN APOSTOLAKIS: So, I guess we can break for lunch now and then pick up the specifics after that. We have comments on specific sections. I don't think it will take more than an hour or so.

DR. BONACA: No, I don't have extensive comments.

CHAIRMAN APOSTOLAKIS: Gerry.

MR. EISENBERG: I just wondered, the question Dr. Bernsen raised is a more generic question.

CHAIRMAN APOSTOLAKIS: Yes.

MR. EISENBERG: Are we going to revisit that after lunch?

CHAIRMAN APOSTOLAKIS: I thought we were done, but at the end there will be -- we will go around the table so that the members --

MR. BERNSEN: I guess my question is, is the discussion clear on this? Have we had a reaction from you, or are we still waiting? With regard to --

CHAIRMAN APOSTOLAKIS: Our reaction to the categories?

MR. BERNSEN: Your consideration of the acceptability of retaining the three categories and the utility of it.

CHAIRMAN APOSTOLAKIS: Well, why don't we think about it and maybe come back to it. But at the end I plan to go around the table and maybe this is a question to which we will have to.

MR. BERNSEN: Fine.

DR. BONACA: I think there is a lot of questions, of course. And, you know, I want to say that still I can see the strength of the high level requirement approach, that is a real strength over the previous, because it is

structured, the top process, how you get into that.

CHAIRMAN APOSTOLAKIS: Well, the thing is the NRC staff itself, in Reg. Guide 1.174, recognized that the degree of sophistication of a PRA varies with the application. That is why we have the shades of gray and there is a discussion about sensitivities and model uncertainties and so on, as you approach the boundaries.

So, people do recognize that not all PRAs have to be, you know, the perfect PRAs for all applications.

What you are doing here is you are going one step beyond that and you are actually trying to formalize that by defining categories. And, you know, the implications and consequences of this kind of thing is something that we are all thinking about. And, again, my concern, as I expressed earlier, is how are certain licensees going to use this in light of the OMB directive. And if it is used to impose certain constraints on the staff, then I think that would be an unfortunate use of the standard.

So, let's come back to this at the end, around 2:00 or so, after we finish with the specific questions. But this is certainly something that is extremely important.

Okay. So, we will come back at 1:00.

[Whereupon, at 12:05 p.m., the meeting was recessed, to reconvene at 1:00 p.m., this same day.]

A F T E R N O O N S E S S I O N

[1:06 P.M.]

CHAIRMAN APOSTOLAKIS: Back in session. So, we will discuss first, some of the items under Risk Assessment Technical Requirements, and some of the specific questions, and then perhaps go back to a general discussion of the standards, and let's plan on finishing maybe like 2:15 or 2:30.

Okay, we've discussed already initiating events, accident sequence analysis, success criteria. Any comments?

[No response.]

CHAIRMAN APOSTOLAKIS: System analysis. Success criteria, I think Bill Shack may have some comments. Do we know where he is?

MR. MARKLEY: Have you seen Dr. Shack?

MR. SIEBER: He had an appointment over lunch.

CHAIRMAN APOSTOLAKIS: He did? Well, that brings us to Human Reliability Analysis, which is me.

And that takes us to page 76. Yes, that's where it starts, right, 76.

[Pause.]

On page 78, under C, for pre-initiator HRA, it says that the evaluation of errors in pre-initiator human action shall be performed using a well defined process that recognizes plant-specific nature of the human failure

events.

Are you referring to the Swain Guttman various adjustment factors there?

MR. MROWCA: Bruce Mrowca, I'm a Project Team Member and also from Baltimore Gas and Electric. I didn't get to the section you were talking about.

CHAIRMAN APOSTOLAKIS: Page 78.

MR. MROWCA: 78.

CHAIRMAN APOSTOLAKIS: There's a table there on high level requirements for human reliability analysis. Under C, Quantification --

MR. MROWCA: Okay.

CHAIRMAN APOSTOLAKIS: Plant-specific nature, the plant-specific nature of the human failure events, I was wondering what that meant.

MR. MROWCA: This is for pre-initiating actions?

CHAIRMAN APOSTOLAKIS: Yes.

MR. MROWCA: My page numbers are different than yours. That's what I'm struggling with.

MR. BERNSEN: Our page 76.

MR. WALL: Dr. Apostolakis, if I might offer a small suggestion, if you use the index number on the righthand column, it avoids the confusion about the page.

CHAIRMAN APOSTOLAKIS: Righthand column. How about if I give you a table number, 4.4-5.

MR. WALL: The index number gives you the right --

MR. BERNSEN: But he's talking about the high level requirements, Table 4.4-5, page 78 of mine. Is that the same page for you?

MR. MROWCA: It's 76 for us.

CHAIRMAN APOSTOLAKIS: You dropped two pages, but you're not going to tell us which ones. Quantification.

MR. MROWCA: That's the quantification of pre-initiators?

CHAIRMAN APOSTOLAKIS: Yes.

MR. MROWCA: The intent was to reflect the plant unique features of test calibration and maintenance, and have a process that will identify those tests, maintenance, and calibration activities that, one, need to be identified; and, then whether they're proceduralized, and some method to address the degree of proceduralization and the degree of independent degree and checking that's going on in the development of those actions.

It actually is not meant to endorse, again, a particular methodology.

CHAIRMAN APOSTOLAKIS: The only methodology really that is out there and people are using is the NRC Human Reliability Handbook when it comes to pre-initiators. I don't know of any other.

So, in this particular case, it doesn't really matter. It's the post-initiator that is subject to.

MR. MROWCA: I've seen many ways to employ a single methodology.

CHAIRMAN APOSTOLAKIS: Yes, because it has a lot of discussion on performance factors, so I was wondering whether you were referring to that.

MR. MROWCA: Well, the key thing I think we're trying to say is that the two attributes that you need to consider were proceduralization and independence, and having a technique to reflect those attributes.

CHAIRMAN APOSTOLAKIS: Okay. On page 80, which is 78 for you, I suppose, supporting requirements, Table 4.4.5(b), under both Category II and III applications, you have a parenthesis that says, i.e., latent.

Now, first of all, we said earlier this morning -- and I don't know if you were here -- that the definition earlier was not quite accurate.

But this is not something that people do routinely, I don't think. Wouldn't it be worthwhile to explain what you mean by latent conditions and latent errors somewhere?

I was pleasantly surprised to see it here, but I don't know that most people will understand what you mean by latent, unless they have worked in the field.

MR. MROWCA: Are you making a distinction between post-initiators and latent errors?

CHAIRMAN APOSTOLAKIS: No, no; this applies to both.

MR. MROWCA: Excuse me, pre-initiators and latent errors, is what I meant to say. They are the same thing, right, the way you read it.

CHAIRMAN APOSTOLAKIS: Oh, I see.

MR. MROWCA: Essentially, I think they're being used interchangeably in the standard, for pre-initiators being any action prior to the initiating event.

CHAIRMAN APOSTOLAKIS: Right, and you refer to miscalibration, for example.

MR. MROWCA: Miscalibration, maintenance, alignments.

CHAIRMAN APOSTOLAKIS: What I am saying is that in his book, Jim Reason and others defined latent conditions in a broader sense, so my mind went to that. I didn't go to a specific human action that disables something before the initiator.

For example, latent conditions may include things like prioritizing something or giving it a low priority, so even though the Agency is aware of second actions that must be taken, they will take them sometime in the future, and then something happens before the corrective action is

taken.

And a recent review by Idaho for the Staff here identified many of those. They did a number of root cause analyses and confirmed that.

So, the word, latent, means now something very specific in the HRA community. And I think you should make that clear that you are not referring only to the specific action of miscalibration.

MR. SIMARD: Would you suggest a change then to our definition of latent human error?

CHAIRMAN APOSTOLAKIS: There is a definition which is very specific.

MR. SIMARD: Right.

CHAIRMAN APOSTOLAKIS: I suggested earlier this morning to broaden it.

MR. SIMARD: Thank you.

CHAIRMAN APOSTOLAKIS: But I'm not sure that just listing a definition will do it. Maybe some elaboration somewhere here as to what latent conditions are would help. I'm sure the Staff will be happy to give you the INEL study, or at least the viewgraphs that were presented to us, and that will give you an idea of where people are coming from.

MR. SIMARD: All right, thank you.

CHAIRMAN APOSTOLAKIS: One other comment on this table: Oh, on page 82, again I was pleasantly surprised to

see under HR-C-4, assess the dependency of pre-initiator human actions among multiple systems and trains, including whether the work process itself introduces a mechanism for dependency.

Well, I don't know of anyone besides me who worries about work processes, so this was really very pleasant to me. Is that something that you are doing and I don't know about it?

MR. MROWCA: Well, I think maybe it's maybe the interpretation of what work processes --

CHAIRMAN APOSTOLAKIS: The way the term is used at the plants?

MR. MROWCA: We assess whether there are different crews that look at redundant channels, for example, and whether there are a couple of mechanisms that's possible between those redundant channels. That's what we do at Calvert Cliffs.

When we look at pre-initiators, we're trying to actually identify mainly those things that do take out redundant channels, because those were the ones of most interest to us.

CHAIRMAN APOSTOLAKIS: So you are focusing on the number of crews, perhaps?

MR. MROWCA: Well, not only the crews, but whether the indications of the test will provide indication that it

was mis-done. For example, if there is adequate feedback to the checker, that he will know that; whether the checker is actually embedded into the proceduralized process or performing the test or calibration or maintenance activity.

CHAIRMAN APOSTOLAKIS: In a maintenance work process, for example, you will have maintenance request. There is some prioritization, again, because there are too many of those, and there is a scheduling step.

There are all those things which are before the actual execution. What you are saying, I think you are focusing on the execution itself and how many people are involved and whether there is feedback.

MR. MROWCA: Well, maybe I misunderstand your point, but most of the latent failures that I have been concerned with are the ones that have occurred as a result of maintenance being performed, not as a result of waiting for maintenance to be performed.

And those are typically captured in the unavailability conditions that you have in the plant, and the length of time that they're in that condition. And so you would see that information in the unavailability data or failure data, more than you would see it in developing human error probabilities.

CHAIRMAN APOSTOLAKIS: I think both the INEL work and work at MIT have seen the prioritization process --

MR. MROWCA: As important.

CHAIRMAN APOSTOLAKIS: As important, yes. But since the words, work process, really means something again to many people, maybe you need to define it and explain in what context you're bringing it up here.

MR. MROWCA: Okay.

CHAIRMAN APOSTOLAKIS: And I would encourage you to do that. Page 88, I have something on 88.

Oh, well, yes. The issue of model uncertainty is really not raised anywhere in this guide, not just the HRA. And it seems to me if one does a Category III PRA, and if one goes back again to 1.174, you realize that the issue of model uncertainty in some instances may be important.

And the Staff now explains very clearly in the Guide, that those cases where we're near the boundary, increased management attention means that we're going to look at sensitivity studies and so on, because the Staff also recognizes that there is no accepted method for dealing with model uncertainty, although expert judgment elicitation techniques come into that.

And in the post-initiator -- I think we are there, pre- and post-, so it applies to both -- in the post-initiator HRA, the issue of model uncertainty, of course, is very important, simply because there are many different groups around the world that have developed their own

models, and we have SLIM MOD; we have ATHENA from here, although ATHENA hasn't quantified anything yet.

And we have ACEP from 1150 and so on. So it seems to me that if there is one place perhaps Level II PRA where model uncertainty is really important, it's the post-initiator HRA.

And yet the standard is silent, and what's -- there is also inconsistency between what you're doing here and the level of detail and what you do later for common cause failures and expert judgment, but especially common cause failures where you actually list five methods for handling common cause failures.

And yet in this chapter, you are completely silent as to what methods exist out there. So that's a broader comment for you that, again, we have this inconsistency that we discussed also in the context of Bob Budnitz's --

MR. MROWCA: In those cases, do you have a recommendation that you would prefer to see listed?

CHAIRMAN APOSTOLAKIS: I would stay away from recommending methods, and I will recommend later in the context of common cause failures, that --

MR. MROWCA: To remove them?

CHAIRMAN APOSTOLAKIS: -- they delete the five models. But that's my personal view, and I'm not going to defend it in depth.

MR. MROWCA: Okay.

CHAIRMAN APOSTOLAKIS: The reason is that, as you know very well, these methods -- I mean, there is no single method that is acceptable by the group of people, but we have to recognize, it seems to me, the fact that there are different models out there, and perhaps you are aware of some benchmark exercises that were run by the ISPRA laboratory of the European Union a number of years back.

And Mr. Fleming, in fact, participated in at least two of those, I believe. One was a common cause failure.

MR. FLEMING: That's right.

CHAIRMAN APOSTOLAKIS: And they have nice tables. I mean, the table on HRA is just mind-boggling. The same team using different models get orders of magnitude different results, and different teams, of course, using the same model also get that.

So, it's all over. And that's not your problem, but you have to recognize here, it seems to me, that there is such significant model uncertainty, and that if the issue of recovery actions, for example, is important, important enough to attract increased management attention, some handling, some sort of sensitivity analysis here, you know, using perhaps two or three of these models or arguing that the model we're going to use under these assumptions is really the bounding one, we need some guidance on this, it

seems to me.

And I'm not saying it's an easy task, and I'm not saying it was obvious and we missed it, but it strikes me that's something that is unique to this particular subject, and I think the fact that even this Agency in this era of limited resources is spending considerable resources in developing ATHENA, shows you that this is an area where there is really a lot of activity.

So I would recommend that you do that, but I would also recommend the higher-ups that they put something on model uncertainty somewhere.

Yes?

MR. FLEMING: I don't think this will end up being an impressive list, but there are a limited number of examples of modeling uncertainty that's addressed in the standard to some extent, and a couple that come to mind are the seal LOCA.

CHAIRMAN APOSTOLAKIS: Exactly.

MR. FLEMING: The reactor coolant pump seal LOCA, which is a modeling uncertainty issue, and the other one is the modeling of the electric power recovery process.

CHAIRMAN APOSTOLAKIS: Right. This morning, I don't know if you remember, but I suggested to Bob that he list a few examples in the expert judgment section of Level I issues that would require experts.

Now, again, why do they require experts? Because of model uncertainty. So the whole thing ties in very nicely, but I think somebody who can influence the whole thing, can make -- must make sure that these things are coordinated.

You wouldn't go to expert judgment in Level II unless you had model uncertainty, right? If it's a parameter issue, it's not a big deal.

Well, we can move on. So, my personal view is not to list any models. You know how people -- at least some people are. They might say, well, one of these is acceptable and we'll do that.

If, on the other hand, in the context of model uncertainty, you say, well, there is a number of models out there, e.g., such and such, and then immediately you say one would need to do something with those, then it's okay.

MR. FLEMING: Okay.

CHAIRMAN APOSTOLAKIS: Yes?

MR. FLEMING: Sid just reminded me of something else to point out for the record, and that is when we get down to quantification, there are specific requirements to include modeling uncertainty.

CHAIRMAN APOSTOLAKIS: Wonderful.

MR. FLEMING: That's in a general sense, not a specific sense.

CHAIRMAN APOSTOLAKIS: Yes, but this is an area where guidance is needed, because, you know, I don't think we disagree.

I have just a minor comment on 87, Table 4.4-5(f), the third row, HR-F3, Category 3, include best estimate time-dependent HEPs for initiation control, and the previous one says best estimate, best estimate.

It is a crusade of mine to eliminate that terminology from reactor safety. I realize it will be an uphill battle when it comes to thermal hydraulics, fighting an entrenched establishment.

But I have yet to find a book on probability and statistics that tells me what a best estimate is, and I think that is a pretty powerful argument. And I would suggest that you, especially in Category III, avoid the words, best estimate, and, in fact, there may be uncertainty in that time.

I remember seeing a paper way back in the early 80s where people said, the author said that -- well, and I think they are right -- that what really matters is not the available time. It's what the operators perceive as the available time.

They're not going to do thermal hydraulic calculations there in 20 minutes, so that's what they perceive as the available time.

Then, of course, the authors went out and asked operators what the available time would be under a given condition, expert judgment elicitation, and the available time was overestimated systematically by a factor of three or more.

This confirms another finding from the psychologists that people tend to be optimistic when it comes to their profession and their ability of handling those situations.

So my suggestion is to eliminate, at least under Category III, the words, best estimate, and maybe state something to the effect that the time itself may be uncertain.

MR. MROWCA: Okay.

CHAIRMAN APOSTOLAKIS: And then on page 90, this is data. We're moving on to data. But overall, I thought it was a pretty good high level description of the requirements.

MR. MROWCA: There was a strong attempt to try to stay away from methodologies and just stick to characteristics that were important.

CHAIRMAN APOSTOLAKIS: Which is the theme of the standard, right? Now, I don't know how some of these things will affect the quantification, but that's a universal problem.

I mean, I don't know whether we can really argue that the quality of the written procedures is so high that I should use rates lower than what another fellow is using, but at least it makes people think about it.

Any other comments on HRA from the audience, perhaps?

[No response.]

CHAIRMAN APOSTOLAKIS: No? Data analysis is the next chapter, 4.4.6. On page 90 of mine, where it talks about parameter estimation -- and this is repeated later. I guess, Karl, you are the man here?

MR. SIMARD: That would be Ian Wall.

CHAIRMAN APOSTOLAKIS: Ian, I'm sorry. Okay, Ian Wall.

Under Requirement C, Parameter Estimation, it says uncertainty intervals should address key parameters. Why intervals and not distribution? That's my page 90, Table 4.4-6.

MR. WALL: Which index number.

MR. BERNSEN: It's high level C.

CHAIRMAN APOSTOLAKIS: High level requirements for data analysis, Table 4.4-6, or maybe the numbering of the tables has changed.

MR. WALL: Let me say up front, Dr. Apostolakis, that as penance for a lifetime of sins, I was assigned this

section, even though I lack expertise.

CHAIRMAN APOSTOLAKIS: Your's is not to blame, it's just to come up with a better product.

MR. WALL: I was fortunate in having some excellent help as facilitator, including Karl Fleming and Stanley Levinson, and other consultants, Shobba Roa, who I think you may know for PLG. So if I cannot answer your questions, I will be happy to take notes of them and get an answer later on.

CHAIRMAN APOSTOLAKIS: So, the question is really why -- first of all, are we on the same page?

MR. WALL: We're on the same page.

CHAIRMAN APOSTOLAKIS: Uncertainty intervals shall be addressed for key parameters. My question is, why not distributions, because what are you going to do with the intervals?

MR. FLEMING: I think I have an insight here. This is a high level requirement which is phrased so that it applies to all three categories. If you go down to the detailed categories, you will see that we're insisting on uncertainty quantification -- full uncertainty quantification for Category III, but less -- you know, more of a qualitative examination of uncertainties in Categories I and II.

So the phraseology up at this level --

CHAIRMAN APOSTOLAKIS: For Category I, Karl, you really don't ask for any uncertainty, so why would they come up with an uncertainty?

MR. FLEMING: There are still requirements to understand uncertainty from a qualitative perspective, even in Category I, so the choice of words up at this level was selected to be broad enough. It says considered.

It says uncertainty intervals shall be considered. Down in Category III, you will see uncertainty distributions have to be quantified.

CHAIRMAN APOSTOLAKIS: Why didn't you note that? You confused me, and if you guys want to take action --

MR. FLEMING: I think the word, intervals, was the problem.

CHAIRMAN APOSTOLAKIS: The word, intervals, bothers me.

Then on page 94, alpha factor, multiple Greek letter, basic parameter binomial. Why? This is the only place where you do this.

Table 4.4-6(e), third row. Use one of the following models for estimating CCF parameters, and it gives a reference, which I bet is NUREG. And I don't know why all of a sudden you decided to be so specific here and list models.

I mean, I would rather do what the HRA folks did,

and say use a model from out there, but be careful and do all these things that we're telling you.

As you know, I don't know that the binomial failure rate model is one of the following models, at the same level as a multiple Greek letter model. I would rather go with multiple Greek letter model than the binomial failure rate model.

And also, you know, now it begs the question, the alpha factor model was developed to correct certain statistical things in the multiple Greek letter model, and yet we say you can go back and use the multiple Greek letter model. I would take them out.

It would be consistent with the other chapters, and you wouldn't get questions like this, the ones I'm giving you now. Now you're endorsing models.

MR. FLEMING: If I might respond to that, I think that, yes, I think it is true that there are some inconsistencies across the elements in the position they took with respect to methods.

There were a few example like an accident sequence definition where we throw out some concepts like event sequence diagrams, dependency matrices, and so forth, to provide specific examples of a systematic method for a certain task in the PRA.

But in each case, we made judgments. There is an

important distinction we need to make between when we compare HRA to Common Cause, and that is that, in fact, one of the conclusions of the ISPRA benchmark exercises on these different elements was that the selection of the method, the modeling method itself, was not fundamental to the nature of the result.

It was more in how the model was applied and how the data was screened and so forth. So the variability across methodologies among all the ones that are mentioned here, are not nearly as strong as they are in the HRA field.

But we have a tradeoff here. We can list methods that we know are acceptable, and say justify alternatives, or we can take this out and then replace it with the recreation of these NUREGs that describe all the acceptable characteristics that you have to have.

CHAIRMAN APOSTOLAKIS: If you took out the binomial failure rate model, it wouldn't bother me.

MR. BERNSEN: George, that's a carryover from Draft 10. It's a direct statement, quote, out of Draft 10, but it's still a valid comment on your part. I'm not --

CHAIRMAN APOSTOLAKIS: Yes, I think you would have to think about the issue of consistency from chapter to chapter, but coming to the specific thing here, I mean, sure, Karl has a point, people have spent a lot of effort and resources on developing these. But the binomial failure

rate model, I'm not sure belongs in the same category as the others.

As a matter of fact, we were told that in a different context. But the San Onofre risk monitor uses a multiple Greek letter model. So you really don't want to say just use the alpha factor.

I agree with you, Karl, that some statistical corrections really never made a big difference, which brings me to the other point which I may have missed. But as you know, a lot of the emphasis of the NRC work on this subject over the last several years has been on building up a good database, and then urging the user to screen all these events.

I think, in fact, that goes back to you, Karl, in the early days when you started this project.

To screen these past events as to their applicability to the particular facility for which the PRA is done. Is that emphasized anywhere here or have I missed it? In any table here it says go to the data and actually screen and be careful when you screen. I mean all it says is usually a list of common cause probabilities. But the probabilities come after a long investigation.

MR. FLEMING: For example, if you look at DA-B8.

CHAIRMAN APOSTOLAKIS: B8?

MR. EISENBERG: DA-B8.

MR. FLEMING: DA-B8, which is at the top of one of the pages of Table 4.4-6B. It is probably page 94 in your IEEE. The very top requirement in that.

MR. SIMARD: It is the one right before the requirement.

MR. FLEMING: It is suggesting that for Category III applications you have to do this plant-specific screening as indicated in the NUREG. So, yes, it is mentioned for Category III applications.

CHAIRMAN APOSTOLAKIS: Yes, supported by plant-specific screening and mapping. All right. If that is good enough, that is good enough. And, again, we have a particular reference here.

MR. WALL: I would like to note, Dr. Apostolakis, that the supporting requirement DA-B8, to which Karl has referred, is actually responding to an ACRS comment on the previous draft, your comment in one of your attachments. So, we did listen last time and we will listen again.

CHAIRMAN APOSTOLAKIS: So, our promises are coming back to haunt us, is that what you are saying Dr. Wall?

MR. FLEMING: In fact, we refer to this as the Apostolakis requirement.

CHAIRMAN APOSTOLAKIS: Okay. Well, so I don't know, is your inclination right now -- I know that you cannot really commit the committee, but to eliminate all

four or keep the first three and delete the binomial failure rate model?

MR. FLEMING: I think those are good comments that we will certainly take very seriously.

CHAIRMAN APOSTOLAKIS: I would like to see a little more emphasis on the screening. Just saying plant-specific screening, maybe that is good enough, I don't know.

Well, I think I am done with the common cause failures, unless -- no, there is more. There is more. I'm sorry. There is data analysis. Yeah, that is part of data analysis. I have more comments. Page 96, Table 4.4-6C. Again, the caption talks about intervals but we have discussed this.

On the righthand side there are four bullets. Are we on the same table? I like this one, verify that the Bayesian updating does not produce a posterior distribution with a single bin histogram. That way you don't -- in fact, I like it so much I think you should elaborate a little bit more, because the original data specialization paper did not, unfortunately, emphasize this enough, and people take test data, for example, and you don't need very many of those. If you have done a few Bayesian calculations, you know that very quickly, the posterior distribution becomes very narrow, and if the idea was to keep a tail for the accidents, for the accident conditions, and the data come

only from tests, then you have a problem.

MR. FLEMING: That's right.

CHAIRMAN APOSTOLAKIS: And I think that was the intent here, but I think perhaps only a few of us understand this if you just read it. So --

MR. FLEMING: True.

CHAIRMAN APOSTOLAKIS: And then the fourth bullet says, verify the reasonableness of the posterior distribution mean value. I would say, verify the reasonableness of the posterior distribution. Why just the mean? I mean since you have done the work, you might as well look at it, which is related to the previous comment.

MR. FLEMING: Good comment.

CHAIRMAN APOSTOLAKIS: And I think now I am done with the data.

MR. WALL: Before you leave the data, Dr. Apostolakis, I would like to just mention that you may react to the fact how much smaller this section is than Rev. 10, and I would like to provide some assurance to you that we systematically went through Rev. 10 and took each of the "shalls" from Rev. 10 and made sure it was handled in this section as an action statement. And this section, I tried also, in the square brackets on the lefthand side, to show the paragraph in Rev. 10 from which that statement came.

CHAIRMAN APOSTOLAKIS: Good. Thank you. Well,

this is an area that is fairly mature now. The data has subsided. So, unless someone else has a comment on data?

MR. FLEMING: George.

CHAIRMAN APOSTOLAKIS: Yes.

MR. FLEMING: I just wanted to -- Ian brought up a very good point, it is something that I just wanted to bring to your attention, the committee's attention, is that one of the characteristics of Rev. 10 that we tried to address in this rev. was that if you go back to Rev. 10 and develop a frequency distribution of the number of pages of requirements against the elements, there was a strong feeling by many of us that it was out of balance. That Rev. 10 tended to write the most about the things that we have the least concern about in PRA, system analysis, data analysis. There were lots and lots of requirements in here, and fewer and fewer requirements in there that are really tough.

So, we tried to balance, come up with a better distribution of the level of detail of the requirements to reflect the importance of the PRA element, and that was part of what Ian was trying to accomplish this.

CHAIRMAN APOSTOLAKIS: One last thing, the user will, if they go the literature, which I am sure they will, or the PRAs, will find terms such as state of knowledge distribution, more recently, epistemic, alliatory.

Shouldn't these be in the glossary definitions?

MR. FLEMING: If we use them.

CHAIRMAN APOSTOLAKIS: And perhaps in the data section, say a few words about the terminology. Because I can see someone getting completely lost. Right now it says, you know, develop a probability. In the definitions, I didn't see it. But I think there is complete silence on these things, and I think people will find it useful.

MR. FLEMING: In the quantification section, QUD2, the ones we were referring to earlier, we do, in fact, use alliatory and epistemic.

CHAIRMAN APOSTOLAKIS: Yeah, but in the data section.

MR. FLEMING: Therefore, we should have a definition.

CHAIRMAN APOSTOLAKIS: So, there are two places, one is the definitions and the other in the data section. But when we talk about uncertainty intervals for parameters like failure rates, maybe you put a parenthesis and say, you know, this is epistemic.

Dr. Shack, we skipped the success criteria section. Do you have any comments?

DR. SHACK: No.

CHAIRMAN APOSTOLAKIS: It's okay?

DR. SHACK: It's okay.

CHAIRMAN APOSTOLAKIS: Fine.

DR. KRESS: I had one question on success criteria, I guess. It is sort of the same question I had on the fission products. They call for use of remediation things in fission product, but this requires you have a model for fission product release and transport, but there is no standards, or no requirements related to what that is.

I had sort of the same question on success criteria. It calls for using realistic thermal-hydraulic analysis or whatever to determine the success criteria. But that is about as far as it went. And I was a little bit concerned, well, I can do an awful lot in perturbing the results of a PRA by screwing around with success criteria. But it seemed like we didn't talk much about how one determines those success criteria and what are the standards of the deterministic calculations or the other kind of calculations that are used for those. And it was just a comment. It just seemed --

CHAIRMAN APOSTOLAKIS: That is actually related also to the available time.

DR. KRESS: And available time, yeah. Yeah.

CHAIRMAN APOSTOLAKIS: It all comes together.

DR. KRESS: Same -- available time is the same sort of issue there. So, I thought it needed a little more discussion or something about that in there.

CHAIRMAN APOSTOLAKIS: In fact, different success criteria do have an impact, right?

MR. FLEMING: Absolutely.

CHAIRMAN APOSTOLAKIS: It is not like failure rates and common cause failure.

I think Dr. Kress makes an important point. I think you can tie that to the available time for HRA purposes and all that, and maybe say a few words about the uncertainties in the so-called deterministic analysis. Right?

MR. FLEMING: Right. Good comment.

CHAIRMAN APOSTOLAKIS: Okay. Mario.

DR. BONACA: In many cases it makes enormous difference.

DR. KRESS: Yeah, you can really, you can make enormous differences with it.

DR. BONACA: Train auxiliary feedwater, the reality, the best estimate, a cantilever, a three redundant. Really, if you have a three redundant train, rather than two redundant. So that just is an example, you can derive very big differences just by the fact that you can prove that you have three redundant system rather than two.

CHAIRMAN APOSTOLAKIS: Sure.

DR. BONACA: I had some comments on the quantification here. One of them is I believe mostly

editorial, I brought it up yesterday, it is on page 109. I am not sure it is only editorial. If you look at the high level requirements, they are listed as B and C and they are the same. But if you go into the supporting requirements, page 113 and 115, they are different. So, I think probably, C was meant to be something else.

MR. SIMARD: Oops, a mistake there.

CHAIRMAN APOSTOLAKIS: They are identical, yeah.

MR. SIMARD: The official answer to that is "oops."

DR. BONACA: But the supporting requirements are different in their meaning, so maybe you want a different heading here under C.

MR. FLEMING: I believe that one of them was intended to be Completeness and Scope, and the other one supposed to be Completeness and Detail, but we will confirm that. But it is obviously a failure of our document.

MR. SIMARD: Yeah. Obviously a failure of the computer.

MR. FLEMING: Yes.

DR. BONACA: At the beginning I scratched it, and then when I went back, and I said, oh, I can't scratch the supporting requirement there.

MR. FLEMING: That is where I hit "do what I mean" button and nothing happened.

DR. KRESS: I wish I had one of those buttons.

DR. BONACA: On page 110, under index, a couple of the tables you have, under Category I, applications, two applications and three, the only difference is one is understanding, two is a sound understanding, and three is sound understanding and quantification, which is fine. But when you get down to the first supporting requirements, and often after that, you use the word "estimate CDF and LERF," rather than calculate. Any reason here? I mean estimate seems to me like such a more vague word that has a lot of latitude to it, estimate things.

MR. FLEMING: I don't believe we had any profound reasoning in the use of that term and it is probably superfluous. It probably could be --

DR. BONACA: Well, I just, you know -- since you are using it also for a Category III, I thought it may have been something else at the beginning. Anyway, look at it, for whatever that.

On page 111, the top of the page, now if you look at Category I, again, it says it should have an understanding of the impact of key uncertainties. And so I don't know why the next supporting requirement, QUA9, you know, the truncation requirement, would that apply also to Category I? I mean you still want to truncate at a sufficiently low enough value that the importance

calculations are understood. Even if you don't have the same level of scrutiny or precision, you would want to have that.

And I had the same comment somewhat on QUA11 here. You are talking about, this is something that I have seen analysts do always. I mean at some point they estimate what they have lost in the truncation. It is a simple check, I mean it is not that this is a major undertaking. My sense is that they will be beneficial by just using the word "consider," to me says that if you don't consider, you may lose the understanding of the impact of key uncertainties.

So, my suggestion here is just that you review the high level requirement against the supporting requirements to see that there isn't a logical inconsistency. And that goes down also to QUA12. I don't know, the screening value seems to be pretty large.

CHAIRMAN APOSTOLAKIS: I have a minor editorial comment off of there.

DR. BONACA: So that is -- I'm sorry.

CHAIRMAN APOSTOLAKIS: Understanding and quantification of the impact of uncertainties, I would say quantification of the uncertainties, to avoid. And that is everywhere.

MR. FLEMING: Yes.

CHAIRMAN APOSTOLAKIS: Yes. I also got the

comment from Mr. Barton, he is also wondering whether people will really understand the distinction between a realistic quantification and straightforward quantification. He asks, what is meant by realistic basis? And I think that is related to what Dr. Bonaca just raised. He actually -- we make a distinction here between an understanding and a sound understanding.

These are very fine lines to walk --

DR. BONACA: That's why at the beginning I didn't critique it.

I just went down into the supporting to see if that, by that clarification --

CHAIRMAN APOSTOLAKIS: I really don't know what you guys can do about it but I am just telling you what the reaction of people who have not lived with this for the time that you have lived with it is when they see that a distinction between one category and the other is that here you are modeling something but here you are doing a realistic model. Here you understand something but here you have a sound understanding.

If you can do something to make it clearer, I don't know what you can do but this is a reaction, okay?

MR. FLEMING: Just a comment on that. I think that you see to some extent a work in process along the way from a point in time when we were trying to figure out the

logic for, an appropriate logic for differentiating requirements across the three categories.

At one time it was oversimplified to say that in Category 3 you shall do something, should, and may, so we converted the actions statements --

CHAIRMAN APOSTOLAKIS: Right.

MR. FLEMING: -- and we don't mean unsound understanding if you don't say sound, so I think this is good feedback.

We need to go back and tighten that up.

CHAIRMAN APOSTOLAKIS: And that is why I will come back to my comment yesterday and this morning that if you tie these categories to the decisionmaking process and the decisionmaking process is 1.174, and refer to the decision criteria of 1.174, at least for me that makes it much clearer as to what you mean by Category 3 and Category 2.

MR. FLEMING: Right.

CHAIRMAN APOSTOLAKIS: The Staff is on the record saying that as you approach the boundaries things become darker, increased management attention, but when you attract increased management attention you better have a Category 3 analysis.

MR. FLEMING: That's right.

CHAIRMAN APOSTOLAKIS: That makes it clearer to me.

MR. FLEMING: That's right.

CHAIRMAN APOSTOLAKIS: Otherwise, sound versus unsound, realistic versus unrealistic -- it's a little difficult.

It may be in the same context -- I mean I can see the distinction between Category 2 and 3 in the context of 1.174. Category 1, I can't place it, so that is something I am sure we will discuss again.

DR. KRESS: 50.59?

[Laughter.]

CHAIRMAN APOSTOLAKIS: 50.59 is always the answer.

DR. BONACA: I had one more comment here.

CHAIRMAN APOSTOLAKIS: One more comment, yes.

DR. BONACA: Which is general. That's all I've got -- which is more of the use of the word "may" rather than use like -- let me give you an example -- QUA-14 on page 111.

Under Category 3 you are making it a requirement to use the same truncation limit for solving each system in the overall sequence CDF, because it is the proper approach.

When you come down to the other two categories you are using the word "may" -- now if I had seen the word "should" I would have said that's fine. It's a recommendation. People don't have to follow it, but "may" seems to be a little bit -- almost too loose.

CHAIRMAN APOSTOLAKIS: Too weak.

DR. BONACA: Too weak. I mean "may" -- yeah, I may also take a walk.

[Laughter.]

CHAIRMAN APOSTOLAKIS: But should you though?

[Laughter.]

DR. BONACA: Just a suggestion though -- it seems a little bit, you know, especially for Category 2 --

CHAIRMAN APOSTOLAKIS: Too wimpy.

DR. BONACA: Category 2 I would see that, certainly I would want to see there a "should" and then if I go to Category 1, I would almost I will put the word "may do without using" by saying, you know, well, okay, but "may" I couldn't understand what it meant.

I can understand the trouble you are going through and I wouldn't want to be in your shoes, actually, going from where you are going before you had all those "shall" -- but still I think it would help.

MR. FLEMING: Just to comment on that, it was our intention but although not completely successful, in preparation of this draft to use the word "may" only as a permissive. You had several options. You could say you could do it (a), (b), or (c), but there are some remnants and this was one of them of leaving a "may" to be a somewhat less than "should" -- which we don't intend to leave in

there.

MR. BERNSEN: We also don't want to use "should" -- we have had too much trouble with that so we will come up with something else.

DR. BONACA: Okay.

MR. WALL: It may be appropriate to point out that in the process of going to action statements we translated the "shalls" to a plain declarative verb, "shoulds" to a consider -- so it would be use this -- the "shoulds" to consider using something, and we left the "mays" as "mays" so that was the general thing, the way we presented this.

Now in the process of other hands doing things, some of those "consider usings" may have turned into "mays."

MR. FLEMING: That's right.

MR. BERNSEN: We'll fix it.

CHAIRMAN APOSTOLAKIS: Level II we have covered.

Process check is one little paragraph. Anybody has a comment on the little paragraph?

DR. BONACA: I just want to ask would this process check be different from a review that you normally have for a standard calculation? What I mean is that there are very specific requirements in QA whereby after performing a calculation you have an independent reviewer who reviews it and he also takes the responsibility to make a statement that says I sign it, I have reviewed it for approach and

content and I agree or disagree on the following issues.

Would you see it differently? It doesn't sound like -- it is kind of loose, a little bit here?

MR. BERNSEN: This is a bit of a special problem. We have been discussing whether to incorporate things like specific QA requirements and some other requirements like that as by reference in the standard and decided not to do that because it is really up to the user at this stage.

The general feeling of the project team was that even though one might not apply an Appendix B process to this, although I am not sure where it would be done, parentheses, there was a need to do some level of independent review but perhaps not as sophisticated as a number of licensees have developed in their design control program.

It is certainly permissible under Appendix B to do any kind of independent review for design verification. This is not intended to be something else other than that, but it was trying to clarify that we wanted some level of checking yet we didn't want to impose the formality, because it is really up to the user in their program.

DR. BONACA: Once the user applies this tool for, say, 1.174 application, doesn't it take a role, a regulatory role, where there are certain requirements in quality assurance, et cetera?

MR. BERNSEN: Probably, but that is another venue right now.

DR. BONACA: I think we should note, however, that it is not included.

MR. BERNSEN: Yes. We have done both things in ASME standards. In some cases we have explicitly called for some kind of QA and in other cases we have allowed for different incorporation of QA requirements.

In some cases we have not been explicit.

We are finding our way. We are primarily interested in the PRA here, and not configuration control, not QA, not things of this nature.

Management systems -- we are not trying to address those. We are talking about the techniques that need to be applied to the PRA, so this is an attempt to recognize something needs to be done, but it is still worth your questions.

I think if it is not clear, we need to clarify it some more.

DR. BONACA: When you go to Section 5, on PRA configuration control and you say certain things that place a burden on processes --

CHAIRMAN APOSTOLAKIS: Bob, do you have any comments?

DR. UHRIG: This standard is different than any

other that I have had occasion to deal with in the sense that a boiler code basically specifies that you have got confidence that this is not going to blow up.

You use an ASME standard in the specification of materials, in a system, you know what you are getting, and if you don't get it you can sue.

[Laughter.]

DR. UHRIG: This is totally different and I have had a little trouble grasping it. I think I have got a pretty good feel.

I accept the categories you have got here and they make sense and I have read through what you have tried to do but I am bothered by George's comment about people using the same system and getting totally different results.

Am I misquoting you?

CHAIRMAN APOSTOLAKIS: In some instances, no, you are not. In some instances, comma, no, you are not.

DR. UHRIG: We are going to have a chaos out here in the regulatory area if Utility A gets different results from Utility B and they both have got essentially the same plants and the -- I don't know how we are going to resolve that.

CHAIRMAN APOSTOLAKIS: Well, it is not their job to resolve it. Their job is to make sure that the Applicant recognizes it and does something about it, but I don't think

the standard really should resolve issues of model uncertainty that exist out there, so my comment was in the spirit of make sure that the Licensee realizes that here there is a real problem and if they have to do a Category 3 PRA they should expect comments from the NRC Staff.

DR. UHRIG: You have got the same problem eliciting expert opinions. Two different sets of experts will give you two different views.

CHAIRMAN APOSTOLAKIS: Yes.

DR. UHRIG: So it is probably inherent in the process.

CHAIRMAN APOSTOLAKIS: Mario? I'm sorry. Karl, you had a response?

MR. FLEMING: Yes. I think it is an excellent observation. I think it reflects the state-of-the-art to some extent, but I think the other examples that you mentioned, buying materials, building a pressure vessel, and so forth, it could be simplified in the sense that you could talk about the state variables of something you could measure in an objective sense, and the problem that we have is that we are trying to do something that is a function of not the state variables but our state of knowledge about the state variables and the variability, the variability stems from the fact that our states of knowledge are different.

CHAIRMAN APOSTOLAKIS: Not only that but let's not

forget that PRAs are extremely ambitious. They are supposed to have everything that can go wrong at the plant. This is really a huge task which necessarily leads to this situation, so it is not a specific issue we are dealing with and we don't have the parameters to measure it and so on.

I mean ideally it should be the model for the plant and it is people and everybody. Necessarily then you are led to this situation.

I think, Jack, have you been trying to say something?

MR. SIEBER: Yes. I would just like to comment on Dr. Uhrig's comment, and this is something that you and I have talked about too.

When I reviewed the standard I reviewed it, I thought it was good, and I understood what it was you were doing, but I kept in mind some things that were said at a meeting we had on January 27th where you were a presenter, Mr. Fleming -- Perry.,

CHAIRMAN APOSTOLAKIS: That was the ACRS retreat in Florida, where Mr. Fleming and Dr. Perry were invited experts.

MR. SIEBER: Right, and a couple of the statements that were made was typical industry PRA is too simple and often incomplete and sometimes has low probabilities for initiating events.

Another one was typical industry PRAs have differing engineering assumptions related to equipment performance and phenomenological analysis.

There were some conclusions out of that with CDF and LERF, et cetera, are relative terms and the absolute value compares from plant to plant is significantly influenced by the engineering assumptions and when used to evaluate a change in risk PRAs of varying quality may still give valuable risk insights related to plant changes.

Then Mr. Perry said the current quality of typical PRAs is not sufficient to move from risk-informed regulation to risk-based regulation.

I think that everybody can at least intuitively say all these factors are correct.

When I reviewed the standard I tried to review it with the thought in mind is will the varying qualify from plant to plant of PRAs and the different answers the different practitioners would get analyzing the same plant with the same initiating events as far as the absolute value, will that be helped by this standard?

I came to the conclusion that with the exception of the question of completeness, which is the only thing I could pull out of here that was more or less addressed, that that problem of inconsistency from one practitioner to another would probably remain.

I don't know whether that is good or bad. From the delta risk standpoint it makes no difference in my view. On an absolute value, which is your Category 3 it does make a difference, and I am not criticizing or suggesting that you change anything but I would like to hear your comments on my way of thinking about it.

MR. BERNSEN: Yes. My reaction is that the introduction of this standard and application of it is going to lead in time to more convergence.

MR. SIEBER: Okay.

MR. BERNSEN: I don't think that all by itself it will get you there, but there is a lot of cross-pollination built into this, if you will, through the peer review process, through the questions and responses that we will have to answer over the years, through the additional things that we are going to have to generate to supplement the standard.

This is just the beginning. I mean if you recall, we were talking about it before, the original nuclear boiler code was a vessel design code for the reactor vessel, nothing more. Look how far this has evolved to respond to the need.

I think that we are going to see this as the top level that generates over a period of time a lot more formalized and informalized guidance and examples and

probably training and cross-communication that is going to bring things closer together in time.

It is not going to happen overnight but if we don't begin to move in that direction, and starting with a basis that people can use based on the kinds of standards, kinds of PRAs they have, so we encourage them to begin to use it in a logical way, control fashion, we are never going to get there, so this is I think a major step in that direction, but we have got a long way to go.

MR. SIEBER: Well, I see it as just one element. There is the standard and you can publish the standard and the Commission can endorse it, but equally important are two other elements that are the peer review and certification process to me is the one that will have the greatest influence on standardizing methodology and in self-criticism and criticism of bad or inadequate phenomenological analysis.

The other element to that is the sourcebook or paper that really combines what was contained in Version 10, okay, as a way to say here are the standard methods that are being used. These are the "how-tos" and make the real standard, the obligatory part, and the other one just a tutorial, so to speak, and so I see this as really a three-pronged effort which one of those is the standard itself. The second one is peer review and certification. The third

is publishing the "how-to" portion of it, and that at least is the way I see it.

CHAIRMAN APOSTOLAKIS: But I do agree with you, Jack, that if there is one contribution I am sure there is more than one of this standard is in the area of completeness, because it raises all the issues that the practitioner has to think about.

MR. SIEBER: Once they are in the standard you can't ignore them.

CHAIRMAN APOSTOLAKIS: That's right.

MR. SIEBER: Obviously you aren't complying and so you have to give due consideration to all the factors that are in the standard. From that standpoint it is a good thing.

CHAIRMAN APOSTOLAKIS: In fact, given the state-of-the-art, I would oppose a standard that went beyond that and actually recommended methods because I don't think that --

MR. SIEBER: And I agree.

CHAIRMAN APOSTOLAKIS: In many areas we are not ready.

MR. SIEBER: Well, that is my global comment.

CHAIRMAN APOSTOLAKIS: Well, it seems to me that Mr. Sieber has broadened the discussion, so maybe we can go around the table and see what the members have to say in

terms of general comments, if members so desire, or we can open up the discussion in terms of specific issues and have an unstructured formal discussion --

[Laughter.]

CHAIRMAN APOSTOLAKIS: -- of the issue by issue.

We certainly have to revisit the issue of categories because ASME is obviously very much interested in knowing the subcommittee's views.

I don't hear any suggestions, so I will pick one method. Why don't we go around the table. I think Jack just --

MR. SIEBER: I already gave mine.

CHAIRMAN APOSTOLAKIS: -- did his piece. Tom?

DR. KRESS: Certainly. Thank you.

Well, a general comment. I was just a little disappointed that the standard chose to limit itself to the current definition of CDF and LERF. The reason I say that is I think having limited itself to those it did a pretty good job. I mean I really have no complaints, but I think that NRC when they go in to risk inform the regulations they are really going to be in the business of looking at fission products and the frequency of their releases and controls on those and the standard comes up short on discussing fission products.

I think more will be needed later by NRC or

somewhere on the standards associated with that, so that is just a statement saying as far as it went I think you did a good job. I think it left out an important part.

You always have to limit what you do, especially if you have got limited time and resources so I think it is appropriate to limit it but I was a little disappointed in that.

I do think the main issue with the limited set is going to be the categories and not so much that it is appropriate to have different categories for different applications. I think it is. I think you almost have to buy off on that presumption.

The problem is going to be how to be sure you are fitting the right application in the right category and I think the guidance on how to do that might be a little too loose, that I can fit things into categories one way or the other by some small assumptions.

I think there might be some thoughts about saying if you are unclear about what category to use, use the more stringent one. I really don't see that admonition in there.

I also share George's view that the categories might be tied to some extent to how well you need to know the answer and that is either in terms of a predetermined confidence level you need in the CDF and LERF, which may or may not be something a standard ought to deal with. That is

something that NRC has to come up with, but then if they came up with the confidence level they need, how do they go to these categories and say this category will give me this confidence level?

That connection is not made explicitly and I think George's suggestion that looking at it in terms of the 1.174 may be a way to make that link and I did kind of like that suggestion, George.

I thought the definition of LERF that allowed site specific flexibility probably goes against the intention of the definition of LERF in the first place in that it ought to be made independent of the site.

I am not quite sure of that one yet. I have to think about it awhile but that was my first reaction to that.

I thought the requirement to have a full uncertainty analysis for Category 3 needed a little bit more expansion, and the reason is -- I share George's views -- I can't see any plant-specific PRA doing a full uncertainty of the NUREG-1150 type. What they will do is do the Monte Carlo propagation which is easily done, but I think there's some guidance needed on how you deal with the knowledge uncertainty. What do you call it, George? Is that the epistemic? I didn't see real good guidance on how you deal with that in here, because I don't think it is going to come

out of a routine uncertainty analysis, so I thought that was a missing element on how to deal with it first, particularly for Category 3.

That is basically all the general comments I have right now, besides the specific ones I had before.

CHAIRMAN APOSTOLAKIS: Mike, do you want to say anything?

MR. MARKLEY: Yes, I have just got one slightly technical and the other two just a formality.

I guess I am a little bit uncomfortable when I am told that something is intended for a general purpose and not really for regulatory purposes and then something like the maintenance rule A4 is partitioned into Category 1. I know you are going to go look at all that stuff.

The other two things were just that the member comments, I just wanted to reinforce that. They are just their own views. They do not represent the subcommittee's or the full committee's, and I wanted to mentioned the schedule for the full committee, and that is from 1:15 to 3:15 p.m. on Wednesday, July 12th.

CHAIRMAN APOSTOLAKIS: In fact, we should talk about it before adjourn today as to maybe recommendations that the members might have, what you should address, because it is only an hour and a half, right?

MR. MARKLEY: It's two hours.

CHAIRMAN APOSTOLAKIS: Two hours, and points to focus on -- let's not forget we should do that before we -- we usually do it with the Staff, because we don't want to repeat everything verbatim that was done today.

Maybe you will have a chance to think about some of our comments today and respond to the extent possible. Dr. Bonaca?

DR. BONACA: I gave all the comments before, but just to summarize what I view as important in addition to the points already made by the members.

One is again we talked about the view, characterization of Category 1 for maintenance rule and I meant to say this morning the fact that some part of the guidance and presentation as been pointed out in Category 1 is primarily decisions based on deterministic analysis supplemented with basic insights.

I am not sure that the maintenance rule right now says that as far as the role of risk information to make decisions so that adds another thing, saying that this point really has to be resolved.

There is an inconsistence.

Somewhere else also there is some inference that the PRA -- for example under Category 1, page 3, it says PRA applications are not expected to impact safety-related SSCs, but you are pulling them out of service. There is an issue

there.

The second is the point I made this morning and I still believe it is important. The chart which you are presenting there, which is important, because visually it helps to understand, has the fundamental presumption that one can build a model to fit a need, and that is simplistic in PRA.

A complete PRA at a plant is a massive model that contains all kinds of information and my suggestion would be simply that in the text somewhere you can explain that. The reason or the intent of doing that is only, the intent is to say that if the application is limited enough and clear enough then it can be used for the purpose, but there is some warning there that says don't -- and this is really with good intent.

You may have a very low capability that begins to do some, for example, subtle electrical changes, in some support systems which are nonquality related, and yet they cascade into dependencies which are important.

The third point I would like to make is I recognize that the probably there isn't any PRA out there that meets strictly the minimum requirements of Category 1 but the standard allows it. I don't know how we go around --

CHAIRMAN APOSTOLAKIS: Say that again. There is no

PRA that what?

DR. BONACA: That meets only the minimum requirements of Category 1.

CHAIRMAN APOSTOLAKIS: I thought that Karl said that Category 1 in fact is higher level than the IPEs. Isn't that inconsistent with this?

DR. SHACK: It's the intention.

MR. FLEMING: Again I think the distinction needs to be broken down at the subelement level, and so we are looking at the individual elements and subelements of the PRA. There are some out there that are Category 0, 1, 2, 3 4, so --

CHAIRMAN APOSTOLAKIS: I see.

MR. FLEMING: -- so no full PRA is only Category 1. It is a mixed bag.

DR. BONACA: The message here is only -- I don't want to interfere in the process. I only want to make sure that as a committee you can review that and look at Category 1 and ask yourself does it provide you a very low standard and do you want to support it, yes or maybe no.

It may be that you feel comfortable with that and I trust that the committee can do that. I just say that if I were in your shoes I would do that, just a simple verification.

The last thing I would like to add is only that we

did not discuss the issue of peer review.

CHAIRMAN APOSTOLAKIS: Yes. Today we didn't.

DR. BONACA: Yes. But, you know, when I look at some of the qualifications for example of the PRA I don't understand exactly what kind of latitude you are allowing the PRA peer review team qualification, because here it says somebody who is knowledgeable in the requirements in the standard for the area of review, which means we are all knowledgeable enough right now with the standard.

Have the most experience performing PRA activities relevant to the area -- it doesn't say he has performed PRA. It says somebody who is doing some, you know, evaluations, and have collective knowledge of the plant design, containment design and plant operation.

Now these general characteristics, I don't believe that they are capable -- how capable the members will be of performing a true independent and thorough evaluation.

CHAIRMAN APOSTOLAKIS: It will come down to what the Staff has. The Staff sees two or three of those that are shallow the whole process will die.

A comment from somewhere?

MR. HILL: Just a little bit of a response to your concern. Our original -- as you probably saw on Rev. 10 -- we used timing requirements, so many years experience, et cetera, in various areas, but the point was made that you

could have that many years' experience and still not know what you are doing, so that doesn't necessarily qualify somebody.

CHAIRMAN APOSTOLAKIS: That's right.

MR. HILL: And it is difficult to tap into the brain of the reviewer and say how much do you really know. We chose these kinds of statements to be able to say that they need to be able to cover all the ground of the NSSS, the containment type, the operations, et cetera, and leaving it somewhat on the judgment of the team leader.

That person has to make sure that they have the right set of skills and talents available to perform their review.

So, yes, it is somewhat vague and somewhat general, but I am not sure how you can nail it down because every time you try to nail it down with some specific somebody can say, well, that specific doesn't prove capability.

DR. BONACA: The reason why I am raising this issue is because this is a unique area where the work done for most PRA in the country have been done by a few specialists and then put in the hands of the utilities. From my experience many of these do not have the expertise internally. They have expertise to tinker with some change inside, but they don't understand oftentimes some of the

real subtle issues that were addressed by the professionals who built the PRA. That is the only reason why I raised the question.

MR. HILL: And you had another comment about why doesn't it say performing requirements of having performed PRA.

We did have those kinds of words in there but we came to the rapid conclusion that we don't have people performing PRAs anymore. We have people updating PRAs because the PRAs already exist and there probably won't be any more performed.

If we limit it to that, five years from now with the career paths we won't have anybody available.

DR. BONACA: And I think, I was talking to some utility guys last week and they were talking about how to build a PRA capability at their facilities, and every single one of them wanted an experienced systems engineer who would be willing to learn PRA methods, and today we are talking about experienced people doing this, experienced people -- I don't think college graduates will find a job in the nuclear business anymore, because all the jobs are for experienced people.

[Laughter.]

DR. KRESS: Of course.

CHAIRMAN APOSTOLAKIS: I don't know what they have

to do to enter the field.

DR. BONACA: Still this is a unique issue because I mean --

CHAIRMAN APOSTOLAKIS: It is. It is, but it ultimately comes to the guys behind us. If they start rejecting the quality of PRAs that have undergone the PRA review, then there is a problem, because I am sure that they will at the beginning at least review, themselves, the products.

DR. BONACA: They are not rejecting thermal hydraulic codes.

CHAIRMAN APOSTOLAKIS: What?

DR. BONACA: But that is a different issue.

[Laughter.]

CHAIRMAN APOSTOLAKIS: Thermal hydraulics isn't different. Thermal hydraulics came from the fountain.

DR. KRESS: It was handed down from on high.

George, I think a good graduate student that specializes in PRA at the right institution with the right teacher could probably qualify as being experienced.

CHAIRMAN APOSTOLAKIS: I don't think so, Tom, but very kind of you. Dr. Uhrig?

DR. UHRIG: The only thing I have to add is related to a comment you made, concern about this OMB regulation.

CHAIRMAN APOSTOLAKIS: Yes.

DR. UHRIG: I don't think that is a real problem. I think if NRC -- I think it has the right to reject or modify specific parts of any of the codes and having been on the other side of the fence a time or two, if NRC wants to do something they usually get it done.

CHAIRMAN APOSTOLAKIS: Still, though --

DR. UHRIG: Philosophically it is a concern but --

DR. KRESS: Well, they have gotten themselves in that trap with the backfit rule.

DR. UHRIG: What?

DR. KRESS: They are certainly gotten themselves in that trap with the backfit rule.

DR. UHRIG: Yes, they have. What I alluded to was before the backfit rule came into effect. That's it.

CHAIRMAN APOSTOLAKIS: Okay, thank you. Bill?

DR. SHACK: I think it is a very interesting attempt -- I think there is a lot of good, useful information on the categorization in your viewgraphs and in 1-5 I think you beat up enough on that already today, but I think you really do have the material to make a useful approach to the categorization in the viewgraphs.

CHAIRMAN APOSTOLAKIS: Don't worry about limitations of space when it comes to 1.5, okay? Take as much as you want.

[Laughter.]

MR. BERNSEN: Well, I am going to go around our side too. One of the points that was made I guess by Tom or somebody with regard to the completeness of this standard, as we mentioned before, this is the first effort.

You are probably aware of the fact that ANS is writing some parts to the overall PRA and the low power shutdown, external events.

We have had on our plate, work assignment, to look at what is needed in the future, and in fact Karl graciously agreed I still think to lead our little task group to define what we should be doing in the future, so this is not the end of the line in the process by any means. It is the first step.

We recognize -- I think all of us -- that you need to go further in terms of detail, in terms of guidance, in terms of expansion of scope and things of this sort and that will be done and we will work in a coordinated fashion with ANS in doing that.

DR. KRESS: Will this be like other ASME standards that may get updated?

MR. BERNSEN: Yes. It's intended -- this is a living document.

DR. KRESS: Living document?

MR. BERNSEN: That we have done with our O&M, with

our code sections, with our QA and with all the other standards. They are living documents. They are maintained.

I was going to say, Bob, you know, think of this standard more in terms of a QA program standard, which really didn't give prescriptive requirements on how you do things either.

This is not the first step. It is somewhere in the middle between them but we have had to deal with different approaches for standards, but as I say, the main thing to keep in mind is this is the first step. It is going to be maintained. It is going to be interpreted.

I am sensitive to the concern whether or not -- the Staff certainly can accept or reject pieces and parts of the standard. It makes it more difficult for them to do that if we have something in the standard that says this is the way we intended it to be used, so we have got to be careful that we don't necessarily lead the pack when we should be following. We will think about that.

DR. KRESS: Okay.

MR. FLEMING: I just wanted to make one final comment about the categories that I don't think we had a chance to bring up is that there is I think a quantum leap in improvement when we went from one line in the sand to the idea of multiple categories, because what we were trying to avoid is by having one line in the sand is the unfortunate

consequence of having everybody expected to get to that line and stop, so the idea of having, recognizing the three categories, especially Category 3, also points a direction for future enhancement of the technology.

We wanted to try to avoid just this idea of meeting the requirement -- what do I have to do to meet the requirement, as opposed to what we need to do to advance this technology so we can make better decisions.

To echo something Sid said in response to Jack's comments earlier, I do believe that already the certification process is already helping this problem of variability in the PSA results and I also agree with what you say. It can't be done with any one leg of the stool.

MR. SIEBER: Right.

MR. FLEMING: It is all three of these -- the certification process, the standard and the methodology enhancements have to be working together.

CHAIRMAN APOSTOLAKIS: Gerry?

MR. EISENBERG: I am going to hand off to Ron first.

CHAIRMAN APOSTOLAKIS: Sure. You are not obligated to speak.

MR. SIMARD: All the good comments have been taken.

I would just like to thank you on behalf of the

project team for some good discussions, some constructive suggestions over the past day and a half.

I think I have heard that we have struck a reasonable approach by trying to approximate the spectrum of possible applications with these three categories, have certainly gotten the signal that we need to do a better job of characterizing the attributes of these categories, and appreciate the fact that you gave us specific suggestions that we can work on, so I just want to thank you.

CHAIRMAN APOSTOLAKIS: You are welcome. Ian, would you like to say anything? No?

Before we adjourn though, I think there are two points to be brought up.

As a prelude, I always find that sometimes being a reviewer gives you a certain perspective that is not always right, so I always learn when I have to defend my research contracts at MIT before other people who are reviewing me. I get upset a little bit at the beginning when they dare ask questions, but then after awhile I realize that this is the name of the game, so imagine I sitting over there and I act accordingly.

Now why is that relevant to this?

Well, there was a suggestion made yesterday at the workshop which I thought was very good. The suggestion was that the NRC Staff apply this standard to its own work, and

what came to mind was the SPAR models.

This committee recommended in the recent past to the EDO that the SPAR models be subjected to peer review. The response from the EDO was no, we have had enough peer review and they have been used by some Sandia folks -- that is good enough.

It seems to me that we should come back to this and if the committee agrees, of course, we should come back to it and I think it will be a healthy exercise for the NRC Staff to use this approach and maybe try to categorize SPAR models and what they can do -- well, I think that will be a very healthy exercise.

DR. BONACA: We will have to develop that.

CHAIRMAN APOSTOLAKIS: If we can demand perfection from others --

DR. BONACA: We have to develop a new category then because --

CHAIRMAN APOSTOLAKIS: What?

DR. BONACA: I will not mention it.

[Laughter.]

CHAIRMAN APOSTOLAKIS: But I mean the SPAR models eventually will be, unless I am mistaken, will be the plant-specific PRAs that the Staff will be using not to make decisions but as a major input to their decisionmaking process.

DR. KRESS: That's right.

CHAIRMAN APOSTOLAKIS: And I don't see why the SPAR models cannot be subjected to this particular process.

Yes? We get a smile from the Staff. Are we getting anything more? Oh, there you are.

MR. CHEOK: By default I'm it. This is Mike Cheok from the Staff.

I guess the SPAR models will be used as an initial stepping stone into whether something is risk significant or not. All it is is to tell us if something needs to be looked at some more, and if something needs to be looked at some more, we will look at the licensees for more specific information.

CHAIRMAN APOSTOLAKIS: Well, I guess you just told us that the SPAR cannot be Category 3.

[Laughter.]

CHAIRMAN APOSTOLAKIS: Now the question is are they Category 1 or Category 2?

MR. CHEOK: In my opinion, probably not Category 1.

CHAIRMAN APOSTOLAKIS: 1.5 perhaps.

MR. CHEOK: It is probably below a Category 1.

DR. KRESS: Category 1.9.

CHAIRMAN APOSTOLAKIS: Below Category 1?

MR. CHEOK: Yes.

CHAIRMAN APOSTOLAKIS: Well, they just did it. But we may find other examples.

MR. CHEOK: That's right.

CHAIRMAN APOSTOLAKIS: Thank you very much, anyway, for the comment. That is your expert opinion. Give it to Budnitz. He will give it to us.

The other one is do the members have any suggestions regarding the July meeting? Should, for example, Mr. Bernsen and Mr. Fleming and Mr. Simard come here with the same presentations or should they modify them a little bit?

MR. SIEBER: Condense them.

CHAIRMAN APOSTOLAKIS: I mean we can't tell you what to do. I'm sorry. I am using the word "should" -- you are not Staff.

MR. BERNSEN: "Should" is a recommendation.

CHAIRMAN APOSTOLAKIS: Recommendation, okay, or "shall" they -- they should consider. They should consider.

DR. KRESS: I think they ought to consider the same stuff, only condensed a bit and maybe focus a little bit on the categorization process.

CHAIRMAN APOSTOLAKIS: I would agree with that.

I mean if you could -- I don't know how much time you have until then, but maybe take the major comments that were made today and give us some preliminary reaction?

DR. KRESS: Yes.

CHAIRMAN APOSTOLAKIS: That will bring the committee up to speed. I don't know if you realize this is not a paying job, for some of you anyway, so it may not be enough time, but if you could address some of these comments or what you thought was something --

MR. BERNSEN: We can do that. Of course we will not have had all the comments. We won't have a project team meeting, so again, just as I said in this meeting where we are representing ourselves as knowledgeable --

CHAIRMAN APOSTOLAKIS: Sure.

MR. BERNSEN: -- committee members and project team members, we certainly will be able to I think identify some of the issues you have raised and the fact that we are going to take them under advisement in some possible ways to the extent we can.

CHAIRMAN APOSTOLAKIS: For example, I mean when, Karl, you presented the categories, you might modify your viewgraphs a little perhaps to reflect some of the things that you accept and say this is what eventually the document will say I think that will promote better understanding.

Again, you don't have to do this. These are individual comments.

MR. MARKLEY: And because we had four members who didn't attend I think it is unavoidable to have the

overview.

CHAIRMAN APOSTOLAKIS: We will have the overview.

MR. MARKLEY: Short and brief and concise as you can, but the issues are really the important points.

CHAIRMAN APOSTOLAKIS: And judging from the experience of yesterday and today, the question of how do you really define the categories is there, so if they feel they have gotten any useful comments today, then maybe they should do it.

MR. EISENBERG: You mentioned there is a two-hour window for that. How much of that window is the subcommittee presentation?

DR. KRESS: Normally --

MR. EISENBERG: Go ahead.

MR. MARKLEY: I'm sorry, Tom. Normally it is about five to ten minutes, just introductory to introduce you and then you have the majority of the rest of the --

CHAIRMAN APOSTOLAKIS: Well, I can go over the major points.

DR. KRESS: Normally though, when you have two hours you ought to count on about an hour of that is yours. The rest of it is interruptions from us.

MR. EISENBERG: I understand -- just to know what the ratio was.

DR. BONACA: I think they have a very good summary

presentation. If you went through that and if you just simply acknowledged some of the questions you got, to anticipate those --

CHAIRMAN APOSTOLAKIS: I will try to sketch some of the major points in my introduction, okay.

DR. BONACA: -- so that we avoid having to jump in again and again on the same issues, and otherwise I think the summary presentation was good.

CHAIRMAN APOSTOLAKIS: And the nature of that meeting is not to go into details and say on line this you said that and so on, but we will write a letter, right, addressed to the EDO?

Does anyone have any comments or questions from the people around the table or others?

Hearing none --

DR. BONACA: I want to say we had a lot of comments, a lot of criticism, et cetera. Again, you know, at least personally -- I don't want to leave a perspective that I don't think that there hasn't been progress since last year. I think there has been progress and that is just my personal view and that you people should be more than encouraged for what you are going through.

I mean you are sifting through not only our comments but so many others and so that is what I wanted to say.

DR. KRESS: Yes. I second that. I think you are on the right track with this as the kind of standard we need to come up with. I certainly want to thank you guys.

MR. EISENBERG: Thank you very much.

CHAIRMAN APOSTOLAKIS: It's a very difficult job trying to draw the line between various applications and so on, and a lot of it is subjective, as we discussed, so we do realize that you have a difficult job on your hands.

The comments are offered, you know, in a constructive spirit and hopefully they will improve the product, because there is a need out there, even internationally. I am being asked by a lot of people when I travel, especially people who are not in the business, and they are surprised that there is no standard for doing this new thing, so I appreciate your coming here and being patient with us and thank you very much.

I think it was a very good meeting. We all learned something, and on that note this meeting is adjourned.

[Whereupon, at 2:44 p.m., the meeting was concluded.]

REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

NAME OF PROCEEDING: RELIABILITY AND PROBABLISTIC RISK ASSESSMENT

CASE NO:

PLACE OF PROCEEDING: 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.

Mark Mahoney
Official Reporter
Ann Riley & Associates, Ltd.

REVISED 6/26/00

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MEETING OF THE SUBCOMMITTEE ON PROBABILISTIC RISK ASSESSMENT
ROOM T-2B3, 11545 ROCKVILLE PIKE, ROCKVILLE, MD
JUNE 28-29, 2000

ACRS Contact: Michael T. Markley (301) 415-6885

- PROPOSED SCHEDULE -

June 28, 2000

	TOPIC	PRESENTER	TIME
1)	**Introduction**		8:30-8:35 am
•	Review goals and objectives for this meeting	G. Apostolakis, ACRS	
•	Review points raised in ACRS report dated March 25, 1999; ACRS member assignments for reviewing the proposed Standard	G. Apostolakis, ACRS	
2)	**ASME Presentation**		8:35-10:00 am
•	Introductory remarks	G. Eisenberg, ASME	
•	Discussion of revised ASME document entitled, "Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications," including proposed use of industry certification programs.	S. Bernsen, Chairman ASME CNRM R. Simard, ASME Project Team Leader Others, TBD	
•	Reconciliation of comments (ACRS, NRC, industry, and public) on draft #10		
•	Public comments from the June 27, 2000 public workshop on the revised Standard.		
	**** BREAK ****		10:00-10:15 am
3)	**ASME Presentation - continued**		10:15-12:00 noon
•	Discussion of technical issues associated with the proposed Standard and its use, including the use of expert opinion, peer review, quantitative and qualitative aspects, methods and models.	ASME, TBD	

	**** LUNCH ****		12:00-1:00 pm
4)	**General Discussion and Recess**		1:00-2:30 pm
•	General discussion and comments by Members of the Subcommittee; items for July 12-14, 2000 ACRS meeting	G. Apostolakis, ACRS	

June 29, 2000

	TOPIC	**PRESENTER**	**TIME**
5)	**Introduction**		8:30-8:35 am
•	Review goals and objectives for this meeting	G. Apostolakis, ACRS	
•	Review points raised during March 2000 ACRS meeting and issues noted in ACRS report dated October 12, 1999	G. Apostolakis, ACRS	
6)	**NRC Staff Presentation**		8:35-10:15 am
•	Discussion of public comments on proposed 10 CFR 50.69 and associated Appendix T (Option 2)	C. Carpenter, NRR T. Bergman, NRR T. Reed, NRR	
•	NRC staff perspective on proposed industry peer certification process and draft NEI guideline on special treatment		
•	Plans to brief the Commission in September 2000 on proposed reconciliation of public comments.		
	**** BREAK ****		10:15-10:30 am
7)	**Industry Presentation**		10:30-11:30 am
•	Petition for rulemaking to 10 CFR 50.44 concerning combustible gas control systems	B. Christie, Performance Technology, Inc.	
	**** LUNCH ****		11:30-12:30 pm
8)	**NRC Staff Presentation**		12:30-2:00 pm
•	Discussion of proposed revision to 10 CFR Part 50 (Option 3) and 10 CFR 50.44 concerning combustible gas control	T. King, RES M. Cunningham, RES M. Drouin, RES	

systems

•	Status of 10 CFR 50.44 rulemaking petition	C. Carpenter, NRR	
	**** BREAK ****		2:00-2:15 pm
9)	**Industry Presentation**		2:15-2:45 pm
•	Industry perspective on proposed revision to 10 CFR 50.69 and Appendix T	S. Floyd, NEI A. Heymer, NEI	
•	Issues and priorities noted in the NEI letter dated January 19, 2000		
•	Status of industry guidance development		
10)	**General Discussion and Adjournment**		2:45-3:00 pm
•	General discussion and comments by Members of the Subcommittee; items for July 12-14, 2000 ACRS meeting	G. Apostolakis, ACRS	

Note: Presentation time should not exceed 50% of the total time allocated for a specific item. Number of copies of presentation materials to be provided to the ACRS - 35.

INTRODUCTORY STATEMENT BY THE CHAIRMAN OF THE
SUBCOMMITTEE ON RELIABILITY AND PRA
11545 ROCKVILLE PIKE, ROOM T-2B3
ROCKVILLE, MARYLAND
JUNE 28-29, 2000

The meeting will now come to order. This is the first day of the meeting of the ACRS Subcommittee on Reliability and Probabilistic Risk Assessment. I am George Apostolakis Chairman of the Subcommittee.

ACRS Members in attendance are: Mario Bonaca, Thomas Kress, William Shack, Jack Sieber and Robert Uhrig.

The purpose of this meeting is to discuss the proposed final ASME standard for probabilistic risk assessment for nuclear power plant applications. Tomorrow, the Subcommittee will discuss the status of risk-informed revisions to 10 CFR Part 50, including proposed revision to 10 CFR 50.44 concerning combustible gas control systems, issues in the Nuclear Energy Institute letter dated January 19, 2000 (Option 3), and public comments related to the Advance Notice of Proposed Rulemaking on 10 CFR 50.69 and Appendix T (Option 2). The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee. Michael T. Markley is the Cognizant ACRS Staff Engineer 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 May 16, 2000.

A transcript of the meeting is being kept and will be made available as stated in the Federal Register Notice. It is requested that speakers first identify themselves 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. However, Mr. Bob Christie of Performance Technology, Inc. has requested time to make a presentation during tomorrow's session concerning proposed revision to 10 CFR 50.44.

(Chairman's Comments-if any)

We will now proceed with the meeting and I call upon Mr. Gerry Eisenberg of ASME to begin.

Workshop and ACRS subcommittee meeting on Rev 12 of the ASME standard
June 27-28, 2000

Major changes from the previous draft in response to public comments

Ron Simard
Chair, ASME Project Team

Rev 10 approach

- Specify a single set of requirements for Elements of a PRA that provides a realistic estimate of CDF

- Specify requirements for documentation, configuration control, peer review

- Describe a process for
  - **determining the extent to which the PRA Elements are necessary and sufficient to support a particular application**
  - **comparing the plant PRA to the Standard PRA**
  - **evaluating the significance to that specific application of any differences between the plant and Standard PRAs**

Rev 10 comments

- Prescriptiveness and perceived difficulty in applying the process
- need to distinguish among grades of application with a commensurate level of PRA capability
- need to recognize primary use of standard will be with existing PRAs
- need for closer alignment with the industry peer review and certification process

Rev 12 approach

- **Significant restructuring, e.g.,**
  - process moved from back to front to emphasize intended use of the standard
  - mandatory appendix with generic data base removed
- **Range of possible risk informed applications approximated by three Categories**
- **Corresponding PRA capabilities presented in tables with three columns**
  - action statements whose scope of applicability varies across the three columns

Rev 12 approach (cont.)

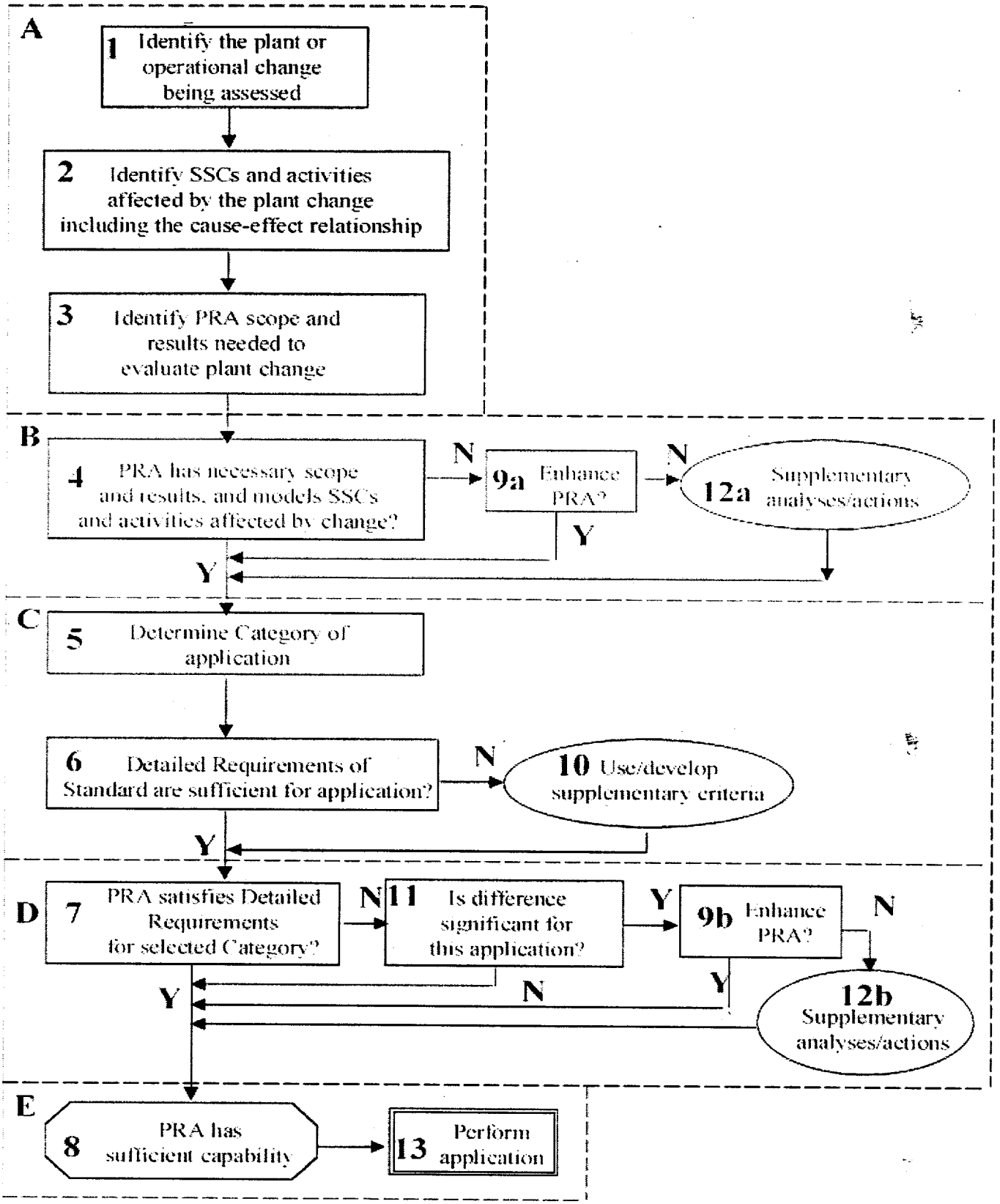
- PRA Element requirements linked to industry certification process criteria, where possible
- peer review requirements reference the industry certification process methodology
- retention of Rev 10 requirements, where appropriate
- modification of the application process to make it easier to use

The application process

- Requirements in Section 4 of the standard apply only to a PRA to be used with this process
- The process is intended to be used with PRAs that have had a peer review that meets the requirements of Section 6 of the standard
- PRA capabilities are evaluated for each Supporting Requirement in Section 4, *vice* specifying a capability level for the entire PRA
- Only those aspects of a PRA Element required to support the application in question need the capability level appropriate for that application

The application process (cont.)

- Define the application in terms of SSCs affected by the proposed change
- Determine if the scope and level of detail of the plant PRA is sufficient for the application (if not, enhance or supplement PRA)
- Determine the Category of the application and whether the level of detail in the standard is sufficient for the application (if not, use supplementary criteria)
- Compare the PRA to the appropriate requirements in the standard to determine whether the PRA has adequate capability to support the application
- If difference is significant, enhance or supplement PRA


A
1 Identify the plant or operational change being assessed
2 Identify SSCs and activities affected by the plant change including the cause-effect relationship
3 Identify PRA scope and results needed to evaluate plant change
B
4 PRA has necessary scope and results, and models SSCs and activities affected by change?
N
9a Enhance PRA?
N
12a Supplementary analyses/actions
Y
Y
C
5 Determine Category of application
6 Detailed Requirements of Standard are sufficient for application?
N
10 Use/develop supplementary criteria
Y
D
7 PRA satisfies Detailed Requirements for selected Category?
N
11 Is difference significant for this application?
Y
9b Enhance PRA?
N
Y
N
Y
12b Supplementary analyses/actions
E
8 PRA has sufficient capability
13 Perform application

Workshop and ACRS subcommittee meeting on Rev 12 of the ASME standard
June 27-28, 2000

INTRODUCTION

Sid Bernsen
Chair, ASME Committee on Nuclear Risk Management

MEMBERSHIP

PROJECT TEAM

R. L. Simard, *Chair*
G. M. Eisenberg, *Secretary*
M. Drouin
C. R. Grantom
R. A. Hill
B. W. Logan
W. J. Parkinson
R. E. Schneider
G. A. Krueger
R. A. West
H. D. Brewer
R. J. Budnitz
K. N. Fleming
H. A. Hackerott
S. H. Levinson
B. B. Mrowca
F. J. Rahn
B. D. Sloane
I. B. Wall

STANDARDS COMMITTEE

S. A. Bernsen, *Chair*
G. M. Eisenberg, *Secretary*
R. E. Bradley
H. D. Brewer
R. J. Budnitz
M. A. Cunningham
K. N. Fleming
R. E. Hall
R. A. Hill
T. G. Hook
S. H. Levinson
T. A. Meyer
W. J. Parkinson
L. Sage
F. A. Simonen
G. L. Zigler

DEVELOPMENT PROCESS

- Use ASME redesign process
- Project Team for development
- early opportunity for review & comment
- approval by balanced committee of stakeholders - CNRM
- oversight by ASME Board on Nuclear Codes & Standards
- recognition by ANSI

CURRENT STATUS

- draft 10 issued spring 99
- more than 2000 general and specific comments received
- project team worked *intensively* to address comments
- draft 12 issued for comment June 14 2000
  - includes a white paper

SCOPE AND PURPOSE

- Level 1 PRA analysis of internal events
  - at power - excluding fires
- Limited Level 2 - Sufficient for LERF evaluation
- Developed to support
  - risk informed applications
  - use of existing PRAs
- Process for determining PRA ability to support an application and provides options for augmentation

PROJECTED SCHEDULE

- August 14, 2000 comment period ends
- Project Team dispositions comments
- Early October 2000 to CNRM committee for approval
  - includes responses to substantive comments
- November, 2000 receive votes and comments
- Project team resolves comments
  - changes to committee for review and reconsideration
  - initiate formal public review
- End of Year BNCS final review and approval

PURPOSE OF CURRENT REVIEW

- resolution of your specific comments on Draft 10.
- acceptability of other changes
- recommendations for future consideration
- comments should be supported with basis/justification
- include proposed word changes, additions or deletions

FORMAT AND AGENDA

- Rev 10 approach and comments received
- major changes from rev 10 to rev 12
- risk assessment application process
- approach used to develop PRA technical requirements
- peer review
- general discussion
- closing remarks

ROLE OF PARTICIPANTS

- individual experts
- comments do not necessarily represent position of CNRM or ASME
- seeking feedback and recommendations
- position still on several issues still needs definition
- **We welcome your interest and input**

Workshop and ACRS subcommittee meeting on Rev 12 of the ASME standard June 27-28, 2000

Matching PRA Element capabilities and application characteristics

Karl Fleming
Member, ASME Project Team

Application Categories

- The standard is intended to be used in a wide range of applications
- Three broad Categories were used to develop and present the requirements of Section 4
- The plant PRA capabilities will not fall all into one Category applications
- For some ~~requirements in Section 4~~, the plant PRA may not have to meet any of the three Categories for a given set of elements

The Category of a given application depends on ...

1. Extent of the reliance of the risk informed <u>decision on the PRA</u>

Decisions are based ...

- Category I: primarily on deterministic analysis supplemented with risk insights
- Category II: ... on a balanced set of PRA insights and deterministic analyses Rev. 10
- Category III: ... primarily on PRA insights supplemented with little deterministic analyses

The Category of a given application depends on ...

2. Required level of resolution of the PRA <u>results needed by applications</u>

- Category I: PRA products are used to differentiate among broad categories of safety significance using order of magnitude CDF and LERF estimates

- Category II: PRA products are used to prioritize/risk rank SSCs and to resolve risk contributors for risk significance determinations

- Category III: PRA products are used to prioritize/risk rank SSCs; to resolve risk contributions for risk significance determinations; and to achieve confidence in results when decision/risk acceptance criteria are approached

The Category of a given application depends on ...

3. Degree of accuracy required of the PRA <u>results</u>

- Category I: Order of magnitude estimates of the PRA results for dominant sequences and contributors
- Category II: Realistic estimates of PRA results for all risk significant sequences and contributors
- Category III: Realistic (better than order of magnitude) estimates of PRA results for sequences and contributors

The Category of a given application depends on ...

4. Degree of confidence in the PRA results

- Category I: Only a general understanding of the sources and magnitudes of uncertainties and their impacts
- Category II: Detailed understanding of the sources and magnitudes of the uncertainties and their impact on all risk significant sequences and risk contributors
- Category III: Same as Category II with uncertainty quantification for CDF and LERF

Scope of Coverage of High Level and Detailed Requirements

- Category I
  - Dominant accident sequences and contributors
  - Definition of dominant is to capture a major fraction that is sufficient to support intended applications
- Category II
  - Risk Significant accident sequences and contributors
  - Definition of risk significant is to capture sufficient fraction to support risk significant determinations in which PRA results are used supported by deterministic considerations
- Category III
  - Risk Significant accident sequences and contributors as well as non-risk significant sequences and contributors that are relevant to a Category III application
  - Definition of coverage of sequences and contributors is to capture sufficient fraction to support applications whose decisions are primarily based on PRA results are supported by deterministic considerations

The Category of a given application depends on ...

5. Safety significance of the application

- Category I: Typically do not impact safety related SSCs
- Category II: Expected to impact safety related SSCs
- Category III: Expected to impact safety related SSCs

4.3 PRA Elements and Attributes

Table 4.3-1 describes the attributes of PRA Elements appropriate to the three categories of applications described in Subsection 1.5.

TABLE 4.3-1 PRA ATTRIBUTES

ELEMENT		CATEGORY I	CATEGORY II	CATEGORY III
Initiating Events Analysis	IE	Identification and quantification of dominant accident initiating events	Identification and realistic quantification of risk significant accident initiating events	Identification and realistic quantification of initiating events
Accident Sequence Analysis	AS	Modeling of dominant core damage and large early release accident sequences	Modeling of risk significant core damage and large early release accident sequences	Modeling of core damage and large early release accident sequences
Success Criteria	SC	Bases and supporting analyses for establishing success or failure in dominant accident sequences	Realistic bases and supporting analyses for establishing success or failure in risk significant accident sequences	Realistic bases and supporting analyses for establishing success or failure for modeled accident sequences
Systems Analysis	SY	Modeling of key components and failure modes contributing to the function of systems expected to operate in dominant accident sequences	Realistic modeling of major components and failure modes contributing to the reliability and availability of systems expected to operate in risk significant sequences	Realistic modeling of components and failure modes contributing to the reliability and availability of systems expected to operate in modeled sequences
Human Reliability Analysis	HR	Modeling of major human actions (i.e., latent, response and recovery) with screening Human Error Probabilities (HEPs)	Realistic modeling of human actions (i.e., latent, response and recovery) with plant-specific HEPs in risk significant sequences	Realistic modeling of human actions (i.e., latent, response and recovery) with plant-specific HEPs
Data Analysis	DA	Quantification of point estimates for basic events, and associated parameters with generic data for dominant accident sequences	Realistic quantification of mean values for basic events, and associated parameters in a manner that accounts for relevant plant specific and generic data for risk significant sequences	Realistic quantification of risk significant basic events in a manner that quantifies impacts of uncertainties
Internal Flooding	IF	Modeling of dominant flood sequences	Realistic modeling of risk significant flood contributors	Realistic and thorough modeling of flooding contributors
Quantification	QU	Quantification of CDF and key contributors	Realistic quantification of CDF and key contributors supported by	Realistic quantification of CDF and risk significant contributors supported by a sound understanding and quantification of the impact of uncertainties

point estimates of CDF

mean values of CDF

full quantification of CDF

ELEMENT		CATEGORY I	CATEGORY II	CATEGORY III
		supported by an understanding of the impact of key uncertainties	a sound understanding of the impact of uncertainties	
Level 2 Analysis	L2	Quantification of LERF with an understanding of the impact of key uncertainties for the dominant LERF contributors	Realistic quantification of LERF with a sound understanding of the impact of uncertainties for risk significant accident sequences.	Realistic quantification of LERF supported by a sound understanding and quantification of the impact of uncertainties

Section 4 requirements

- High Level Requirements (HLRs) attempt to capture the important technical issues identified while drafting this standard
- HLRs apply to PRAs used with this standard for any application
- Supporting Requirements (SRs) are phrased as action statements that support the HLRs
- When an action statement extends to more than one Category, its scope of applicability varies as appropriate for applications in that Category

Table 4.4.2 HIGH LEVEL REQUIREMENTS FOR ACCIDENT SEQUENCE ANALYSIS (HLR-AS)

A	**Functional Sequence Categories** The *Accident Sequence Analysis* shall provide a reasonably complete set of scenarios that can lead to core damage following each initiating event or initiating event category defined in *Initiating Events Analysis.* These scenarios shall cover system responses and operator actions, including recovery actions, that support the key safety functions[(2)] necessary to prevent core damage, and shall be defined in a manner that supports the Level 1/Level 2 interface. (HLR-AS-A)
B	**Plant Specific CDF and LERF Quantification** The *Accident Sequence Analysis* shall provide a sequence definition structure that is capable of supporting plant specific quantification of the CDF, and LERF via the Level 1/Level 2 interface. (HLR-AS-B)
C	**Interface with Success Criteria** *Accident Sequence Analysis* shall provide an interface with the success criteria, mission times, and time windows needed to support each key safety function[(2)] represented in the modeled scenarios. (HLR-AS-C)
D	**Treatment Of Dependencies** Dependencies due to initiating events, human interface, functional dependencies, environmental and spatial impacts, and common cause failures shall be addressed. (HLR-AS-D)
E	**Documentation** The *Accident Sequence Analysis* shall be documented in a manner that facilitates PRA applications, updates, and peer review by describing the processes that were followed, with assumptions and bases stated. (HLR-AS-E)

[(2)] Key safety functions are the minimum set of safety functions that must be maintained to prevent core damage and large early release. These include, at a minimum, reactivity control, core heat removal, reactor coolant inventory control, reactor coolant heat removal, and containment bypass integrity in appropriate combinations to prevent core damage and large early release.

TABLE 4.4-2a SUPPORTING REQUIREMENTS FOR ACCIDENT SEQUENCE ANALYSIS HIGH LEVEL REQUIREMENT A
FUNCTIONAL SEQUENCE CATEGORIES: The *Accident Sequence Analysis* shall provide a reasonably complete set of scenarios that can lead to core damage following each initiating event or initiating event category defined in *Initiating Events Analysis*. These scenarios shall cover system responses and operator actions, including recovery actions, that support the key safety functions(2) necessary to prevent core damage, and shall be defined in a manner that supports the Level1/Level 2 interface. (HLR-AS-A)

Index No. AS	CATEGORY I APPLICATIONS Modeling of dominant core damage and large early release accident sequences	CATEGORY II APPLICATIONS Modeling of risk significant core damage and large early release accident sequences	CATEGORY III APPLICATIONS Modeling of core damage and large early release accident sequences
AS-A1 [AS-6] [3.3.2.2]	CHOOSE a method for *Accident Sequence Analysis* that explicitly models the appropriate combinations of system responses and operator actions that affect the key plant safety functions for each modeled initiating event. DEFINE and INCLUDE the critical safety functions that are assumed to be necessary to reach a safe stable state in the model.		
AS-A2 [AS-4] [3.3.2.2]	USE a method for *Accident Sequence Analysis* that : a) includes a reasonably complete set of event sequences involving core damage that could result from each modeled initiating event. b) considers the different plant responses and containment challenges that could result from each modeled initiating event; and c) provides a framework to support sequence quantification. d) reflects the initiating event categories defined in the *Initiating Events Analysis*	USE a method for *Accident Sequence Analysis* that : a) includes a reasonably complete set of event sequences involving core damage that could result from each modeled initiating event. b) models the different plant responses and addresses the containment challenges that could result from each modeled initiating event; and c) provides a framework to support sequence quantification. d) is explicitly traceable to the initiating event categories defined in the *Initiating Events Analysis*	
AS-A3 [AS-4]	DEFINE separate accident sequences as needed to address differences in timing, system success criteria, and operator actions.		
AS-A4 [AS-8]	ADDRESS a level of discrimination in the event tree structure that represents the key procedurally directed operator actions and delineates the differences in success criteria reflected in challenges to the critical safety functions.	DEVELOP a level of discrimination in the event tree structure that represents the key procedurally directed operator actions and delineates the differences in success criteria reflected in challenges to the critical safety functions.	
AS-A5 [AS-4] [3.3.2.2]	USE event trees or their equivalent to represent the accident sequence logic. JUSTIFY the use of alternatives to event trees (e.g., single top fault tree).		

(2) Key safety functions are the minimum set of safety functions that must be maintained to prevent core damage and large early release. These include, at a minimum, reactivity control, core heat removal, reactor coolant inventory control, reactor coolant heat removal, and containment bypass integrity in appropriate combinations to prevent core damage and large early release.

TABLE 4.4-2a SUPPORTING REQUIREMENTS FOR ACCIDENT SEQUENCE ANALYSIS HIGH LEVEL REQUIREMENT A
FUNCTIONAL SEQUENCE CATEGORIES: The *Accident Sequence Analysis* shall provide a reasonably complete set of scenarios that can lead to core damage following each initiating event or initiating event category defined in *Initiating Events Analysis*. These scenarios shall cover system responses and operator actions, including recovery actions, that support the key safety functions[2] necessary to prevent core damage, and shall be defined in a manner that supports the Level1/Level 2 interface. (HLR-AS-A)

Index No. AS	CATEGORY I APPLICATIONS Modeling of dominant core damage and large early release accident sequences	CATEGORY II APPLICATIONS Modeling of risk significant core damage and large early release accident sequences	CATEGORY III APPLICATIONS Modeling of core damage and large early release accident sequences
AS-A6 [AS-4] [3.3.2.2]	USE an acceptable event tree/fault tree method for interfacing the Accident Sequence Analysis with the Systems Analysis tasks. Acceptable approaches for event tree/fault tree modeling include. event trees with conditional split fractions(also referred to as event tree linking), and fault tree linking, both described in (Reference [4.4.2-1]). JUSTIFY the use of alternative approaches for this function.		
AS-A7 [3.3.2.4.1]	DEVELOP the event trees in sufficient detail to: a) determine which safety systems, functions, and operator actions have been challenged for each accident sequence b) determine whether core damage has occurred or core damage may be assumed initially in the PRA development c) identify the conditions needed to define the appropriate operator recovery actions and the necessary conditions for each sequence.		
AS-A8 [AS-4]	INCLUDE each necessary critical safety function in the quantitative model. JUSTIFY exceptions to the critical safety functions that are omitted from the model.		
AS-A9 [AS-7]	INCLUDE those relevant systems that support each critical safety function in the event sequence model in support of sequence quantification.		
AS-A10 [AS-8]	Transfers between event trees MAY be used to reduce the size and complexity of individual event trees. DEFINE any transfers that are used and the method that is used to implement them in the qualitative definition of accident sequences and in their quantification. USE a method for implementing an event tree transfer that preserves the dependencies that are part of the transferred sequence. These include functional, system, initiating event, operator, and spatial or environmental dependencies.		
AS-A11 [AS-8]	When event tree branching and event tree transfers are employed, DEVELOP the structure in a manner that maintains and unambiguously resolves the definition of success and failure paths.		
AS-A12 [3.3.2.4]	CONSIDER USING one or more accepted methods for developing and documenting the event sequence modeling process. Accepted methods include: a) functional and systemic event trees or both (as explained in Reference [4.4.2-1]) b) event sequence diagrams c) system dependency matrices	USE one or more accepted methods for developing and documenting the event sequence modeling process. Accepted methods include: a) functional and systemic event trees or both (as explained in Reference [4.4.2-1]) b) event sequence diagrams c) system dependency matrices	
AS-A13 [3.3.2.4]	INCLUDE a traceable interface between the event tree development process and the method or methods chosen from above or JUSTIFY use of alternative methods	INCLUDE a traceable interface between the event tree development process and the method or methods chosen from above.	

TABLE 4.4-2b SUPPORTING REQUIREMENTS ACCIDENT SEQUENCE ANALYSIS HIGH LEVEL REQUIREMENT B
PLANT SPECIFIC CDF AND LERF QUANTIFICATION: The accident sequence analysis shall provide a sequence definition structure that is capable of supporting plant specific quantification of the CDF and LERF via the Level 1/Level 2 interface. (HLR-AS-B)

Index No. AS	CATEGORY I APPLICATIONS Modeling of dominant core damage and large early release accident sequences	CATEGORY II APPLICATIONS Modeling of risk significant core damage and large early release accident sequences	CATEGORY III APPLICATIONS Modeling of core damage and large early release accident sequences
AS-B1 [AS-5]	INCLUDE models and analyses for *Accident Sequence Analysis* that are consistent with the as-built and as-operated plant. PERFORM realistic modeling of the as-built plant as supported by available information. Conservative modeling of the as-built plant MAY be performed to the extent that Category I applications are not distorted..	INCLUDE models and analysis for *Accident Sequence Analysis* that are consistent with the as-built and as-operated plant. PERFORM realistic modeling of the as-built plant as supported by available information.	
AS-B2 [AS-9]	DEFINE the success paths in the *Accident Sequence Analysis* that are logically consistent with the plant specific definition of core damage. Conservative treatment of success paths MAY be implemented only to the extent that Category I applications are not distorted by such conservative assumptions.	DEFINE the success paths in the *Accident Sequence Analysis* that are logically consistent with the definition of core damage and in a manner that supports a realistic and plant specific quantification of CDF.	
AS-B3 [AS-16]	INCLUDE models for repair and recovery that are based on data or accepted models applicable to the plant and that account for accident sequence dependencies such as time available, adverse environment, and lack of access, lighting, or room cooling. Conservative evaluations of repair and recovery MAY be incorporated only to extent that the relative risk significance of modeled SSCs is not distorted.	INCLUDE models for repair and recovery that are based on data or accepted models applicable to the plant and that account for accident sequence dependencies such as time available, adverse environment, and lack of access, lighting, or room cooling.	
AS-B4 [AS-19]	PROVIDE functions and structure of the event trees in a manner that is consistent with the plant specific EOPs and abnormal procedures.		

TABLE 4.4-2b SUPPORTING REQUIREMENTS ACCIDENT SEQUENCE ANALYSIS HIGH LEVEL REQUIREMENT B
PLANT SPECIFIC CDF AND LERF QUANTIFICATION: The accident sequence analysis shall provide a sequence definition structure that is capable of supporting plant specific quantification of the CDF and LERF via the Level 1/Level 2 interface. (HLR-AS-B)

Index No. AS	CATEGORY I APPLICATIONS Modeling of dominant core damage and large early release accident sequences	CATEGORY II APPLICATIONS Modeling of risk significant core damage and large early release accident sequences	CATEGORY III APPLICATIONS Modeling of core damage and large early release accident sequences
AS-B5 [AS-19]	ACCOUNT FOR procedurally directed operator actions (both positive and negative impacts) that substantially influence the accident sequence progression or its probability in the accident sequence structure or the supporting fault tree analysis. INCORPORATE into the *Accident Sequence Analysis* the expected responses to an initiator as reflected in the plant emergency and abnormal operating procedures, training simulator exercises, and existing plant transient analysis. CHARACTERIZE the operator responses in a manner that is consistent with operator training and results of applicable simulator exercises. INCLUDE operator training input in the interpretation of proceduralized steps. INCLUDE operator actions that influence accident progression in the accident sequence model. Exceptions to this requirement MAY be taken only to the extent that Category I applications are not distorted.	ACCOUNT FOR procedurally directed operator actions (both positive and negative impacts) that substantially influence the accident sequence progression or its probability in the accident sequence structure or the supporting fault tree analysis. INCORPORATE into the *Accident Sequence Analysis* the expected responses to an initiator as reflected in the plant emergency and abnormal operating procedures, training simulator exercises, and existing plant transient analysis. CHARACTERIZE the operator responses in a manner that is consistent with operator training and results of applicable simulator exercises. INCLUDE operator training input in the interpretation of proceduralized steps. INCLUDE operator actions that influence accident progression in the accident sequence model.	
AS-B6 [AS-20, AS-22]	Clearly DEFINE the Level 1 end states as core damage or a safe stable state. USE a definition of core damage that is consistent with the requirements for *Success Criteria*		
AS-B7 [AS-20, AS-22]	RESOLVE other end states such as "core vulnerable" into core damage or safe stable states. ADDRESS the treatment of the impact of containment failure or vent on continued RPV makeup capability and basis for assumptions regarding ultimate end-state when such resolutions are made.		
AS-B8 [AS-20, AS-22]	Conservative definitions of core damage MAY be used only to the extent that Category I applications are not impacted.	DO NOT USE conservative definitions of core damage	

TABLE 4.4-2b SUPPORTING REQUIREMENTS ACCIDENT SEQUENCE ANALYSIS HIGH LEVEL REQUIREMENT B
PLANT SPECIFIC CDF AND LERF QUANTIFICATION: The accident sequence analysis shall provide a sequence definition structure that is capable of supporting plant specific quantification of the CDF and LERF via the Level 1/Level 2 interface. (HLR-AS-B)

Index No. AS	CATEGORY I APPLICATIONS Modeling of dominant core damage and large early release accident sequences	CATEGORY II APPLICATIONS Modeling of risk significant core damage and large early release accident sequences	CATEGORY III APPLICATIONS Modeling of core damage and large early release accident sequences
AS-B9 [AS-21]	USE a method for *Accident Sequence Analysis* that supports the development of an interface between Level 1 and Level 2 LERF analysis. To accomplish this, core damage sequences MAY be further developed by using accident sequence knowledge or information or consequence questions to unambiguously assign the modeled sequence to an appropriate plant damage state (PDS).		
AS-B10	USE Level 1 plant damage states that provide adequate information to support Level 2 analysis with minimal loss of information. If individual sequence cut sets are assigned to Plant Damage States (PDS), PROVIDE sufficient information to be able to remove ambiguities in mapping the basic event cutsets to unique PDS. Exceptions to this requirement MAY be made only to the extent that Category I applications are not distorted.	USE Level 1 plant damage states that provide adequate information to support Level 2 analysis with minimal loss of information. If individual sequence cut sets are assigned to Plant Damage States (PDS), PROVIDE sufficient information to be able to remove ambiguities in mapping the basic event cutsets to unique PDS.	
AS-B11 [AS-14]	Grouping of sequences into broader plant damage state categories MAY be performed only to the extent that Category I applications are not distorted. DO NOT GROUP sequences or plant damage states in a non-conservative manner (subsuming of sequences into broader categories not bounded by the worst case accident).	Grouping of sequences into broader plant damage state categories MAY be performed only to the extent that such grouping does not distort realistic CDF and LERF estimation. DO NOT GROUP sequences or plant damage states in a non-conservative manner (subsuming of sequences into broader categories not bounded by the worst case accident).	
AS-B12 [AS-15]	The Accident Sequence Analysis may be modeled using a single top event linked fault tree model. When this option is selected, DEVELOP such models in manner that meets all the technical requirements of this section. PROVIDE justification for any requirements that are not met or do not apply.		

TABLE 4.4-2c SUPPORTING REQUIREMENTS FOR ACCIDENT SEQUENCE ANALYSIS HIGH LEVEL REQUIREMENT C
INTERFACE WITH SUCCESS CRITERIA: *Accident Sequence Analysis* shall provide an interface with the success criteria, mission times, and time windows needed to support each key safety function [2] represented in the modeled scenarios. (HLR-AS-C)

Index No. AS	CATEGORY I APPLICATIONS Modeling of dominant core damage and large early release accident sequences	CATEGORY II APPLICATIONS Modeling of risk significant core damage and large early release accident sequences	CATEGORY III APPLICATIONS Modeling of core damage and large early release accident sequences
AS-C1 [AS-17]	Based on the functional success criteria developed in *Success Criteria*, INCLUDE a reasonably accurate treatment of the functional requirements associated with the plant-specific safety functions, system capabilities and system interactions, procedural guidance to operators, and the timing of events within the *Accident Sequence Analysis* for each modeled initiating event category.		
AS-C2 [AS-18]	IDENTIFY the information sources used as the basis for the *Accident Sequence Analysis* including: (a) system analysis and system dependencies (b) success criteria, plant thermal hydraulics, and plant transient response (c) plant operating procedures and practices.		
AS-C3 [AS-18]	PROVIDE a sequence definition that is based on realistic thermal hydraulic analyses to support the success criteria used in the *Accident Sequence Analysis*. Conservative analyses MAY be used only to the extent that Category I applications are not distorted.	PROVIDE a sequence definition that is based on realistic thermal hydraulic analyses to support the success criteria used in the *Accident Sequence Analysis*. Conservative analyses MAY be used only to the extent that realistic estimates of CDF and LERF are not distorted.	
AS-C4	DEVELOP and SPECIFY the success criteria in a manner that shows an interface with the definition of core damage and PDS, definition of plant safety functions needed to prevent core damage or PDS, and the boundary conditions for the systems analysis. INCLUDE a definition of the success criteria and mission time for each event tree top event. If multiple success criteria and mission times are needed for the same event tree top event, PROVIDE this information for each case.		
AS-C5 [AS-23]	INCLUDE in the definition of success criteria for sequences terminating with no core damage, a mission of at least 24 hours with stable plant conditions or an appropriate representation for accident sequences with unstable conditions that is consistent with the sequence end-state. JUSTIFY and PROVIDE any mission times less than 24 hours for stable sequences and all assumed mission times for all unstable sequences.		

(2) Key safety functions are the minimum set of safety functions that must be maintained to prevent core damage and large early release. These include, at a minimum, reactivity control, core heat removal, reactor coolant inventory control, reactor coolant heat removal, and containment bypass integrity in appropriate combinations to prevent core damage and large early release.

TABLE 4.4-2d SUPPORTING REQUIREMENTS FOR ACCIDENT SEQUENCE ANALYSIS HIGH LEVEL REQUIREMENT D
TREATMENT OF DEPENDENCIES: Dependencies due to initiating events, human interface, functional dependencies, environmental and spatial impacts, and common cause failures shall be addressed. (HLR-AS-D)

Index No. AS	CATEGORY I APPLICATIONS Modeling of dominant core damage and large early release accident sequences	CATEGORY II APPLICATIONS Modeling of risk significant core damage and large early release accident sequences	CATEGORY III APPLICATIONS Modeling of core damage and large early release accident sequences
AS-D1 [AS-5] [3.3.2.4.1]	PROVIDE a sequence model development with a clear interface with the system analysis and dependency evaluation tasks of the PRA.		
AS-D2 [AS-10] [3.3.2.4.1]	INCLUDE a visible and a reasonably accurate treatment of dependencies and interfaces among the plant safety functions, system responses, and operator actions needed for accident mitigation in the *Accident Sequence Analysis*. These dependencies include functional, phenomenological, and operational dependencies and interfaces. IDENTIFY dependencies among all modeled event tree top events and INCLUDE these quantitatively in the model.		
AS-D3 [AS-11] [3.3.2.3]	PROVIDE a systematic evaluation of dependencies, such as that provided by dependency matrices. When using dependency matrices for this purpose INCLUDE a matrix or set of matrices that accounts for: a) initiating event to system dependencies b) dependencies among support systems c) dependencies between support and front line systems; d) dependencies among front line systems that support key safety functions (2) PROVIDE an event sequence model that realistically treats, and consistently applies, to capture the dependencies among event tree top events.		

(2) Key safety functions are the minimum set of safety functions that must be maintained to prevent core damage and large early release. These include, at a minimum, reactivity control, core heat removal, reactor coolant inventory control, reactor coolant heat removal, and containment bypass integrity in appropriate combinations to prevent core damage and large early release.

TABLE 4.4-2d SUPPORTING REQUIREMENTS FOR ACCIDENT SEQUENCE ANALYSIS HIGH LEVEL REQUIREMENT D
TREATMENT OF DEPENDENCIES: Dependencies due to initiating events, human interface, functional dependencies, environmental and spatial impacts, and common cause failures shall be addressed. (HLR-AS-D)

Index No. AS	CATEGORY I APPLICATIONS Modeling of dominant core damage and large early release accident sequences	CATEGORY II APPLICATIONS Modeling of risk significant core damage and large early release accident sequences	CATEGORY III APPLICATIONS Modeling of core damage and large early release accident sequences
AS-D4 [AS-10]	INCLUDE the following types of accident sequence dependencies: Functional: Functional failures, e.g.: a) LOCA initiator causes debris clogging of ECCS Suction b) turbine driven system dependency on SORV, depressurization, and containment heat removal (suppression pool cooling). c) low pressure system injection success dependent on need for RPV depressurization. Intra and Intersystem: Common cause failures and functional dependencies between systems. IDENTIFY system dependencies, dependency matrices, and/or linked fault trees. Human: Adverse environment or sequence timing influences on operator actions. Spatial/Environmental/Phenomenological: Spatial/Environmental dependencies that may result from initiating events and subsequent sequences. Example of Phenomenological dependencies: These dependencies manifest themselves when the environmental conditions generated during an accident sequence influence the operability of equipment or the capability of the operators to implement procedures and recovery actions. Examples of phenomenological impacts include generation of harsh environments that actuate protective trip circuits, loss of pump net positive suction head (NPSH), clogging of flow paths, and consequential effects of other failures.		
AS-D5 [AS-10]	INCLUDE dependencies between the initiating event and mitigating systems as well as dependencies between and among the mitigating systems and operator actions. ACCOUNT for dependencies between the initiating event and mitigating systems, including immediate (e.g. loss of electric power) and delayed responses (e.g., loss of room cooling) in the accident sequence model or reflected in the system logic models. Dependencies among mitigating systems and operator actions MAY also be modeled in the accident sequence model or the system logic models.		
AS-D6 [3.3.2.4.1]	When developing the event sequence structure, ORDER the event tree top events representing the response of systems and post initiator operator actions sequentially according to the timing of the events along the sequence to ensure proper treatment of time dependencies.		
AS-D7 [3.3.2.4.1]	When the event trees with conditional split fraction method is used, if the probability of Event B is dependent on the occurrence or non-occurrence of Event A, PLACE Event A to the left of Event B in the ordering of event tops.		

TABLE 4.4-2d SUPPORTING REQUIREMENTS FOR ACCIDENT SEQUENCE ANALYSIS HIGH LEVEL REQUIREMENT D
TREATMENT OF DEPENDENCIES: Dependencies due to initiating events, human interface, functional dependencies, environmental and spatial impacts, and common cause failures shall be addressed. (HLR-AS-D)

Index No. AS	CATEGORY I APPLICATIONS Modeling of dominant core damage and large early release accident sequences	CATEGORY II APPLICATIONS Modeling of risk significant core damage and large early release accident sequences	CATEGORY III APPLICATIONS Modeling of core damage and large early release accident sequences
AS-D8 [3.3.2.4.1]	For the event trees with conditional split fraction method, DEVELOP the event trees to a level of detail sufficient to identify intersystem dependencies and train level interfaces. For the fault tree linking method, DEVELOP fault trees and apply flag settings and mutually exclusive files or comparable method to resolve these same dependencies. If plant configurations and maintenance practices create dependencies among various system alignments, DEFINE and MODEL these configurations and alignments in a manner that reflects these dependencies. PROVIDE one event sequence model or set of event trees that accounts for each initiating event or initiating event category defined in the *Initiating Event Analysis* element so that initiating event dependencies can be properly modeled.		
AS-D9 [AS-12]	PROVIDE an explicit model of the Pump seal LOCA in the *Accident Sequence Analysis* when applicable. PROVIDE the basis for the model.		
AS-D10 [AS-13]	INCLUDE in the *Accident Sequence Analysis* and quantified model an explicit and realistic treatment of dependencies introduced by the time phasing of the event progression. A conservative treatment of time phasing MAY be used to the extent that Category I applications are not distorted.	INCLUDE in the *Accident Sequence Analysis* and quantified model an explicit and realistic treatment of dependencies introduced by the time phasing of the event progression. A conservative treatment of time phasing MAY be used to the extent that realistic estimates of CDF and LERF are not distorted.	

TABLE 4.4-2d SUPPORTING REQUIREMENTS FOR ACCIDENT SEQUENCE ANALYSIS HIGH LEVEL REQUIREMENT D
TREATMENT OF DEPENDENCIES: Dependencies due to initiating events, human interface, functional dependencies, environmental and spatial impacts, and common cause failures shall be addressed. (HLR-AS-D)

Index No. AS	CATEGORY I APPLICATIONS Modeling of dominant core damage and large early release accident sequences	CATEGORY II APPLICATIONS Modeling of risk significant core damage and large early release accident sequences	CATEGORY III APPLICATIONS Modeling of core damage and large early release accident sequences
AS-D11 [AS13]	INCLUDE events for which time phased dependencies could be introduced. For SBO/LOOP sequences , INCLUDE key time phased events such as: • AC power recovery • DC battery adequacy (time dependent discharge) • Environmental conditions (e.g., room cooling) for operating equipment and the control room For ATWS/failure to scram events, INCLUDE key time dependent actions such as: • SBLC initiation • RPV level control • ADS inhibit Other events that MAY be subject to explicit time dependent characterization include: • CRD as an adequate RPV injection source • Long term make-up to RWST		

TABLE 4.4-2d SUPPORTING REQUIREMENTS FOR ACCIDENT SEQUENCE ANALYSIS HIGH LEVEL REQUIREMENT D
TREATMENT OF DEPENDENCIES: Dependencies due to initiating events, human interface, functional dependencies, environmental and spatial impacts, and common cause failures shall be addressed. (HLR-AS-D)

Index No. AS	CATEGORY I APPLICATIONS Modeling of dominant core damage and large early release accident sequences	CATEGORY II APPLICATIONS Modeling of risk significant core damage and large early release accident sequences	CATEGORY III APPLICATIONS Modeling of core damage and large early release accident sequences
AS-D12 [AS-13]	As part of the time dependence assessment, ADDRESS the following: • Mission time of diesel generators • Mission time of RPT, ARI, scram system • Time to core uncovery		
AS-D13 [AS-15] [3.3.2.4.1]	To model the changing nature of certain sequences, ACCOUNT for operational dependencies. ACCOUNT for interfaces when sequences are modeled in multiple event trees with transfers. Example of event progression: In developing sequences for a transient initiating event in which the reactor coolant boundary is initially intact, event progression may lead to sequences in which reactor coolant system safety or relief valves open such that a transient induced LOCA condition is created.		
AS-D14 [AS-15]	When transfers are being employed, INCLUDE Transfers among event trees explicitly in the quantification except for cases that are noted in the documented descriptions of the sequences to address dependencies properly. PRESERVE the appropriate dependencies, both hardware and human related, from the original event sequence model across the transfer interfaces.		

TABLE 4.4-2e SUPPORTING REQUIREMENTS FOR ACCIDENT SEQUENCE ANALYSIS HIGH LEVEL REQUIREMENT E
DOCUMENTATION: The accident sequence analysis shall be documented in a manner that facilitates PRA applications, updates, and peer review by describing the processes that were followed, with assumptions and bases stated. (HLR-AS-E)

Index No. AS	CATEGORY I APPLICATIONS Modeling of dominant core damage and large early release accident sequences	CATEGORY II APPLICATIONS Modeling of risk significant core damage and large early release accident sequences	CATEGORY III APPLICATIONS Modeling of core damage and large early release accident sequences
AS-E1 [AS-25]	DOCUMENT the results of the Accident Sequence Analysis consistent with the process that was used for its development. PROVIDE the basis for the accident sequence process.		
AS-E2 [AS-26]	DOCUMENT the results of independent reviews of the *Accident Sequence Analysis* and the qualifications of the reviewers.		
AS-E3 [AS-26]	DOCUMENT the treatment of each initiator and event tree to support reviews and applications.		
AS-E4	DOCUMENT interfaces between *Accident Sequence Analysis* and other PRA tasks. INCLUDE the following interfaces in the documentation: • a link between the definition of initiating event category in the Initiating Event Analysis Task and the event sequence model • the definition of core damage and associated success criteria that is consistent with that documented in the Success Criteria Task • key definitions of operator actions and sequence specific timing and dependencies reflected in the event trees that is traceable to the HRA for these actions • the basis for the sequence and cutset quantification in the Level 1 Quantification And Interpretation of Results Task • a framework for an integrated treatment of dependencies in the initiating events analysis, systems analysis, data analysis, human reliability analysis, Level 1 quantification, and Level 2 LERF quantification PRA elements.		

TABLE 4.4-2e SUPPORTING REQUIREMENTS FOR ACCIDENT SEQUENCE ANALYSIS HIGH LEVEL REQUIREMENT E

DOCUMENTATION: The accident sequence analysis shall be documented in a manner that facilitates PRA applications, updates, and peer review by describing the processes that were followed, with assumptions and bases stated. (HLR-AS-E)

Index No. AS	CATEGORY I APPLICATIONS Modeling of dominant core damage and large early release accident sequences	CATEGORY II APPLICATIONS Modeling of risk significant core damage and large early release accident sequences	CATEGORY III APPLICATIONS Modeling of core damage and large early release accident sequences
AS-E5	DOCUMENT a) a description of events and the end states included in the development of the models b) the success criteria for each modeled event c) the actual models.		
AS-E6	DOCUMENT: a) the success criteria established for each initiating event category including the bases for the criteria (i.e., the system capacities required to mitigate the accident and the necessary components required to achieve these capacities); b) the models used (including all sequences) for each initiating event category c) a description of the accident progression for each sequence or group of similar sequences (i.e., descriptions of the sequence timing, applicable procedural guidance, expected environmental or phenomenological impacts, dependencies between systems and operator actions, and other pertinent information required to fully establish the sequence of events); d) any assumptions that were made in developing the accident sequences, as well as the bases for the assumptions and their impact on the final results; e) existing analyses or plant-specific calculations performed to arrive at success criteria and expected sequence phenomena including necessary timing considerations; f) sufficient system operation information to support the modeled dependencies; g) calculations or other bases used to justify equipment operability beyond its "normal" design parameters and for which credit has been taken; and h) description of the interface of the accident sequence models with PDSs. i) how all requirements for *Accident Sequence Analysis* have been satisfied when sequences are modeled using a single top event linked fault tree.		

References

[4.4.2-1] NUREG/CR-4550, Vol. 1 Rev. 1, A Analysis of Core Damage Frequency: Internal Events Methodology, pp 4-1 to 4-22, January 1990