UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

MEETING OF THE SUBCOMMITTEE ON REGULATORY POLICIES AND PRACTICES

CLOSED MEETING

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THURSDAY,

NOVEMBER 16, 2007

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

MEMBERS PRESENT:

WILLIAM J. SHACK	Chair
SAID ABDEL-KHALIK	Member
JOHN D. SIEBER	Member
JOHN W. STETKAR	Member
J. SAM ARMIJO	Member
MARIO V. BONACA	Member
MICHAEL CORRADINI	Member
GEORGE E. APOSTOLAKIS	Member

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CONSULTANTS TO THE SUBCOMMITTEE PRESENT:
GRAHAM WALLIS
THOMAS S. KRESS

NRC STAFF PRESENT:
SHER BAHADUR
ATA ISTAR
JASON SCHAPEROW
ROBERT PRATO
CHARLIE TINKLER
RICH SHERRY
HOSSEIN NOURBAKSH
RANDY SULLIVAN
JIMI YEROKUM
JOHN FLACK
FRANK GILLESPIE

ALSO PRESENT:
RANDY GAUNTT

M-O-R-N-I-N-G S-E-S-S-I-O-N

8:31 a.m.

OPENING REMARKS AND OBJECTIVES

CHAIRMAN SHACK: On the record. The meeting will now come to order. This is the meeting of the ACRS Subcommittee on Regulatory Policies and Practices.

I am Bill Shack, Chairman of this meeting. Members in attendance are Said Abdel-Khalik, George Apostolakis, Sam Armijo, Mario Bonaca, Mike Corradini and John Stetkar. Also in attendance are ACRS consultants Tom Kress and Graham Wallis. I thought we were going to have some members of the ACNW, but they don't seem to be here.

The purpose of the meeting is to discuss the status of the staff's effort associated with the State-of-the-Art Reactor Consequence Analysis SOARCA Project. The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate for deliberation by the full committee. Dr. Hossein Nourbaksh is the Designated Federal Official for this meeting.

All portions of today's meeting will be closed to prevent disclosure of information, premature

T-A-B-L-E O-F C-O-N-T-E-N-T-S

disclosure of which would be likely to frustrate implementation of a proposed Agency action pursuant to 5 USC 552(B)(c)(9)(b). A transcript of the meeting is being kept. It is requested that speakers first identify themselves, use one of the microphones and speak with sufficient clarity and volume so 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.

In our previous meeting on the SOARCA Project we had a number of, I thought, fairly major issues associated with the use of a cutoff frequency for events to be considered, how we were going to handle emergency planning for the seismic events which turned out to be the dominant sequences of interest and could significantly affect emergency planning and then the choice of a dose threshold or the use of a dose threshold in calculating consequences and the only one of those that's specify addressed as a topic today is dose threshold but I'm sure the other topics will come up as we go through.

DR. BAHADUR: Yes sir.

CHAIRMAN SHACK: And we'll now proceed with the meeting and I will call upon Dr. Sher Bahadur of the Office of Nuclear Regulatory Research.

I. STATE-OF-THE-ART REACTOR CONSEQUENCE ANALYSIS (SOARCA) PROJECT OVERVIEW

DR. BAHADUR: Thank you, Dr. Shack. Good morning. My name is Sher Bahadur. I'm the Deputy Division Director for the Systems Analysis. As you know, the research has recently reorganized and we know have three technical divisions. The other two divisions are the Divisions of Risk Assessment and also the Division of Engineering.

Today we're going to be talking about the State-of-the-Art Reactor Consequence Analysis which is not a new subject for the Subcommittee. We came to you about four months back. We gave you the project overview and also outlined the approach that we're going to be following. The staff also talked about the initial sequence selection and also the preliminary results. Subsequent progress has been made and actually we have completed analysis on two of the sites.

Yesterday, we met with the other advisory committee, the one on Nuclear Waste and Materials, and we presented specifically, well of course, with Dr. Bob Salka (phonetic) but we specifically presented to them the staff's thinking on the dose threshold, the models that we are going to be following. And at the end of the meeting, it was clear to us that although we have thought it out carefully and we have developed a number of options that the staff has followed for calculating the latent cancer fatalities, the issues are still debatable and, to that extent, we have an IOU to the ACNW&M where we are going to go back to them and give more details of the options that the staff has developed and we'll try to share some of those discussions that we had yesterday with the other committee with you as well today.

I have Bob Prato who is the Project Manager on SOARCA. He and his team will give you all the information on SOARCA as the day goes by. I also have Jimi Yerokum who is the Chief of the Special Branch out there and he is there with his team in case there are any questions that need to be answered and, of course, as the day goes by and if there are some questions that we can't answer now we can always come back.

With that, if the Subcommittee doesn't have any questions for me, I'll ask Bob Prato to start the briefing and before Bob starts the briefing, I would like to be excused. If I get up in the middle of the briefing, there are two or three more actions going on where I need to be there. But I'll keep coming back. Bob.

I. STATE-OF-THE-ART REACTOR CONSEQUENCE ANALYSIS (SOARCA) PROJECT OVERVIEW

MR. PRATO: Good morning. My name is Bob Prato. I'm the Project Manager for SOARCA and we're going to covering a number of items at today's meeting. Before we get started, I'd like to thank you. A lot of work has gone into SOARCA. A lot of staff resources and a lot of people have been involved and a lot of work has gone into it and we'd like to thank you for your interest in the subject.

The agenda today, I'm going to cover a couple of the administrative matters before I get into the actual context. The Commission paper on Reporting Latent Cancer Fatalities will be moved up a little bit prior to the preliminary results and we're going to have discussions on emergency preparedness as part of the process overview. The rest of the emergency preparedness is integrated the results discussion and we're going to cover that a great deal and you're going to see how important it is with regards to the initial results that we've identified.

In addition, last time we came here we presented the process in a lot of detail. What our intent is here today, because we understand there are three new members, we're going to go through the overview and the process again in not as much detail to refamiliarize the Committee and to help orient the new members of the Committee.

At the last meeting, we took a lot of notes. We also reviewed the transcripts and we did come up with the same three major issues and we plan to talk about those in addition to a couple of the other minor issues. So we hope that we're going to be addressing all the questions that you had from last time as well.

The objective of SOARCA, our objective is to develop a state-of-the-art, more realistic evaluation of severe accident progression, radiological release and offsite consequences for dominant accident sequences and we want to provide a more accurate assessment of potential offsite consequences to replace previous consequence analysis such as NUREG --

DR. WALLIS: What do you mean by "dominant accident sequence"?

MR. PRATO: The Commission had directed us to focus on dominant accidents. Therefore, we set a threshold which was the issue that was discussed initially and we're going to get to that in our discussion.

DR. WALLIS: It seems to me a dominant accident is one which kills people and if you end up with a conclusion that no one is going to be killed, then you don't have any dominant accidents.

MEMBER APOSTOLAKIS: These are dominating the core damage frequency.

MR. PRATO: It's based on core damage frequency.

MEMBER APOSTOLAKIS: I think you should say that.

DR. WALLIS: Yes, but dominant, from the public point of view, is something which has the largest effect on the public it would seem. It's a different idea, isn't it?

MEMBER APOSTOLAKIS: That's not what he means.

DR. WALLIS: I know it's not what you mean. But if this is for public consumption, then the public may have a different idea of what dominates their awareness of nuclear accidents.

MR. PRATO: We phrased that. We've given numerous presentations not only internally to the entire management chain and to the Commission but also to the public and we'll make sure that that's clear in our next presentation.

MEMBER APOSTOLAKIS: But this objective, the first question is it has to be stated accurately. So you really have to say the sequences dominating core damage events.

DR. WALLIS: Okay. So core damage is the metric you use.

MEMBER APOSTOLAKIS: Yes, but --

(Several speaking at once.)

CHAIRMAN SHACK: -- sequences with risk greater than 10 to the minus -- They have a frequency cutoff before they look at it. But once they take the frequency cutoff, then they do look at the risk significance.

MEMBER APOSTOLAKIS: What are you talking about? I mean, dominant is only CDF. We're coming back to it. If it is not, then the full project doesn't make sense.

MEMBER CORRADINI: But I think you guys are arguing -- You're in agreement.

CHAIRMAN SHACK: We're in agreement. It's just --

MEMBER APOSTOLAKIS: If you leave it like this --

CHAIRMAN SHACK: A more precise definition.

MEMBER APOSTOLAKIS: If you leave it like this, you have to do Level 3 PRA and tell us what sequences dominant which is what Graham is saying.

DR. WALLIS: By dominance, you mean on the CDF.

MEMBER APOSTOLAKIS: But that's not what they did.

DR. WALLIS: On the basis of CDF.

MEMBER APOSTOLAKIS: Yes, CDF with some consideration of the containment. I mean, you don't put everything up there. But essentially, they are cutting it off at an earlier stage. So that would make it clear.

DR. WALLIS: But you see --

MEMBER APOSTOLAKIS: But the second thing is why didn't you do a Level 3 PRA?

DR. WALLIS: Yes, that's right because the project is on reactor consequences. It's not on reactor core damage. It's on consequences, public consequence really, isn't it?

MEMBER CORRADINI: But I think the staff -- My sense of this from the last time we beat them up that they're constrained and I think the constrain is due to they shalt do it on the way you described it. Right?

DR. WALLIS: I know.

MEMBER APOSTOLAKIS: But that was my next question. Did the Commission decide this?

MR. PRATO: Yes sir.

MEMBER APOSTOLAKIS: So you really had no freedom to say maybe we should do something else.

MEMBER KRESS: I wonder about that because you know the peer review group had a number of what I call relatively good recommendations and the team rejected them because they weren't in the SRM. I mean, they weren't within their guidelines. I was wondering. That seems a little strange to me because I would think you would go back to the Commission and say, "Hey, we're doing -- Your guidelines you gave us are just constraining too much to meet our real objectives. Can we do this instead?" I don't know why that hasn't taken place.

DR. BAHADUR: Let's see if Charlie Tinkler has --

MR. TINKLER: Yes. Let me try to address this. We have given this issue more thought and to the extent that we can better clarify how we got to where we are. Why are we using screening criteria when obviously we could do a full Level 3 PRA and prove to everyone's satisfaction more or less that we have identified what's important? You have to go back to the underlying premise of this project. The underlying premise of this project is that the, I don't want to offend anybody here, Level 2 and Level 3 aspects of PRA are areas that deserve more attention and more rigorous quantification.

It was our view that the use of an integral method, alla MELCOR and MACCS, together with an uncertainty analysis was an area ripe for shedding insights on risk. Rather than trying to approximately quantify thousands of sequences, we believe that Level 1 PRA has done an outstanding job at this point of identifying what the important sequences are, both from a CDF perspective and from their own examination of LERF. But we believe further insights can be gained by that more rigorous quantification and a scrutable rigorous quantification.

If you don't like MELCOR, you can at least attack its particular models. If you don't like MACCS, you can attack its particular models. It's not buried, I'm sorry, in a sea of number from which it is very difficult to extract. Now that means we're going to take a handful of sequences. We're not going to have a multitude because we think the Level 1 PRA has guided us towards where important sequences are.

Why CDF? Why did we pick CDF? Well, for starters, there is kind of an historical emphasis at the NRC on CDF. Also there is an abundance of information on CDF. We have our updated, benchmarked SPAR models. We have our best shot at what CDF is. To the extent people have updated their own PRA, the licensees, they've updated that Level 1. We've done 10, 15 years most recently on phenomenological research to address those early containment failure issues, DCH, hydrogen, steam explosions, some of the lesser longer term issues like core-concrete interactions. That's where we've put our attention. But our view was it hadn't all been folded back into the Level 2-Level 3 PRA.

MEMBER KRESS: I'm confused. You said that one of the main motivations for this study is because Level 2 and Level 3 hasn't been given enough attention compared to Level 1. But we're going to use Level 1 CDF as our metric to choose -- I don't understand.

MR. TINKLER: It's only our screening criteria. Okay. It's our screening criteria because at this point it's in general directions and we do know about containment failure modes.

MEMBER KRESS: That's what bothers me is because I would think the screening criteria would be maybe on LERF or LRF.

MR. TINKLER: But then we would be substituting the simplified LERF models for the more rigorous quantification.

MEMBER KRESS: I don't know if that's as bad as using CDF for Level 2 and Level 3.

MR. TINKLER: But like I said, let's look at the criteria that the staff, that the NRC, uses for risk significance in Reg Guide 1174. It uses a CDF of 10^{-6} and a LERF of 10^{-7}. We meet the criterion Reg. Guide 1174 on CDF and if you believe that the conditional containment failure probability is 0.1 we meet it for LERF also. So we're clearly capturing dominant, or excuse me, risk significant sequences, now at least insofar as the bypass sequences are concerned.

The only issue that could, and we have thought about this, is for non-bypass sequences. Are we capturing all the significant contributors to LERF by using our CDF as opposed to a LERF? Again, for the PWRs, is there any significant dispute that early conditional containment failure probabilities are 0.1

or less? I don't think we're at that point where we think there are significant containment failure probabilities greater than, that the LERF for large dry PWRs is greater than 0.1.

So what are we left with? We're left with BWRs and we're left with a Mark I.

MEMBER KRESS: And we're left with ice condensers.

MR. TINKLER: And ice condensers.

MEMBER KRESS: That statement of 0.1 may not apply.

MR. TINKLER: So let's look at those. So for the Mark I -- And like I said, the PRA points us to the usual suspects in these things. We have long-term station blackout. So what's left? Short-term station blackout. Our short-term station blackout didn't meet our CDF and we talked a long time about that within the team. We talked for what it seemed like on and off months. Should we included short-term station blackout? It didn't meet our criteria.

But then we go back and we look at the general thinking on LERF and we go back to a document that's often cited, the BNL NUREG, I think it's 6595 where there's a definition of LERF. In our calculations, we did frankly some very preliminary short-term station blackout calculations on Peach Bottom. We didn't get vessel failure for nearly nine hours.

The customary and historical definition of early is four hours. We got an EPZ evacuation time estimate of six and a half hours. Where's LERF? Now that's a case-by-case example.

MEMBER KRESS: I still think you shouldn't neglect LRF because they're very important, too. That's where you get your land contamination and --

MR. TINKLER: I understand. But we are focused on health effects here.

MEMBER KRESS: I know.

MR. TINKLER: Okay.

MEMBER KRESS: I know but that seems like a missed focus to me. I think that's the right focus.

MR. TINKLER: I wanted to -- Like I say, we do believe that a large benefit is derived in the study from looking at the quantification more carefully to look at mitigation that hasn't been addressed yet in PRA, both the B.5.b, SAMGs, other things that have not just been quantified in PRA. Jason is going to show you calculations we did frankly that showed some of the Level 1 could be adjusted for some of these thoughts.

MEMBER KRESS: If I was going to have a slide on objectives, I wouldn't have that slide because that's what you're doing. My slide would say I want to gain insights. I want to see what SAMDAs and things, have on Level 2, Level 3. I want to see if the improvements of the Code make a lot of difference or something like that would be --

MR. TINKLER: We also believe that the PRA, the Level 1 PRA, the body of information, now is pretty strong and points us. It's not as if we -- let's see. There's some other sequence. We just haven't -- We continually identify the same sequences over and over and we saw that when we started looking at a variety of plants. Like I said, there was one case where the CDF might not have been a good measure. Now you want to say LRF, not LERF. Okay. But again, I don't want to steal Jason's thunder.

MEMBER KRESS: Yes. Okay.

MR. TINKLER: But Jason is going to show you, but Jason is going to show you calculations to show it's not all that large.

MEMBER KRESS: Well, looking -- Still I'm on this slide here. That second bullet.

CHAIRMAN SHACK: It's the second bullet that gives him the problem, I think.

MEMBER KRESS: Do you think that is something you're going to do?

MR. TINKLER: Why not?

MEMBER ARMIJO: Why not? I mean, that's what they've been asked to do by the Commission and I'd like to hear what they have to say.

MEMBER KRESS: Offsite consequences, they've going to give a better estimate of this?

MEMBER ARMIJO: Yes.

MEMBER APOSTOLAKIS: One of the motivations here the way I understand it was that the Sandia study had very conservative results. Correct? And that was what? Twenty some years.

MEMBER CORRADINI: Twenty-five years ago.

MEMBER APOSTOLAKIS: Twenty-five years ago.

MEMBER BONACA: 1982.

MEMBER APOSTOLAKIS: So we have this study, very conservative results, one extreme. Do we want to do something about it?

MR. TINKLER: But can I just add --

MEMBER APOSTOLAKIS: And what we are doing is we're going all the way to the other side and produce extremely optimistic results.

MEMBER ARMIJO: I don't think you're doing either one.

MEMBER APOSTOLAKIS: -- consequences. How is that going to look to the public?

MEMBER ARMIJO: I don't think extremely optimistic is the effect.

MEMBER APOSTOLAKIS: Well, you say zero. What else is there?

MEMBER ARMIJO: I haven't seen the results. All I've seen is the objectives.

MR. TINKLER: Let me just say. There is -- We are also using the concept that risk significance stops at some value.

MEMBER APOSTOLAKIS: That's right.

MR. TINKLER: Okay. Now you can argue "Why stop LERF at 10^{-7}? Why not take LERF all the way down to 10^{-9}?" Because the Agency's already said at least in the reg guide that below 10^{-7}, that's no longer risk significant.

MEMBER APOSTOLAKIS: On the other hand, you know, below that's where you start seeing some consequences.

MR. TINKLER: Yes. But I would also argue that's also because we probably haven't spent enough time quantifying that because the number was already low.

MEMBER APOSTOLAKIS: I do not object to what you have done. I think it's perfectly legitimate to say this is what I want to do. I want to take the sequences that dominate core damage, give some consideration to the containment and see what happens because we have bad history. In the past we did it overly conservatively.

I view this more like a missed opportunity to actually do a good Level 3 PRA and so it's not really that I'm objecting to what you have done. Of course, the objectives have to be restated in my view to clearly reflect what you have done. But why not -- and I mentioned it last time, but nobody seems to pay any attention. This EPRI report on the protective actions, they did it both ways and I don't see why they can do that and an agency like ours cannot do it. And they found results consistent with yours. There's no question about it. But they did show some latent fatalities at very low frequencies when they had no cutoff on the sequences.

So I'm sitting there wondering why didn't the Agency do something like this too. I mean, if EPRI can do it, we can do it. And --

CHAIRMAN SHACK: I don't think it's a question of can you do it. It's what are you trying to communicate.

MEMBER APOSTOLAKIS: My answer to myself was yes, they can. So the question is why did they.

MR. TINKLER: Well, in part because they reported the results as individual risk and not purely as consequences.

MEMBER APOSTOLAKIS: As risk, yes.

MR. TINKLER: I mean, they reported it as latent -- probability of a latent cancer fatality for an individual. We are charged with presenting absolute values of consequences. Okay? Numbers.

MEMBER KRESS: Total numbers.

MR. TINKLER: Total numbers, okay.

MEMBER APOSTOLAKIS: Total numbers.

MR. TINKLER: So it's a little different presentation of results and I've spent some time looking at the EPRI report. There is also -- While it appears in some cases as if they've used more conservative and capture some lower frequency events, they've also been a little more aggressive in their treatment of EP and lateral motion, so forth.

MEMBER APOSTOLAKIS: Let me ask you this. As I recall now because -- In terms of the dose and the consequences, you used the 5 rem per year and 10 rem per lifetime, something like that?

MR. TINKLER: Ten rem lifetime.

MEMBER APOSTOLAKIS: Yes, 10 rem lifetime.

MR. TINKLER: Ten rem lifetime. Five rem a year and ten.

MEMBER APOSTOLAKIS: So you did the sensitivity there. Why didn't you do it here too and go down to 10^{-9} and see what happens?

MR. TINKLER: Well, I mean, we could but again --

MEMBER APOSTOLAKIS: You could. There's no question you can't.

MR. TINKLER: We could, but, again, it seems relatively clear that the Agency's position as risk significance for LERF at 10^{-7} is an acceptable level.

MEMBER CORRADINI: But -- So I guess I have to come back, Charlie, because I think you're talking about motivation of ledger here. So one motivation was that potentially overly conservative 25 years ago. But at that time there was no MELCOR. So I was guessing that you were about to say that another motivation is now MELCOR at least is a systematic way of looking at Level 2/3 together.

MR. TINKLER: Absolutely.

MEMBER CORRADINI: Okay. But my

impression also is that if you don't look below that you could be open to the criticism that there is something there and you simply don't want to show it. That's what --

MEMBER ARMIJO: Right. You're avoiding --

MR. TINKLER: I understand.

MEMBER CORRADINI: I think that's what is George's biggest issue.

MR. TINKLER: Well, I mean to put it in trivial terms, 10^{-9} X 1 is bigger than 10^{-7} X 0.

DR. WALLIS: But isn't 10-9 X --

MR. TINKLER: But is 10^{-9} X 1 a significant number?

DR. WALLIS: But isn't -9 X 10^{6} is a big, a significant, number.

MR. TINKLER: We see no evidence short --

DR. WALLIS: There isn't 10^{6} --

MR. TINKLER: To get those kinds of numbers you have to be in the realm of things that are so poorly quantifiable that you have no business writing it on paper.

MEMBER CORRADINI: Not that I'm going to let you slip away from my point. My point really is that by not even looking below the limit you're open to the criticism that you were trying to avoid knowing what the plateau is down there and its level. I'm not saying that you were. I'm saying that you're open to that criticize.

MR. TINKLER: I understand. But if we were doing this in a vacuum where we didn't know how cores heat up and how vessels fail, then I could -- then maybe those points would have more. But short of the direct vessel rupture scenarios and other very, very low frequency events that people assigned numbers to simply for the sake of saying I included it and assigned a number to it. It's quantification is really suspect.

MEMBER APOSTOLAKIS: So what you are saying --

MEMBER CORRADINI: Can I just -- One last thing.

MEMBER APOSTOLAKIS: Go ahead.

MEMBER CORRADINI: So let's take that approach. Let's say you're right. Let's say that below 10^{-7} there are things down there that could be there but they're speculative in terms of the quantification of we know they're low, but the quantification is suspect. At least, is the report going to talk about those and saying why those things are essentially eliminated? I mean I'll take the one that the Commissioner did at the quad-partite meeting. I was sitting there getting a bit nervous relative to steam explosions. Right?

MR. TINKLER: Yes.

MEMBER CORRADINI: So then it would seem to me a SOARCA by not looking at that potential early containment failure mechanism ought to say something that based on physical parameters X, Y and Z it was eliminated. It's so below the 10^{-7} that we're not looking at and we are proud to say why we are not looking at and then the next one and the next one. In other words, if you're not going to do it with numbers, write it out so that you avoid the criticism that you knew there were these dirty little secrets sitting in the closet and you weren't going to calculate it.

MR. TINKLER: We have indicated that we expected in this report to lay out why we think the last 20 years of research allows us to dismiss certain issues, the work that was deemed steam explosions, DCH, etc. So people can understand the difference between where we are today and where we used to be and we've been preparing white papers and assorted documentation to explain that to show some of those conditional probabilities were either zero or very,

very low. But again, you know, to the extent the Commission has a general view of remote and speculative and to the extent 10^{-7} seems to be that level for remote and speculative, we could include words about that.

DR. WALLIS: This is incomplete. This is a very good job and a very good job within your constrains. But if you get in a public forum, people will say "Okay. You've told me about the accidents that don't kill people. Now tell me about the accidents that could kill people and tell me how you evaluate those." You're going to have to do that some day because people are going to ask you those questions.

MEMBER APOSTOLAKIS: But also there is a message here that we really shouldn't be trying to do Level 3 PRAs because your argument is and maybe you're right that we're getting into the realm of speculation, extremely rare events and the results don't make any sense.

MR. TINKLER: That's any argument that has been made that we're in residual risk here.

MEMBER APOSTOLAKIS: I am willing to accept it. I have to think a little more about it because you also have a point somewhere in the document that once you get down to those frequencies why not go back and include rupture of the vessel. We are not including it now as an initiating event, initiating and endpoint, because the argument is that its frequency is less than 10^{-7}. That's what the likes of -- and we believe it.

But now if you go down there, maybe you should go back and include that. You are now in the domain of frequencies that are so low that meteorites may hit you.

MR. TINKLER: That's right.

MEMBER APOSTOLAKIS: But Level 3 PRA is out of the question.

DR. WALLIS: But just maybe because --

CHAIRMAN SHACK: I think that's the real thing. Even if the consequences are severe if it happens once in a billion years, you know, once in a million seems like a reasonable kind -- Or you could at least argue that that's a reasonable cutoff for things that you're going to deal with and worry about. Even if the potential consequences are high, if it's so unlikely, there are other things like asteroids that have high consequences that are so unlikely. But it seems to me it's that kind of argument that's really going on here in terms of risk communication.

MEMBER APOSTOLAKIS: But the argument is not being made explicitly. I would like to see an argument like that, but it's not being made. It's just declared "We will use this cut-off frequency" and go with it because I think -- point is very good. All this discussion is very good, but it's not reflected in the written documents.

MEMBER BONACA: On the other hand, this may be an opportunity for, in fact, discussing the reasons why.

MEMBER APOSTOLAKIS: Exactly.

MEMBER BONACA: And make it logical in a way that rather than just throwing in the results of a Level 3 with all the speculation without any discussion of who it's speculative. So I'm --

MEMBER APOSTOLAKIS: We are getting into that domain now and I --

MR. TINKLER: I would expect that the eventual written documentation would relate some of the arguments and clarify some of the remarks I made today and tie it back --

CHAIRMAN SHACK: Clearly, what it can't say is the SRM told us to cut it off.

MR. TINKLER: No. It's not.

(Several speaking at once.)

CHAIRMAN SHACK: But it's the answer we see to the peer reviewers.

MEMBER APOSTOLAKIS: Now continually you are invoking the SRM.

MR. TINKLER: I understand. But I invoked Reg Guide 1174 today.

CHAIRMAN SHACK: Yes, but that's a mean value that includes all sorts of long tails that you chopped off.

MEMBER APOSTOLAKIS: But even the --

DR. WALLIS: Who is the customer of these documents? It's not just the Commission.

MEMBER APOSTOLAKIS: It's something we created. But the argument should be in terms of these speculative events.

DR. WALLIS: The public.

MEMBER APOSTOLAKIS: And forget about regulatory guides because we wrote them. So people might say "Well, gee. You're writing something you wrote eight years ago and you are using it as an argument."

MR. TINKLER: I understand, but I presume this Committee also agreed that 10^{-7} was a reasonable threshold.

DR. WALLIS: I tried this on my wife and

she said it's baloney. I don't believe that there are no consequences. There must be some consequences. Just tell me about them. That's the reaction you're going to get. It's not just the Commission you have to answer to.

MEMBER BONACA: I think the point however that he is making is that by Level 3 PRA more realistic issues that you are pretty comfortable with that you understand are being thrown together with the level of speculative considerations and the bottomline is going to be something that is speculative and maybe this way -- They're not defending it because I've been with the Committee from the beginning of the issue that is 10^{-7} makes it look bad. But in reality, it may be an opportunity for it may be an opportunity in the report to explain the basis for eliminating that on the basis that you don't want to eliminate some of the speculative issues.

MR. TINKLER: I agree and, again, I think that the insights from this work that point to the potential effectiveness of mitigation measures and focus attention on how we make those mitigation measures more reliable and more effective is of much higher value than chasing after something that might be speculative or at best poorly quantified.

Now they may end up in a Level 3 dominating the results, but that's a different issue. I don't know how to address that one right now.

MEMBER CORRADINI: But, Charlie, I guess what I'm hearing is a general comment and you can take it and store it away and do what you want with it, but if you're saying below the 1174 guidelines, things become speculative. Then somewhere at the end of the report qualitatively you're going to have to address that and I think the allied point that Graham is making is very fair. The general public is going to start looking at this just like other members of the "relatively attentive public" that looked at the 1982 document and if you don't address this, it will look like an omission. And if you have a qualitative argument, what you're really saying to George is, I don't believe the quantitative down there, it's too wide uncertainty, fine. Then you're going to have to make a qualitative comparison argument on other things that are by from the general public's mind are clearly low probability, worry only if you really die to worry about things, and that's the level we're talking about. But if you don't make that argument, that omission is going to actually taint the whole thing. That's what concerns a lot of us.

MEMBER APOSTOLAKIS: I think that's one and secondly, I think the objective should be stated clearly this is what we did.

MEMBER CORRADINI: Sure.

MEMBER APOSTOLAKIS: And maybe the next slide should be the --

CHAIRMAN SHACK: I would like to move on, gentlemen. We'll come back to this, but this is a fundamental issue. So I wanted to let it run for awhile.

MR. PRATO: But I'd like to recap. I understand that we need to change these objectives to make them clearer and more specific to our task. I also want you to know that we have spent a great deal of effort thinking about the Committee's comments from last time. We really have and we've done some analysis and we've really spent a lot of time on this and we also understand what risk communication is. It's probably one of the more important --

CHAIRMAN SHACK: The most inflammatory documents you handed us was your response to the peer review.

MEMBER APOSTOLAKIS: Yes.

CHAIRMAN SHACK: Where every response was well, the SRM said to do this.

MEMBER APOSTOLAKIS: Right.

CHAIRMAN SHACK: That's not an argument.

MEMBER APOSTOLAKIS: I started believing it myself.

(Laughter.)

MEMBER APOSTOLAKIS: No, I mean, I appreciate that if the Commission tells you to do A, B, C, you must do A, B, C. There's no question about it. But then if you go deeper, then you wonder -- I mean, I looked at the names of the PR reviewers. These are NRC guys. They do know what an SRM means and yet they raise arguments on it. So SRM maybe was not as clear as you guys wanted to make it. I agree with Bill. I think that was not a very good exchange. I think what Charlie told us today makes much more sense and he left.

PARTICIPANT: He's coming back.

MEMBER KRESS: I think you're going to have to better justify this 10^{-6} cutoff.

MEMBER APOSTOLAKIS: Yes.

MEMBER KRESS: And the reason I say that is you have to keep in mind that if you have 100 reactors operating for 100 years that becomes 10^{-2} probability and the 10^{-2} probability occurs -- that's the probability you're going to have containment failure that kills a lot of people and the question is how you say if I have that, that's an acceptable probability for killing that many people. You have to have a reason for that. I think -- Don't get me wrong. I think this is an acceptable probability 10^{-2} if we kill a lot of people with nuclear.

But you'll have to come somehow to reach that argument and say this is a cost/benefit argument that that's an acceptable thing to have and that's the way you're going to have to justify the 10^{-6}. I don't think these other arguments hold together very well.

MEMBER APOSTOLAKIS: It also, Tom, appears that going a Level 3 PRA and it's beginning to fade away. Maybe it's not a meaningful experience based on what they found.

MEMBER KRESS: Well, if I have a reactor design that has a LRF of 10^{-6} and most of them are lower than that, I think Level 3 kind of goes away for those reactors. I think that's sufficient evidence that it meets our acceptance criteria on Level 3 even though we don't have a good acceptance criteria.

MEMBER APOSTOLAKIS: That's a very useful insight.

MEMBER KRESS: Yes, I think.

MR. PRATO: So we are fully aware that

risk communication is our greatest challenge including making it very clear that we're not trying to imply that there is no risk to the operation of the nuclear power plant. We understand that. Okay. Next slide.

MEMBER APOSTOLAKIS: Number four.

(Laughter.)

MEMBER CORRADINI: That was ten minutes a slide. That was pretty good.

MR. PRATO: Charlie covered a lot of this. Severe accident improvements in 25 years of national and international research, we've made the determination that certain phenomenological scenarios are not feasible. They are from old failure, for instance, direct containment heating due to high pressure melt injection and catastrophic failure of large dry containments are some examples of those. And we also from this research determined that there are some scenarios that are mitigatable and, for instance, the Mark I liner melt-through.

There have been numerous regulatory improvements that reduce the likelihood of some severe accidents, the ATWS rules, Station Blackout Rule, the maintenance rule. All of these things have contributed significantly to reducing the likelihood of severe accidents. The development of MELCOR and

MACCS, in 1982 MELCOR did not exist and what we had for MACCS was a very, very primitive model. It has evolved over the years. It has been improved over the years. And for SOARCA we added a considerable number of improvements as well.

Improvements and plant design, the post-TMI era, there were a lot of modifications. There were modifications for Station Blackout. A lot of licensees put the time and the effort and the resources into adding additional diesels. So there was a lot done over the last --

DR. WALLIS: Can I comment on this?

MR. PRATO: Yes sir.

DR. WALLIS: What is missing from all of this probably is human behavior. I mean, TMI, Chernobyl, Davis Besse, all seem to be the results of unexpected human fallibility or however you want to put it. When you get down to 10^{-6} that probably becomes the dominant event and it's not really very well modeled in your model. So in view, there's some expected human quirk is more likely than any of these things because you're down so low with all the physical stuff. That, of course, is part of the trouble you have in really being realistic.

MEMBER APOSTOLAKIS: In other words, what you're saying is that the argument that the core damage frequency is what we think it is may not be quite true.

DR. WALLIS: Well, it can't be because you can't imagine all the ways people can screw up.

MEMBER APOSTOLAKIS: I mean, Davis Besse.

MEMBER KRESS: They don't follow the laws of physics.

DR. WALLIS: I think it's a very good study, but you have to admit the human factor is something very, very difficult to put into this especially at that level, 10^{-6}.

MEMBER BONACA: Yes, but I mean clearly TMI and what happened after TMI was a turning point. It was because there we went from a situation where we said after 200 seconds the operator will take care of it and that was typical of all the analysis done before TMI in the FSARs. You could go back and look at it. We changed the situation when we said we has to understand what it does. We have to do training. We have to put it in there. We have to build the simulators. We have to -- So there has been -- I totally agree with you that the human factors of Davis Besse demonstrates that.

DR. WALLIS: You have a containment and if you just do a CDF analysis for some of these modern reactors you don't need a containment. But you do because of the uncertainties about what people are going to do with the system. Anyway, I don't want to say that again. But just at this point since you have this wonderful model, I'd like to make that point.

MEMBER APOSTOLAKIS: You could add a bullet here maybe up front there to say that at that time 25 years ago because of the lack of knowledge in many areas people were conservative. That is something that is worth mentioning here. That's a statement of fact. I mean they were conservative.

(Off the record comment.)

MEMBER BONACA: Not on the human factor.

MEMBER APOSTOLAKIS: Not on the human factor but on everything else they're listing here.

MEMBER BONACA: That's true.

MEMBER APOSTOLAKIS: They were conservative.

MEMBER CORRADINI: In fact, from just a historical standpoint 25 years before that you have the 1957 study which was incredibly conservative.

MEMBER APOSTOLAKIS: Right. That's Wash 700.

MEMBER STETKAR: I would argue that 25

years ago we were conservative on the things we looked at. We were extremely optimistic on the things that we did not look at. We screened out huge amounts of things that we've learned about in the last 25 years that if you do look at them they might not be -- I don't understand the word "dominant" because that doesn't mean anything to me.

But the things that contribute two, three, four percent and if you have 50 of those, that's a factor of two and if you have 100 of those, that's a factor of four and we indeed did not look at a broad spectrum of events that modern studies, not done here but modern studies, do look at and are surprised. They're constantly surprised. "Oh, I looked at that and it contributes five percent to my core damage frequency."

MEMBER CORRADINI: You're talking about Level 1 side.

MEMBER STETKAR: Level 1 and indeed they propagate through Level 2. So saying that we -- We were conservative in the things that we looked at 25 years ago. We were extremely optimistic in the things we did not look at because we didn't look at them and the last 25 years have taught us that people who have been really doing risk assessment for the last 25 years that you do need to look at those things. You do need to really turn over all of the things you said that's insignificant. We can screen it out. We know that's not important.

I think you need to be careful with this constant theme of 25 years ago we were excessively conservative because we were excessively optimistic in terms of the issue of completeness of what we looked at because mostly our tools were so limited that we didn't have the computational capabilities. We didn't have the money. We had to cut off the scope of what we looked at in terms of the things we thought were going to be important.

MEMBER CORRADINI: Just so I understand, John, the way you phrased it there is that -- and I interpreted it based on human actions within a system and system availability for various system states.

MEMBER STETKAR: I didn't say human actions.

MEMBER CORRADINI: But I meant those are the two things that I keep on thinking about because the uncertainty at least what I remember back in '82 was that the uncertainty there was essentially physical phenomena.

MEMBER STETKAR: That's true. Right. And

therefore when in doubt take the worst possible consequence of the physical phenomena in lieu of having done enough experimentation, enough analysis, to know where it went.

MEMBER APOSTOLAKIS: And that I think probably makes the whole thing more conservative.

MEMBER STETKAR: That's true. I'm talking about --

MEMBER APOSTOLAKIS: Okay.

MEMBER STETKAR: But this is not only physical phenomena.

MEMBER APOSTOLAKIS: There's no question.

MEMBER STETKAR: Because we're talking about frequency here. I'm talking about --

MEMBER APOSTOLAKIS: In terms of actual risk results, I think the conservatism is Level 2, probably. I mean I can't provide it.

MEMBER STETKAR: I suspect that's true in a Level 2 range. But since you can't separate frequency from consequences.

MEMBER APOSTOLAKIS: The question really is this because as we all know the notion of a sequence is kind of fuzzy, what is a sequence.

MEMBER STETKAR: Yes.

MEMBER APOSTOLAKIS: Can you have

sequeneces that may be 10^{-9} frequency while you have so many of those that the aggregate becomes --

MEMBER STETKAR: Different plant designs have shown that kind of thing. It's kind of an exponential growth as a function of decreasing frequency.

MEMBER APOSTOLAKIS: So if you put all of them together.

MEMBER STETKAR: It's this thousandth 10^{-9} type of --

MEMBER APOSTOLAKIS: Yes, and then you might come up with something that is --

MEMBER STETKAR: It's phenomenologically different in the Level 2 PRA world. Usually not. I must admit that. But in terms of completeness and infrequency and looking at in many cases coming back to the human element things where human performance may have been evaluated relatively low in terms of Level 1 but given that numbers of failures is essentially certain they're not going to do much at least in the first couple of hours after core damage occurs.

MEMBER APOSTOLAKIS: So these are the kinds of issues that perhaps you guys could answer or investigate. I mean, yes, individual sequences may be very, very low of low frequency. But how many of those do we have? Again, I am not sure that -- Well, I don't know. I don't know what the result will be. I think the result will be very low anyway. But whether you can say it's zero is something which -- the miscommunication is a problem.

MEMBER CORRADINI: I think they want to move on.

MEMBER APOSTOLAKIS: Yes. We all do.

MR. PRATO: Our plan improvements --

MEMBER APOSTOLAKIS: We don't act that way but we do.

MR. PRATO: I'd like to move to preparedness guideline from mitigated measures. The next slide is the SOARCA process. This is just a flow diagram. We're going to get into a lot of the specifics as we go on through this presentation. But I just wanted to give you an overview. I normally start this presentation by saying it was never intended to be a risk study. I think we've covered that in sufficient detail.

We use enhanced SPAR model CDF as our input along with consideration of external events. Along with that, our PRA folks has helped us with containment system states and with the mitigated measures and with site specific information. All of these elements serve as input into MELCOR.

Along with those elements, we've done a site-specific structural analysis for the two licensees that we've analyzed so far to try and determine where containment failure would occur and how it would occur. And we're going to have a separate presentation on that from Ata here in a few minute.

MEMBER APOSTOLAKIS: I need a clarification here.

MR. PRATO: Yes sir.

MEMBER APOSTOLAKIS: You have tables regarding containment systems and you say this system will function until we run out of water or this system is available. This is not available. So the probability that these systems or the condition of probability that these systems will be there to do their jobs is not included in the sequence, isn't it? I mean, you are really having -- When you say 10^{-6}, you mean all the way to core damage and then you are looking at the containment functions of systems and you say, "Now for this sequence, I will not have system A, but I will have system B." You are not saying the probability that they will work as such and such and will be such and such and integrated into the 10^{-6}. Is that a correct understanding?

MR. PRATO: Rich, correct me. Do you want to address this, Rich?

MR. SHERRY: Yes, any systems which were not considered evaluated could be available in the Level 1 we assessed in ad hoc manner and, as we discussed before, generally it was that we determined they were either available or unavailable based on the availability of support systems which were determined in the Level 1. So we didn't generally -- We didn't develop a probability that it was available or not.

MEMBER APOSTOLAKIS: And this -- The reason for that is what? I mean, the Level 2 PRAs do that, don't they?

MR. SHERRY: We do not have -- We did not have available at that time Level 2 PRAs for these plants, SPAR models.

MEMBER APOSTOLAKIS: Didn't NUREG 1150 do that? I don't remember now.

MEMBER CORRADINI: There were event trees.

MEMBER APOSTOLAKIS: They were event trees?

MR. SHERRY: They had the event tree models.

MEMBER APOSTOLAKIS: But not probabilities?

MR. SHERRY: Yes, they assessed the accident progression for the sequences, the core damage sequences, which were calculated for the 1150 study. They don't reflect the current core damage sequences calculated by the SPAR models nor would they reflect the current thinking on the phenomenological accident progression. So we judged that we could not use 1150 Level 2 model.

MEMBER APOSTOLAKIS: But is it possible, Rich, for someone to say you have this sequence at least to core damage with frequency 10^{-6}. Then you are saying that the containment systems A and b are available and you are arguing why and I get no consequences. Now what if they are not? What if, for some reason, there may be a probability of, I don't know, one in 100 or something that it would not be available and you might get consequences with some frequency of 10^{-7} or 10^{-8}? That part is not in the analysis, right, because you assume that either they're available or not available.

MR. SHERRY: Yes, I think our judgment was that if the independent failures of the front-line systems and containment systems would be of sufficiently low probability that they would drive the overall accident sequence well below the 10^{-6} frequence cut-off.

MEMBER APOSTOLAKIS: But the threshold was on the CDF.

MR. SHERRY: The original threshold was on release frequency and we moved back to core damage frequency because we did not have available Level 2 models.

MEMBER APOSTOLAKIS: Again, that statement is kind of strong. I thought 1150 did a lot of that. Hossein, are you familiar with 1150?

MR. NOURBAKSH: Yes, they had -- they developed plan damages state and then they had accident progression event tree and both phenomenologically aspect and systems questions were asked again.

MEMBER APOSTOLAKIS: And they were assigned probabilities?

MR. NOURBAKSH: Assigned probabilities.

MEMBER APOSTOLAKIS: So at 1150 had that.

MEMBER CORRADINI: But I don't -- Just to support some of what Rich is saying if I remember in 1150 in the containment analysis there was no coherent and maybe there's a person here that when it was done there was no coherent calculation through an accident sequence. There were speculations and auxiliary calculations using various models to get the branch point probabilities. But there was no coherent calculation.

MEMBER APOSTOLAKIS: I mean, the containment spray system, for example, it doesn't make sense to ask what is that probability that would not work?

CHAIRMAN SHACK: Yes, but I think his answer is it keeps driving the frequency down.

MEMBER APOSTOLAKIS: Right.

CHAIRMAN SHACK: And if you've already started at 10^{-6} then you're below the frequency that, yes, this can happen but if it's going to happen at 10^{-8} --

MEMBER STETKAR: You have to be careful that if I go in with a sequence that has half my electric power down, everybody thinks in terms of purely pitch black and purely sparkling white. I think of gray. You go into a sequence that has half your electric power down and a couple other things fail and you go to core damage. Well, half the electric power down takes away half your containment spray. It takes away half your containment isolation.

It takes away half your containment fan coolers.

The conditional probability of each one of those things failing now I'm not going to speculate on numbers. Take George's one in 100, one in 50. Those conditional probabilities may be much higher than the completely black everything is dead. So you have this gray area in between where everything is sparkling white there is a very low probability of those, let's call them, independent failures occurring.

At the bottom where everything is pitch black, of course, they're dead. In the middle there may be relatively high conditional probabilities and those conditional probabilities may be higher than the pitch black conditions. That's what we find.

MEMBER CORRADINI: So can I just --

MEMBER STETKAR: That's what we tend to find in the Level 2 risk assessment business is the middle partially failed things.

MEMBER CORRADINI: Can I just ask, Rich, about this relative to John and George's question? So did you take a particular system where you actually had a good feeling for the probability was of the branch for equipment and looked at the downside and confirmed in a couple cases that it was outside your screening criteria? That would be a way of pointing out because if I understood correctly that was your answer to George that it was outside the realm of --

MEMBER APOSTOLAKIS: Yes, I mean there was a cut of frequency and anything that would make an existing frequency lower than that was eliminated.

MR. SHERRY: In response to John, I don't think we had an cut sets of sequences we screened in that had partial failure of support systems needed for our containment frontline systems.

MEMBER STETKAR: That's a little surprising, but that's possible certainly.

MR. SHERRY: We only had a very few internal event sequences that were actually screened in and evaluated.

MEMBER APOSTOLAKIS: Say that again, Rich.

CHAIRMAN SHACK: Internal events sort of disappear because they're all --

MR. SHERRY: That's correct.

MEMBER APOSTOLAKIS: Yes. You mean the external event.

CHAIRMAN SHACK: yes.

DR. WALLIS: While you're on this diagram, it always goes from initial to result. But if you were an accident investigator and you have this accident which did something, you would try to figure out how did you get there. So you can work back and say what would have had to have happened in order for me to get to this final state of a certain amount of radiation to a certain number of people and certain place. You figure you have failed to containment. So you had to have pressure or something and if you try working backwards to see what sort of minimum number of things had to happen in order for you to get to certain files. I just wonder if there was any use at all to try to do that.

MR. PRATO: No sir.

DR. WALLIS: Okay. Thank you.

CHAIRMAN SHACK: You'd better move on. Don't hesitate or they'll be more.

MR. PRATO: Yes.

MEMBER ARMIJO: When they take a breath, change the chart.

(Laughter.)

MR. PRATO: The object (Inaudible) challenge basically. That feeds into the MACCS analysis along with meteorological data along and emergency preparedness and the outcome from that is early and latent cancer fatalities.

MEMBER APOSTOLAKIS: What did Sandia use instead of MELCOR when they did their analysis?

MR. PRATO: I don't know the answer to that.

MEMBER APOSTOLAKIS: Could you use in the future --

MR. PRATO: Randy?

MR. SULLIVAN: What's the question?

MEMBER APOSTOLAKIS: Maybe you could use a diagram like this, the previous diagram, to point out the conservatisms that we discuss earlier.

MR. PRATO: What was used in the 1982 study instead of MELCOR?

(Off the record comments.)

MEMBER KRESS: They put in --

MEMBER APOSTOLAKIS: You have to come to the microphone.

MEMBER KRESS: They chose source terms and then stuck them in the crack too.

MEMBER CORRADINI: Right. That's what I thought.

MEMBER KRESS: They had a series of source terms that were really bad and really not so bad and you had to just decide what the frequency --

MEMBER APOSTOLAKIS: But I think it would go a long way towards understanding this if you pointed out in terms of this diagram where you think your major conservatisms were for the discussion we had earlier with John which would make it a little more clear that, yes, there was some optimism in this part but there was extreme conservatism in this part. This core did not even exist. And that probably tends to make everything very conservative. I'm saying I don't want to see you like that.

MR. NOURBAKSH: These release categories that Sandia used has a definition associated with it what is the phenomena they assumed. This is early containment failure. This is vapor explosion, no containment failure or very late.

MEMBER APOSTOLAKIS: Yes.

MR. NOURBAKSH: And they assign a frequency to this. But they calculated the worst case exposed.

MEMBER APOSTOLAKIS: Yes, but do you agree that in terms of this diagram it would be easier to communicate off of slide 5 where the major conservatism is.

MR. NOURBAKSH: The conservatism that is there I think they did not screen. They reported the very -- What we understand low frequency but high sequences.

MEMBER APOSTOLAKIS: That's one.

MR. NOURBAKSH: Yes.

MEMBER APOSTOLAKIS: But I think the staff is arguing that also the terminology was extremely conservative.

MR. PRATO: I think that's the same thing.

MR. NOURBAKSH: Yes.

MR. PRATO: Using the Alpha 1 scenario bound a lot of potential source terms.

CHAIRMAN SHACK: I mean there are source terms of severe core damage, loss of all and swelled safety features and severe direct reach of containment and they assigned at a frequency of 10^{-5}.

MEMBER APOSTOLAKIS: "Assigned" means what? Did they calculate it or they just said --

CHAIRMAN SHACK: I think that's probably a conservative number.

(Laughter.)

MR. NOURBAKSH: It is. They looked at WASH-1400. It basically came right up after WASH-1400 and they looked at them and then they assigned probability based on insights from WASH-1400.

MEMBER APOSTOLAKIS: But even they came up with results that were lower than those of reactor safety study.

MR. NOURBAKSH: Yes. Even NUREG 1150 came much lower frequency.

MEMBER APOSTOLAKIS: But an order of magnitude in terms of release of cesium and so on.

MR. PRATO: Okay.

CHAIRMAN SHACK: Let's move.

MR. PRATO: Okay. Next slide. The approach, it was based on full power operation. We didn't do any low power and shutdown analysis or any spent fuel pool analysis. Again, plant specific sequences. So with a CDF of $1E^{-6}$, greater than or equal to $1E^{-6}$ or a CDF of greater than or equal to -7 to bypass events. We did include external events. We did do analysis on external events.

Consideration of low or mitigated measures including B.5.b.

MEMBER BONACA: Did you consider aircraft impact?

MR. PRATO: I'm sorry, sir.

MEMBER BONACA: Did you consider aircraft impact?

MR. PRATO: No, sir, we did not, but we consider the mitigative measures that came out of that analysis.

MEMBER BONACA: Okay. So whatever capabilities the plants have.

MR. PRATO: Right. At that stage when we started the analysis the licensees had purchased the equipment and they were developing the procedures.

MEMBER BONACA: Okay. I understand.

CHAIRMAN SHACK: I thought I read somewhere that you didn't consider SAMgs and then Charlie said you did.

MR. PRATO: Oh yes. We considered all mitigative measures.

CHAIRMAN SHACK: All mitigative, okay.

MR. PRATO: Yes sir. We did sensitivity analysis to assess the effectiveness of the different safety measures. One of the comments we got from you last time do with and without mitigative measures and we did that.

The state-of-the-art accident progression modeling, that 25 years of research and that development of MELCOR and MACCS, and that's what we used. We used MELCOR and MACCS for accident progression and consequence analysis. The second one is the MACCS model for the more realistic off-site dispersion modeling. Site specific evaluation of public evacuation based upon site specific emergency plans.

And we did use those thresholds for

reporting latent cancer fatalities of 5 rem in the first year and 10 rem in a lifetime. Now we're going to have a discussion on this. But this is one of the parameters that's used in MACCS. So MELCOR --

DR. WALLIS: Why do we have millirems and things in the regulation if 5 rem is the threshold?

MR. PRATO: I would like to defer that discussion, if I could, to when we get to dose threshold.

DR. WALLIS: You read the regulations. There are various places where you find sort of 20 millirems or 50 or 5.

MEMBER APOSTOLAKIS: But you will also tell us what the ACNW thinks.

MR. PRATO: Yes sir. Certainly will.

MEMBER APOSTOLAKIS: Good.

MR. PRATO: The dose threshold is a --

MEMBER ARMIJO: Before we leave that, is it at all possible, and I ask the Chairman, some of us are going to have to leave a little early and I would hate to miss the dose threshold discussions? Would the Committee agree and the staff agree to kind of move that forward a little bit?

MR. PRATO: We have, sir. And we have moved it in front of the initial results which is the bulk of this presentation.

MEMBER ARMIJO: Okay. Thank you.

MR. PRATO: So we should get to it in about another 20 minutes or so.

MEMBER ARMIJO: Okay. Great.

MR. PRATO: You're welcome.

MEMBER APOSTOLAKIS: And B.5.b means what?

MR. PRATO: B.5.b is the -- There was an order issued based on 9/11 and one of the subparagraphs is B.5.b and it was the plants had to implement certain mitigative measures to deal with loss of large area due to fires and explosions.

MEMBER APOSTOLAKIS: Okay.

MR. PRATO: Okay. Next slide. SOARCA insights. SOARCA sequences are dominated by external events, primarily large seismic events. We did have two other internal events for PWRs that's steam generator tube rupture and an inter-system LOCA line low pressure injection system and that was --

DR. WALLIS: I would say I guess go back historically. The main accident events that have occurred in the world have not been caused by seismic events.

MR. PRATO: That's correct.

DR. WALLIS: It's just an observation.

This hasn't been historically the major cause. You're saying the sequence is dominating but it's not history.

MR. PRATO: Previously used sequences have, we've determined, significantly low probability of occurrence are not considered to be feasible, for instance, the alpha mode failure, the high pressure melt-through, ATWS and there are a number of others.

MEMBER APOSTOLAKIS: So which ones are not considered feasible?

MR. PRATO: The alpha mode and the melt-through, sir.

(Off the record comments.)

MR. PRATO: Excuse me. Melt ejection. I'm sorry. That's the wrong character there.

DR. WALLIS: ATWS is still feasible?

MR. PRATO: Excuse me?

DR. WALLIS: ATWS is still feasible?

MR. PRATO: Yes, but the probability is extremely low. What's the probability of ATWS? Do you know, Rich? No? It's low.

B.5.b measures are very effective at preventing core damage and containment failure. Most of the B.5.b measures are portable equipment, self-contained portable equipment, and we're finding them to be very effective to mitigate some of these scenarios. Next slide.

MEMBER APOSTOLAKIS: So there is no probability that the measures might not work.

MR. PRATO: Nobody is saying that. We're not implying that.

MEMBER APOSTOLAKIS: But you are assuming that if the measure is in place.

MR. PRATO: They are in place and it's support system and support equipment and it's sufficient time and it's sufficient access. We believe that. We took credit for them being effective.

MEMBER STETKAR: Under a large earthquake you took credit for operators actively depressurizing the primary side in 15 minutes after a large earthquake. That to me sounds pretty doggone optimistic. But we'll get to the sequences later. The operators won't be out of the bathroom for 15 minutes.

(Off the record comments.)

MR. PRATO: I have no response to that.

MEMBER APOSTOLAKIS: These are formal operators.

MR. PRATO: I am one also, sir.

MEMBER ARMIJO: The Kashiwazaki earthquake, probably a lot of information from a real big unexpected earthquake and operator actions, we have that information.

MR. PRATO: Right.

MEMBER ARMIJO: But the firefighters didn't show up on time that they were counting on to put out the transformer fire. So a lot of these mitigating actions --

MEMBER STETKAR: I think we have to be -- We can go on but my fear is that before lunch when we have to leave we aren't going to get to the results. I just wanted to at least get one barb in.

MR. PRATO: Preliminary findings and I'm not going to steal any of Jason's thunder and I may default a lot of your questions to Jason, but all events identified by the screening criteria will be mitigated by B.5.b measures. In some cases, other plant systems will be effective and that's on the two internal events, the steam generator two rupture and the bypass LOCA low-pressure injection and that's our initial findings.

Analysis were performed which confirmed effectiveness of mitigative measures. We did do sensitivity studies as we say in the next slide also.

So that was one of the recommendations that came out of the Committee last time and we did perform those sensitivity studies. And finally the analysis performed with and without mitigative measures resulted in significantly less severe consequences that was reported by the 1982 study.

MEMBER APOSTOLAKIS: But are you still saying that there are no consequences when you assume without mitigating measures? If a mitigating measure is going to work, you still claim the zero deaths?

MR. PRATO: No.

MEMBER APOSTOLAKIS: No.

PARTICIPANT: There are some scenarios.

MR. PRATO: Some scenarios.

PARTICIPANT: Certainly.

MR. PRATO: But --

MEMBER APOSTOLAKIS: But the overall thing?

MR. PRATO: No. That's not true. We do have some consequences when we have no mitigative measures.

MEMBER APOSTOLAKIS: Okay.

MR. PRATO: Okay. Now I'll get into a few of the blocks on the flow diagram in doing the process aspect to help some of the new members understand what we did for the initial screening. For the sequence screening process, the initial screening we used enhanced SPAR models to screen out low CDF, initiating events --

DR. WALLIS: To go back now to John's point, when they did the technology-neutral framework in the appendix, they evaluated it at PWR and they worked out all of these consequences and then they screened out, they took away, everything below a certain frequency. I added up the sum of all the consequences, all the low frequency stuff, and I came up with a number which actually violated the criteria. When you have sort of 20 of these less than 10^{-6} events, you come up with something that is significant and there's an example there in that appendix. If you start throwing out of these low frequencies when there is lot of them, you lose something.

MR. SHERRY: Let me address that. In order to avoid the problem that you are talking to, we grouped similar sequences before we performed a screening analysis. So we didn't keep bifurcating sequences until they were all below a screening criteria.

DR. WALLIS: That's, of course, the danger. You keep bifurcating until it all goes away.

MEMBER KRESS: Yes right.

MEMBER APOSTOLAKIS: Bill, there's a lot of discussion here on they did it. It's interesting, the results. Maybe we can just skip on how and go to the results.

MR. PRATO: We're going to have to because our primary intent is for the intent results and to give the Committee time to comment on the initial results. So we're going to move a little bit quicker through some of these slides.

MEMBER APOSTOLAKIS: Yes. I think you should go to slide 22 as soon as you can because all this structural analysis and all that, I'm not sure --

MR. PRATO: I mean, we've discussed sequence screening in quite a bit of detail. If any of the members looked through the actual process and have questions, we'd be certainly glad to help that. The same thing with containment system states, we did talk a lot about that and mitigative measures. We explained that in great detail and we discussed it briefly. Here we are at slide 14.

CHAIRMAN SHACK: I agree with George though. We went through the structural analysis the last time.

DR. WALLIS: We've seen it before.

CHAIRMAN SHACK: And I don't think we need to go through it again.

MR. PRATO: Okay.

CHAIRMAN SHACK: That's one we could save.

MR. PRATO: Okay.

MEMBER CORRADINI: That sounds good.

MR. PRATO: I'm on slide 14 and I think this is an important point because this is one of the points the Chairman brought up that we promised to discuss and we've spent a lot of time thinking about this and I asked Randy Sullivan to prepare something in writing for me and I'm going to take a couple minute to read through some of his comments and then if you have any questions, I'm going to turn it over to Randy. Okay.

But everybody understands that the real issue here is how to deal with a seismic event and its impact on the infrastructure and ultimately the evacuation times and capabilities. So I'm just going to read through some of Randy's comments. "The Commission addressed this issue of earthquake impact on EP during licensing of the Diablo Canyon and San Onofre plants. In 1984, the Commission published proposed amendments to its EP requirements that stated that neither emergency response plans nor evacuation time estimates need consider the impact of earthquakes on EP."

CHAIRMAN SHACK: That's a regulatory result.

MR. PRATO: I understand that, sir.

MEMBER ARMIJO: It's a historical statement.

MR. PRATO: Allow me to go through this.

(Several speaking at once.)

DR. WALLIS: They said that? They actually said that?

MR. PRATO: Yes sir.

MR. SULLIVAN: Bob, why don't we just get into the discussion which is probably not an easy one? Randy Sullivan answered. I'm the fellow responsible for this reporting to you all and I appreciate the opportunity, sort of.

(Laughter.)

CHAIRMAN SHACK: Sort of?

MR. SULLIVAN: Sort of, yes. Look, this is a difficult issue. There is a large amount. I understand that you are a technical committee and you're interested in technical answers and, of course, we all deeply respect that. There's a large amount of case law on this issue and the licensing basis for a few plants is wrapped up in the Commission decisions on how to treat earthquakes and emergency preparedness.

We think that reopening that issue would not be very productive. However, we have to address the technical issue. I mean, we have to find someway to address the technical issue. Our plan is to do a sensitivity analysis. We'll slow the population down, although they are already moving pretty slow. We have to look at some of our assumptions. They seem rather conservative, but one way or another, we'll slow the population down further. We delay the notification time and see if there's an impact.

DR. WALLIS: Well, I have a problem here.

MR. SULLIVAN: Okay.

DR. WALLIS: If the Commission says something or the law says something, if there's a bridge between the people and the escape route and the bridge is down because of the earthquake, no amount of the law saying the bridge is there or the Commission saying the bridge is there will put it back.

MR. SULLIVAN: Yes, I understand that that would be a technical way of looking at it.

(Laughter.)

MR. SULLIVAN: We're a regulatory --

DR. WALLIS: Is there any other way?

MEMBER STETKAR: If you were on one side of the bridge, you understand the technology.

MR. SULLIVAN: Well, I beg to differ. I said we're going to slow down the population. The effect of losing a bridge is that the population moves slower. They don't just sit there.

DR. WALLIS: But they may swim.

MEMBER STETKAR: But they just stop.

CHAIRMAN SHACK: You know, your sensitivity analysis bothers me a little bit. I would like to have your best estimate analysis. We must have some understanding of what the fragility of overpasses and bridges are and we have some understanding of what kind of earthquake it takes to get the kind of damage you're talking about here.

MR. SULLIVAN: We can do that technical analysis. The staff is capable of doing it at a first order magnitude.

CHAIRMAN SHACK: Well, then do it.

MR. SULLIVAN: Bare with me for a second.

CHAIRMAN SHACK: Okay.

MR. SULLIVAN: This is not necessarily the staff's call. Reopening these issues and then presenting actually is an Office of General Counsel call. Now I understand you may not see it that way. You know, being technically oriented, you want a technical answer. There's also a licensing basis for plants and the Commission has --

CHAIRMAN SHACK: That's why we're in closed session so we can look at these things and decision what the consequences -- But it seems to me in order to make an informed judgment we need the best answer we can get.

DR. WALLIS: Can I go back to the original slide? It says, "A State-of-the-Art Realistic Evaluation" not some kind of legal assumption about what might be the case.

MR. SULLIVAN: And why is a sensitivity analysis where you slow down the population --

MEMBER ARMIJO: It's artificial.

MR. SULLIVAN: -- and delay --

MEMBER ARMIJO: It's artificial if you don't have real events, you know, a bridge falls down or firefighters that you're counting on don't show up or the police aren't there because something else has happened during this event. Those are real kinds of things that will happen and just to say "I'll apply this little knob on the sensitivity on speed and all of that."

MR. SULLIVAN: The effect of that is to slow down the population and delay their notification. So if we look at those issues, why have we not enveloped the problem?

CHAIRMAN SHACK: That's fine as long as your sensitivity study tells me this is the most likely one and my estimate of the probability of these based on my best judgment is such and such, then I'm perfectly with that. But I just don't want it we cut it by five or we cut it by two and I have no idea whether that's a reasonable way to do it or not.

MEMBER ARMIJO: It's so easy to attack.

CHAIRMAN SHACK: You have to give some technical justification for the sensitivity study, not an arbitrary choice of numbers.

MR. SULLIVAN: Okay.

MR. PRATO: Other than this meeting is closed, the results from SOARCA is going to be public in the end.

CHAIRMAN SHACK: In the end, yes. But at least as we go through we can test this.

MEMBER CORRADINI: Just to make the point, I think you're going to get a fairly unanimous view from the Committee that the way Bill frames it is actually a mild way of putting it which is do you sensitivity study but have some sort of engineering calculation that when it's two why it could be two. If it's five, why it could be five plus or minus. Without that, it really isn't even a sensitivity study. A collection of numbers.

MEMBER STETKAR: But be careful when you do sensitivity studies because if you do a sensitivity study on a fixed set of results --

MR. SULLIVAN: Yes, I know that. I don't want to go there.

MEMBER STETKAR: -- and vary evacuation planning around those sets of results, you're capturing the correlations that you need to capture. If I have a 1g earthquake, it may be very likely that my -- I know I have a 50 percent probability of implementing all of the mitigative features that you take credit for in the Level 1-2 study and given that 1g earthquake, I may not be able to evacuate many people very rapidly. So it's not a sensitivity study on a fixed set of results. It's a sensitivity study across the full spectrum of initiating condition to the evacuation times. So it's not multiple disjoint sensitivity studies performed at different artificial slices in the process and that's why I'm worried about hearing when we say we'll look at a sensitivity study on the tail end of things.

MR. PRATO: You're looking for an informed sensitivity study.

MEMBER STETKAR: That's right. An integrated sensitivity study.

MR. PRATO: That's what you're asking for. And I think we need to go back and think about this and --

CHAIRMAN SHACK: And as John said, you have a notion of the earthquake that gives you the damage and that earthquake has to be integrated into the EP study.

MEMBER CORRADINI: Right, and how it affects all of these in some total sense.

MEMBER STETKAR: All the way through the whole --

MEMBER CORRADINI: All the way down to John's where are the operators and how long are they doing what they need to do before they get back to John.

MEMBER STETKAR: Right.

MEMBER ARMIJO: As a datapoint, people heard about the Japanese earthquake and they initially it was bad news. Then it was starting to be good news. Nothing bad happened. So the earthquakes you consider should be at least that strength so you can say "Hey, look. We predict."

(Off the record comments.)

MEMBER ARMIJO: Okay. 1g I know is too high.

MR. SULLIVAN: So I understand the Committee's unanimous, I think, I heard it called, recommendation is that --

MEMBER CORRADINI: That was an observation by the questions you got.

MEMBER APOSTOLAKIS: Yes, we cannot make recommendations today. I mean you'll just --

CHAIRMAN SHACK: You'll get a letter, but I wouldn't be surprised if it said something like that.

MEMBER APOSTOLAKIS: Especially knowing who is going to write it.

MR. SULLIVAN: Fine, but it's not that the staff isn't capable of doing that.

MEMBER APOSTOLAKIS: No, that was never a question.

MR. SULLIVAN: It's what it does to precedent. Now I understand that may not be the Committee's main concern. It may be the Commission's main concern and we've drafted a SECY paper to that effect. We haven't really processed it pending your advice. But there will be lawyers and the Commission involved before we actually publish such an analysis.

MEMBER APOSTOLAKIS: Are you submitting anything to the Commission any time soon?

MR. SULLIVAN: It's up to management. The paper is written.

MEMBER APOSTOLAKIS: So there is a SECY. Is that what it is?

MR. SULLIVAN: There's a draft SECY that's written. It's not my call. It's management's call.

MEMBER APOSTOLAKIS: I understand that.

MEMBER CORRADINI: Is this the one that we have here reporting latent cancer fatalities?

MR. SULLIVAN: No. That's the next one.

MEMBER CORRADINI: Sorry. I'm reading the wrong one.

MEMBER APOSTOLAKIS: I'm trying to understand. We are sending a letter to the Commission. What will the Commission have in front of it from the staff?

MR. YEROKUM: Let me try to respond to that question.

MEMBER APOSTOLAKIS: Yes.

MR. YEROKUM: Is your question -- Does it have to do with the total project or the specific issue of EP?

MEMBER APOSTOLAKIS: The question is very simple.

MR. YEROKUM: Right.

MEMBER APOSTOLAKIS: A letter comes from the ACRS to the Commission.

MR. YEROKUM: Yes.

MEMBER APOSTOLAKIS: The Commission reads about our comments and so on. Do they have anything from you to go back and look at some document and say, "Gee, the ACRS doesn't really know what they're talking about here" or "They have a point" or what would they have from the staff? Just oral presentations? Slides? Or something more substantive?

MR. YEROKUM: At this point, the Commission has slides from the staff on the results, a complete picture.

MEMBER CORRADINI: He's asking about the earthquake issue.

MR. YEROKUM: No, I think he's asking about the project.

MEMBER APOSTOLAKIS: No. The SOARCA.

MR. YEROKUM: Right. Everything. They have the slides which details the information that we are presenting to you to some extent. All the technical issues such as a dose threshold and possibly EP seismic possibly, all the technical issues that are going in separate shifts, memos, SECYs, drafts in different shapes and forms.

At this point there are no plans to have a draft report of the project to the Commission before next year which we'll get to in another part. I'm pretty certain we will have a need to go and meet with the Commission and discuss this in a little more detail. But your question, I think, December is the full Committee meeting. At that time, I think we expect there will probably be a letter from the Committee to the Commission. The Commission will not have any draft report of the entirety by that time.

MEMBER APOSTOLAKIS: So the intent of our letter then will be just to offer advice as the project progresses and then the Commission based on what they have heard from the staff will make a judgment.

CHAIRMAN SHACK: As I understand it, they are sort of more or less done with this pilot study.

MR. YEROKUM: That's not correct.

MR. PRATO: We have more sensitivity analysis to do.

MR. YEROKUM: We have peer reviews.

MR. PRATO: Safety analysis and peer reviews.

MR. YEROKUM: Everything. I mean the results of these two --

CHAIRMAN SHACK: But we will be commenting on the pilot study is the way I look at it.

MR. YEROKUM: Absolutely. There will be multiple --

CHAIRMAN SHACK: Even though we don't have a formal report on that.

MR. PRATO: We need to talk about that more later on. But we're at least a year away from having any final results.

MEMBER ABDEL-KHALIK: Could we also comment on the wisdom on the whole exercise?

MEMBER APOSTOLAKIS: Sure.

CHAIRMAN SHACK: We can comment on the wisdom of the whole exercise.

MEMBER APOSTOLAKIS: You can be sure about that.

(Laughter.)

MEMBER CORRADINI: They won't listen but -

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MR. PRATO: The next slide is the MACCS2 assumptions. We've covered most of these in our previous presentations and if anybody has any question, we'll be glad to answer that.

The next one is on reported latent cancer fatalities. I'm going to give you the current status of things. Right now, we have a Commission paper and notation that's in review. We currently have three options within a range --

(Off the record comment.)

MR. PRATO: I'm sorry. This is slide 101. I apologize. 101. I moved it up.

(Off the record comments.)

MR. PRATO: At the front, I told you we're going to talk about it up front. All the rest of the slides are really on the structural analysis and the initial findings.

MEMBER APOSTOLAKIS: You're showing 16.

MR. PRATO: Yes. I'm sorry. I apologize. Just hit 101.

DR. WALLIS: Are we going to slip through this?

MEMBER APOSTOLAKIS: You have 103 slides?

CHAIRMAN SHACK: That's what I was worried about.

MR. PRATO: Here we go.

CHAIRMAN SHACK: He's a wild cockeyed optimist.

(Laughter.)

MR. PRATO: We made it to 101.

(Off the record comments.)

MEMBER APOSTOLAKIS: We did it though. Yes.

MR. SULLIVAN: Bob, we might as well just get to the crux of this issue, too, if that's all right.

MR. PRATO: What's that?

MR. SULLIVAN: Let me just introduce the issue to the Committee and we can have a discussion.

MR. PRATO: Okay.

MR. SULLIVAN: The basis of our -- The thrust of what we're doing here is that this report is a best estimate of the staff. We've made decisions along the way. You've heard them and we've had an exchange on some of those decisions. What we're attempting to do is present the staff's best estimate of consequences.

If we're going to publish fatality results and that could be argued, we could go the way industry has with risk to individuals and maybe we'll do that, too. But in any case, the staff believes that we ought to present consequence results just to align with old studies to say here is what the early fatalities are. Here is what the latent fatalities are.

People disagree. I mean, ACNW is suggesting maybe we ought to just publish doses. Commissioner Jaczko said the same thing. We've also heard back off the consequences and give risk to the individual. I think that's kind of obscure to communicate to the public, but nevertheless, it's a reasonable thing to try to do.

But if we're going to publish consequences in terms of deaths, then here's where we're at. We have these options. Ultimately, there's a source term. There's a dose calculation. You've heard about how emergency response is modeled. We move people however coarsely that might be. MACCS tracks those people. It does 1,000 weather trials. It gives you the mean consequences. It can't tell you how many people are involved in that mean consequence because it's a limitation of MACCS and you get bodies, if you'll excuse me. It's early fatalities and latent cancer fatalities.

These accidents are slowly enough developing and our estimates of EP effective enough that there are no early fatalities in these events even without mitigating measures. However, there are latent cancer fatalities. So we have to choose a threshold for those latent cancer fatalities.

The Commission directed us to use a range. We're questioning that because we think that's very poor for risk communication. Walk with me for a second. We'll be presenting one scenario and four or five different answers. We just think that's very difficult to communicate to the public. So although that was our initial direction, we're now questioning that and we'd like to do something different.

We could easily do LNT, just go ahead, issue the source term, calculate it out to 1,000 miles, run it for four days, assess the consequences for, I don't know, 300 years and say 2MR times, by the way, 1,000 miles of Peach Bottom. What is that? Eighty million people. We're going to kill whatever. This is a closed meeting. Right? I hope you don't mind the drama. So then we'll say that our best estimate is that there will be many, many thousands of -- Well, depending on whether you use the mean or some 90 percent, you'll have 2MR times 80 million people and you'll claim that you're going to kill a bunch of them.

CHAIRMAN SHACK: Of course, your total cancer fatalities in 80 million people also would be a rather large number.

MR. SULLIVAN: Exactly. And that is lost.

(Off the record comments.)

MR. SULLIVAN: But we argue that even if you could present the context, let's allow me round numbers. Let's say there's 100 million people on the eastern seaboard. You know, 33 million of them are going to die from cancer. You cannot see 20,000 cancer deaths.

MEMBER ARMIJO: Right.

MR. SULLIVAN: You will not see the effects of this accident no matter what.

MEMBER ARMIJO: The headlines would say 20,000 cancer deaths due to nuclear accident per NRC study.

MR. SULLIVAN: Right. That's exactly --

MEMBER ARMIJO: That's what it would say and the Union of Concerned Scientists would say, "No, that number should be two million."

MR. SULLIVAN: Right.

MEMBER ARMIJO: And that's where we're in in this bizarre environment?

MR. SULLIVAN: That's --

MEMBER APOSTOLAKIS: So what's the remedy for this?

MR. SULLIVAN: I'm not sure I have the remedy for that. But the staff is arguing and I'm not sure we're successful. But the team is arguing and the NRC staff is not at one mind in this at all. There is a lot of disparate views and many of them are to stick to LNT. But the team is arguing that we ought to set a threshold and we thought about having an expert committee and we thought of many different things, some statistical analysis that we soon got beyond our depth on and we decided here's the Health Physics Society position paper, 5 rem in an event.

DR. WALLIS: QHO and the QHO if you use the formula, the linear no threshold, you get four millirem is equivalent to the QHO. So you have a number like millirems already in the Commission statement.

MR. SULLIVAN: We could choose many thresholds. That's exactly right.

DR. WALLIS: It's there. The QHO is there.

MEMBER APOSTOLAKIS: Four million rem per year.

MR. SULLIVAN: We could choose 100 millirem. We could choose one rem. We choose the PAGS (phonetic). Yes.

MEMBER CORRADINI: So I guess you said something and I asked him about it. But I want to go back because you said if. Let's go back to the if. It's not undisputable but it's a whole less confusing that you have an interim result which is dose. That is, if I had an individual at a location going about their daily whatever, this is the dose that they would receive. So you have a dose map. Once you have the dose map, then you go through all the if they move, if they breathe, if they do this, if they do that, and you get into this Whz-z-z.

And is it not -- So I'm listening to what you said ACNW said and I guess I'm somewhat persuaded that at least as an interim result you essentially alleviate all of this fanning of what it could be to essentially what's driving it. So is not dose an interim result that would be useful?

MR. SULLIVAN: We're not convinced of that.

MEMBER ARMIJO: You're going to get that anyway. Right?

MEMBER CORRADINI: I'm not sure they're going to publish it, but you would have a dose map.

CHAIRMAN SHACK: But I mean I don't know what it communicates to the public.

MEMBER ARMIJO: Yes, so what?

MEMBER CORRADINI: Exactly. What it was it conducts the issue --

(Off the record comment.)

MEMBER ARMIJO: -- was that good that the NRC has the obligation to tell them whether it's good or bad for them.

MEMBER APOSTOLAKIS: But the official -- isn't the official position of the agency that you should the LNT?

MEMBER CORRADINI: Yes. That's my --

MR. SULLIVAN: May I address that?

MEMBER APOSTOLAKIS: Yes. Sure.

MR. SULLIVAN: Actually, that's something we had mulled over quite a bit. The official position of the agency for regulatory purposes is to use LNT. We're attempting to make the argument that this is not a regulatory document. We're attempting to make the argument that this is the staff's best estimate and this is what we want to use for our best estimate.

MEMBER APOSTOLAKIS: The staff's best

estimate is based on the Health Physics Society statement.

MR. SULLIVAN: That's right. But I'm also --

MEMBER APOSTOLAKIS: The ICRP has not changed their position.

MEMBER ARMIJO: Well, apparently they have.

MR. SULLIVAN: What they have done --

MEMBER ARMIJO: Have you seen this letter, this quotation? Unless it's taken out of context, this --

MEMBER CORRADINI: What page are you on?

MEMBER ARMIJO: Page two of the draft letter.

MEMBER APOSTOLAKIS: I read that. That's why I'm asking the question.

MR. SULLIVAN: Yes. ICRP has not been bold enough to set a threshold. But what they've said is that, in a nutshell, to use LNT in this case is a misuse of collective dose.

MEMBER APOSTOLAKIS: I remember that.

MR. SULLIVAN: If you want to use collective dose to compare two processes which might be better, that's just fine. That's a good use of collective dose. But to go multiply 100 million people times 2 mR is a bad use of collective dose. Now NCRP has suggested that you stratify the population in terms of age and dose and distance and fragility and we're just not capable of doing that. I mean, not that I disrespect that idea, but MACCS can't support it. We don't have the resources. So that analysis could be done, but I'm not even sure where it leaves you.

Then you have this segmentation of the population. It certainly would be a more sophisticated look. In any case, this project can't support it. So I'm stuck with the totals we have and we think this is a reasonable outcome. But it is not sure. The executives are going to get together and decide what to do with this. The staff is at very much disagreement. The team would like to go this way and indeed our initial calculations are using this threshold.

MEMBER CORRADINI: That's what we'll see.

MR. SULLIVAN: That is what you'll see. There are many in the agency that disagree with that and say we should be consistent with the regulatory process of LNT. We could choose many thresholds. Four mR would not be unsatisfying. One hundred mR would not be unsatisfying. We happen to have this position paper unsolicited.

DR. WALLIS: But don't you want differing professional opinions if you pick this one?

MEMBER APOSTOLAKIS: Sure will.

DR. WALLIS: Are you going to find the staff will raise these professional opinions?

MR. SULLIVAN: Well, I mean, the staff is going to be heard and our attempt is to reflect the full staff range of views in the pros and cons. So that's our attempt at short-circuiting those sorts of issues. But, yes, those sorts of issues, I mean, somebody could file a DPO although there is no regulatory decision. Right?

MEMBER APOSTOLAKIS: Now the 10 rem over a lifetime, why is that useful?

MR. SULLIVAN: Many of our calculations in MACCS involve populations that return to a slightly contaminated area. I haven't deeply parsed the data to see who's actually dying from this event. But what MACCS will do is Pennsylvania happens to allow people back in at 500 mR a year. The EPA would say 2 rem a year and that's our Virginia analysis. But in any case, people return to their contaminated homes and get 500 mR a year.

MEMBER APOSTOLAKIS: Even if they know that it's contaminated.

MR. SULLIVAN: I do not believe anybody is going to return to a 500 mR a year home. But we had to use --

(Off the record comments.)

DR. WALLIS: Background. It's comfortable with background, isn't it?

MR. SULLIVAN: Well, background we're saying is around 300 mR a year.

DR. WALLIS: But if they're comfortable with background.

MR. SULLIVAN: This would be above background.

DR. WALLIS: Yes, but --

MR. SULLIVAN: Do you really think anybody's bringing their children back?

MEMBER ARMIJO: Is there background in Sweden or Finland?

MR. SULLIVAN: That's the American average.

MEMBER APOSTOLAKIS: The point is that I find this is typically 70 years.

MEMBER KRESS: People will come --

MR. SULLIVAN: Yes.

MEMBER APOSTOLAKIS: So what they're saying is that --

DR. WALLIS: They are 40,000 --

MEMBER APOSTOLAKIS: -- over a period of years if they get 10 rem.

MR. SULLIVAN: Yes.

MEMBER APOSTOLAKIS: Then they die for sure.

MR. SULLIVAN: No, that's the threshold. If they're getting more than 10 rem, we would assess them for -- They would be in the pot for us to estimate latent cancer fatality.

MEMBER APOSTOLAKIS: There would be a probability that at 11 rem --

MR. SULLIVAN: 10^{-4} times a rem and then you multiply that out.

MEMBER APOSTOLAKIS: But they would be very old by then, won't they?

MR. SULLIVAN: I would hope.

MEMBER KRESS: Is it five rem radiation --

MEMBER APOSTOLAKIS: So this business of saying number of deaths given that peopled don't live forever, it doesn't make sense.

MR. SULLIVAN: It's MACCS gives you a

probabilistic representation of consequences and, I mean, the numbers just roll.

MEMBER APOSTOLAKIS: But I mean to say that after 70 years now you have a 10^{-4} probability that you would --

MR. SULLIVAN: No, Doctor, the latent cancer period is typically about 20 years. So we measure the dose over 70 years indeed.

MEMBER APOSTOLAKIS: So by the time they are 90.

MR. SULLIVAN: There you go.

MEMBER APOSTOLAKIS: Come on.

MR. SULLIVAN: They might have gotten 10 rem at age 20.

PARTICIPANT: -- you're worried.

MEMBER APOSTOLAKIS: With a 10^{-3}, yes, sure.

MR. SULLIVAN: Now there is some good science behind the HP Society threshold. There are many who disagree. So what we're attempting to do is come up with the staff's best estimate.

MEMBER APOSTOLAKIS: Okay.

MEMBER KRESS: Okay.

MEMBER APOSTOLAKIS: But the ACNW said what about it?

MR. SULLIVAN: The ACNW --

MEMBER KRESS: They support this whole --

MR. SULLIVAN: ACNW wanted to see the details of the calculation.

MEMBER APOSTOLAKIS: Okay.

MR. SULLIVAN: Which I couldn't present yesterday and so we're going to make another presentation to them as to how MACCS uses these numbers in some detail. We are working out that. But, in general, my sense was while they are sympathetic to using a threshold, they were also talking using other metrics, risk to the individual, dose at the fence post, maybe dose to the population if they follow the emergency plan.

MEMBER APOSTOLAKIS: What's wrong with risk to the individual?

MEMBER ARMIJO: Do they think that every individual out there knows whether that dose number is good or bad?

MR. PRATO: We've asked that question and they --

MEMBER ARMIJO: Nobody knows that. I've talked to lots of groups and if you talk dose, they go glassy-eyed. Then you have to start explaining and what it means to them. I think it's the responsibility of this agency to say what the impact on their health is, will be. And if it's cancer --

MEMBER APOSTOLAKIS: Is there something wrong with individual risk?

MEMBER KRESS: Its professors understand it, George.

MEMBER APOSTOLAKIS: No. The death of an individual, isn't that something that the agency uses?

MEMBER KRESS: It's not what the public thinks about. I think it's a good thing. There's nothing wrong with individual risk and it's not what the public thinks about.

MEMBER ARMIJO: They don't understand that.

MEMBER APOSTOLAKIS: But I sense that the staff doesn't even want to evaluate that.

MR. SULLIVAN: No, especially the recent EPRI. Well, especially the recent EPRI document, I think is quite impressive in going down to the risk to the individual and I think it's a nice treatment. It just doesn't answer the mail.

(Off the record comments.)

MEMBER KRESS: I personally hope the ACRS supports this and continues.

CHAIRMAN SHACK: I think it's time to move to the results.

MEMBER APOSTOLAKIS: Let's go to the results.

MR. FLACK: But before we leave --

MR. PRATO: Chairman.

MR. FLACK: Yes. Bill, can I make a comment? This is John Flack of the ACNW staff since I sat in on that meeting yesterday. There was two points that I think the ACNW made at that meeting. One was that this threshold is not a best estimate in the traditional sense although the staff has used that. I'm just making the comments that the ACNW had made yesterday. It is not a best estimate from their perspective.

MEMBER APOSTOLAKIS: What is?

MR. FLACK: This using a no threshold. I mean, you hear that this could be considered as a best estimate using a threshold, a 5 rem threshold, below which there are no considered fatalities. I think that was the --

MEMBER KRESS: If they have a suggestion for a best estimate.

MR. FLACK: Well, they went back to the dose. They felt it was important to talk about dose and not fatalities in a public arena since fatalities indicate deaths and this sort of biased the group. They felt it was very strong to give this dose map that people should understand what they would get should there be an event and there are releases. They did not believe that saying deaths was the way to go and that was the other point.

MEMBER KRESS: Once again, that can be misused like the original Sandia --

MR. FLACK: Those are the two points.

MEMBER APOSTOLAKIS: Are you saying that the dose is something that the public does not understand? Yes. The Yucca Mountain regulations in terms of dose.

PARTICIPANT: That's right.

MR. FLACK: It's a dose criteria.

MEMBER APOSTOLAKIS: But it's a major undertaking.

CHAIRMAN SHACK: We know how well that's received.

MEMBER APOSTOLAKIS: Not because of that.

MEMBER CORRADINI: Not because of that.

MEMBER APOSTOLAKIS: Not because of that.

MEMBER CORRADINI: Not because of that. I guess, at least, for an interim result I guess would support, I would be with Tom on that fact that I would like to see the interim result of dose now. It's not our call -- Well, it's not definitely our call, but I'm not exactly sure the rest of the Committee believes me on this, but I think the ACNW relative dose, I really think eventually people are going to start understanding in those terms and if you start hiding the net calculation which then creates all this confusion about how you report it.

MEMBER KRESS: Why not report both?

MEMBER ARMIJO: Yes, that's what I think. That's what I expected.

MEMBER KRESS: Use the 5 rem and 10 rem and take the dose and convert and say, "If you use this, this is what you get."

DR. WALLIS: I think then you need a tutorial about what dose means, how many bananas and how many people and all that.

MEMBER KRESS: You might need to talk about those things.

MEMBER ARMIJO: You should because somebody will use those doses. Nobody hides it. The guys have --

CHAIRMAN SHACK: Guys, this is a letter writing discussion. Can we move onto results?

MEMBER CORRADINI: Yes.

MR. SULLIVAN: Might I just add?

CHAIRMAN SHACK: -- the information that we need.

MR. PRATO: Okay. We left off on page --

MR. SULLIVAN: I'm sorry. I just wanted to chime in one last time and I thank you for your thoughts on this process. This population is moving. It's evacuating. So we would have to parse the dose to a fencepost versus the dose to the expected 99.5 percent compliant population and that adds to the confusion. This population is not a fencepost. You know, it moves.

MEMBER ARMIJO: Yes. You could do a dose to a static population and your best shot at a moving population if you wanted to but more within an area.

DR. WALLIS: Just comparing to an international thing, does the IAEA or someone embrace the no-threshold or what? Obviously, around the world.

MR. SULLIVAN: The French are trying to. The international community -- LNT is used for regulatory purposes just about worldwide.

MEMBER CORRADINI: So let me ask one other question since he wants to go to results and he'll shut me down. So at 2006 to report on the 20 year anniversary, NCRP had a session that I attended on Chernobyl. They had as I remember two methods of reporting it. One was dose and one was essentially latent cancers. Why not take at least that and see how essentially the international study did it because to me again historically people only think about history? So they're going to say what you're showing, what did they say about Chernobyl? What did they say about TMI? So what did --

I suggest the staff go back and look and see how the 20 year anniversary of Chernobyl is reported by NCRP and ICRP. There was a symposium here in Washington in 2006 about that in April. So to me, again the public is a lot smarter than you take them for. They're going to look at things that are published and they're going to do an analysis and that's the closest analysis historically that we're going to look at as major accidents.

MEMBER APOSTOLAKIS: Slide 22.

MR. PRATO: Slide, thank you.

MEMBER CORRADINI: Slide 22.

MEMBER ARMIJO: Just one last question now. This letter, is this the staff proposal to the Commission now? Will it go out or is it going to be buried in the --

MR. SULLIVAN: It's in process. There is going to be -- We do not have concurrence from all offices. There's going to be a meeting of --

MEMBER ARMIJO: The Committee may not see a lot of this.

MR. YEROKUM: Yes. Let me try to address that because it's important that you have a good understanding of that letter. What you have I think is Rev 2. I'm not sure what rev number it is and since then, I'm guessing that's changed. We met with the ACNW yesterday. This dose reporting came up. There's one other option we need to closely look at.

And is this going to make it to the Commission? I mean, with all the issues we have with the different opinions amongst the staff. So I wouldn't put too much on that draft SECY. It was very draft. That's what it was at that time. Although we have notified the Commission that we are planning to look at this range or these options of reporting and we are currently using the 5 and 10 and the Commission expects something from us in the sense of a proposal of what we plan to go by.

MEMBER APOSTOLAKIS: It was very well written by the way.

MEMBER ARMIJO: I thought it was a very

good letter and I hope it gets to them.

MEMBER APOSTOLAKIS: Very good.

MR. YEROKUM: I think that will be welcome in your letter.

CHAIRMAN SHACK: Since I'm the Chairman, can you do a MACCS calculation for Chernobyl?

MEMBER CORRADINI: There exists one.

CHAIRMAN SHACK: What do you get from that?

DR. WALLIS: Can you explain how the plume got to Northern Scotland by doing a MACCS calculation?

MR. SULLIVAN: I'm not sure I can answer that. I mean we need census maps. We need real weather trials.

MEMBER CORRADINI: NRC calculations. Lawrence Livermore calculations. A group of calculations for Chernobyl.

CHAIRMAN SHACK: The question is whether you want to stand by them. Okay. Onward. Thank you very much.

MR. PRATO: We're on slide 22. That's three-fourth of the ways through the structural slides and I'm going to ask Ata to explain these slides to you.

II. STRUCTURAL ANALYSIS

MR. ISTAR: Slide 22 is just the results of Surry, structural part of it. If you want me to elaborate that, I'll do that.

MEMBER APOSTOLAKIS: But the question is whether we want to look at that or the actual results. When are we losing members?

MEMBER STETKAR: Noon.

MEMBER APOSTOLAKIS: Noon.

CHAIRMAN SHACK: I think we ought to move on to the results then.

MEMBER APOSTOLAKIS: The real results then.

MR. PRATO: Okay. So let's go to page 24 and Jason is going to present the initial results.

III. PEACH BOTTOM RESULTS

MR. SCHAPEROW: Yes. I'm Jason Schaperow of the NRC Research staff. This first slide 24, this is largely a summary of what we presented to the Committee in July. Our view of the PRA models indicated that core damage frequency is dominated by the seismic event which is --

DR. WALLIS: This is for Surry.

MR. SCHAPEROW: I'm sorry. This is for Peach Bottom.

DR. WALLIS: This is for Peach Bottom.

I'm sorry. I didn't mean to --

MR. SCHAPEROW: For Peach Bottom.

MEMBER APOSTOLAKIS: Are you sorry?

(Off the record comments.)

MR. SCHAPEROW: I was planning to start with Peach Bottom first. The first set of slides that I have here is for Peach Bottom. Then I'll move into Surry.

For Peach Bottom, we came up with the seismic event initiating a long-term station blackout. The CDF associated with this event is in the range of $1E^{-6}$ to $5E^{-6}$ per year.

MEMBER APOSTOLAKIS: Long-term means what?

MEMBER STETKAR: A couple questions. What's the acceleration of -- I mean, you obviously have a group of sequences. So you have some seismic initiating event. What's the acceleration range or the mean G?

MR. SCHAPEROW: Referring to?

MEMBER STETKAR: And the frequency to that?

MR. PRATO: This is the long-term station blackout for Peach Bottom.

MEMBER STETKAR: The g level for that?

MR. PRATO: There's an envelope of 0.5 to

1 g.

MEMBER STETKAR: 0.5 to 1 g range? Okay.

MR. PRATO: Yes sir.

MEMBER APOSTOLAKIS: The long-term --

MEMBER STETKAR: Mean frequency?

MR. SCHAPEROW: Basically it means you've lost AC power and you have batteries.

MEMBER APOSTOLAKIS: For how long?

MR. SCHAPEROW: For several hours.

MEMBER STETKAR: What's the mean frequency?

MR. SCHAPEROW: I have more details on that as we get into this.

MEMBER STETKAR: You have that information back here somewhere.

MR. SCHAPEROW: Let's see. $1E^{-6}$.

MR. SHERRY: It's on this slide.

MR. SCHAPEROW: Yes, the frequency of the event is on the slide, $1E^{-6}$, $5E^{-6}$ per year.

MEMBER STETKAR: It's the direct core damage. Okay. Thank you.

MR. SCHAPEROW: We also -- Included in that range of frequencies are fire and flood events. These events would be similar in terms of core damage progression.

For internal events, all the internal events we came up with had CDFs of less than 10^{-6} per reactor year. We did initially identify one sequence, the lost of vital AC bus E-12 sequence as having a CDF exceeding our screening criteria. But we did actually subsequently determine that it would be less than that. We looked at the model and we found an issue with it.

DR. WALLIS: Well, 10^{-10} per year really doesn't mean anything, does it?

MR. SCHAPEROW: Yes. Actually, before I get there, I would like to mention we did do some MELCOR analysis for that particular internal event and independent we concluded that that thing would not go to core damage.

MEMBER CORRADINI: That's only with or without crediting, I misread it.

MR. SCHAPEROW: Yes. Without crediting additional portable equipment associated with be five --

MEMBER CORRADINI: Okay.

MR. SCHAPEROW: I'll show some of those results.

MEMBER STETKAR: Since you looked at loss of vital AC buses, I'm assuming you looked at losses of DC buses.

MR. SCHAPEROW: I think we looked at everything. We went through the SPAR model.

MEMBER STETKAR: You didn't look at everything. Did you look at DC buses?

MR. SCHAPEROW: As far as the limitations of our SPAR model and also we had meetings with the licensee to understand --

MEMBER STETKAR: Did you look at loss of DC buses? Do you know that or not?

MR. YEROKUM: Yes.

MEMBER STETKAR: You did?

MR. SCHAPEROW: Again, I would like to make that point that we did actually -- Before we determined that it was less than 10^{-6} per year, we actually did some MELCOR analyses and we independently concluded that would not be a core damage sequence.

DR. WALLIS: Unfortunately, it's called Bus E-12, isn't it?

MR. SCHAPEROW: I'm sorry. I should have left the dash out. I don't think we need that dash for anything.

MEMBER CORRADINI: Right.

MR. SCHAPEROW: And finally, you're right. We have an extremely low number for the bypass event from the SPAR model.

DR. WALLIS: There's something that you didn't think that's much more likely here.

MEMBER APOSTOLAKIS: So all you are doing here is looking at the seismic.

MR. SCHAPEROW: That's correct and also I do have some material here to cover the E-12 sequence to describe what an integral analysis of that sequence would not lead you to core damage.

MEMBER STETKAR: I'll ask you. Since the upper end of your seismic range is 1g which is a pretty decent shake, did you look at structural interactions in your seismic fragility analysis, structural failures and structural interactions?

MR. PRATO: The answer to that is yes. We've been dealing with the seismic folks a great deal and we're in the process of trying to get a formal analysis from the seismic folks on the general condition of the plant with regards to the structural, piping, large things like stairways, fallen cable trays, that kind.

MEMBER STETKAR: And that's factored in here?

MR. PRATO: It's factored in for these two on a case-by-case basis. We have initiated a request to our seismic folks to do on a more generic basis.

DR. WALLIS: Suppose Peach Bottom has an event with a bypass. What does that do to the whole study? I mean, you said that probably that's 10^{-10}. Suppose it happens. What does that do to the credibility of everything else?

MR. PRATO: I don't know the answer.

PARTICIPANT: I don't understand.

MEMBER APOSTOLAKIS: What do you mean?

MR. PRATO: That's beyond --

DR. WALLIS: When you start having numbers like 10^{-10}, you actually write them down and then it happens. It's due to the credibility in a Bayesian sense of everything else.

(Off the record comments.)

DR. WALLIS: I'm saying it's dangerous to give these very low numbers.

MR. PRATO: Okay.

MEMBER APOSTOLAKIS: If it happens, then we'll update.

DR. WALLIS: Right. Best estimate.

(Laughter.)

MEMBER KRESS: We'll update you.

DR. WALLIS: We'll do something dramatic.

MR. SCHAPEROW: For the Peach Bottom long-term station blackout, we began by performing MELCOR analysis, crediting the B.5.b equipment and procedures. We did this to, as Bob mentioned, evaluate the sufficiency of these measures to prevent an environmental release and we did demonstrate that these measures would prevent core damage for this event. We also performed MELCOR analysis without crediting the B.5.b equipment and procedures and we did this to understand the value of these mitigation strategies.

Now getting a little more specific here referring to Peach Bottom long-term station blackout, this event was initiated by the seismic event. It resulted in a loss of offsite and onsite AC power. The plant response would be that RCIC would start automatically. And the operator by procedure would begin depressurizing at one hour.

MEMBER STETKAR: Let me stop you there. What's the conditional failure probability of RCIC given a 1g earthquake?

MR. PRATO: It was the initial conditions set that RCIC was available at that -

MEMBER STETKAR: At 1g?

MR. PRATO: Yes sir.

MEMBER STETKAR: The zero probability of

failure of RCIC at 1g?

MR. PRATO: No, we're not saying that. We're saying that if you add the probability of RCIC failing --

MEMBER STETKAR: What's the conditional failure?

MR. PRATO: -- then it would fall below our threshold.

MEMBER STETKAR: Suppose it was 0.5. Would it be just below your threshold?

MR. PRATO: I don't know the answer to that, sir. We get input from our PRA folks. I'll turn that over to Rich.

MR. SHERRY: Yes. Let me --

MEMBER STETKAR: Let me ask you a second part. How important is RCIC availability to this particular sequence? If RCIC were failed, how would the characteristics of this sequence change, failed at time T zero irrecoverable?

MR. SCHAPEROW: As Charlie mentioned earlier, we did run some preliminary calculations back in March or February for that case and that would be considered a short-term station blackout because you have no injection and things happen earlier because you didn't have injection for several hours. So everything got shifted several hours. I'll show you the slides for this and you can imagine if we shifted everything back several hours what it would look like.

We did have some discussions with the licensee on batteries.

MEMBER APOSTOLAKIS: Now is it -- I mean, the next bullet, operator by procedure depressurizes at one hour. Is that a reasonable thing to assume with a 1g earthquake?

MR. PRATO: With DC power available, yes sir.

MEMBER APOSTOLAKIS: Yes, but how about the state of the operator himself or herself? What can happen to them? I don't know.

MEMBER STETKAR: What sort of failure probability?

MEMBER APOSTOLAKIS: One g is really pretty stuff. Right?

MEMBER STETKAR: Yes, that's right.

MEMBER APOSTOLAKIS: Plants may fall down or --

MEMBER STETKAR: There is no chance the operators are, I'll use a polite term, incapacitated from falling things in the control room. Was that looked at? Once your earthquake is a good earthquake

--

MR. PRATO: One of these sequences is that the turbine building failed. In that condition we assumed that the turbine building operator was no available.

MEMBER STETKAR: The control room operator?

MR. PRATO: The control structure is a safety related structure, seismically qualified. It is assumed not to fail.

DR. WALLIS: But the operators are not seismically qualified.

MR. PRATO: They're not, sir.

MEMBER CORRADINI: So can I just ask? I'm sorry that I'm not really seismically educated here. So he says it's big. You guys are talking -- So give me a comparison point. The '95 Kyoto earthquake, was that a 1g earthquake?

MEMBER STETKAR: I don't know.

MEMBER CORRADINI: I'm sorry to -- I mean, you're going to eventually give this to the public.

MR. PRATO: Yes.

MEMBER CORRADINI: And then the public, they're going to start saying, "Okay. Is it like this" or "Is it similar to that?"

MEMBER STETKAR: One g earthquakes tend to be about seven on the Richter scale. The problem is there's not a direct translation.

MEMBER CORRADINI: Okay.

DR. WALLIS: So the Kobe earthquake was like that?

MEMBER CORRADINI: The Kobe, I'm sorry. The Kobe earthquake.

MEMBER STETKAR: It was.

MEMBER CORRADINI: Because I was in the Kobe earthquake.

DR. WALLIS: You weren?

MEMBER CORRADINI: I don't think -- Yes, I was in Osaka at that time of the earthquake. People didn't do every much right after that. So I think his questions about operator --

DR. WALLIS: But that was some distance from the epicenter too.

MEMBER CORRADINI: Thirty kilometers.

MEMBER STETKAR: An hour is a long time, but they still don't perform well after an hour.

MR. SHERRY: As a comparison, the recent earthquake in Japan which affected the nuclear plants there had peak vertical ground accelerations that ranged from 0.5 to about 0.68.

MEMBER CORRADINI: Okay. Yes.

MEMBER APOSTOLAKIS: The latest one.

MEMBER STETKAR: Yes. Rich, I don't remember. I think a 1g roughly is around a seven or so, isn't it?

MR. PRATO: It's between a seven and a eight.

MEMBER STETKAR: A seven and an eight. That's kind of a ball park.

MEMBER APOSTOLAKIS: I know. It depends on --

MEMBER STETKAR: But to give you an idea of things that you can --

(Several speaking at once.)

MEMBER CORRADINI: Okay. Thank you.

MEMBER APOSTOLAKIS: -- as to how far. So we've never seen a 1g then. Is that what you're saying?

MR. SCHAPEROW: Not at a power plant.

MEMBER STETKAR: Not at a power plant. We've seen it in the U.S.

MEMBER APOSTOLAKIS: We have?

MEMBER STETKAR: Historically, not in recent history. The McGurd (phonetic) was a 1g earthquake.

MR. SCHAPEROW: The next thing that would happen in this long-term station blackout would be that eventually you would exhaust your batteries. We talked to the licensee to try to understand what a best estimate would be for a battery lifetime under these conditions and they told us four hours.

So using these initial conditions, these basic assumptions, we proceeded to apply the B.5.b mitigation measures. They would use a portable power supply, the right DC power once the batteries have been exhausted. This is needed as you'll see in the upcoming plots to hold the SRVs open and to provide a level indication for the reactor vessel so that they can adjust RCIC flow as needed to maintain the water level in there.

If they did not perform these mitigation measures which are again associated with B.5.b, these portable equipment type measures, after four hours the SRV would be closed, the RCIC would stop and for that case, we assume no subsequence operator actions taken.

A little more information on the next slide about the mitigation that we modeled for the mitigated case. Peach Bottom would implement a portable power supply for SRV operation and level indication. One objective of this portable power supply is to prevent excessive cycles on the SRV which would basically be sitting at its relief setpoint. Also they need to be able to have level indication, the reactor vessels, to know how to adjust the RCIC flow.

Another important element of the B.5.b mitigation is manual control of the RCIC pump without DC power.

MEMBER STETKAR: Excuse me. How do you do that?

MR. SCHAPEROW: How do you do that?

MEMBER STETKAR: Yes, how do you do that?

MR. SCHAPEROW: Manual control of RCIC?

MEMBER STETKAR: Yes. How do you do that?

MR. SCHAPEROW: Under the B.5.b requirements they --

MEMBER STETKAR: No. How do you do that?

MR. SCHAPEROW: -- have been developing procedures to do this.

MEMBER STETKAR: No. How do you do that?

MR. SCHAPEROW: I don't know how to do that.

MEMBER STETKAR: I used to work at a power plant and -- driven off speed water. How do you do that?

MR. SCHAPEROW: There are similar procedures that are being developed.

MEMBER STETKAR: We couldn't do that for Surry. We couldn't control our turbine driven off speed water because it kept tripping.

MEMBER CORRADINI: It was either on or off.

MEMBER STETKAR: No. It kept tripping. You would try to control it, but it kept tripping.

MR. PRATO: Part of B.5.b requirements is to --

MEMBER STETKAR: No, it was a function of the pump. It wasn't a function of B.5.b.

MR. PRATO: I understand that.

MEMBER STETKAR: You couldn't control it.

MR. PRATO: It's a function of the control system.

MEMBER STETKAR: No, no. It's -- this is no control system. It's manual.

MR. PRATO: Right.

MEMBER STETKAR: This is manual mechanical control of a turbine that likes to overspeed and trip.

MR. PRATO: All licensees are required to do this as part of B.5.b.

MEMBER STETKAR: That's fine. Everybody

is required to be able to do something.

MEMBER ARMIJO: Is it a demonstrated capability?

MEMBER STETKAR: Did the Peach Bottom operators show you they could do this under real flow conditions with real steam with a real tripped pump?

MR. PRATO: B.5.b is in the process of implementation. Give me a second here. They are going to go out and inspect each licensee's proposed mitigative measures to address B.5.b. One of the issues that they are going to address is this ability to demonstrate.

MEMBER STETKAR: Not just measures, actual in place because this is actually a pretty difficult --

MEMBER APOSTOLAKIS: Why couldn't they control it?

MEMBER STETKAR: The problem is when you crack open the steam line you get a slug of steam. The thing overspeeds and it trips again. Now you have to reset the trip and you crack open the steam line and get a slug of steam and it overspeeds and it trips.

MEMBER CORRADINI: You have to have a fairly --

MEMBER STETKAR: You have to have a really adept operator at knowing how to reset the trip and locating manually crack open the steam line because that's what you have to do to get this thing running and if it's manual with no DC power and no AC power, it's a knack that you need to develop. This is not pushing a button. It's not running a dial with controller. It's not -- It can be done, but it's not easy. My own point is if this is a best estimate analysis and if I were a betting person, I would bet against the operators. I would give them maybe a 25 percent chance of succeeding in this case before they give up, before they said let's try something else.

MR. SCHAPEROW: I would like to point out that although this is what we had included in the MELCOR simulation, they also have -- Actually, the next line, they have a portable diesel driven pump which could be brought to bear and this is --

MEMBER STETKAR: That's probably a better bet.

MR. SCHAPEROW: We brought it into position after a couple of hours and hooked it up to mitigate this. We did the injection. We did model that from RCIC.

Finally, they have a portable air supply which they have purchased to operate containment event valves to manage containment pressure.

Now I'd like to show a few of MELCOR results for this scenario. I'm not going to go into every bump and wiggle on the curve. I'll try to hit what I think some of the more important ones.

MEMBER CORRADINI: The high points. Sorry.

MR. SCHAPEROW: Of course, the first thing that you see here is the depressurization at one hour. The operator opens up one SRV and it brings it down to about 150 pounds.

DR. WALLIS: He has to go somewhere to do that and there's no problem after an earthquake.

MR. SCHAPEROW: He has DC power for four hours. He can do --

DR. WALLIS: It says manually. That's why I was wondering.

MR. SCHAPEROW: He has indication in the control room. It has equipment, things, that rely on DC power.

DR. WALLIS: This is from the control room now.

MR. SCHAPEROW: That's right.

DR. WALLIS: It's not walking out to the

SRV and turning something on.

MEMBER CORRADINI: Turning a crank.

MR. SCHAPEROW: The SRV would be inside the containment.

DR. WALLIS: That's not what you meant by manually. Right?

MR. SCHAPEROW: No. The SRV --

CHAIRMAN SHACK: Manually controls.

MR. SCHAPEROW: Sorry about that. Communications.

MEMBER KRESS: Initiating opening.

DR. WALLIS: It's different all together.

MR. SCHAPEROW: And also this slide shows that once they get down to this one SRV open and the pressure gets down that it stays level. That includes the modeling of the fact that they would have a portable power supply in place to keep the SRV open.

MEMBER STETKAR: Jason, just out of curiosity, what's their portable power supply? Is it a little -- Do you know what they have?

MR. SCHAPEROW: I'm not sure they had purchased it at the time we made the site visit. We were there in --

MR. PRATO: It's a motor driven power supply that goes through an invertor.

MR. SCHAPEROW: It can't be motor driven. You're thinking of Surry. At Surry, it's actually a portable generator. It's about this big.

MEMBER STETKAR: Yes, just a little Kmart.

MR. SCHAPEROW: It's not a big device. It's not like this thing that weighs thousands of pounds.

MEMBER STETKAR: I was just curious.

MR. SCHAPEROW: It's man portable.

MEMBER STETKAR: Okay.

MR. SCHAPEROW: Now for Peach Bottom, I don't know that they had purchased it when we made the site visit back in May.

If you'll turn to the reactor vessel level plot, slide 29.

MEMBER ARMIJO: Could you just -- You mentioned after four hours unmitigated. Are we looking at the unmitigated?

MR. SCHAPEROW: I'm sorry. This is all the mitigated case. I'm going to take you through that first.

MEMBER ARMIJO: Okay. I'm sorry.

MR. SCHAPEROW: I'll take you through the mitigated case first. Well, we like to think positive and then we'll take you through the unmitigated case.

If you go to the level plot, you can see the initial drop in level associated with the shrink and then the RCIC operation starts and level starts to recover and level dips again when the operator opens the SRV because of the loss of inventory and then finally RCIC catches up. In about two hours, it's back in the normal operating range.

I've also indicated on here that as a result of the seismic event the condensate storage tank is assumed to fail. Now that typically would be a problem for RCIC because RCIC, that's it's main draw means of source. This condensate storage tank does have a wall or a berm around it. So RCIC can draw from there for awhile. But a low level signal would be seen by RCIC and that would call for RCIC to be switched over to the --

DR. WALLIS: It draws from the pool around the broken tank.

MR. SCHAPEROW: The whole thing is one. It communicates between the berm and whatever is left inside the tank.

But the RCIC would have to be -- would signal -- The low level signal would signal for the switchover to the suppression pool. So there would be two options here. The operators could realign RCIC's suction to the suppression pool or they could configure this portable pump, this portable B.5.b pump, to keep putting water into the berm area. Also the portable pump could be configured to pump water from the cooling tower ponds into the CST reservoir and provide long-term water supply.

After about -- If we were relying on the suppression pool for RCIC water source, at about ten hours the suppression pool would have been heated up to the point where you might start having MPSH issues and I've indicated that here.

MEMBER ARMIJO: That's a statistically qualified berm around the pump?

MEMBER KRESS: I think that's no likely.

DR. WALLIS: It's around the tank.

MEMBER CORRADINI: It's the take I think the berm's around.

MEMBER KRESS: Yes.

MEMBER STETKAR: If the tank fails , it's a seismic event.

MEMBER CORRADINI: No. I understand. I just didn't understand -- Just for my clarification, I was getting confused before he asked the question. He just helped me along. So where are you switching from? Where are you switching to that tank in the berm?

MEMBER STETKAR: It normally takes suction.

MR. SCHAPEROW: This doesn't show that. This just assumes that that was taken care of.

MEMBER CORRADINI: Okay. Where would it normally happen?

MR. SCHAPEROW: Switching over from the --

MEMBER CORRADINI: I'm misunderstanding your explanation.

MR. SCHAPEROW: I'm sorry.

MEMBER CORRADINI: Normally, it's taking its suction from where?

MEMBER STETKAR: The tank.

MEMBER CORRADINI: That tank.

MEMBER STETKAR: A low level in that tank it switches over to the suppression pool.

MEMBER CORRADINI: Ah.

MEMBER STETKAR: The problem is if you keep the suction aligned to the suppression pool eventually you run out of water.

MR. SCHAPEROW: Well, actually the suppression pool would overheat and you might --

MEMBER STETKAR: Yes.

MR. SCHAPEROW: -- lose MPSH because this is a boil-off scenario and the steam is going into the suppression pool.

MEMBER STETKAR: You mean you're not --

MEMBER CORRADINI: It's not going anywhere.

MEMBER STETKAR: Right.

MR. SCHAPEROW: It keeps going into the suppression pool and heating up. So eventually --

MEMBER STETKAR: You have to get cold water in there somewhere.

MR. SCHAPEROW: Or reestablish suppression pool cooling.

MEMBER CORRADINI: So the flow path is from this tank to the pump and then switch-off occurs and then eventually you're going to get to some sort of high suppression pool temperature.

MR. SCHAPEROW: That's correct.

MEMBER CORRADINI: Okay.

MR. SCHAPEROW: If you'll move to the pressure responses, this is the containment pressure. The containment pressure will start to rise because again we don't have cooling of the containment. Eventually the operators will need to open a containment vent to prevent containment failure. We're opening it fairly early here. This was one of our interpretations of the procedures for containment venting. The design pressure limit for this containment is about 60 pounds. So they do have a ways to go.

If you'll turn to slide 31. As a result of our analysis, we conclude that B.5.b equipment is sufficient to prevent core damage. No source term. No offsite health consequences.

MEMBER CORRADINI: So I guess -- I do want to interpret one little wiggle.

MR. SCHAPEROW: Sure.

MEMBER CORRADINI: Is this switch-over occurring somewhere after a couple of hours? Is that why I start seeing a rise in the slope as if I actually have no heat loss from the system? Am I interpreting this correctly?

MR. SCHAPEROW: Are you looking at between zero and one hour?

MEMBER CORRADINI: Yes.

MR. SCHAPEROW: I believe we're --

MEMBER CORRADINI: I mean, that's what I interpret the wiggle is that now I've gone internal and all I'm doing is just pouring water on top of something. The whole saturation temperature of the whole system is rising on me and that's why the pressure is rising. Am I interpreting that correctly?

MR. SCHAPEROW: I don't know.

MEMBER CORRADINI: Okay.

DR. WALLIS: This is the optimistic scenario where everything goes right.

MR. SCHAPEROW: That's right. This is the one where they -- I wouldn't say everything goes right. I would say that this is the one where --

DR. WALLIS: Enough goes right.

MR. SCHAPEROW: Enough goes right. They've been able to establish RCIC flow. At some point, they are able to continue to provide a source for the RCIC flow and if need be they can bring in this portable pump to go in place of RCIC.

CHAIRMAN SHACK: Now he's actually -- We have sort of several scenarios here. He could be doing several different things.

MR. SCHAPEROW: He has different options. The one we model is where he took a suction on the suppression pool and has left that on the suppression pool and we assume we didn't run into any MPSH issues even though we would have gotten a signal around 10 hours.

If you'll turn to slide 32, I'd like to talk about the unmitigated case. So this time we performed an analysis which we are calling without mitigation and what we mean by that is we did not apply those B.5.b items that I listed on a previous slide. So the first four sub-bullets are exactly the same: loss of AC power, RCIC starts, operator opens the SRV and batteries exhaust.

Of course, then we start to run into some issues. We lose RCIC. We get core uncovery core damage and eventually we get reactor vessel and containment failure at about 20 hours. I do know that the very last bullet here, the evacuation is started much earlier, about 17 hours earlier.

DR. WALLIS: So a major earthquake. Right?

MEMBER CORRADINI: So just as a point of comparison, if I -- I thought it was in NUREG 1150. If I did a comparison point as to how this accident proceeds here versus how it would have been calculated for back then, I thought there were some MELCOR calculations for 1150. Am I remembering wrong?

MR. SCHAPEROW: The basis of the --

MEMBER CORRADINI: I'm trying to understand.

MR. SCHAPEROW: Yes. The basis of --

MEMBER CORRADINI: I'm trying to

understand core uncovery times.

MR. SCHAPEROW: Sure. Those were likely among the questions that were asked in the accident progression event tree. The experts that were elicited there, their opinions on these matters, they each had their own codes and MELCOR was not one of them. I think source term code package was a major player for some of these elicitations.

MEMBER CORRADINI: I thought MELCOR was functioning at the time. Maybe not.

MR. NOURBAKSH: There was an accident progression event tree and the input to them was the result of source term code package was provided on the major issues to the experts.

MEMBER CORRADINI: Okay.

MR. SCHAPEROW: Yes. We actually had a fairly large body of source term code package calculations that were published in the late '80s in a series of Batell --

MEMBER CORRADINI: Wasn't it NUREG 0956?

MR. SCHAPEROW: Pardon?

MEMBER CORRADINI: Wasn't it NUREG 0956 was the basis of the source term core package calculations that fell into 1150?

MR. SCHAPEROW: Yes, there was a big set

that were done by Batell Columbus in the mid to late '80s.

MEMBER CORRADINI: Okay.

MR. SCHAPEROW: Actually, one of the people that worked on this project, Mark Leonard, worked on that earlier work, the Peach Bottom analysis.

MEMBER APOSTOLAKIS: So if you consider then probabilities that the B.5.b measures might or might not work, the result would be somewhere in between there. Right?

MR. SCHAPEROW: Well, the B.5.b measures, I mean there are several of them. There's enough -- We believe that there was -- I guess the conclusion we can draw is that the frequency of these events would be lower and we like to think that it would be significantly lower.

MEMBER APOSTOLAKIS: No, but I mean, you know --

MR. SCHAPEROW: The core damage frequency.

MEMBER APOSTOLAKIS: In the case where you have mitigation, there is no source term.

MR. SCHAPEROW: Correct.

MEMBER APOSTOLAKIS: Now you're going to

have something.

MR. SCHAPEROW: That's correct.

MEMBER APOSTOLAKIS: Kind of late. But we will have something. So if there is some uncertainty about a B.5.b what I'm saying as a result it would be somewhere in between.

MR. SCHAPEROW: Correct.

CHAIRMAN SHACK: But he's saying he's going to weight it towards the B.5.b works.

MEMBER APOSTOLAKIS: The result you gave us at the beginning of the session was that there are no consequences. So you're not weighting them. You're just saying this is it.

MR. SCHAPEROW: We're saying the B.5.b measures are sufficient to prevent core damage for these cases.

MEMBER APOSTOLAKIS: So there is no such thing. There are no deaths.

MR. SCHAPEROW: There's always -- There's a probability they won't work. How big is that I think is the question you're raising.

MEMBER APOSTOLAKIS: Yes.

MEMBER STETKAR: Let me go back to something I asked originally. I don't know what the fragility curves look like, but it wouldn't be surprising that a fragility for integrated RCIC system with the controls and the pump and valves. I would be surprised if its median capacity was much higher than 1g. In fact, I'd expect it to be lower than 1g which means there is kind of 50 percent probability or better that RCIC fails at time T zero irreparably. How does the progression of this event and the timing of this event change if I have absolutely zero high pressure makeup and if the operators only have a 25, 30, percent probability of successfully depressurizing in an hour? In other words, I stay at a high pressure condition, no makeup.

MR. SCHAPEROW: I would like to ask Rick to help with this a little. This gets to the basis of our frequency cutoff.

MEMBER STETKAR: That's exactly what I'm trying to get at.

MR. PRATO: I think Charlie addressed part of your answer in that we did do a short-term which did take into account no RCIC being available.

MEMBER STETKAR: I don't understand why that's a short-term station blackout because RCIC being available versus not being available has no impact on electric power. So I don't understand the difference between short-term versus long-term.

CHAIRMAN SHACK: Time to failure.

MR. TINKLER: I use a notation because the short-term and long-term station blackout is a fairly -- I don't know. It's a notation. It's a term of art that's been going back.

MEMBER STETKAR: But to me seismic failure of everything sounds like a long-term condition.

MR. TINKLER: I understand. But, for example, in the PWRs when you have a direct loss of turbine-driven AFW it's normally considered a short-term station blackout. Okay. It would be lumped into that even though it may come on. But if we in this case didn't allow RCIC to start and overfill and then fail on overfill, we had approached some preliminary calculations that showed we had vessel failure in nominally nine hours. Things speeded up. We didn't have the -- We weren't filling it. We weren't actively running RCIC for five hours and then failing on overfill. We were failing at time zero and then we got to core uncovery quicker.

MEMBER STETKAR: But it's a different --

MR. TINKLER: But what you see in these new calculations is the time between first core uncovery and vessel failure has really been stretched out from earlier calculations because we have a much more detailed model of heat distribution within the vessel, heat transfer to structures in the lower head of the vessel, the BWR, as you well know, lower head is a forest of steel, lower core plate. It turned out that even from a few years ago where a Mark I vessel model didn't actually take credit for the elephant's foot and all the structure on the lower core plate.

Adding all that steel slowed this whole process down so that we weren't failing and what I said before is if we didn't fail the vessel for nine hours and we had liner melt-through shortly thereafter, that speeds things up. But we had an evacuation time estimate albeit for a nonseismic event of six and a half hours. So we still couldn't get the LERF. We still hadn't shown the source term magnitude yet.

The other point here is because you hold the vessel together so long you drive most of the volatile fission products into the suppression pool. There are very few volatiles. When you cook a core for eight hours, there's not a lot of fission products left, volatile fission products left, in the core. So cesium and iodide are driven off. And that's the difference between a very quick core melt vessel failure calculation and a calculation that allows you to take credit for heat transfer and cooking the core and driving the fission products out.

Although while the fragility of RCIC could be debated and will be and we're looking at those kinds of things as Bob mentioned, you were only willing to give a conditional probability of 0.2 to 0.3 on the SRV. But I don't know if we would have anywhere near a low that conditional probability on --

MEMBER STETKAR: That's debatable also.

MR. TINKLER: -- operability of that SRV.

MEMBER STETKAR: Not operability. The person --

MR. TINKLER: The person.

MEMBER STETKAR: Recognizing during a big earthquake that I know what's going on and that I need to know what that SRV --

MR. TINKLER: But when there's so few systems available operators are pretty sensitive to deep pressure rising.

MEMBER STETKAR: Operators are pretty sensitive at trying to get back the things that they really rely on which are things that put water into the core.

MR. TINKLER: Agreed.

MEMBER STETKAR: That's what I think

operators are sensitive to.

MR. TINKLER: But SRVs are a key compliment.

MEMBER STETKAR: I won't go on.

MEMBER ABDEL-KHALIK: But in some cases SRVs fail to lift during surveillance tests. Do the operators have --

MR. TINKLER: He has lots to chose from here. He has manual control over many SRVs.

MEMBER ABDEL-KHALIK: Unlikely when he tries to lift one that does not lift. How long does it take to determine which options when he's using a portable power supply?

MR. TINKLER: Like I said, this is from the control room.

MR. PRATO: He has power.

MR. SCHAPEROW: He has power for four hours.

MEMBER ABDEL-KHALIK: Any of the SRVs?

MR. SCHAPEROW: That's correct.

MR. TINKLER: He doesn't have manual -- I don't believe he has manual control over each and every one. But he has --

MEMBER STETKAR: He has the ADS valves.

MR. PRATO: He has the ADS and there are

typically five of them in a Mark II containment.

MR. TINKLER: He has at least a half of dozen, maybe nine or ten.

MEMBER STETKAR: Yes, he has the ADS. I don't know.

MR. PRATO: He has a few to chose from.

MEMBER STETKAR: But he has valves.

CHAIRMAN SHACK: Just to come back to this, the one thing about these seismic events is that you guys didn't really calculate these frequencies. I mean this is sort of an impressionistic 10^{-6} or an expert judgment I should say. It's the notion that the losing RCIC puts us below the frequency sort of depends on whether we really believe this is a 10^{-6} event and it's not really a 10^{-5} event.

MR. SHERRY: The basis for the --

MEMBER STETKAR: If it was $5E^{-6}$ and then the RCIC conditional failure probability was 0.5, it would still be 2.5 X 10^{-6} if I did the math right.

MR. SHERRY: The basis for the identification of the external event sequence is including the seismic and the estimation of their frequencies, of those based on review of past studies, primarily the NUREG 1150 studies for both these plants. So these numbers just weren't sort of picked out of the air at random. They were derived from a review of what was determined in 1150.

(Off the microphone) It is true that it is --

MEMBER CORRADINI: You have to go to the mike.

MR. SHERRY: It's basically as I said the external event frequency seismic fire. I'm trying to remember if --

MR. TINKLER: I thought it included fire and flood.

MEMBER CORRADINI: Fire and flood --

MR. TINKLER: And as my recollection is the fire and flood were actually more frequent than --

MEMBER CORRADINI: The seismic.

MR. PRATO: For Peach Bottom. No, Surry was a bigger issue.

MR. TINKLER: And while we believe the overall response is the same, it may be hard to argue that the timing is as severe for a fire initiated.

MEMBER STETKAR: Right. That's what we're getting back to. I mean the conditional failure probability, given the fact that the fire really doesn't affect RCIC, conditional failure probabilities and effecting the relative timing of these things are what we're talking about before with this kind of gray area thing. If it's a conditional failure probability for something that's kind of in the middle range is relatively high, that might be more important than a thing that has a slightly higher frequency, namely a fire.

MR. TINKLER: But in this case --

MEMBER STETKAR: -- a relatively low conditional failure probability of RCIC, for example.

MR. TINKLER: In this case we conservatively grouped them, I think.

MEMBER STETKAR: Yes and as soon as you do that, you have to --

MR. TINKLER: I --

MEMBER STETKAR: Live by the sword, die by the sword kind of thing.

MR. SCHAPEROW: I would like to take you through a few of the MELCOR. The MELCOR plots have a better chance of answering some of your questions on some of the bumps in these plots.

MEMBER CORRADINI: There are more bumps.

MR. SCHAPEROW: More bumps. More is going on here. Again, we have our initial depressurization at one hour. At battery exhaustion of four hours, the

SRV recloses and now you see the reactor pressure rising up to the release valve setpoint. And then you see this jagged thing here. That's the SRV opening and closing on its spring.

MEMBER CORRADINI: And then it just dies?

MR. SCHAPEROW: Well, now it's about ten hours into this thing and we're starting to get some core damage.

MEMBER ARMIJO: Why did it seize open?

MR. SCHAPEROW: That's what I'm getting to.

MEMBER ARMIJO: Okay.

MR. SCHAPEROW: About ten hours into this thing, we're starting to see some core damage and things are really getting hot. So now we have this steam passing through a degrading core. So we have very hot steam going through the core and we're getting hot steam up through the SRV.

Once the SRV gets really hot, we assume it seizes in the open position. We're using as a criteria about 1,000 K based on the idea that once you get to these kinds of temperatures the components will start to expand inside the valve and the thing won't be able to function. So we seize the valve open.

MEMBER CORRADINI: So what happens if it

accidently seized closed?

MR. SCHAPEROW: The next valve would open.

MEMBER CORRADINI: Okay.

MR. SCHAPEROW: There's a whole series of these.

MEMBER CORRADINI: They all eventually --

MEMBER ARMIJO: Unless they all seized closed and that's really asking for trouble.

MR. SCHAPEROW: The reactor depressurizes. So we see the pressure coming down and I guess it's really what I wanted to mention from this curve.

If you'll turn to slide 34, reactor vessel level. Same behavior as in the earlier cases until we get to four hours. So for the mitigated and unmitigated, the same for four hours. At four hours, the SRV closes. This ends the loss of steam.

MEMBER CORRADINI: What closes? I'm sorry.

MR. SCHAPEROW: SRV. Battery exhaust --

MEMBER CORRADINI: Excuse me. I'm sorry. I was looking at the wrong slide.

MR. SCHAPEROW: I'm sorry. Slide 34.

MEMBER CORRADINI: I'm sorry. Excuse me.

MR. SCHAPEROW: The SRV closes and so we don't lose any more steam at this point at least through the SRV. So we still have RCIC operating. RCIC is running. We assume it to be running at whatever the speed it was running at before it lost power. But in relatively short time, about an hour, RCIC will flood the vessel. Water will go down the steam line and into the RCIC turbine at which point we assume that RCIC stops and that's the end of RCIC.

Then the system starts heating up and eventually the SRV opens again. It starts opening and closing and then we see this long decline in level in the vessel. The water boils through the SRV into the suppression pool. The core will become uncovered to grade and around 20 hours we see failure of the lower head of the vessel.

So turn to the next slide, containment pressure. Containment pressure rises throughout this transient. We see a fairly steep rise around ten hours when we start oxidizing the cladding. And when we hit 80 pounds, we do start leakage from the drywell through the drywell head flange bolts. This is as a result of bolt stretching just from the pressure buildup inside the drywell.

Shortly after that, well, actually about the same, just right about that time is when the core leaves the vessel, ends up on the drywell floor and we get drywell liner melt-through and then, of course, pressure drops off. We now have a release path between the drywell and the torus room.

MEMBER CORRADINI: This is at 20 hours.

MR. SCHAPEROW: Twenty hours, that's correct.

MEMBER CORRADINI: So when you say head flange leak recloses, I'm not sure what that means.

MR. SCHAPEROW: The head flange. Again when the core --

(Off the record comments.)

MR. SCHAPEROW: That's what I thought was happening.

MR. SCHAPEROW: It will reclose because you relieve the pressure. What was holding the head flange up a little bit, it was being --

MEMBER KRESS: It was pressure.

MR. SCHAPEROW: -- pushed open like a spring, kind of opened up a little.

MR. PRATO: And that's covered in the slide.

MEMBER CORRADINI: That's fine. You explained it. I didn't understand the words. I'm sorry.

MR. SCHAPEROW: Okay. I would like to

turn to fission products now. I would like to turn to slide 36.

MEMBER STETKAR: Drywell head flange bolts stretch before any of the electrical penetrations or anything into the drywell.

MR. PRATO: Is that so?

MR. SCHAPEROW: Yes.

MR. ISTAR: Because Peach Bottom has a unique condition which was not considering IPs and the head flange bolts are kind of snug tight. They are not torqued all the way to the yield of those bolts. It's about 15 percent of the yield which is very, very low and in the original IP it was considered torque values very, very high. So during our site visit, we discovered that it's just a snug tight condition.

MEMBER STETKAR: Is that unique? I don't know much about drywell head bolts. But in your experience, is that relatively unique for Peach Bottom or is that --

MR. ISTAR: I don't know for the other ones but you know --

MEMBER STETKAR: Why would they do that?

MEMBER ARMIJO: They use organic seals. They don't use stainless steel.

MR. ISTAR: Right. Seals are -- We are

assuming that during the liftoff it's going to recover about ten percent and it's just the sealing capability up to ten percent recoverable because it's compressed in such a way. Under radiation conditions and everything, we're assuming it's going to fail as it's lifting up.

CHAIRMAN SHACK: No, I meant why wouldn't you pre-stress the bolt?

MEMBER ARMIJO: You crunch the seals and they don't work as well.

MR. ISTAR: Right. Crunch the seals.

MEMBER ARMIJO: That's fine. But it's just limited.

MR. SCHAPEROW: I would like to turn to slide 36 and talk a little bit about fission products. Charlie already kind of led in here a little bit. What we're seeing is around ten hours --

CHAIRMAN SHACK: Mario reminds me. It might be time for a break.

(Off the record comments.)

MR. SCHAPEROW: This is kind of a high point here.

CHAIRMAN SHACK: Okay. A few more slides.

MR. SCHAPEROW: A crescendo. So at ten hours, you can see here we're starting to heat up the core, release fission products and you'll see this dark blue line. They're all heading in the suppression pool and from here at about ten to about 15 hours we basically steam off all these, cook off all these, fission products.

DR. WALLIS: It's supported by experiment that you can get so much iodine captured in the suppression pools?

MR. SCHAPEROW: Yes.

DR. WALLIS: So big bubbles are going through there and there's diffusion inside the bubbles. Is that the idea?

MR. SCHAPEROW: This is going through the safety relief valve through the safety relief valve tailpipe to the bottom of the suppression pool and through spargers. So these things are actually benign.

DR. WALLIS: So it's pretty small bubbles then.

MR. SCHAPEROW: That's right. These are small bubbles. As a matter of fact, there's a little bump here at 12 hours showing where some iodine is actually making it through the suppression pool into the drywell. I'm not sure I believe that. I think that if we looked a little harder that we might not be getting anything. There's 23 feet of water.

Now on the other side of the story, these bubbles are half steam, half hydrogen. So this is non-condensable gases with fission products floating up through the pool, but they're fairly small bubbles because they're coming a sparger and they are going through 23 feet.

MEMBER ARMIJO: What's the chemical form of the iodine coming off? Is it cesium iodide? It's a stable compound.

MR. SCHAPEROW: Correct. Cesium iodide and at these kind of temperatures that we're thinking of they would be aerosol. They wouldn't be vapors anymore.

MEMBER ARMIJO: And when they get into the water, what happens? Is there a chemical reaction that traps it or is it stable?

MR. SCHAPEROW: We have a model called SPARC-90 which has been implemented in MELCOR to handle this to model the rising of the bubbles through the pool and the capture by the fission products in the pool as the bubbles rise through the pool.

(Several speaking at once.)

MEMBER ABDEL-KHALIK: All of the previously discussed alternations to this possible scenario, do they really change this picture other than shifting that initial point of ten hours?

MR. SCHAPEROW: My opinion is no. I think we'll just shift things over to the left. Do I have that calculation to show you today? No, I don't.

MEMBER ABDEL-KHALIK: So why not sort of take this picture and do parametrics on when this starting point is going to be?

MR. SCHAPEROW: Kind of the short answer is it didn't meet our frequency criteria, our CDF cutoff.

But as you can see, we are getting a small release to the environment starting when we get a containment failure of 20 hours. It's a gradual release. It's coming as you can see here from the drywell and maybe a little bit from a little bit of rebate position from the reactor.

MEMBER CORRADINI: So it's not coming through the head flange. It's coming through the melt-through.

MR. SCHAPEROW: That's correct because the head flange is done.

MEMBER CORRADINI: And then percolating up this way.

MR. SCHAPEROW: It goes from the drywell

into the torus room, not the torus, but into the room that the torus is in and up through the equipment hatches in the Peach Bottom reactor building and then out through the blow-out panels. There are actually panels that are on hinges up in the very top of the reactor building.

DR. WALLIS: This is important that it actually has to go through the SRVs or has to go through the pool. If it doesn't go through the pool, then the scenario looks very different presumably. Some other break occurs that --

MEMBER CORRADINI: That's why the reclosure. That's why I asked about the thing.

DR. WALLIS: Yes, and you assume the gasket is still intact or you assume the gasket is gone?

MR. ISTAR: Partially it's gone because radiation effects on gaskets are notoriously bad.

MR. SCHAPEROW: Actually, I would like to take a step back. By the time 20 hours rolls around, the pool has done its job. There is no more scrubbing in the pool. So with regard to release path whether it's the liner melt-through that causes the release path or the head flange, it's not really going to make a big difference. We do get a little more flow because it has to go through a little more of the reactor building to get out.

MEMBER CORRADINI: So we saturated the pool with this stuff. The reason I'm going to ask that is because you're going to go to the next one with cesium and I'm going to ask why is the partition different.

MR. SCHAPEROW: Yes, cesium is less volatile.

MEMBER CORRADINI: I understand you with iodine. I was about to go to cesium.

MR. SCHAPEROW: That's why. Cesium is less volatile and actually you'll see not as much made it to the pool. The blue line is lower. More of it gets stuck in the reactor vessel. It didn't make it as far through the system. If it was more volatile it would move further before it deposited somewhere. So that's the whole idea.

MEMBER CORRADINI: Let me ask this one question. So resuspension and movement of this, is that a well-known model in MELCOR that is -- I was always under the impression, I'm old and I've forgotten, so somebody is going to tell me I'm wrong, that resuspension is one of the last piece of physics relative to aerosol transport that is not what I'll call an accurate science. But it's very much parametric. Am I wrong?

MR. SCHAPEROW: The thing we're seeing here is the revaporization. So it's the highest --

MEMBER CORRADINI: So it's -- by revaporization.

MR. SCHAPEROW: It's a high temperature effect that the drywell gets hot, things revaporize and start to leave.

MEMBER CORRADINI: And that's why we're -- Is that why we're seeing it decreasing within the RPV in the green? You had the other slide on cesium.

MR. SCHAPEROW: I'm sorry. Cesium?

MEMBER CORRADINI: On the next slide.

MR. SCHAPEROW: Cesium is a revaporization from the RPV.

MEMBER CORRADINI: You probably said that. Were you talking about iodine? I apologize.

MR. SCHAPEROW: No. That's fine. That's exactly right. You see the green curve coming down and the red one coming up. This is the core sitting on the drywell floor. It's the whole -- The drywell is fairly small in relationship to other containments and the core is right there. So it's heating everything up. Everything in the drywell is getting very hot.

MEMBER CORRADINI: It says within the RVP. I'm still struggling with --

MR. SCHAPEROW: The RVP is in the drywell and it has a big hole in the bottom.

MEMBER CORRADINI: So it's coming out the hole. Excuse me.

MR. SCHAPEROW: Yes. It is coming out the hole.

MR. TINKLER: It couldn't go through the pool anyway. The delta P, there's not enough delta P to drive it through the hole.

MR. SCHAPEROW: Right.

MEMBER CORRADINI: But -- All right. Okay. I understand.

MR. SCHAPEROW: Thank you.

MEMBER ABDEL-KHALIK: But back to the question I raised earlier about shifting this initial point, you said you don't want to do that or you didn't do that because it would bring it down below your cutoff frequency. Given all the questions that were raised about when the operators can actually act, whether or not RCIC will be available, can you truly tell what the probability associated with an event that would start this rapid rise at five hours is rather than ten hours?

MR. SCHAPEROW: That's the basis for our work.

MEMBER ABDEL-KHALIK: What is the probability of an event that would start this process at five hours rather than ten?

MR. SCHAPEROW: At a factor of ten lower.

MEMBER ABDEL-KHALIK: That number comes from where?

MR. SCHAPEROW: From our review of the Peach Bottom NUREG 1150 external events analysis and whatever other things that we've looked at. I'm not -- Maybe Rick can help me a little on this. I think that's kind of the gist of it.

MR. SHERRY: What's the question? The frequency --

MR. SCHAPEROW: Our short-term station blackout, we didn't have RCIC. That would be about a factor of ten lower in frequency.

MR. SHERRY: Approximately yes.

MR. PRATO: We have to have a starting point to bound our analysis. There are all kinds of avenues we can take, all kinds of roads.

MEMBER ABDEL-KHALIK: Right. I understand.

MR. SCHAPEROW: Do you want to take a break now or do you want to keep going?

DR. WALLIS: What's the bottom line?

MR. SCHAPEROW: Okay. Next slide, the release is relatively small. We're not seeing the kind of releases we saw with the SEC-1 source term in back in 1982. I think we had a 45 percent release of iodine and a similar release of cesium back in 1982. Now we're down in the two to four percent range.

The event is slowly progressing. So this slow progression coupled with the emergency evacuation we see a much lower --

DR. WALLIS: Are you going to talk about evacuation at some time?

MR. SCHAPEROW: Hopefully.

DR. WALLIS: But not now. Not before the break perhaps.

MR. SCHAPEROW: Yes. We don't have any numbers in the presentation. I think we presented those back in July.

DR. WALLIS: But I was a bit concerned about these 263,000 vehicles. What's the state of the amount of gas that they have in their tanks? Are they all supposed to evacuate?

MEMBER CORRADINI: During a seismic event.

DR. WALLIS: I mean there must be a lot of them. They're going to run out of gas.

CHAIRMAN SHACK: Let's come back to that after the break.

(Off the record comments.)

CHAIRMAN SHACK: Ten minutes. Off the record.

(Whereupon, at 11:13 a.m., the above-entitled matter recessed and reconvened at 11:26 a.m.)

CHAIRMAN SHACK: On the record. Can we now come back into session. Background discussion cease.

MR. SCHAPEROW: Turning to the bottom line final result for this sequence, without mitigation with the portable equipment we estimate no prompt fatalities and 25 latent cancer fatalities. The 25 latent cancer fatalities was based on this health physics position of five rem per year as a threshold below which no cancer fatalities are induced and with a 10 rem lifetime cap.

MEMBER APOSTOLAKIS: So this is five rem per year or ten rem in a --

MR. PRATO: In a lifetime.

MR. SCHAPEROW: Whichever hits first. Whichever one has hit first.

MR. PRATO: But it is not an indication that we don't believe that there are cancers induced. It's the level at which we believe that cancers are detectable.

MR. SCHAPEROW: I do provide some numbers here. I went back to the 1982 study and stuck in the numbers from there. The early fatalities were 92. The latent cancer fatalities number is 2700. Now that 2700 number is, in fact, based on an LNTH assumption.

MEMBER ARMIJO: A what?

MR. SCHAPEROW: Linear noted threshold hypothesis.

MEMBER ARMIJO: Okay.

MR. SCHAPEROW: That's the LNT assumption. So that number is large.

MEMBER ARMIJO: If you had made the same --

(Laughter.)

MEMBER STETKAR: You guys are reading my mind. I'm too obvious.

MR. SCHAPEROW: That number wouldn't go down to 2500 because --

(Laughter.)

MR. SCHAPEROW: We got 92 early fatalities for the 1982 study. So it's still going to be a pretty sizable number would be my opinion.

DR. WALLIS: You didn't even calculate it?

MEMBER ABDEL-KHALIK: You didn't calculate it? It would be easy to do.

MEMBER APOSTOLAKIS: They are not really a narrow threshold.

MEMBER ABDEL-KHALIK: No, but just for your own curiosity.

MR. SCHAPEROW: No.

MEMBER ARMIJO: Would it have been higher than the '82 study for the latents?

MEMBER APOSTOLAKIS: Higher?

MR. SCHAPEROW: Well, our release is much smaller. So I would like to think it would be much smaller.

MEMBER ARMIJO: Yes, it has to be smaller then. Is it going to be 25? Two hundred and fifty?

MR. SCHAPEROW: I would like to turn it over to the Peach Bottom E-12 sequence.

MEMBER APOSTOLAKIS: But is your result really a mean value?

MR. SCHAPEROW: Yes. It's a mean over the weather. That is the main thing that -- I'm sorry. I didn't mean to -- This mean reflects the MACCS analysis which they do an analysis over the variability of the weather which you know can be quite wide. You could have rainfall. You could have sequences. We average it out over the weather.

MEMBER APOSTOLAKIS: So it's an alleatoric.

MR. SCHAPEROW: Yes, I think so. If I understand what that word is.

MEMBER APOSTOLAKIS: Well, you should after all these years.

(Laughter.)

CHAIRMAN SHACK: But it only considers some of the alleatory variation.

MEMBER APOSTOLAKIS: This is weather.

CHAIRMAN SHACK: Yes.

MR. SCHAPEROW: I'd like to turn briefly to the second sequence that we had done some analysis for with MELCOR, the loss of vital AC bus E-12. As was pointed out earlier, this was actually screened out. Initially, we didn't --

MEMBER APOSTOLAKIS: This is not 10^{-12}?

MR. SCHAPEROW: No. I think this was more like about 10^{-7}.

MEMBER APOSTOLAKIS: No, I mean, for --

CHAIRMAN SHACK: It's E-12.

(Off the record comments.)

MR. SCHAPEROW: I'm sorry. The name of the sequence is E-12. I'll get rid of that dash. I think Graham had pointed that out.

MEMBER STETKAR: Just out of curiosity, was vital AC bus E-12 involved with RCIC control and do you know why this one popped up as compared to other electrical buses?

MR. SCHAPEROW: Yes, this had the same issue about you losing power to RCIC. So RCIC --

MEMBER STETKAR: Vital AC buses are kind of strange beings.

MR. SCHAPEROW: You'll see that theme. I have about a half a dozen slides before I go through that.

MEMBER STETKAR: Okay. Go. Go.

MR. SCHAPEROW: Now without crediting the B.5.5 equipment, we were able to show the event mitigated. We think this is a significant finding because it kind of indicates some conservatisms in the PRA model.

So I just want to take you through this briefly. Slide 41, this is a loss of division for DC power. The initiator resulted in a loss of division for DC power resulting in a scram. MSIV closure and containment isolated. So the whole system is bottled up that way. We would get an automatic start of RCIC.

The unique feature of the sequence is that we have one control rod drive hydraulic system pump operating and that's kind of the main insight here. So with these operator actions that would be taken under these conditions are load shed to maximize DC power. Another item which we assumed at last in the base case analysis was to adjust the throttle valve to maximize the flow from the CRD pump into the RCS. We're pressurizing the RCS at one and a half hours. And we also modeled securing the control rod drive hydraulic system, that one pump. We secured it for a couple of hours because we actually started to see the vessel overfilling and kind of a big picture conclusion was we did prevent core damage.

I would like to take you through a couple of the plots for this sequence. Pressure response at one and a half hours, even before one and a half hours, we have a little dip in the pressure. This is because the RCIC comes on. It starts injecting cold water. We see a big drop in the pressure at one and a half hours when we started the depressurization by opening an PORV, I'm sorry, SRV.

At four hours, the battery dies. In this case, again as in the earlier one, SRV would reclose.

We also assume that RCIC would stop operating in this case.

DR. WALLIS: Now these four hours, is this a regulatory thing or is it realistic that the battery will die?

MR. SCHAPEROW: This is a realistic time. That's what this is. Actually, there was a lot of discussions about battery life. When we first went to the plant visit, we were hearing numbers like eight hours when we were talking with the staff at the plant and when we finally got their final answer, it was four. I think if you look at the PRA model, I think you'll see a number like two.

DR. WALLIS: Isn't that a conservative --

MEMBER STETKAR: Four hours from no load shed.

MR. SCHAPEROW: I believe four hours considered load shed.

MEMBER STETKAR: Four hours with load shed?

MR. SCHAPEROW: That's correct. That was the best number. That's their best estimate of this.

MEMBER ARMIJO: These batteries are qualified to operate after 0.5 or 1g earthquake?

MR. SCHAPEROW: Are you referring to the -

- This is a different scenario.

MEMBER ARMIJO: A different event.

MR. SCHAPEROW: This is a random equipment failure event.

MEMBER ARMIJO: Okay.

MR. SCHAPEROW: Yes, I'm sorry. That's a random.

DR. WALLIS: They were available in the earthquake.

MEMBER STETKAR: So it's a relevant but an hour ago.

MR. SCHAPEROW: Yes. This event was a random failure of a vital AC bus E-12.

(Off the record comments.)

MR. SCHAPEROW: The next characteristic of the plot is that in four hours the pressure will start to rise again when the SRV recloses. So at about six hours, we started to see the relief valve opening and closing and, at about 13 hours, the SRV sticks open. Now this is not because of core damage. We're not getting high temperatures. What we've had is we've had several hundred cycles on the valve at this point and at some point we say "uncle." That's it. We're not going to keep moving up and down. So we freeze it and the valve is now stuck open and the pressure goes back down again. Turning to the level response, we see the level initially dropping from the scram. It starts to recover when you get RCIC starts operating.

Once we get to four hours, we assume the battery is dead now or not enough voltage to do what it has to do and the SRV recloses and we start to see a level increasing in the vessel because we are pumping water in via the control rod drive hydraulic system. They have one pump operating in the sequence.

DR. WALLIS: It's rather important when that starts. I mean, you're really diving down in level and you have to turn it around.

MR. SCHAPEROW: I'm sorry. Which?

DR. WALLIS: Turn that level around at some point there. The level is really falling rapidly at 14 hours.

MR. SCHAPEROW: Fourteen hours, yes. I'll get to that. Thank you.

DR. WALLIS: Okay. You haven't gotten there yet. Right?

MR. SCHAPEROW: No, I'm on the left at four hours. At four hours, we lose the battery. We're still pumping water in with CRD and actually the main thing is we've shut the SRV. So now there's no losses from the system. So we have water coming in with no losses. So actually, we assume the operators take action to shut off even the flow from the CRD because they have level going way high.

So even with this off, now we're starting to get expansion of the water in the vessel and eventually expansion reaches a point where it heats up and then we start to open the relief valve. So if you look at six hours, when we're starting to open the relief valve again, now we're starting to lose steam again from the system. So the levels are starting to decrease.

As Graham pointed out, when you get to about 13 hours, that's where this relief valve sticks open after experiencing several hundred cycles and --

MEMBER STETKAR: Does CRD come back on at seven hours?

MR. SCHAPEROW: Yes. CRD comes back on.

MEMBER STETKAR: How do you get it back on?

MR. SCHAPEROW: The operators restarted it.

MEMBER STETKAR: How did they get it back on? You have no DC power.

(Off the record comment.)

MEMBER STETKAR: CRD is an AC system.

MR. SCHAPEROW: They may have circuit breakers --

MEMBER STETKAR: You need DC power.

MR. SCHAPEROW: Yes, you wouldn't have been able to shut it off either. I think --

MEMBER STETKAR: No, you can shut it off because you can mechanically trip the breaker to shut it off if they really wanted to shut it off. Getting it back started is tough.

MR. SCHAPEROW: Yes. The assumption here could be that they shut off low from the pump somehow without having to -- I'm not --

MEMBER STETKAR: They aren't going to run a pump dead-headed for four hours.

MR. SCHAPEROW: Yes. I don't have a good answer for you.

MEMBER STETKAR: All right. So it's hard to get CRD restarted at --

MR. SCHAPEROW: We do actually have sensitivities where the CRD runs the whole time.

MEMBER STETKAR: Runs the whole time would be okay.

MR. SCHAPEROW: Yes. We have that and --

MEMBER STETKAR: Not restart would --

MR. SCHAPEROW: That's the next case.

MEMBER STETKAR: Okay.

MR. SCHAPEROW: We get the relief valve sticking open at about 13 hours due to a high number of cycles. Now we really start to get an inventory loss from the vessel and we start seeing the water level coming down. The other thing that happens when the pressure comes down at about 14 hours, now the pressure is getting lower, the CRD flow rate actually increases because it doesn't have as much back-pressure to pump against. So now we're going from around 110 gpm up to about 180 gpm and now we're able to keep up with the dk power.

DR. WALLIS: What turns it around? Just that?

MR. SCHAPEROW: That's correct.

DR. WALLIS: Just the CRD pump. That whole thing is dependent on the -- Otherwise you have it down to dryout.

MR. SCHAPEROW: That's right. The CRD pump actually is operating the whole time. What's going on is now we have a significant increase in the flow rate from the CRDHS system because the reactor pressure is a lot lower now. It's just depressurized.

MEMBER CORRADINI: Sorry. I came in late. So I heard it's sitting there trying to pump against a head that it can't get in.

MR. SCHAPEROW: I guess at about 110 at the normal pressure. It pumps at about 110 gpm. At these lower -- At this low pressure, it pumps at about 180 gpm.

DR. WALLIS: This looks like too rapid a turnaround. You would think it would be more a curved turnaround if it's just the pump being able to beat the pressure. It looks as if something happened at 14 but apparently nothing dramatic happened at 14 hours.

MEMBER ARMIJO: Just the valve could pump.

MEMBER CORRADINI: I don't think so.

DR. WALLIS: The pressure dropped so rapidly that the pump could pump.

MEMBER ARMIJO: Right.

MEMBER ARMIJO: Well, you almost double in the flow in the pipe.

DR. WALLIS: Yes.

MEMBER ARMIJO: And your heat is low too.

MR. SCHAPEROW: We have a little bit of core uncovering here. So we're heating up at the top of the core a little. I'm not sure if that's a factor or not.

MEMBER BONACA: You can help me. What is the sequence of events? I mean, you have the loss of

-- What is the initiator?

MR. SCHAPEROW: You have a loss of vital AC bus E-12. We're losing a bus, a vital bus. That causes a loss of DC power from the division four DC which is one of the divisions of DC power and that causes -- it's listed on 41. I'm sorry. I maybe went over it too quickly.

MEMBER STETKAR: You probably do have DC here. You do have DC to the remaining CRD pump.

MR. SCHAPEROW: Okay.

(Several conversations at once.)

DR. WALLIS: Is this Peach Bottom?

MR. SCHAPEROW: Sorry. This is a little bit complicated. Yes.

MEMBER STETKAR: Because this is only single division DC.

MEMBER CORRADINI: Could I ask a question that has nothing to do with the power? So I'm just looking at timing. The previous one before, you start it sticks open, those bloody valves.

MR. SCHAPEROW: Correct.

MEMBER CORRADINI: And it starts depressurizing in about 13 and a half hours. Do I have that right?

MR. SCHAPEROW: Correct.

MEMBER CORRADINI: At about the same time as it starts depressurizing the two-phase level? The two-phase level, the red?

MR. SCHAPEROW: That's correct.

MEMBER CORRADINI: Decreases.

MR. SCHAPEROW: Correct. You got it. This one has a hole in it now. You've blown it out.

DR. WALLIS: You're losing fluid.

MEMBER CORRADINI: And then I'm still trying to resolve your answer to Graham's question of why it turns around so abruptly and I'm not there yet.

DR. WALLIS: The pressure drops very rapidly in the previous slide is what happens.

MR. SCHAPEROW: Right.

DR. WALLIS: The pressure drops very rapidly because he's assuming this SRV sticks open. It could stick open at some other time.

MEMBER CORRADINI: I'm not quarreling about that. I'm trying to understand. You asked him a question about --

DR. WALLIS: Because it drops so rapidly.

MEMBER CORRADINI: Why?

DR. WALLIS: Because the SRV is stuck open.

MEMBER CORRADINI: The shut-off head up at the high pressure?

MR. SCHAPEROW: No, it's running at 110. I believe the model that we have is a proportionally one. As the pressure goes down, the -- Maybe Randy can help me with this. I don't know if you know that level of detail or not.

MR. GAUNTT: That's what's happening, Mike, is when the back pressure --

MEMBER CORRADINI: Mr. Gauntt, identify yourself.

MR. GAUNTT: Randy Gauntt, Sandia Labs. When the valve opens up and the system pressure falls, immediately the head on the pump is relieved and the flow is increased.

MEMBER CORRADINI: But it's increasing linearly from essentially zero at 1200 down to 180 at 200.

MEMBER ARMIJO: No. It's already 100. It was already pumping.

MEMBER CORRADINI: It's already pumping at 100?

MR. SCHAPEROW: One hundred and ten. It goes approximately 110 to 180.

DR. WALLIS: That's enough to turn it around.

MR. SCHAPEROW: Yes.

MEMBER CORRADINI: Then I'm confused.

MR. GAUNTT: Before the valve opens up, Mike, you see the water level is kind of asymptoting there.

MEMBER CORRADINI: Right. That's because it's putting in --

MR. GAUNTT: It's just keeping up and the valves are lifting and so it's kind of approaching a balance there.

MEMBER CORRADINI: Okay. All right.

MEMBER ABDEL-KHALIK: It would have eventually turned back up again even if the valves didn't stick open.

MEMBER CORRADINI: So this is just a combination of different rates that I get this -- What I'm looking for is this abrupt turnout at 14 hours. Thirty minutes later, it's coming back up and it's a matter of 110 to 180 and I'm scratching my head that is 70 gpm that much of a difference that it takes it out.

MEMBER ABDEL-KHALIK: What is the thermal power of this machine? What's the licensed thermal power for this machine?

MR. SCHAPEROW: Thirty-eight hundred

megaWatts or something.

PARTICIPANT: Less.

MR. SCHAPEROW: Thirty-five hundred.

MEMBER ABDEL-KHALIK: So at 13 hours or thereabouts, decay heat is about 0.6 percent.

MEMBER CORRADINI: Decay heat would be about 20 megaWatts.

MEMBER ABDEL-KHALIK: So you could keep up with 110 gpm.

MR. SCHAPEROW: Yes. Actually, I do have a number on the next slide. I have a number of the next slide actually. I have four hours to make up rates of about 150 gpm.

DR. WALLIS: So what really is important is that the flashing stops, isn't it?

MEMBER ARMIJO: Yes.

DR. WALLIS: So the -- stops because it's flashed and then --

MEMBER CORRADINI: Thank you.

MEMBER STETKAR: I'm sorry. I did have to back up because Mario got me thinking about something. A simple guy. I need to think about scenarios. This scenario is initiated by loss of one and only one vital AC bus.

MR. SCHAPEROW: Correct.

MEMBER STETKAR: And you said that leads to loss of division for DC power somehow.

MR. SCHAPEROW: Correct.

MEMBER STETKAR: I'll just take that at face value. I'm assuming -- I don't know how many divisions of DC power that this plant has. Perhaps you could help me. Two or four? Since it's division four, it probably has four.

MR. SCHAPEROW: Yes.

MEMBER STETKAR: Let's assume that three of them are not affected by this event. This is only a loss of a single bus. Why am I losing DC power? Why do valves suddenly -- It says termination of DC power. Why are the operators shedding loads to conserve DC power? I have all the DC power in the world on the other three divisions.

MEMBER BONACA: I don't understand that fact this is such a dramatic event caused by just one vital --

MEMBER STETKAR: Well, single vital buses can be pretty interesting depending on what's connected to them. But what I don't understand suddenly because I convinced myself they could restart and control CRD because they do have DC power. But because they do have DC power, why are the operators doing anything to extend the life of the batteries?

MEMBER ARMIJO: It's an operator error.

MEMBER STETKAR: They're just throwing things away because they don't -- and why is the SRV reclosing if I still have all the DC power in the world?

DR. WALLIS: It's just getting tired of opening and closing.

MEMBER STETKAR: I mean, I probably don't have DC power for a couple of ADS valves, but, fine, the other ones have power. So I'm not quite sure why is this important. Is it because the operation of the SRVs here affect the whole pressure response of the whole thing?

MR. SCHAPEROW: This is correct and actually the open SRVs are good.

MEMBER STETKAR: The open SRVs are good.

MR. SCHAPEROW: Because they give you more flow and I'll show that on the next slide.

MEMBER STETKAR: Yes, but I don't care about slides at the moment. I want to see how this analysis that you did tracked a real event because I don't see why in this event if it only affects one division of DC power why I'm doing -- why an analysis is now considering operator actions to shut loads on batteries and why the analysis has some time at which --

MR. SCHAPEROW: Because our SPAR model had this as an event which ended in core damage.

MEMBER STETKAR: I don't care about models. I want to go back to what's happening the plant right now.

MR. SCHAPEROW: Okay. The goal of me showing these half a dozen slides is to show that there are places in the PRA model that have some conservatism in them that if one would run an integrated plant analysis with a code like MELCOR these conservatisms would be uncovered.

MEMBER STETKAR: In this case, I'd rather use the word conservative to there are places that the PRA models are absolutely wrong.

MEMBER BONACA: The question I have is what is the frequency of --

MEMBER STETKAR: No. If the SPAR model shows this as the functional equivalent of the loss of all AC power where the operators must shed loads and eventually you lose batteries, the SPAR model is, I'll use the simple term, wrong. It is not correct.

MEMBER APOSTOLAKIS: John, they have a description of the branch of the tree.

MEMBER BONACA: Listen. I had a question.

MEMBER STETKAR: Where?

MEMBER APOSTOLAKIS: In the document they sent us.

MEMBER STETKAR: Yes. I didn't read that.

MEMBER APOSTOLAKIS: This document under Peach Bottom cut-set review.

MEMBER STETKAR: Okay.

MEMBER APOSTOLAKIS: And they say there are three different sequences all initiated by loss of heat --

MEMBER BONACA: What is the frequency of loss of vital AC bus?

MEMBER APOSTOLAKIS: They have all this information here. I can tell you what it is.

MEMBER BONACA: Yes. Could you give me that number?

MEMBER APOSTOLAKIS: Yes. The CDF resulting from all this is $2(10)^{-6}$.

MEMBER BONACA: Yes. That's fine.

MR. SCHAPEROW: Originally. That was the initial evaluation.

MEMBER BONACA: What is the frequency --

MEMBER APOSTOLAKIS: Yes.

MR. SCHAPEROW: We went back and revisited that and it wasn't that high.

MEMBER APOSTOLAKIS: The initiating event is $9(10)^{-3}$ almost 10^{-2}.

MEMBER BONACA: Yes. Almost 10^{-2}.

MEMBER APOSTOLAKIS: Yes. And now if you want to know the other events, do you want to know what is going on?

DR. WALLIS: We wonder whether the sequence of events makes sense.

MEMBER BONACA: Yes.

MEMBER APOSTOLAKIS: Loss of vital AC bus E-12 and failures of HPCIC and RCIC, pump hardware failures, DC power failures and reactor coolant system depressurization, power switch failure, DC power failure or operator error. That's one. That's a dominant sequence.

MEMBER BONACA: All right. So you have a sequence of --

MEMBER KRESS: They have a bunch of things. So this title is misleading.

MEMBER APOSTOLAKIS: This is 95 percent of the total contribution of this initiator.

DR. WALLIS: This is all DC power?

MEMBER APOSTOLAKIS: So it's loss of vital bus and failures of HPCIC, RCIC (pump hardware failures, DC power failures) and RCS depressurization, power switch failure, DC power failure or operator error. So that takes you from a 10^{-3} initiator.

MEMBER BONACA: To 10^{-2}.

MEMBER APOSTOLAKIS: To a 2 (10^{-6}) sequence for core damage.

MEMBER BONACA: Okay. Now I understand. I just was looking at this. This is --

MEMBER STETKAR: Okay. Go on with this. I don't understand it, but that's all right.

CHAIRMAN SHACK: It's additional failures.

MEMBER APOSTOLAKIS: Additional failures.

MEMBER STETKAR: The other problem is that he said RCIC fails and RCIC is working here. So I don't understand.

MR. SCHAPEROW: I didn't list all the failures.

MEMBER STETKAR: Yes.

MR. SCHAPEROW: In shorthand, I listed what was working.

MEMBER APOSTOLAKIS: There are three sequences. That was the dominant one. In the second one, loss of vital bus E-12 with failure of SBCSDC, operator error, hardware failures, operators fail to recover PSC, containment failure due to initiator failing CVS and late injections and boldface letters, HPCIC, RCIC and RCS depressurization are successful. So that's the second sequence.

And the third one which is really very small frequency, loss of vital AC bus E-12 with a failure of the reactor protection system ATWS. We have an ATWS, but that's a very low frequency. So there are three sequences. The most dominant one is where you lose actually HPCIC and RCIC and it says due to hardware faillure.

MEMBER BONACA: Just reading the slides I just felt uncomfortable about one event like this causing all the drama and there are other failures.

MEMBER KRESS: Causing so much damage.

MEMBER BONACA: Okay. That's fine.

MR. PRATO: Slide 44.

MR. SCHAPEROW: Actually I can take us through a bunch of sensitivities we did. Let me just briefly mention. We did shut-off. We did a sensitivity without maximizing CRD flow. We did a sensitivity with and without this CRDHF off to prevent the overfill of vessel. We also looked at this operator depressurization. Anyway, the bottom line is that in just about all of these cases we have averted core damage and only in some of the most severe cases here did we get into core damage and we did not get vessel failure.

Slide 45. Again what we set out to show here and indicate that we did have sufficient injection with the remaining available systems for the sequence to prevent core damage and that SPAR and I think the other PRA models generally did not do much in the line of crediting CRD for coolant makeup. Again, CRD becomes important once if you can depressurize. Of course, you get more flow. If you can get farther out in the decay power curve, then CRD is very helpful.

Another thing that we didn't even model in here in this sequence, we did have another system available which was standby liquid control. Again, another 150 gpm, could be important if you have nothing else and trying to coupe with 150 gpm need from boiling off.

MEMBER STETKAR: Not a lot of volume though.

MR. SCHAPEROW: No, it's true. Well, if it gets out to the decay heat curve --

MR. PRATO: You saw what a difference from 110 to 180 did and that's --

MEMBER STETKAR: Every little bit helps.

IV. SURRY RESULTS

MR. SCHAPEROW: Again we're trying to highlight the importance of mitigation and where some of these things could benefit the risk modeling.

If you'll move to slide 46, I'd like to start on Surry sequences. Surry, we have more sequences. We have actually four scenarios that we identified from our review.

MR. PRATO: Can I make a suggestion? The most severe sequence for Surry is the short-term station blackout. Can we go into that sequence in more depth and then come back and look at these other sequences at a little higher level?

MEMBER ARMIJO: Sounds good.

MR. SCHAPEROW: Gee, I thought the long-term was kind of interesting because it's a nice contrast for -- we just did the Peach Bottom long-term.

MEMBER APOSTOLAKIS: By the way, you are ahead of schedule now if you start moving to Surry.

CHAIRMAN SHACK: Since we are losing people, I'd like to move ahead.

MR. SCHAPEROW: Whatever you would like.

CHAIRMAN SHACK: Just keep going on.

MEMBER APOSTOLAKIS: So let's do what Bob suggested and look at that sequence.

MR. SCHAPEROW: All right.

MEMBER APOSTOLAKIS: I don't think you have time to go through the four.

MR. SCHAPEROW: Let's move to slide --

MR. PRATO: Sixty-one.

MR. SCHAPEROW: This is a sequence of core damage frequency of 1 X 10^{-6}.

MEMBER APOSTOLAKIS: Sixty-one?

MR. PRATO: I'm sorry. Fifty-nine.

MR. SCHAPEROW: Fifty-nine. This is shall we say a pretty severe sequence if I can use the term loosely.

MEMBER APOSTOLAKIS: Short-term --

MEMBER CORRADINI: This is seismic.

MR. SCHAPEROW: That's right. This is seismic.

MEMBER APOSTOLAKIS: This is seismic?

MR. SCHAPEROW: This is a seismic flooding and fire. This is an external event with a frequency of 1 or 2 X 10^{-6}.

MEMBER STETKAR: This one is consequences.

MEMBER APOSTOLAKIS: And on the inside.

MR. SCHAPEROW: That's right. I tried to list here the big deal ones which is that we've lost

AC and DC power. So that's a big deal because now we've lost all our injection and all our controls. We lost our indication.

MEMBER APOSTOLAKIS: We lost the turbine driven pump.

MEMBER STETKAR: I'll play the same game. Any idea what g level you're talking about here?

MR. PRATO: Close to 1g, sir.

MR. SCHAPEROW: Close to 1g. You're up in the same range. The second item I've listed here is mechanical failure of turbine-driven aux feedwater.

MEMBER STETKAR: It's interesting that the independent mechanical failure of the turbine-driven aux feedwater pump is much more likely than its conditional probability of failing under a 1g earthquake because typically the mechanical failure of the turbine-driven aux feedwater, I mean, even if it's 0.1 which is pretty bad that says --

MEMBER APOSTOLAKIS: He's not saying it's independent of the earthquake, is he?

MR. SCHAPEROW: No, this is caused by the earthquake.

MEMBER STETKAR: It is caused by the earthquake.

MEMBER APOSTOLAKIS: Yes.

MEMBER STETKAR: Okay. I'm sorry.

MR. SCHAPEROW: Another analysis --

MEMBER APOSTOLAKIS: He's just pointing out --

(Several speaking at once.)

MEMBER STETKAR: Okay. I'm sorry.

MR. SCHAPEROW: In a previous analysis that we did for Surry a couple years back and we presented to the Committee the effect of losing power to the turbine-driven aux feedpump at Surry would be that the Surry -- this pump would come on at design speed and run and fill up the reactor vessel.

MEMBER STETKAR: Okay. I'm sorry. I misunderstood.

MR. SCHAPEROW: The reason this is here is because this is kind of to contrast with some earlier analysis that we presented to the Committee. We said we got no injection at time zero. Boom. Nothing.

(Several speaking at once.)

MEMBER APOSTOLAKIS: You can start there by saying the external event causes and you have the three --

MR. SCHAPEROW: I'm sorry.

MEMBER APOSTOLAKIS: You don't have to be sorry, Jason.

MR. SCHAPEROW: I try to be as -- as I can.

(Several speaking at once.)

MR. SCHAPEROW: So again we analyzed two cases. For our mitigated case, we began spraying into the containment spray system with a portable pump. This is one of the B.5.b improvements. For the unmitigated case, we assumed nothing. Nobody did anything. The plant just went on its merry way and started having a meltdown.

With regard to the B.5.b mitigation that we used in this analysis, we evaluated the ability or the idea of injection with the portable pumps into the RCS and into the steam generator. They could do this. We thought maybe it would be hard to do because things are happening fairly quickly with regard to accident progression.

MEMBER ABDEL-KHALIK: What do you think if you would -- What would happen if you would inject water into bone dry steam generators?

MR. SCHAPEROW: What would happen?

MEMBER ABDEL-KHALIK: You would make a lot of steam.

MR. SCHAPEROW: That is an action they may try to take at some point during this. That's true.

MEMBER STETKAR: But you're saying you didn't take credit for that.

MR. SCHAPEROW: No, we did not take credit -- By the way, we didn't take credit for injection into the steam generator reactor coolant system. What we did take credit for was hooking up and injecting into the containment spray system at eight hours with a portable pump with one of the series portable B.5.b pumps.

MEMBER ARMIJO: In the B.5.b options, that's the only thing left?

MR. PRATO: No sir. There are multiple options. We don't know the state of the plant. Accessibility is difficult. We know that. Water source, the limitation on water source, being available, the extra running of hoses and stuff like that, all of that accumulated into us taking a more conservative approach and instead of giving them two hours to hook up this pump, we said it was going to take a lot longer and we gave them until eight hours which was sufficient for containment.

DR. WALLIS: Does the steam generator a little thing that says "attach emergency pump here"?

MR. PRATO: No sir. But it is procedure.

MEMBER STETKAR: They do at some plants.

I mean they do.

MR. PRATO: It is proceduralized. They have it in their procedures.

MEMBER STETKAR: If they put it in, they do have --

DR. WALLIS: They have to have it some very clear.

MEMBER STETKAR: They do a pretty good flanged fire hose connection.

DR. WALLIS: Very accessible and everything. Right.

MR. SCHAPEROW: The setup they delivered this capacity which was called LFFG, loss of the large flood and fire guidelines which Surry has put into place to have procedures to implement these portable pumps.

DR. WALLIS: They have to actually move it around. They can't just open a valve. They have to move the pump to the --

MR. PRATO: Yes sir.

MR. SCHAPEROW: That's right. But Surry has three pumps and two relatively high pressure pumps, about 1,000 pounds in the 250 gpm area and then they also have one low pressure pump which is just a 2,000 gpm pump.

DR. WALLIS: On the back of a pickup or something?

MR. SCHAPEROW: They are skid mounted. They actually built a shed to house these things. They're in a steel shed just outside the protected area.

DR. WALLIS: They have to tote them with something?

MR. SCHAPEROW: They have to either forklift or pick it up and bring it over to where they need it.

MEMBER ABDEL-KHALIK: And power to those pumps comes from?

MR. SCHAPEROW: They are all diesel-driven. They're self-contained. The whole thing is on a pad.

CHAIRMAN SHACK: Skid.

MEMBER APOSTOLAKIS: What?

MR. SCHAPEROW: These three portable pumps that Surry purchased are all skid-mounted.

MEMBER CORRADINI: I'm just listening to all this and so I have it a distance away from the reactor. And after a seismic event, I have to go get it. I have to move it into place and connect it.

MR. SCHAPEROW: That's right. It takes

time.

MEMBER CORRADINI: And so it's not all seismically, whatever. So all hell could be broken loose between the island where it's nice and everything is working a la Japan and 100 or 200 yards away where it's in -- I just want to understand --

MR. PRATO: It's right outside the fence line.

MR. SCHAPEROW: It's not that far.

MR. PRATO: Okay. So it's on Hog Island. Okay. The typical hookup time to estimate would be around two hours and that's why we pushed it out to eight hours and said -- four.

MEMBER STETKAR: Is it stored in a seismically qualified --

MR. SCHAPEROW: It's a shed. It's a steel, like a very light duty steel shed.

CHAIRMAN SHACK: That's either good or bad, but it's --

(Several speaking at once.)

MEMBER STETKAR: You could -- but the fire trucks are stored in a rather non-seismically qualified garage that collapses in the earthquake. So you don't get the fire truck out.

MR. SCHAPEROW: I'd like to go to slide 61 and just talk a little bit more about these portable pumps. We assume that the portable pump would run until the containment was filled one meter above the bottom of the vessel. That's about one million gallons. So we turned it on at eight hours and we ran it until it reached one million gallons in the containment. In the very, very long term, we did see a containment overpressure. Eventually all that water would start boiling in the very, very long term assuming nobody did anything.

When we did manage to overpressurized the containment at three days, of course, we didn't get a release of the noble gas because everything was in the water. We could have done the calculation a little differently if we would have assumed intermittent spray. We could have kept containment from failing for very long periods of time. We could have put more water in the containment.

I would like to bring you through a couple of the notebook plots here like I had in the past.

MEMBER CORRADINI: So this -- I'm sorry. I just want to make sure I get this. So the STSBO --

MR. SCHAPEROW: Short-term station blackout, right.

MEMBER CORRADINI: Somewhere between two

and eight hours they toddle over this thing and pump in one million gallons through the containment spray header.

MR. SCHAPEROW: Correct. You'll see that reflected in the -- Not in the plot.

MEMBER CORRADINI: And then they -- Poof and the water runs out.

MR. SCHAPEROW: Pardon?

MEMBER CORRADINI: And the water runs out.

MR. SCHAPEROW: We just assume it's shut off.

MEMBER CORRADINI: Shut off. I'm sorry.

MR. SCHAPEROW: It's just an assumption of the calculation. We could have let run longer. It could have run it intermittently or perhaps prevent containment failure.

Okay. Go to reactor pressure, slide 62. Initially, you see this big drop in pressure until you get to about one hour. That's the heat removal by whatever water is remaining in the steam generators. At one hour, the steam generators is dried out. There's a dry out. Now we start to see the reactor coolant system increase until we go up to the relief valve setpoint and the relief valve opens and closes. So you see the squiggly line. Around three hours we start to get into core damage.

MEMBER CORRADINI: Why does the squiggly line stop?

MEMBER ARMIJO: It failed open I guess.

MEMBER CORRADINI: Did something stick open?

MR. SCHAPEROW: Let me just check my notes. That may be our reactor coolant pump seal leakage.

MEMBER CORRADINI: That sounds right.

MR. SCHAPEROW: Randy, do you have this marked on your slide?

MR. GAUNTT: What is the question?

MR. SCHAPEROW: On the three hour station blackout pressure spots.

MEMBER CORRADINI: Just before three hours, why does the squiggly line get nice and smooth?

MR. GAUNTT: I think that's a bad sign because the water level in the core filled up to the point that the steam is not produced rapidly enough to keep the --

MEMBER CORRADINI: So we're not essentially below mid-plane, possibly just a couple feet of water left.

MR. GAUNTT: I believe that's what you're seeing. It could be near bottom of active fuel.

MR. SCHAPEROW: It could be because again we do have reactor coolant pump seal leakage once this thing starts heating up.

DR. WALLIS: Or vessel dryout is there almost.

MR. SCHAPEROW: We are starting to melt the core, to degrade the core, and we do get hot leg creep rupture at almost four hours at which point we depressurize into the containment.

There's your answer on the next slide. We get an accumulator injection at -- No, wait a minute. That's not it.

DR. WALLIS: Are you sure that the hot leg fails before the steam generator tubes?

MR. SCHAPEROW: Pardon?

DR. WALLIS: Are you sure that the hot leg fails before the steam generator tubes?

MR. SCHAPEROW: We do have a plan over the next few months to look a little bit more at that issue. We haven't done a lot in that area. Of course, the conditions for steam generator tubes is a stuck open -- Is a stuck open relief valve on the -- or some kind of high leakage on the steam generator and high pressure on the primary. We may not even be in those conditions. But we need to look at that some more. We haven't really done that justice yet.

MEMBER CORRADINI: Let me ask you another question please. So back on page or slide 62, hot leg C creep rupture, why there?

MR. SCHAPEROW: Why C?

MEMBER CORRADINI: Or why a hot leg? Why not the steam generator tubes? It's a u-tube steam generator.

(Off the record comment.)

MEMBER CORRADINI: Did I miss something?

PARTICIPANT: Yes. Steam generators.

MEMBER CORRADINI: I'm sorry, Graham.

DR. WALLIS: That's okay.

MR. TINKLER: It is true that this calculation is -- If you look on 62, you'll see that air steam generators are still sitting at pressure. So we don't -- because it has the steam generator pressure shown on that also. So conventionally the issue of thermally-induced rupture is associated with the high, dry, low. In this case, we don't have a depressurized secondary side. Now that is a subset of this sequence without going back into the frequency argument. But this particular calculation because it's not a high, dry, low MELCOR's global calculation will track the steam generator tubes but we wouldn't get close. The damage index wouldn't be anywhere near high enough in this case.

We don't mean for that to be a substitute for the more detailed fluent calculations and we're all very well aware with that and Jason mentioned we're going to look at that a little more closely depending on the conditional probability. But we also will then have to sort out what fraction of these SBOs go to that condition where the primary side is pressurized and the secondary side is depressurized.

MEMBER STETKAR: What is -- the decent side of the operators might blow down the secondary side in the first couple of hours or so because of creep.

MR. TINKLER: They might try to cool it down but in the absence of any injection --

MEMBER STETKAR: That's right. In a sense, no DC power is helping you here in terms of that issue.

MR. TINKLER: Right.

MEMBER ABDEL-KHALIK: What is holding the steam generator pressure after it becomes totally dry?

MR. SCHAPEROW: The relief valves are still functioning. So it's just sitting there --

DR. WALLIS: So it's not cooled very well.

MR. SCHAPEROW: It's totally dry. It's full of steam.

MEMBER ABDEL-KHALIK: Right.

MR. SCHAPEROW: That's what I mean by dry. By dry means no liquid water in there.

MEMBER ABDEL-KHALIK: Right.

DR. WALLIS: What fails depends very much on you estimate the heat transfer coefficient in the steam generators, isn't it?

MEMBER CORRADINI: I guess what we're all asking is -- where it fails.

MR. TINKLER: Correct.

MEMBER CORRADINI: It has to fail somewhere.

MR. TINKLER: But the issue here is at the time of highlight failure we just don't have that maximum delta P across the tubes.

MEMBER ABDEL-KHALIK: If the steam generator is completely dry and one of the valves on the secondary side were to lift, the pressure will drop just like a rock. There's nothing in there to keep it up.

MR. TINKLER: Agreed. But again it's the same issue. We have no --

MEMBER STETKAR: Experience opening valve would get it.

MR. TINKLER: We're not generating enough pressure in this to cause it to lift at this point. I guess I don't understand why it wouldn't reseat if it's operating on safety mode.

MR. SCHAPEROW: We predict that it would reseat. Now you see the frequency of the thing opening and closing is a lot less in this region. But it does reseat.

MEMBER CORRADINI: So this is really a detail of sequence I guess I missed. So your point is that it stays structurally -- We lose pressure because I'm failing outside of the steam generator but near the entrance into the steam generator.

MR. TINKLER: No, we're failing at the hot leg nozzle.

MEMBER CORRADINI: The hot leg nozzle.

MR. TINKLER: We fail at the nozzle.

MEMBER STETKAR: Depressurizing the primary system.

MEMBER CORRADINI: It's a depressurization system.

DR. WALLIS: But it doesn't cross the containment.

MEMBER CORRADINI: Yes, I understand.

MR. TINKLER: It's hottest closest to the core. That's where it fails at the nozzle.

CHAIRMAN SHACK: Now in the high dry version, there's a real race between the hot leg and the steam generator.

MR. TINKLER: Agreed, but that's typically a high, dry, low. Okay.

DR. WALLIS: Right.

MR. TINKLER: And I'm pretty sure that even our latest calculations where we have not the average tube but a peak tube temperature where the secondary side stays pressurized that the creep damage index is not -- and you need a very, very severe flaw distribution to produce that. But again, we will look at that subset of it in the next --

CHAIRMAN SHACK: Just coming back to the larger question again, you know, how we address uncertainty, this scenario by scenario thing sort of leaves me -- and I think it confuses everybody. They all want to say suppose RCIC goes. Well, that really was a sequence you did look at and you somehow shifted out. But how confident are these that somehow you have the most severe mean sequence?

MEMBER CORRADINI: They're saying that

they've taken a sequence path that encapsulates three or four like you described to us and that the path they take is kind of conservative.

MEMBER APOSTOLAKIS: But there is also --

MEMBER CORRADINI: It's not best estimate because there are a number of things it's trying to envelope. Is that your point?

MEMBER APOSTOLAKIS: I mean, the LPCI was down in one of the sequences with --

CHAIRMAN SHACK: You have this family of sequences that are around this frequency. But somehow when I get right down to it, I pick a sequence and how do I know --

MEMBER APOSTOLAKIS: It comes down what they mean by sequencing. I think they have grouped certain things.

MR. TINKLER: That is actually -- That's quite true. They are groups. There are many cut-sets within this. Now for a sequence that has potential for bypass --

CHAIRMAN SHACK: So you picked this one sequence and you assign it the group frequency?

MR. TINKLER: Yes.

CHAIRMAN SHACK: This is the worst sequence within that group.

MR. TINKLER: Yes.

CHAIRMAN SHACK: And, okay, it gets the group frequency.

MR. TINKLER: Typically.

MEMBER APOSTOLAKIS: This is consistent with what we discussed earlier because in the E-12 is an initiating event. The very dominant sequence is when you don't have low pressure rejection. But then they assume as John pointed out that LPCI was there in some of the situations. So it's not clear how that is handled. We probably have to go down to much more detail.

MR. PRATO: Rich, can you help?

MR. SHERRY: Well, we group sequences and then look at sequences for its characteristics. But we often go below the sequence level to look at individual cut-sets particularly when we want to determine which systems are operating and which are failed. And sometimes we make judgments about we'll select the sequence to evaluate from the cut-set which has the dominant frequency or perhaps one which is more bounding, has less equipment available.

There was no hard and fast rule about which accident progression in terms of equipment available or not being available that we actually chose to analyze. And bus E-12 is sort of a special case because it's really a sequence which has been screened out and I think Jason is showing you sort of historical analysis results and there's a history ab out why it was screened, why it was initially included.

CHAIRMAN SHACK: I'm just sort of -- I'm still unclear in general how the process goes to convince myself that I've gotten out of all the sequences I could pick I've picked the right one for this analysis, if not this one, the seismic external event one.

MR. SHERRY: I think it's a judgment call. That's what's right. Is it the highest frequency cut-set? Is it one you believe at least in the highest consequence even though it has much lower frequency than other cut-sets?

CHAIRMAN SHACK: It's the highest consequence sequence with a frequency greater than 10^{-6} to be consistent.

MEMBER APOSTOLAKIS: That's right.

MR. SHERRY: Then we would probably eliminate everything if we were looking for --

CHAIRMAN SHACK: Yes, that's why you picked these groups.

MR. TINKLER: That's why we picked groups.

CHAIRMAN SHACK: So you have a sort of conservatism there in this.

MEMBER APOSTOLAKIS: But the problem is that in the groups what they call cut-sets, in some cut-sets, certain systems operate. In others, they don't. In the analysis --

MEMBER CORRADINI: Only one thing is done.

MEMBER APOSTOLAKIS: I think only one thing is done.

MEMBER CORRADINI: Right. That's the question that started Bill's --

CHAIRMAN SHACK: But again if they've sort of grouped them and then picked the worst sequence within the group but assigned the group frequency to it --

MR. TINKLER: That's typically true and frankly --

CHAIRMAN SHACK: It's typical that --

MR. TINKLER: The E-12 is kind of an anomalous case. The rest of them we're talking about blackouts where nothing is working. It's not like -- The only question then is which of the B.5.b strategies do you choose. But it wasn't in the blackout sequences. It wasn't a case of --

CHAIRMAN SHACK: No. If I didn't have RCIC, there's a difference between my short-term blackout and my long-term blackout.

MR. TINKLER: Agreed. But then you're talking about an additional failure.

CHAIRMAN SHACK: But you're telling me that's outside my group.

MR. TINKLER: But that was the -- And I did --

CHAIRMAN SHACK: See. I haven't gotten a good feel for how the group was selected because I know it wasn't strictly a 10^{-6} cutoff.

MR. TINKLER: But in the case of long-term station blackout, it's quite clear. But we also conceded, we didn't consider short-term station blackout which would have had a different treatment of RCIC. Now an additional independent failure of RCIC we did not consider because frankly that's not part of that group. An additional independent failure outside of blackout of that wouldn't have been considered.

CHAIRMAN SHACK: What -- the group?

MR. SCHAPEROW: Equipment operating. These are equipment operate.

CHAIRMAN SHACK: Okay.

MR. SCHAPEROW: So you have a different

piece of equipment. You would have a different group.

MEMBER APOSTOLAKIS: But actually in the write-up you're saying that there are three sequences that start with loss of E-12. But the one that will really be evaluated but for MELCOR, with MELCOR, is the one where HPIC and RCIC are down. You say that very clearly here.

MR. SCHAPEROW: The E-12 case was a case where we had to go down to the cut-set level because some of the cut-sets have different equipment operating than other cut-sets. So we divided that into different sequence groups. That's correct and we evaluated the one that had --

MEMBER APOSTOLAKIS: What you're saying here is that you identified the sequence number 39 as a CDF of $2(10^{-6})$. There is a description that clearly states that HPIC and RCIC has failed and then you say sequence group will be further evaluated. Then you go down to again E-12 but now HPIC and RCIC are successful and you say sequence group is screened out because its CDF is more than an order of magnitude lower than 10^{-6}. So you very explicitly state that the sequence where the RCIC is working is screened out.

DR. WALLIS: That's like to the one where it doesn't work?

MR. SCHAPEROW: No.

CHAIRMAN SHACK: But I think that's the reason why this is an historical result. This isn't one of their real sequences.

MEMBER APOSTOLAKIS: Yes, but why is it --

MEMBER STETKAR: If it was screened out because it didn't go to core damage because RCIC was working in a condition where it shouldn't been working, that's George's point. Their initial conditions were for that sequence RCIC was not working, but they eventually screened it out because they said it doesn't really go to core damage with a more detailed analysis. But the detailed analysis took credit for RCIC.

MR. SCHAPEROW: Yes. We also screened it out on the basis there was a different number in the SPAR model. One of the numbers it had was a number that was too high on it, one of the branch points. So it moved down in frequency and then after they did that, we also did a MELCOR analysis and it disappeared on the --

MEMBER STETKAR: But the MELCOR analysis with the RCIC working for a condition where RCIC shouldn't have worked.

MR. SCHAPEROW: Yes, but there was also an error found in the SPAR model.

MEMBER STETKAR: Don't confuse. Two wrongs don't make a right. There might be wrong numbers in an event tree someplace and that's one issue and if that's good enough to make it go 10^{-6} then we shouldn't be discussing it in this forum. Right?

MR. SCHAPEROW: Again, the reason I showed that was to show that application of an integrated tool such as MELCOR might make some of these core damage scenarios go away because when PRAs are done they have to make certain assumptions because the tools weren't available and sometimes the analysis is too costly for whatever reason.

I would like to move onto the level --

CHAIRMAN SHACK: We're going to go to 12:30 p.m. before we break for lunch.

MEMBER CORRADINI: Now that we've gotten the sequences all squared away, I want to ask one thing of Randy if I could or the guys back here. Hot leg C creep rupture, does MELCOR track this and has a temperature failure criterion and it looks at stress and temperature and then says when I hit that point at one of my nodes I then pop it open and that can happen whether it be in the hot leg or the steam generator?

MR. GAUNTT: That's right.

MEMBER CORRADINI: Okay.

MR. GAUNTT: The code is tracking three potential failure locations, the hot leg nozzle, the surge line and then the steam generator tubes.

MEMBER CORRADINI: Okay. And three representative --

MR. GAUNTT: It's doing a creep failure damage function kind of analysis.

MEMBER CORRADINI: Not that I don't trust MELCOR. I trust it. But if I went back 20 years ago, there was a whole lot of other calculations done with various things. Was there anything to benchmark that you'd actually get it here versus in the steam generator tube with a more sophisticated treatment where everything else was essentially, shall I say, boundary-fitted? I'm trying to think back. You guys were doing some stuff and I can't remember tool you used. EPRI was doing some stuff.

MR. TINKLER: We have spent a lot of time comparing these calculations against the system level SCDAP/RELAP calculations.

MEMBER CORRADINI: Sure. Okay. And you're seeing similar --

MR. TINKLER: Yes. Of course.

MEMBER CORRADINI: Okay. Fine.

MR. TINKLER: Now what it doesn't reflect is the peak tube versus the average tube. SCDAP/RELAP calculates an average tube and then you can kind of adjust for a peak tube based on fluent calculations or other more detailed tracking of mixing and flow within the tube bundle. We have not done that yet here.

MEMBER CORRADINI: Okay. Thank you.

CHAIRMAN SHACK: But for the case where you don't depressurize the secondary side, I don't think there would be a whole lot of --

MR. TINKLER: That's correct. The SCDAP/RELAP calculations will show that you do not depressurize the secondary side you would not threaten the tubes and nothing about the fluent calculations would change that.

MEMBER CORRADINI: I couldn't remember it was SCDAP/RELAP. Thanks, Charlie.

MR. SCHAPEROW: I would like to move to slide 63, reactor vessel level response for this case. You see the water level declines. We are losing water out through the pressurizer PORV. The core eventually becomes uncovered, degrades, fails the reactor vessel low head at seven hours.

The mitigation for this case is the portable power to provide containment spray and you can see this actually starts to get into the vessel here at around 14 hours. We flooded up the containment until we start seeing water in the vessel because of course there is a hole in the bottom of the vessel now.

MEMBER ARMIJO: I'm not that familiar with this system, but why did the accumulators eject water?

MEMBER CORRADINI: That's just when you depressure. That's coincident when the pressure came down on the previous slide.

MR. PRATO: They auto-initiate around 600 pounds.

MR. SCHAPEROW: So if you look at the pressure slide it shows the drop in pressure when the hot leg ruptures and that's when the pressure is low enough for the accumulators to start pushing water into the --

DR. WALLIS: So cavity floods in the failed vessel is the point where the vessel fails.

MR. SCHAPEROW: No, the vessel fails at seven hours.

DR. WALLIS: So it's been failed for all that time? Where has the core gone?

MR. SCHAPEROW: It failed at seven hours. The core went down below into the cavity and it's interacting with the concrete there.

DR. WALLIS: Okay. I was just wondering.

MR. SCHAPEROW: It's actually boiling off some water that's down in the cavity. There's a little water in the cavity.

DR. WALLIS: State here where the vessel fails.

MR. SCHAPEROW: Yes. That's a little bit helpful.

MEMBER STETKAR: You start in this scenario, you start the emergency diesel containment sprays at around eight hours.

MR. SCHAPEROW: Correct.

MEMBER ARMIJO: Now why weren't they available earlier? My other question is why is this called a short-term station blackout. It seems like you're in trouble for a long time.

MR. SCHAPEROW: Okay. The short-term is meant to indicate that things happen very quickly in the short-term. We lost power, boom, boom. Everything is gone. It's also known as -- Sometimes I think in some PRAs is known as a fast station blackout where things happen quickly.

MEMBER ARMIJO: Okay.

MR. SCHAPEROW: The other one is about the emergency containment sprays. This again is located in a shed or a small garage just outside the protected area. They have to put the thing on a forklift, bring it into position, install it. So it takes a couple of hours.

MEMBER STETKAR: These are the skids.

MR. SCHAPEROW: That's right. Skid-mounted.

MEMBER STETKAR: These are the portable.

MEMBER CORRADINI: And so they sit there pumping in one million gallons from eight hours until 15 hours.

MR. SCHAPEROW: Correct.

MEMBER CORRADINI: Got it.

DR. WALLIS: And the core is on the floor all this time.

MR. SCHAPEROW: That's correct and it's flooded with this water.

DR. WALLIS: By this time, what's happening physically?

MEMBER CORRADINI: Not much of interest.

MR. SCHAPEROW: It's ablation. It's ablating the floor. It's being cooled from above from the water.

CHAIRMAN SHACK: Just to go back to your previous calculation, that really assumes a loop seal exists. Right? This is all this recirculating flow.

MR. SCHAPEROW: That's correct.

CHAIRMAN SHACK: And MELCOR, you put the loop seal in or MELCOR tells you whether or not there's a loop seal or not?

MR. SCHAPEROW: I believe this is completely analogous to this SCDAP/RELAP calculations that you see many of. The loop seal is there from the beginning.

CHAIRMAN SHACK: You just postulate the existence of it.

MR. GAUNTT: The loop seal is modeled and --

MEMBER CORRADINI: I think you have to go to the microphone again.

MR. GAUNTT: I'm sorry.

MEMBER CORRADINI: Just pull up a chair.

MR. GAUNTT: The loop seal is actually physically modeled in the code. What we don't consider is if you were to blow a pump seal, what effect would that have on maybe clearing the loop seal.

MEMBER CORRADINI: In terms of creating flow on the cold --

MR. GAUNTT: Yes.

MEMBER CORRADINI: Okay.

MR. SCHAPEROW: If you would please turn to slide 64. The action of this containment spray as you can see delays the containment failure which is --

MEMBER ABDEL-KHALIK: I assume this is megaPascals.

MR. SCHAPEROW: Yes. That was a mistake.

DR. WALLIS: It must be.

MR. SCHAPEROW: So pressure increases until we turn the sprays on. The sprays come on. Pressure decreases. You see the pressure spikes associated with hydrogen burns. Shut the sprays off at about a half a day here and then the pressure just rises as a result of the core on the floor heating up the water.

MEMBER CORRADINI: The spike at something before --

MR. SCHAPEROW: That's associated with a hot leg failure.

MEMBER CORRADINI: And then the next bump is the core on the floor?

MR. SCHAPEROW: Yes. Seven hours.

MEMBER CORRADINI: Six hours. Right?

MR. SCHAPEROW: Seven hours. Then next jump up -- The first jump is at three hours.

MEMBER CORRADINI: Yes. I understand. To answer Graham's question, that's everything, Graham, though from about six hours forward and that rise in pressure in the containment is due to all the stuff that's happening in the cavity.

DR. WALLIS: Now your sprays are bringing down the pressure initially?

MR. SCHAPEROW: That's right. The sprays are bringing the pressure down until we shut them off.

DR. WALLIS: Doesn't that depend upon what the flow rate is in the sprays? Isn't there some sort of energy balance? If you don't spray enough, you actually can add pressure. No?

MEMBER CORRADINI: We're way over that hump.

DR. WALLIS: We're way over that hump?

MEMBER CORRADINI: Yes. You mean in terms of essentially the effect of adding mass versus cooling.

DR. WALLIS: Right.

MEMBER CORRADINI: Yes, you're over that hump.

DR. WALLIS: Because you have enough flow.

MEMBER CORRADINI: Right.

DR. WALLIS: But if you didn't have that flow?

MEMBER CORRADINI: You could actually bump the pressure up.

DR. WALLIS: Right. So if your pump doesn't work as well as you thought.

MEMBER CORRADINI: I think it's an equal volume -- It's a mass ratio effect, but I think they're way, way --

DR. WALLIS: Way beyond.

MEMBER CORRADINI: -- beyond that.

MEMBER ABDEL-KHALIK: And these pulses in the pressure are caused by what?

MR. SCHAPEROW: The spray is condensing the steam. So we are no longer steam inerted and then we have the hydrogen in the containment which we burn and then the hydrogen builds up again and burns again. So you're seeing these hydrogen burns resulting in pressure pulses.

MEMBER APOSTOLAKIS: Now the pressure in the containment, the failure of pressure is about 60 pounds?

MR. SCHAPEROW: That's the design

pressure. This is an ultimate pressure that Ata had calculated.

MEMBER APOSTOLAKIS: And it can take up to 130?

MR. SCHAPEROW: I think it's 110 on this.

MEMBER APOSTOLAKIS: One hundred sixteen and then 131.

MR. SCHAPEROW: I'm sorry. I'm looking -- That's correct. About 110 pounds is the ultimate failure pressure for this containment.

MEMBER APOSTOLAKIS: What is the ultimate failure pressure?

MR. SCHAPEROW: One hundred and ten psi.

MEMBER APOSTOLAKIS: One hundred and ten.

MR. PRATO: Where the arrow is.

MEMBER CORRADINI: That's what the arrow shows, high leakage. Now it's starting to kind of open.

MEMBER APOSTOLAKIS: Yes.

MR. SCHAPEROW: So before that time all you have is design basis leakage and then once you get to this point, then you start -- you get liner failure. You start getting cracking of the concrete and start getting a bigger open area.

MEMBER ABDEL-KHALIK: Why were the sprays turned off? Because they just ran out of water?

MR. SCHAPEROW: It was just an assumption. We could have flooded it up even higher. I probably could have made it more likely scenario where they would run them intermittently if they had any sort of indication as to what was going on inside the containment.

DR. WALLIS: Why didn't they just keep spraying?

MR. SCHAPEROW: They could.

DR. WALLIS: Fill it up.

MR. SCHAPEROW: They could.

MEMBER APOSTOLAKIS: So why did you make that assumption?

MEMBER CORRADINI: They had no indication. I think that's where -- We're back to the effect that there's just no indiction. Right?

MR. SCHAPEROW: Why did I make that assumption?

DR. WALLIS: They know the pressure is going up and they turn the spray on again.

CHAIRMAN SHACK: I would have thought so.

MEMBER ABDEL-KHALIK: There was no reason for them to turn the sprays off.

MEMBER CORRADINI: But they have no -- I

just want to make sure I understood. They have no indication of what's going on. They were just following procedures to stick water in and they don't know of the effect of it from the outside.

MEMBER ABDEL-KHALIK: So what tells them to turn it off?

MEMBER CORRADINI: Somebody does.

MEMBER ABDEL-KHALIK: I have no time to conserve water.

MR. SCHAPEROW: They may just as well keep spraying it in.

(Off the record comments.)

MR. SCHAPEROW: Actually one of the bottom lines it doesn't really matter either way because the only thing that's going to get out is going to be in atmosphere is noble gases and you'll see that on the next slide.

MEMBER APOSTOLAKIS: But is there enough water to keep the sprays going?

DR. WALLIS: Does that have an indication of pressure in this thing?

MR. SCHAPEROW: From where?

MEMBER CORRADINI: The river.

DR. WALLIS: Is there an indication of the pressure in the containment?

MR. SCHAPEROW: No, they don't have anything.

DR. WALLIS: They have an indication of leakage though presumably or they wouldn't know that there is a leakage and turn the sprays on again. It's leaking a little bit right from the beginning, isn't it or is not?

MR. SCHAPEROW: That's designed leakage. It's like a pencil lead thickness. It's very --

DR. WALLIS: It can't detect any of that.

MR. SCHAPEROW: If you can turn to slide 65. This is just showing that none of the iodine leaves the containment and the same thing slide 66.

(Two conversations at once.)

MEMBER APOSTOLAKIS: You are doing this for the reason to be conservative. You're just turning off --

DR. WALLIS: So do you model the iodine oozing out through the concrete?

MEMBER APOSTOLAKIS: Yes, but I mean why --

DR. WALLIS: You have the concrete.

MR. PRATO: I think we need to find that out also. We're going to find out --

DR. WALLIS: You modeled that aerosol

deposition in the crack that it's oozing out through the concrete?

MR. SCHAPEROW: Do you mean if it was a design basis leakage?

DR. WALLIS: I mean, you say so much is deposited in containment. You assume that anything that gets into the leakage gets out and the iodine that gets in the leak gets out? Doesn't it get deposited in the leak?

MR. SCHAPEROW: It doesn't really start leaking until about three days and everything is already -- When it says deposited, that means in the water in the containment. It's not airborne anymore.

DR. WALLIS: It's not airborne anymore.

MR. SCHAPEROW: That's correct and so it's going to be down in the water.

DR. WALLIS: So it couldn't leak out anyway.

MR. SCHAPEROW: Yes. We would -- The sprays have been running for several hours and everything that's in the air is now in the water.

DR. WALLIS: So there is no iodine in the air at all?

MR. SCHAPEROW: No.

MEMBER CORRADINI: Nothing comes out with any flashing at pressure or -- No, you're holding pressure. Excuse me. I forgot. You're holding pressure. So you don't have an enormous hole. You basically are now getting equilibrium where it's leaking like a sieve at high pressure.

MR. SCHAPEROW: That's correct.

MEMBER CORRADINI: Thanks.

MEMBER ABDEL-KHALIK: If you look at the picture on page 65, can you dream up any scenario where this picture can be worse?

MR. SCHAPEROW: Worse.

MEMBER ABDEL-KHALIK: I mean, I can't think of any scenario. So the bottom line is if you can get water to the containment before the containment fails, you're not going to release anything out regardless of all the machinations that you can imagine beforehand.

MR. SCHAPEROW: I think this is consistent with the previous work on this containment that's a dry type of thing where these containments are seen as robust and they can last for a long time. The core is not going to attack because it's part of the core. The walls of the containment are -- So these containments are very strong and very robust.

DR. WALLIS: That's why it's there.

MR. SCHAPEROW: The Mark 1 has that special issue about the liner melt-through and it's a much smaller containment.

I'd like to kind of jump to slide 67. It's kind of an overall conclusion. Except for the noble gases, we don't see anything getting out. So, of course, no offsite consequences.

Slide 68, here's the same scenario but no containment sprays. Again, core damage time is at three hours, same as in the containment spray case. We see containment failure earlier in this case, in this case, at 25 hours.

MEMBER APOSTOLAKIS: So for 25 hours, we are doing nothing.

MR. SCHAPEROW: The containment is intact and the fission products are settling in the containment.

MEMBER APOSTOLAKIS: So there are mitigating measures. We are doing nothing.

MR. SCHAPEROW: That's right nothing.

MEMBER ABDEL-KHALIK: No spray.

MEMBER APOSTOLAKIS: We're just sitting there watching.

MR. SCHAPEROW: Everybody is gone home.

MEMBER ABDEL-KHALIK: Again, the first

three bullets there are things that were caused by the initiating event.

MR. SCHAPEROW: Correct. Right. Same as in the last case.

MEMBER ABDEL-KHALIK: Now what would happen if the rods didn't go in as a result of some mechanical failure in the system?

MEMBER APOSTOLAKIS: That's of low frequency. That's a --

MR. SCHAPEROW: At one point, it would push the frequency down. Another point is that once the water leaves the vessel and once you boil off the water from the vessel, everything is the same. You're no longer critical and you still have --

DR. WALLIS: To go back to Said, the only thing that could be worse than this would be if there's a failure of the core and the failure of the containment but almost simultaneous because of some event which did both at the same time.

MEMBER CORRADINI: That's called early containment.

DR. WALLIS: That's the worst thing then.

MEMBER CORRADINI: Those are the things they precluded in those three bullets.

DR. WALLIS: They just don't let it

happen. Yes.

MEMBER ABDEL-KHALIK: I mean, if we're assuming a severe seismic event.

DR. WALLIS: But the catastrophic vessel failure would also fail the containment presumably.

MEMBER APOSTOLAKIS: So the assumption is that the seismic event has failed the things you showed us but the containment's ultimate pressure virtually remains the same. Right?

MR. SCHAPEROW: That's correct.

MEMBER APOSTOLAKIS: So the earthquake does not affect the containment at all.

MR. SCHAPEROW: Yes.

MEMBER APOSTOLAKIS: Is that the reason --

DR. WALLIS: But it doesn't affect the rebars. The rebars are what holds it together, doesn't it?

MEMBER APOSTOLAKIS: But I mean, does it weaken them?

DR. WALLIS: It cracks the concrete. The rebar holds it together, doesn't it?

MEMBER APOSTOLAKIS: And then all of a sudden if you go above 110, they say enough and they go.

MR. PRATO: At 1g we're not expecting

buildings like the turbine building to fail. We're certainly not expecting the containment to fail. There is a NUREG out there, 4334, that talks about the individual controls and probability of failure. It uses ten plants and it evaluates --

MEMBER APOSTOLAKIS: I'm not only talking about the failure of the containment. But we are assuming that the ultimate strength is 110. Right?

MR. SCHAPEROW: That's correct.

MEMBER APOSTOLAKIS: And maybe it's not 110 anymore.

DR. WALLIS: So you want to publish a report like this in some form, something like this presumably and then all the smart people in places like the National Academy of Sciences are going to look at this and they're going to think about all the things that they could do to make a different scenario and there's going to be a lot of stuff coming back at you. Right?

MEMBER ARMIJO: No matter what you do it's going --

DR. WALLIS: No matter what you do. You could have a pretty robust presentation.

MEMBER ABDEL-KHALIK: And I think we just have a very big magnifying glass on stuff that's really not very important.

MEMBER APOSTOLAKIS: What do you mean, Said?

MEMBER ABDEL-KHALIK: We're just looking at the details of what happens to various parameters early on. This is on. This is off. When you can look at it with something like the slide on page 65. The only thing that will change is when this initial point is going to change and people will dream up all sorts of scenarios to push this point as early as they can push it.

MR. PRATO: We had to bound our analysis someplace. We had to. To be able to move forward, you have to make some decisions. You have to bound your analysis and you have to move forward.

MR. SCHAPEROW: I'd like to move onto slide 69 please.

DR. WALLIS: You have to move forward, but you also have to think about ways in which you could be wrong which somebody else might discover and we're trying to help you in that way because we're doing the same thing.

MR. PRATO: We understand that.

MR. SCHAPEROW: It's very much appreciated.

MEMBER ARMIJO: There are guys out there who don't want to help you. There's a lot of people out there.

MR. TINKLER: Actually, in this area for the large dry PWRs, we would argue that we've considered some pretty severe things in the past and then we embarked on a research program and showed that most of those things that were postulated weren't real.

MEMBER ARMIJO: That has to be up front.

MR. TINKLER: And we will.

MEMBER ARMIJO: Because we could be dragging those out over and over again.

MR. TINKLER: Once upon a time, we had a molten core in the bottom of the lower head and then we unzipped the lower head and then we spewed all the molten material into the containment. But then we did tests at three different scales and we did a sorted analysis and we show you couldn't get there.

DR. WALLIS: That's going to be in the report though, isn't it?

MEMBER ARMIJO: Yes, that has to be up front or else you're going to --

MR. TINKLER: Of course. But, of course, somebody else can postulate what if somebody left the door open or is there some other seismic event that could fail the containment in addition to this thing, a worse seismic event which has a lower frequency? So but you have talk more about the bounding argument, but phenomenologically, we have looked at what were traditionally --

DR. WALLIS: Is someone leaving the door open so unlikely when you talking about 10^{-6} and things like that?

MR. TINKLER: Only to the extent that people nowadays -- people have looked at continuous monitoring of penetrations and so forth in terms of leakage so that they can detect gross breaches of the containment boundary. In PRA, failure of containment isolation is a particular issue that is considered. Now it has its own independent failure probability and sometimes it's 10^{-3} and sometimes it's something else.

MR. SHERRY: It's particularly unlikely for Surry since it's subatmospheric and it would be detected quite rapidly.

MEMBER ABDEL-KHALIK: But you know if you're go again to that picture on page 66, in addition to the assumptions that you've made about things that have failed as a result of the initiating event, if the rods didn't actually go in, they didn't get a trip, this picture will, this initiating point will shift to the left by 20 minutes which will not appear on this scale.

DR. WALLIS: It's a very simple result, isn't it?

MEMBER ABDEL-KHALIK: So why are we arguing about all the little irrelevant details?

DR. WALLIS: You're saying as long as the containment holds nothing is going to happen of a significance.

MR. TINKLER: That's true. But if we issue a report that gives credence to a simultaneous blackout and failure of all systems and an ATWS, we're talking about -- If that's not vanishing small, nothing is. So if we put that in a report, it's true that the large dry and then somebody says you did that for the large dry PWR, why don't you do it for the BWR? So we can't just arbitrarily throw that in.

MEMBER ABDEL-KHALIK: I understand that.

MR. TINKLER: It's true that the margin in the PWR is so substantial it could tolerate anything because of the containment.

MEMBER ARMIJO: Is so big.

MR. TINKLER: But why did I impose that additional ATWS on the PWR and not the BWR?

MEMBER APOSTOLAKIS: It all comes down to, I think, to the cutoff frequency, doesn't it? The moment they cross over the threshold they say no, we don't -- But the other stuff they look at great detail.

MR. TINKLER: In defense of looking at the other stuff in great detail, in part we believe there are practical benefits to looking at that. So that elevates the importance of these measures, what has to be done, what has to be done on a timely fashion, what you need to do to make sure you can accomplish these things. That's where there's some real value added in mitigation. While it's not quite as interesting in terms of core melt and early fatalities, from a practical nuclear safety perspective we would argue that it has much larger value, focusing people on how to control a terry turbine and how many hours you have to do it.

Now that's not quite as spectacular a result, I agree, but we think that and to the extent it guides the Commission in establishing how much reliability it wants to associate with those measures and what kind of testing and so forth, we think there's a lot of value in that.

DR. WALLIS: I think the thing really

that's important for the public is that those accidents which do fail containment have this very low probability. That's much more significant than this kind of thing. That's the real message, isn't it? And then you have to justify that somehow.

MR. TINKLER: Yes, we do.

MR. SCHAPEROW: And actually to further clarify one of Charlie's points if you look at this next slide 69, one of the things that we found when we ran the unmitigated case, the one we did not do containment spray, is that pressure rose and by the time you got to about 15.6 hours you've now exceeded the shutoff head of the spray pump, of the pump you were going to use for spray. So one of the insights would be that you do have time to hook up the containment spray pump but you don't have forever. Eventually you're going to hit the shutoff head and you won't be able to hook it up. So you won't be able to pump with it.

MEMBER CORRADINI: So let me ask --

MEMBER ABDEL-KHALIK: For the pump that they have at that site.

MR. SCHAPEROW: That's right. For that pump. Surry has 15.6 hours to hook up that pump.

MEMBER CORRADINI: So let me ask a little bit different question than George asked just to re-ask it. So if I have a seismic event the basis that the leakage, you had it, we skipped it, curve as a function of pressure doesn't change because of some modification and the base integrity of the containment is based on what? In other words, on your slide, don't go back, there's no point, we have it in front of us, on your slide number --

CHAIRMAN SHACK: Twenty-two.

MEMBER CORRADINI: Thank you. Twenty-two where you have essentially P/P_d and leak rate versus that, if I have a seismic event that curves is not going to be the same for a seismically jostled containment. Now it will be different. But I guess my other question is is there some basis in terms of thinking about it physically that it's going to be not substantially different that wouldn't take your blue curve. Because what your blue curve is saying is this is the behavior where we just walk away. If I walk away, it may not be at 100, and whatever it was, 120 something but it might be at 110 something or it might be at 80 something. Do you see what I'm asking?

Where have you looked at the structural integrity when I've now -- because everything is being driven by the seismic event that the curve that you have in 22 may not be the curve and be just a curve of pristine, unwiggled containment?

MR. ISTAR: That's a very good question. But from the structural perspective, the containment was not evaluated based on the seismic event. But the actual curve is much more towards the right and we took numerous issues such as, you know, extreme temperature effect, irradiation, erosion/corrosion, and residual stress effects and to push that curve in a conservative manner. Now I believe it will include some seismic considerations as well. But we're not talking about seismic conditions so extreme that it really fails the containment structure.

MEMBER CORRADINI: I'm trying to be careful not to say fails the containment. I'm just saying changes its leakage rate as a function of P/P_d. That's all I'm saying which I think probably does.

MR. ISTAR: Concrete containments are very complicated structures. They are not like --

MEMBER CORRADINI: They're not a steel shell.

MR. ISTAR: Exactly. They are not ultra-perfect conditions. It's just we have two -- It's a composite structure first of all. You have the real boundary condition, leakage condition, is the liner.

As soon as the liner fails, you have a leak path to outside.

So during our visit to Surry, there was a lengthy discussion with the structural engineer whether any degradations on the liner have been found in the past which they found it and they fixed it and things and it's a huge structure and there might be some areas that -- And welding a seam, it's not an easy thing on a liner and always you're going to have porocities with that weld.

MEMBER CORRADINI: So let me -- You're being very good at telling me why I shouldn't worry about this, but let me just continue to worry. Let me ask the reverse question. You now have a calculation from the standpoint of the severe accident. Now have you done the reverse calculation on slide 22 and said how much would the leakage versus P/P_d have to degrade so that you would go from no early fatalities and no latent cancers to something that all of a sudden would pop up? In other words, how bad would it have to get so --

MEMBER ARMIJO: How much margin.

MEMBER CORRADINI: Yes. How much margin do you have? I guess I'm -- Sam said it right. Now you've made us feel good. Now I want to know how good

I should feel. Should I be jumping in the aisles or should I just be mildly warm and fuzzy?

MEMBER ARMIJO: Or suspicious?

MEMBER CORRADINI: Or suspicious?

DR. WALLIS: You were suspicious already. We can tell that.

MEMBER CORRADINI: I'm sure that. I know that I am.

MEMBER ARMIJO: I'm not suspicious. I just think your story is better than your presenting. If you would just show more information.

CHAIRMAN SHACK: I suspect what happened is you don't really get big leakage here until you reveal that the rebar and the liner. That's not going to happen. So you're going to move that lower part of that curve up and down a little bit, but you're not going to change the location where that thing goes.

MEMBER CORRADINI: That's what I was getting at. And so now that we've thought through physically how it might modify, how bad would it have to modify before you get a story that looks a whole lot like the '82 study for a totally different reason which is now your initiator just squiggles the hell out of everything. I think that would be a way of thinking about what I'm thinking.

DR. WALLIS: I think what you're thinking is that the concrete isn't really going to be solid after an earthquake. I mean, the rebar may be there, but the concrete is going to have --

MEMBER ARMIJO: It may have cracks on it.

(Several speaking at once.)

DR. WALLIS: I think once you've failed the liner you have a much bigger leak rate than you would have --

MR. ISTAR: Let me -- Concrete doesn't have any tensile strength. You just don't assume that.

MEMBER ARMIJO: It's a filler.

MR. ISTAR: It will crack.

CHAIRMAN SHACK: It keeps the rebar in place.

MR. ISTAR: Under normal conditions, that happens.

DR. WALLIS: And then in the Kobe earthquake, you can look at the pillars on the mason thing and they're huge things. I mean, they're many feet diameter and they collapsed and they crumbled.

MR. ISTAR: Well, that we can't -- that kind of --

DR. WALLIS: It didn't have rebar. Is

that it? It didn't have enough rebar. Is that it?

MR. ISTAR: I don't know anything about -- I cannot -- But there's a lot of rebars into this which contains this --

DR. WALLIS: Contains this concrete which has a lot of cracks in it after --

MR. ISTAR: Correct.

MEMBER CORRADINI: I'm just trying to think ahead of where somebody may ask you a question that if you did a few little calculations to try to understand your margin you're way ahead of the game. That's all.

MR. ISTAR: Thank you. If you look at the area, the graph on the left, the areas are not that big. Let's just give you a comparison. Let's pick up 85 square inch. If I were to -- Let's say. Assume we have a tubular crack that reflects to about 10 inch in diameter. Think about how big the containment is. All you need is about a 10 inch diameter to have that much leakage about 285 percent mass per day. You don't need a big -- Even going on the next page, I show the big crack on the containment which I said it's not to scale just to show it to you. You don't need a big area. It's a very small area from that containment. I mean, don't look at those 85 square inches. Just it's very, very small. It's not bigger than this.

DR. WALLIS: Because it gets a high velocity.

MR. ISTAR: Yes. We are assuming the velocity is sonic velocity because you are building --

DR. WALLIS: Unless you're somebody from Sandia who assumes it's by Bernouli's equation.

MR. ISTAR: Well, I had to do the calculation.

MEMBER CORRADINI: Is that a hint to somebody that's not in the room or something?

DR. WALLIS: It's in one of the reports. That's why I brought it up.

MR. ISTAR: Yes. It's a valid discussion.

MR. PRATO: We have about four more slides to finish up this portion. Do you want us to go through them?

CHAIRMAN SHACK: Yes, why don't we just finish it?

MR. PRATO: All right.

MR. SCHAPEROW: If you would go to slide 70. This shows that the iodine is released into the containment about a little before a quarter of a day and then it deposited. It deposits in the containment. So by the time we get containment failure at about a day it's pretty much all deposited. That's that brown line at the top and there's really not much to release. So we have very small release. We've actually carried the calculation out to four days. That's probably a little too far, but the idea is that the release is going to be small here.

Similarly for cesium. Similar size release again one percent or less. The 71 has a mistake in the title. It should say "no mitigation with portable equipment." Sorry about that.

DR. WALLIS: It's believable because at TMI there were lots of events, but the containment held and not much got out and it's conceivable that the public sort of believable thing to say here.

MEMBER CORRADINI: Yes.

MR. SCHAPEROW: Slide 72. That's fine. We actually did take the releases that we estimated as four day releases with MELCOR and we used the two.

DR. WALLIS: How much of this zero depends upon the evacuation? Suppose the evacuation is really screwed up?

MEMBER ARMIJO: If everybody just stay put, I bet it's going to be close to --

DR. WALLIS: If everybody stayed put, what do you get for these numbers?

MR. SCHAPEROW: If everybody stayed put, that's something that we wouldn't want to consider under these conditions.

DR. WALLIS: How much of this zero depends on the evacuation really working?

MEMBER ARMIJO: Not from the standpoint of realism. Just to --

DR. WALLIS: Yes. How much of it?

MEMBER ARMIJO: Just out of curiosity.

MR. SCHAPEROW: I wouldn't even want to venture a guess. Are you asking what the doses are close in for people that don't move?

DR. WALLIS: I mean if you do sensitivity studies on the evacuation or something, doesn't this make these zeros become something bigger than zero?

MR. SCHAPEROW: We actually did have a non-evacuating cohort. We had 0.5 percent of the people did not leave. And we calculated zero deaths. I don't know if that helps at all.

MEMBER ARMIJO: What was that again? I'm sorry.

MR. SCHAPEROW: 0.5 percent of the population in the evacuation zones did not leave.

DR. WALLIS: At Peach Bottom, 357 people

stayed behind.

MR. SULLIVAN: Maybe I can help with that. Randy Sullivan. I don't believe the team would run such a sensitivity analysis as to say there was no evacuation. I think that's a highly improbable result. The evacuation could be less effective.

DR. WALLIS: Yes. Look at something less effective then. How much does that -- zero? That's what I want to know.

CHAIRMAN SHACK: This is a seismic event. What did you assume? How did that alter the evacuation that you would do for some other event?

DR. WALLIS: You said you were going to slow people down. Right?

MR. SULLIVAN: That calculation hasn't been done. This calculation involves a very slow evacuation speed. Now this calculation involves -- Let me try to answer a couple questions at once. These folks, we assumed in our initial calculation that the zero to ten evacuation would happen as drilled and practiced, etc. We then assumed an ad hoc evacuation between 10 and 20 miles which was much sloppier compared to the zero to 10 and the zero to 10, we're at Surry. Right?

DR. WALLIS: Yes.

MR. SULLIVAN: The zero to 10 has something like a seven or eight hour time.

DR. WALLIS: To get out?

MR. SULLIVAN: Yes. Ten to 20 is much longer. It's probably something like 22 hours. I don't have --

DR. WALLIS: The probability of that is not high during some events. There are certain times of the year when I cannot leave my house. I just cannot. There are two feet of snow all around and I just cannot leave my house. There's no way.

CHAIRMAN SHACK: In Surry, that's not likely to be a problem.

MEMBER CORRADINI: Snow is a good thing.

DR. WALLIS: But it takes out -- I'm shoveling radioactive snow. I don't realize that.

(Several speaking at once.)

MR. SULLIVAN: High winds are actually good. So, no, we weren't able to run every weather case. Our EP models make an attempt to smear out the many cases that we're confronted with.

DR. WALLIS: That's what you'll get in a public meeting at Vermont Yankee. You'll get this kind of question that you'll have experienced snowstorms.

MR. SULLIVAN: Yes.

DR. WALLIS: It's not all that uncommon.

MR. SULLIVAN: The sensitivity analysis we intend to do would be to slow down the already slow rate. These folks travel about 30 miles and then MACCS disappears them. So on the question of running out of gasoline, we're figuring most people have 30 miles worth of gasoline in their tank or there's the societal fact that people help people during emergencies and they'll get picked up and we have a 0.5 percent non-evacuating cohort. So you asked that question a few hours ago. That's how we're dealing with it.

DR. WALLIS: We had also an ice storm where Hanover was completely isolated. There was no way you could get in or out of Hanover for several hours.

MR. SULLIVAN: And we have that concurrent with an earthquake and not implementing mitigating systems. Actually, from an emergency response point of view, I think that our treatment of the mitigative equipment is rather conservative. We have an emergency response organization that's been up and running for eight hours and you're telling me I can't get a fire truck there from the surrounding four counties. I can get a lot of fire trucks in that eight hours.

MEMBER ARMIJO: But wasn't it correct that in the Kashiwazaki earthquake the utility as far as firefighting on the site, the utility had contracted with a local community to bring in their firefighters and they were too busy? They didn't come. They didn't come for hours because they were working on damage in the city within a local town.M E M B E R CORRADINI: That's exactly right.

MR. SULLIVAN: We have eight and 15 hours here to perform these actions. The idea that we couldn't get -- I don't understand the mutual aid system in Japan.

MEMBER ARMIJO: Neither do I.

MR. SULLIVAN: But the mutual aid in the U.S. is that as you need it expands to other counties. Fire departments are particularly well matrixed in that.

MR. SCHAPEROW: Surry has its own fire engine.

MEMBER CORRADINI: We need to give you some feel for what this area looks like after it's had a 1g earthquake.

MR. SULLIVAN: I think we've had that

discussion.

MEMBER CORRADINI: Well, I don't know that we did.

MR. SULLIVAN: Yes, a detailed analysis could be performed but would be performed --

DR. WALLIS: I thought earthquake induced fires are a problem.

MEMBER CORRADINI: I think what you are hearing from all of us is still an uncomfortableness that if this is the most robust thing in town, they're not going to come to your aid. They're going to be busy dealing with civilian disaster.

MR. SULLIVAN: Okay.

MR. SCHAPEROW: Surry has its own fire engine onsite in a garage.

MEMBER CORRADINI: I mean, but not the fire engine so much because you actually really talked us through the B.5.b relative to the shed.

CHAIRMAN SHACK: I'm just worried to get people away.

MEMBER CORRADINI: What?

CHAIRMAN SHACK: These results depend on getting people away.

MR. SULLIVAN: These results depend both on using the threshold for LCF that we're talking about and the effectiveness of the evacuation. That's exactly right. Yes.

MEMBER ARMIJO: I think that's what troubles me is I think the system is better, the evacuation is better, and by throwing in on top of that the threshold, that's being masked and it looks like you're getting your zero by piling up a whole bunch of optimistic or -- I'd add another column here and say here is the latent cancer fatalities based on this study with the linear no threshold and with a threshold that we believe is correct.

MR. SULLIVAN: And the reason for your thought process is that optimistic news is too good?

MEMBER ARMIJO: No.

MEMBER CORRADINI: No. I'll say it a different way. As an analyst, I'd want to do a one-off analysis to know the impact of each of the things because you're saying partly it's evacuation, partly it's better modeling of what's happening inside the thing, Charlie said it better than I, relative to MELCOR's ability to do it. Another one is essentially B.5.b measures. I think I would want to do an one-off analysis to identify each of the individual increments and how it affects the total bottom line. You may never publish it, but, boy, to have that in your arsenal to understand to me would be something as an analyst I would want to have.

MEMBER ARMIJO: If I knew how to do it, I would do it in my back room.

DR. WALLIS: I think you would want to publish it too to get credibility because there are a lot of people as smart as us out there who are going to be asking these questions. People smarter than us.

MEMBER CORRADINI: Way smarter.

DR. WALLIS: Way smarter.

MEMBER CORRADINI: Put that in the record.

MEMBER APOSTOLAKIS: That's 0.5 percent as Jason said.

(Laughter.)

MEMBER ARMIJO: The ones that stay put.

MEMBER CORRADINI: I think that was our motivation for bringing it up. I really think a one-off analysis would be very beneficial.

MEMBER ARMIJO: I think that would help it. I think it would help your analysis a lot.

MEMBER APOSTOLAKIS: At least you can have the results in-house and then decide what you do.

CHAIRMAN SHACK: Right. What you publish is a different story.

MEMBER ARMIJO: But what you analyze.

MR. SULLIVAN: I think that we've heard the opinion and respect it. I just wanted to point out that anything we do if we don't publish it, it will be FOIA-ed. So our analyses will come forward and --

DR. WALLIS: You have to be open and say that we have something that we know which you don't know --

MR. SULLIVAN: It's not going to work out in the long run. That's exactly right. If we do it, we might as well publish it.

DR. WALLIS: That's right.

MR. SULLIVAN: Because it will be published by somebody.

DR. WALLIS: And if you try to hide it, then you'll look very bad.

MR. SULLIVAN: Of course. So there is certain analyses we haven't done.

MEMBER ARMIJO: You don't want to be forced to publish you don't know the answer and --

MR. SULLIVAN: There's another way to say that. The team's made a decision as to what the boundaries are going to be and that's what we follow.

MEMBER ABDEL-KHALIK: What I've learned from this is that for large dry containment there is really nothing I can dream of in which the containment will fail before somebody has the time to bring in some other source of water to bring into the containment. You can --

DR. WALLIS: Or it's time to get away too.

MEMBER ABDEL-KHALIK: And that's a very important insight.

CHAIRMAN SHACK: Large dries are good.

MEMBER ABDEL-KHALIK: Regarding of what the initiating event might be.

(Off the record comments.)

CHAIRMAN SHACK: Can we take a break for lunch? 1:45 p.m. Off the record.

(Whereupon, at 12:59 p.m., the above-entitled matter recessed to reconvene at 2:05 p.m. the same day.)

CHAIRMAN SHACK: On the record. Okay. If we could come back into session.

MR. PRATO: Mr. Chairman, how do you want us to proceed?

CHAIRMAN SHACK: I'm just trying to think about that at the moment.

MR. SCHAPEROW: We have results for the Surry long-term station blackout we haven't shown you yet which is quite analogous to the Peach Bottom.

MEMBER CORRADINI: The ISLOCA.

MR. SCHAPEROW: The steam generator tube rupture and an ISLOCA. We actually have two bypass events. We've done a little more on the steam generator tube rupture. We're almost done with the ISLOCA we do have results here.

MR. PRATO: And the steam generator, both bypass events are mitigatable with piped in systems, existing.

CHAIRMAN SHACK: Why don't we look at the long-term station blackout just as a comparison with the Peach Bottom one and, Ed, we can go through it relatively quickly when we come to the containment and it's not going to be challenged.

MR. SCHAPEROW: Okay. If you'll turn to slide 47 please.

MEMBER APOSTOLAKIS: Didn't we just do that?

CHAIRMAN SHACK: No, we did the short-term station blackout. We skipped.

MR. SCHAPEROW: To the so-called non injection case. This case we do have initial loss of AC power. We do have injection though. We do get turbine driven aux feedwater, steam driven system which is controlled by DC power and so we are modeling that coming on. We also model the operator opening the steam generator port for cooldown.

For this analysis, we again modeled batteries exhausting. This time we exhausted them at eight hours and we ran two cases, mitigated and unmitigated. For the mitigated case, again we brought portable equipment to bear to manage the turbine driven aux feedwater injection and to make up, in this case, for our RPC seal leakage which is a little different than the Peach Bottom case which didn't have that issue. For the unmitigated case, after five hours we would emptied out the emergency condensate storage tank which was being used to feed the steam generators and we assumed no subsequent actions were taken.

(Off the record comments.)

MR. SCHAPEROW: The specific B.5.b mitigation that we modeled in this analysis, portable air bottles were used to operate the steam generator power uprated relief valves.

MEMBER APOSTOLAKIS: What did you say? Why is it lower?

MEMBER CORRADINI: It is higher. It's higher because it's a delayed blackout. They actually have --

(Off the record discussion.)

DR. WALLIS: Where do you connect these bottles?

MR. PRATO: What's that? What's the question?

CHAIRMAN SHACK: On portable air bottles.

MR. SCHAPEROW: Some mitigation help here. These are somehow connected into the --

MEMBER ABDEL-KHALIK: The instrument air system.

MR. PRATO: No. From the B.5.b measures, they have some bottles that they carry in and hook up as necessary.

DR. WALLIS: So where do they connect? Where do they have to go to connect them?

MR. PRATO: I'm not exactly sure. I don't remember exactly where they have to go.

DR. WALLIS: That makes a difference, doesn't it?

CHAIRMAN SHACK: It sure sounds tough to get to the SG.

MR. PRATO: It's outside of containment.

DR. WALLIS: Outside of containment.

MR. PRATO: Yes, it's outside containment.

DR. WALLIS: Someone had provided a port.

It's not as if they have to go inside containment or something.

MR. PRATO: No.

MR. SCHAPEROW: In none of our analysis do we assume anybody does anything in containment.

MR. PRATO: And we did walk through it. I just don't remember off the top of my head. I apologize.

CHAIRMAN SHACK: You've walked this down then.

MR. PRATO: We walked through the process with the licensee rather than walking it down in the plant. We did look at some things. I was also involved in the B.5.b analysis and did the site inspections.

MEMBER ABDEL-KHALIK: These things are usually outdoors, aren't they, the steam generator PRVs?

MR. SCHAPEROW: The valves themselves are located in a closure called the main steam valve house. But the actual tail pipes are actually sticking out of the top of the main steam valve house which is adjacent to the containment. But you can look out and see there's the outlets of the steam valves.

Surry had purchased a portable power supply which they have procedures to use to restore level indication for both the steam generator and reactor coolant system. They also have procedures for manual operation of turbine driven aux feedwater without DC power, a situation they're going to get into after --

DR. WALLIS: This is the one that John says you can't do.

MR. SCHAPEROW: Actually, it turns out in this case that we ran out of water first. We actually emptied the entire emergency condensate storage tank out by five hours. So unless somebody took some kind of action to put more water back in the CST, this wasn't going to help them anyway. So I guess maybe it's not fair to say we -- yes, we did credit this. That's right. We did credit this.

Portable diesel-driven high pressure pump, this is something that Surry, the PWR, does need because in this situation, the station blackout, they can start getting RCP seal leakage because they lost seal injection flow. And finally we assume that they used the portable diesel-driven low pressure pump for refilling the emergency condensate source tank for the mitigating case.

CHAIRMAN SHACK: If John were here, he would be skeptical about the manual operation of the turbine-driven --

MR. SCHAPEROW: Correct.

Regarding pressure, about one and a half hours, as you can see the drop-off here in the steam generator pressure, the blue line going down because they've opened a relief valve on the steam generator. This is per procedure. They're supposed to initiate a 100 degree prior cool-down. This drags down the reactor coolant system pressure.

At about three hours, they started, three and a half hours, injecting it into the RCS tube to make up for the leakage. At this pressure, the flow rate into the flow rate into the system was about 150 gpm. They didn't need that and they actually fairly quickly halfed the throttle that because there's not that much leaking out of the reactor coolant pump seals at this time.

If you'll turn to the reactor vessel level slide, this kind of reflects, this shows, the level and the operators are able to successfully keep the reactor coolant system filled. We do see some level dropoff there at about 18 hours. We are getting -- This is a station blackout. We're getting a little bit of boiling in the reactor, a little steam generating. It's going up into the uppermost part of the reactor vessel. But this is a coolable condition. They're above the fuel. The water level is staying above the fuel.

If you'll turn to slide 51. This shows the make up from the portable diesel-driven pump into the reactor coolant system. They start injecting at 150 gpm which is the flow rate. But if you look at the red line which is the leakage out of the seals, it's a lot lower. So they do -- Something would need to be done to throttle this flow to avoid overfilling the reactor coolant system.

And slide 52, a kind of conclusion here from our mitigated case is that we didn't get a source term or an offsite health consequence. We found that this level of mitigation was sufficient to prevent core damage.

MEMBER ABDEL-KHALIK: If you can get 150 gpm into the RCS after four hours, there is absolutely nothing you can do to damage this core.

MR. SCHAPEROW: Good point. I guess you wouldn't need the -- You need to keep the system depressurized because this pump only goes up to 100 pounds. It has about 1,000 pound shutoff head. So the system does have to be depressurized somewhat.

The non-mitigated case, it starts on slide 53. Everything is the same under the first bullet. All the five same sub-bullets are the same. But since we do nothing to mitigate, we do hit core damage at 16 hours. Containment failure at 45 hours and again as a point of comparison, the evacuation begins at two and a half hours. So people are safely out of harm's way by the time the containment fails.

If you look at the pressure slide, everything is the same of the five hours until the emergency condensate storage tank is empty. We assume no refilling of that tank because this is a non-mitigating case. Batteries exhaust at eight hours and the system repressurizes. We do get steam generator dry-out not long after that because our emergency condensate storage tank is empty.

I would like to move to the next slide, reactor vessel level. I would like to note that if you look at around 13 hours the PORVs, the power operator relief valves, on the pressurizer start opening and closing. They begin to cycle. So then we start to see that very long decline in vessel level ultimately resulting in core uncovery, core damage and at 21 hours, we get to lower head failure at which the core leaves the vessel and falls into the cavity.

Containment pressure slide 56. For this case, we predicted containment failure of 45 hours. So we're right around two days before we can get to containment failure and again this is significant because the evacuation would start much, much earlier.

DR. WALLIS: So why does the pressure come down again?

MR. SCHAPEROW: There's one on the curve there at two days and this is because we're now leaking off enough. The hole in the containment has grown enough so that we're balancing out with what the steam that's being generated.

DR. WALLIS: What is the sharp change at two and three-quarter days?

MR. SCHAPEROW: We've run out of water in the cavity. The water was over the core. Debris was heating up, boiling off. We're run out of that water. So the only thing we're generating after that time is noncondensable gases.

DR. WALLIS: You've run out of water. So the core is eating its way through --

MR. SCHAPEROW: The concrete.

DR. WALLIS: Concrete.

MR. SCHAPEROW: That's right. It's eating its way down --

DR. WALLIS: What happens then eventually?

MR. SCHAPEROW: That's a study of a very long-term research effort we've been working on. You know more about that. The MCCI program, you've probably heard about many times.

DR. WALLIS: That says you have a core on the floor at Argonne. I know that.

MR. SCHAPEROW: Maybe somebody else could help me with this a little. I'm not up on that.

MEMBER CORRADINI: What's the question?

DR. WALLIS: What happens along when you're not cooling the core on the floor? It's just going to eat its way through the concrete.

MEMBER CORRADINI: Yes.

DR. WALLIS: What's the long-term result of that?

MEMBER APOSTOLAKIS: It will go to China. Right?

MR. TINKLER: I believe in this, and correct me if I'm wrong, calculation once the leakage begins this is not a reclosing leak.

MR. SCHAPEROW: It's open. It stays open.

MR. TINKLER: This leak stays open.

MR. SCHAPEROW: Several square inches.

MR. TINKLER: So the pressurization from core/concrete interaction, that pressurization rate is much less than boiling water. Earlier in time it might not have dropped so quick, but at this point the core/concrete interactions slow down a lot. We're just not generating enough. This is also a function of what kind of concrete you have, whether you have limestone or basaltic. This particular one doesn't generate enough.

MEMBER CORRADINI: It doesn't stop. The calculation continues and it's slowly eroding.

MR. TINKLER: We're still slowly eroding, but we've now diluted the mixture enough with concrete that it's cooled down and the gas generation rate is just not enough to keep the pressures that high. Presumably, it would --

DR. WALLIS: Eventually run out of concrete and go into the ground?

MEMBER CORRADINI: Yes.

MR. TINKLER: Sure.

MEMBER CORRADINI: But the release path through for the groundwater is nowhere as much as the air release path.

DR. WALLIS: No. In the short term.

MEMBER CORRADINI: In the short term,

correct.

MR. TINKLER: Correct. Yes. We would have -- I don't know what the ablation depth is. But at some point we would get through the three feet of concrete over the embedded liner and presumably we'd be able to eat into the other. But the other deal here is too that the overall dilution will slow it down a lot.

MR. NOURBAKSH: In NUREG 1150 for Zion, they predicted base melt through form of radiomotor containment, but not for Surry.

MEMBER CORRADINI: It takes days. It does take a long time. You're down to millimeters an hour.

MR. SCHAPEROW: Turning to the fission products, this plot looks a lot like the other ones we've seen for the -- This looks like the short-term station blackout plot. Again, by the time the containment fails, fission products have deposited in the containment. So the release is very small.

I'd like to now switch gears and move over the other area that we did, we analyzed, which is the bypass events. If you will please turn to slide 73.

As a result of our initial screening, we did have two bypass events that met our screening criteria. We were screening for bypass events on a core damage frequency of 10^{-7} per year. So we had two that were above that. One was a spontaneous steam generator tube rupture and the other was an interface system LOCA. So I would like to take you through each of those.

The steam generator tube rupture in this case was a break of a single tube. I have kind of a little summary here of the plant response. We get initiation of a ACCS at high pressure injection auxiliary feedwater. The turbine stop valves close and the steam dump valves which lead to the condenser, those also throttle and then go closed.

The first thing that -- One of the important things that happens is the faulted steam generator floods because we now have primary system water filling up the faulted steam generator, the one with the broken tube. The only item I've listed here on operator response is that we judged that the operator would perhaps halt aux feedwater flow to the faulted steam generator because it's overfilled which happens very quickly. This thing overfills. It's about a 500 gpm leak into the steam generator. So in no time, it's overfilled.

MR. PRATO: I think it's important to understand the initial conditions. You have a steam generator tube rupture. The operator does not recognize that had occurred.

MR. SCHAPEROW: Next slide. I'm sorry. So you may ask how do you get into core damage if you have high pressure injection and everything seems to be working. You know, we've had these. We had them at the various plants in the U.S. and other countries. The SPAR assumptions leading to this or the conditions leading to this are listed on the top of slide 74. There's a failure to depressurize. There's a failure to refill the refueling water storage tank which will eventually run out of water and there's a failure to isolate the faulted steam generator.

MEMBER CORRADINI: I thought you said before that it was a -- Did I misunderstand?

MR. SCHAPEROW: All I said was that we secured aux feedwater flow to the faulted steam generator. Isolated would imply like they shut block valves on the relief valves and things like that.

MEMBER CORRADINI: Okay.

MR. SCHAPEROW: To isolate it so nothing can get in or out.

MEMBER CORRADINI: Okay.

MR. SCHAPEROW: That's true. That was the one assumption that looked like it may be kind of got close to these SPAR model items.

MEMBER BONACA: Where did you get the sequence from? Is that from 1150?

MR. SCHAPEROW: This is from the SPAR model and also the same type of sequence is in the Surry licensee PRA. This was in both. It has a similar frequency.

MEMBER BONACA: So it's a credible sequence within the frequency that you estimated anyway.

MR. SCHAPEROW: I'll let you judge for yourself when we get done going through this.

MEMBER BONACA: No, I just was wondering about how risky it is for the operator to do all these things. But anyway it seems to be --

MR. SCHAPEROW: Why don't you see how much time he has? You may judge that he's all this time. How come he hasn't done anything?

DR. WALLIS: Whatever happened to TMI risk for two hours they didn't do anything?

MR. SCHAPEROW: It was a lot more than two hours.

DR. WALLIS: The next shift came on and they started to --

MR. SCHAPEROW: That's exactly. We're

going to get into subsequent --

MEMBER BONACA: They were trained for the wrong thing. I mean, they really even imagine that what happened could happen. It is different. Anyway, go ahead.

MR. SCHAPEROW: All right.

MEMBER CORRADINI: But just so I get the initial conditions before you tell us how incredible it is. So HPI goes on. AFW goes on. The operator secures the AFW.

MR. SCHAPEROW: Only on the faulted steam generator because level has gone up.

MEMBER CORRADINI: Right.

MR. SCHAPEROW: What am I doing? So he shut the level off -- he shut the injection off to that one.

MEMBER CORRADINI: Okay.

MR. SCHAPEROW: And that might have saved the --

MEMBER CORRADINI: And then stop valves are closed. The dump valves --

MR. SCHAPEROW: They go closed.

MEMBER CORRADINI: -- they go closed. And it's not isolated. You said this twice and I'm just trying to remember all the piping. It's not isolated because in the next slide.

MR. SCHAPEROW: It's not isolated because the relief valves can open and close. PORVs can open and close. That's correct.

MEMBER CORRADINI: Okay.

MR. SCHAPEROW: We did a mitigation measure review for the sequence and we had extensive discussions with the operators of the plant talking about tube ruptures and what they train on, how they would respond, how long before the other people would be coming in, before the TSC was manned up, before the EOF was manned up and we concluded that they wouldn't continue making this error forever. So we had -- We picked the time. We picked I think it was three hours, two and a half hours. After two and a half hours, somebody is going to realize that they needed to start taking actions for a steam generator tube rupture.

MEMBER CORRADINI: But in ten minutes they turned off the AFW. I'm still trying to understand the logic here.

MR. PRATO: They have a high-level alarm.

MR. SCHAPEROW: Right.

MR. PRATO: Because they had a high-level alarm, they secured AFW to that steam generator.

MEMBER CORRADINI: But for two and a half hours, they were still trying to figure out where the water was coming from.

MR. PRATO: Yes sir.

MR. SCHAPEROW: They did nothing else, but people realized there was something bad going on. They manned up the TSC, the EOF. They didn't know what to do. That's the crux of it.

MEMBER CORRADINI: Thank you.

MR. SCHAPEROW: So again, at some point, they realized they had a problem. One of the big indications they would have is that the steam generator, turn to slide 75, would be flooded completely up to the very top and even though they secured the aux feedwater to that steam generator. They would know that something was up.

We modeled the usual actions that the operator would take. They have procedures for handling steam generator tube ruptures and concluded that they would get -- start RHR cooling by about four hours. I didn't even include any plots for this case because I didn't think it was all that interesting because it just showed them going through the -- it didn't show anything special going on in the system. But I do have some plots to show what happens when they don't take all those actions, when they just continue to make those errors forever.

The first thing that happens, if you'll look at slide 76, refueling water storage tank becomes empty at 11 hours because they pump the entire tank through the broken tube. The condensate storage tank which is being used to feed the two non-broken steam generators lasts about a day and a half and then a little bit after that, they get into core damage, about two days.

I have a few plots to talk through this to tell you a little more. If you'll turn to page 77.

CHAIRMAN SHACK: When would they declare a general emergency?

MR. SCHAPEROW: We didn't assess this I don't believe.

MEMBER BONACA: Maybe they already did because nobody is onsite. Nobody is feeding the AWST or the ACST I guess.

MR. SCHAPEROW: I think we judged that they would make up there because they were having alarms and they were having problems. They would man these.

CHAIRMAN SHACK: They realize something's going on.

MEMBER ABDEL-KHALIK: The safety injection goes on, don't they?

MR. SCHAPEROW: Yes. It came on immediately.

MR. SULLIVAN: I think that the emergency response organization, I know, it would be activated at an alert. So the help would come in fairly early in this event.

MR. SCHAPEROW: You asked about general emergency.

CHAIRMAN SHACK: I was thinking one would be evacuation start. I have two days, but I don't start evacuating until the core starts to melt. Everybody is kind of clueless about what's going on here.

MR. SCHAPEROW: The case is a little different. We didn't even get into that. I think we drew a little bit different conclusion in this case.

CHAIRMAN SHACK: Okay.

MR. SCHAPEROW: If you'll turn to slide 77, you'll see that when the high pressure injection comes on the HHSI, high head safety injection, it holds the pressure up until the refueling water storage tank is empty and then that pumps stops and then you get pressure equilibrating pretty much with the steam generators and then from that time out what we have going on is we have natural circulation in the reactor coolant system and we're feeding the two non-faulted steam generators and that's keeping things cool for quite awhile.

We actually don't have a lot of flow out of the break anymore because by half a day the pressure is starting to come down. Actually, the primary and secondary pressures aren't all that different because the flow out of the break has been reduced quite a bit by that point. Anyway, this thing just drags on.

MEMBER ABDEL-KHALIK: What trips the reactor coolant pumps?

MR. SCHAPEROW: Cavitation. Once we stop injecting with high safety injection we start to get -- We get some expansion in the RCS and get some cavitation.

MEMBER CORRADINI: So everything works automatically. I'm just trying to understand this. I'm listening. Everything works automatically except for one operator action that isolates the AFW and the rest of the time they just hang out.

MR. SCHAPEROW: Exactly.

MR. PRATO: It may be helpful to

understand how they got to this conclusion that this was a CDF. They backed into it. They determined that at about $10E^{-3}$ you get a tube rupture. That's the probability for a tube rupture. Then they said what would have to happen for us to get to core failure and they came up with these three operator errors. When they got to that point, they stopped. They didn't analyze the equipment or the potential failure for equipment and whatever. So they assumed these operator actions. They did not consider the TSC, the EOF coming in and doing their own analysis of the indications that are out there. They just didn't consider it and they just assumed that nobody did anything basically for duration until they got to core damage.

MR. SCHAPEROW: I'm actually on slide 77. But that's just the way -- Eventually we get enough cycles on the PORV on the steam generator that the PORV sticks in the open position. This is after I think it's about 300 cycles. The valve sticks open and then it depressurizes and that's end of the emergency condensate storage tank because the rest of the water is fed into the steam generators and it just boils off. And eventually we get to core damage around two days.

I have a level plot here, too, but I guess I'm not going to go through that unless anybody wants me to.

The last plot I have here is on the refueling water storage tank and the emergency condensate storage tank. This just shows that the refueling water storage tank is pumped into the reactor coolant system in about a half a day and that's what leaks out the break and that the emergency condensate storage tank lasts a bit longer and it takes us out to about a day and a half.

One issue that came up, if you look at slide 81, on this was what happens to that steam generator that has the faulted tube in it. The steam generator is sitting there full of water for many hours because we're pumping the reactor coolant system into that steam generator and out through the relief valve. So one issue that was raised was how about that relief valve. Is it just going to keep chattering to let the water out? Or is it going to stick in the open position?

So we did a sensitivity analysis to evaluate that relief valve on the faulted steam generator sticking in the open position and, of course, things happen faster now that we have another break in the system. We actually emptied the refueling water storage tank. That took nine hours. We get to core damage at about a day. So this is a bit faster scenario.

MEMBER BONACA: I still see this different from the others you have presented because in the others you had, let's say, a best estimate use of B.5.b equipment to mitigate.

MR. SCHAPEROW: That's correct.

MEMBER BONACA: Or you didn't not mitigate but still you were assume realistic operator actions it seems to me consistent with failures and so on and so forth. This is very --

MR. SCHAPEROW: It is different. That's true.

MEMBER BONACA: And this is just hands-off. Two hours without any intervention to refill the RWST, to refill any tanks, I mean, that's pretty incredible. So these numbers, this must be you said something like 10^{-8} scenario.

CHAIRMAN SHACK: One times 10^{-8} for CDF.

MR. SCHAPEROW: Say that again.

CHAIRMAN SHACK: One times 10^{-8}.

MR. SCHAPEROW: We had a CDF of $5(10^{-7})$ I thought.

MR. PRATO: Both the SPAR and the licensee.

MR. SCHAPEROW: I have it on the initial Surry slide. I have a listing of the CDFs.

CHAIRMAN SHACK: I'm looking at some spreadsheet. This actually may be from last -- from six months ago.

MR. SCHAPEROW: I have $5(10^{-7})$ per reactor year. This met our 10^{-7} cutoff for bypass events. Again, the argument that I'm making is maybe this is not such a realistic case because again even the refueling water storage tank lasts nine to 11 hours. What are people doing kind of thing and this is something that's drilled on and other help that could have come in.

MEMBER BONACA: This seems as if there is nobody onsite.

MR. SCHAPEROW: Yes

MEMBER BONACA: They are all working at home.

MR. SCHAPEROW: Yes. Actually, we had not planned to do any sort of consequence calculation for this at this point unless a need is identified. We don't plan this one out of consequences.

Slide 81.

MEMBER ABDEL-KHALIK: I'm just curious. When does the faulted generator become a water source on this transient?

MR. SCHAPEROW: Which one are you looking at?

MEMBER ABDEL-KHALIK: I'm looking at page 77.

MR. SCHAPEROW: When does it become a water source?

MEMBER ABDEL-KHALIK: Eventually you just pump it back in.

MR. SCHAPEROW: Right. It will go back from that steam generator to the primary.

MEMBER APOSTOLAKIS: Through the hole.

MR. SCHAPEROW: Right. I think we actually did get a little bit of backflow. I got a couple of -- On this slide the pressures are equalizing. So it's about the same. I'm not sure we're getting any backflow into the RCS.

MEMBER ABDEL-KHALIK: You have to eventually.

MR. SCHAPEROW: From the faulted.

MEMBER ABDEL-KHALIK: Right.

MR. SCHAPEROW: Why from the -- We're not pumping any water in it.

MEMBER ABDEL-KHALIK: But it's full.

MR. SCHAPEROW: It's full. It's just in communication with the RCS. But eventually the RCS will start to boil off through the --

DR. WALLIS: And it will be counter coming flow, won't it? It will be coming pretty slowly. It's coming in through a hole.

MEMBER ABDEL-KHALIK: The EOPs say the water will eventually -- are based on the assumption that water will come back from the faulted generator.

MR. SCHAPEROW: If somebody is actively putting water in the faulted generator?

MEMBER ABDEL-KHALIK: No. Because it's there.

MR. SCHAPEROW: I see. If it's full, you need to pressure the RCS. Yes.

MEMBER ABDEL-KHALIK: Right.

MR. SCHAPEROW: Actually, we're not depressurizing the RCS though. It's staying pretty much at pressure the whole time. It's staying at 1,000 pounds if you look at the pressure plot.

CHAIRMAN SHACK: Before you start on this one, we're going to start losing people here at 3:00 p.m.

MR. SCHAPEROW: Okay.

VII. Discussion

CHAIRMAN SHACK: I would like to have a little discussion of what we want to have at the full Committee meeting with the realization that the full Committee meeting is going to be open to the public.

MR. PRATO: Would you like our perspective?

CHAIRMAN SHACK: Yes.

MR. PRATO: Our perspective is we would prefer that preliminary information not be released during that meeting. Maybe a little focus on the process rather than on results.

MEMBER CORRADINI: How would that be different than July, if we're not allowed to release it? Didn't we go over process in July? I'm just talking outloud.

MR. PRATO: A letter wasn't generated as a result of that.

MEMBER CORRADINI: We didn't generate a letter in July?

CHAIRMAN SHACK: No.

DR. WALLIS: Then you can't write a letter.

CHAIRMAN SHACK: We're going to have a presentation.

DR. WALLIS: But you're not allowed to use the results that you know.

MEMBER APOSTOLAKIS: Is the letter going to be classified?

CHAIRMAN SHACK: Yes.

DR. WALLIS: Why don't you have a closed meeting?

MEMBER CORRADINI: Because ACNW had an open meeting. I can't imagine we're going to get a closed meeting.

MEMBER APOSTOLAKIS: Wait a minute. That was an ACNW subcommittee?

MEMBER CORRADINI: Full committee.

MEMBER APOSTOLAKIS: It was open?

MR. PRATO: They left it open. Yes sir.

MEMBER APOSTOLAKIS: But they talk about a specific part.

MR. SCHAPEROW: That one slide we had on LNT.

MEMBER APOSTOLAKIS: Yes.

MR. PRATO: That happened to be before the Union of Concerned Scientists sent a letter in and requested that they be allowed to attend and it snowballed. The bottom line was that any full committee meeting because it's FACA is going to be left open. So it's an OGC decision.

MEMBER CORRADINI: So it will be -- I guess I should have asked it this way. It probably -- There's no way it's not going to be open.

CHAIRMAN SHACK: That's right.

MEMBER CORRADINI: Okay. So then the only --

CHAIRMAN SHACK: Hossein is just telling me that in fact our letter writing discussion period is going to be open.

MEMBER CORRADINI: I think that would be marvelous. So that means then there's nothing from a conclusion or a discussion standpoint that's going to involve any results.

MEMBER ABDEL-KHALIK: Why not talk about large dry containments and say that there's nothing we can find that would fail the containment fast enough before any reasonable person can assume that you can find an alternate water source. Why isn't that a result that can be --

MR. PRATO: I'm going to default to my supervision if he's like to --

DR. BAHADUR: Sher Bahadur. It's not so arbitrary whether we can open or close the meeting unfortunately. When we went to ACNW yesterday, we were going with the idea that the meeting was going to be closed. But the OGC at the 11th hour made a decision that the meeting would be open. The ACRS meeting we are planning on having an open meeting and the plan is to go to the Commission, let them see the results and then let them tell that it's okay for us to go public. We are hoping all this thing to happen between now and when the ACRS committee is scheduled.

If for some reason, the Commission doesn't make that decision, then either we will have to postpone the meeting or go to the OGC to find out if we can have a closed meeting with ACRS. The fly in the ointment is the sequence of events. The Commission would want that we come up with some sort of a consensus on the dose threshold thinking first before they would look at the results and say, yes, go ahead and make it public. The staff is still actively looking at the options about the dose threshold and hopefully we will come to a conclusion in the next week or so. But if we don't, then that's our first falter right there because if we don't come up to some sort of an agreement on the dose threshold we won't be able to go to the Commission and ask for them to have released the information.

So a lot of things are happening in

parallel. We are hoping that we will go through this subcommittee meeting today, would satisfy the subcommittee in the questions that you may have and then depending on your recommendation to the full committee about the study. In the meantime, we would just work our way to the Commission and hopefully get the permission from there. So that's where we are right now.

MEMBER CORRADINI: So you need a Commission -- You're going to seek Commission approval to go open with the results prior to the ACRS December meeting.

DR. BAHADUR: Yes sir.

MEMBER APOSTOLAKIS: I don't think it's going to happen.

DR. BAHADUR: Jimmy, do you need to add to it?

MR. YEROKUM: Yes. If I may add add to Sher. It's not likely we will have permission from the Commission to go open with the results by December's meeting. Not only is unlikely, but I'm betting it wouldn't happen. First, when we started this project the direction and the understanding was we'll have to narrow the results that we could share with the ACRS closed sessions and have you guys as we go along. But at the same time, we have a scope of plans we're looking at and the plan was until we are finished with the additional scope, we will not go public with any results.

As a result of this meeting, there may be something we need to go back and do with the results, how we analyze. So there's all these back and forth that will go on. Peer reviews, all that, all these things that need to be done before we have results we can go public with. So it's going to be awhile before these results go public and we're talking about preliminary results right now, the things that might have to happen.

As for the ACRS interaction, I mean we have a process that has many technical aspects to it. The screening threshold for example is a key part of this process. I mean that requires we're looking for endorsements or comments or issues and a letter from the ACRS. So there are many things that can be discussed with the Commission from the ACRS. With that, you wouldn't have the results to comment on for several months because we wouldn't have the results until we've finished. We can't call these results until -- there are so many things that need to be done. I mean, the sensitivity studies and you come up with some, you know, the seismic, conservation, do this. We need to do all that before we have what we call results. We need to have peer results.

MEMBER APOSTOLAKIS: The comments this morning had nothing to do with the results.

CHAIRMAN SHACK: I don't foresee our letter really discussing results.

MR. YEROKUM: Right.

CHAIRMAN SHACK: We're still focused on --

MEMBER APOSTOLAKIS: The letter even can be open.

MR. YEROKUM: So when we come back in the full committee, the things that we need to focus on I will be -- I mean we will have open meetings.

CHAIRMAN SHACK: I'm sure the Committee will want to comment on thresholds.

MR. YEROKUM: Right.

CHAIRMAN SHACK: We'll want to comment on emergency planning and its relation to seismic events.

MR. YEROKUM: And all those things we discussed in the ACRS open meeting in the past.

CHAIRMAN SHACK: Okay.

MR. YEROKUM: I'm sure we can discuss --

CHAIRMAN SHACK: Our choice of frequency cut-offs.

MEMBER CORRADINI: But, Mr. Chairman, then the presentation then in December would have to be open which means it would be mainly methodology and criteria stuff.

MEMBER ABDEL-KHALIK: Assumptions.

CHAIRMAN SHACK: Yes.

MEMBER APOSTOLAKIS: So some members would be at a disadvantage. If we don't talk about the results, then it's okay.

DR. WALLIS: You're going to comment on the dose fatality relationship.

MR. YEROKUM: Yes.

CHAIRMAN SHACK: Threshold.

MEMBER APOSTOLAKIS: Assumption.

DR. WALLIS: This latent -- relationship I mean.

CHAIRMAN SHACK: I'm sure the Committee will want to comment on that. I don't know what we'll say.

DR. BAHADUR: And that should be all right because we will come here and we will share the staff's --

DR. WALLIS: Discuss some rationale of why you should use one or the other or some compromise.

DR. BAHADUR: Sure.

MEMBER APOSTOLAKIS: Good.

MEMBER ABDEL-KHALIK: Would this be consistent with the questions that we're asked by the ACNW in regard to this model? In other words, your response to ACRS will be essentially an answer to the questions that were raised by ACNW?

DR. BAHADUR: Yes. What the ACNW actually asked was a little more detail on the three options that were presented to them, the LNT and the five and five and ten. And at the time, it was -- the staff said we'll get back to you and give you in detail the position paper in which we can describe each of these options and give you -- So we would do that. That will complete our interaction with the ACNW. They are not expecting on writing a letter. They said we will wait for you to come to us and tell us what exactly is the latest thinking. So that's where we left it.

MEMBER ABDEL-KHALIK: What is the timeline for that? Would that be fast enough that you could present that information at the full committee meeting or are we going to generate a whole list of questions on that topic in addition to the ones raised by ACNW?

DR. BAHADUR: Now I'm getting in the speculation stage in answering this question because firstly the staff members need to complete their position paper on the options. We send it to ACNW&M and then my assumption would be that should satisfy the members and no further counter questions should come. If that happens, then, yes, that would be complete our presentation with the ACNW&M and we'll have no other hanging issues with them.

CHAIRMAN SHACK: It's clear, then, what we'll be doing at the full committee meeting which will have no results in all likelihood.

DR. BAHADUR: Yes, at this stage it doesn't look very optimistic on our part to say that we're bring the results to an open meeting. Things may change, but I doubt.

MR. YEROKUM: Now, if it's closed, it will be a different story. But it's not going to be closed. So that definitely precludes the results.

DR. BAHADUR: Yes. When we went to ACNW&M yesterday, we were somewhat surprised by the OGC's latest determination and enough time was not there for us to talk it out. We have more time at our disposal now between now and the ACRS meeting. It's quite likely that OGC and us might come to some sort of an understanding where it may be possible for us to come to a closed meeting. Should that happen then of course we'll bring everything, whatever we have shared with you, we'll share with the full committee.

MEMBER ABDEL-KHALIK: Now why couldn't they talk about the scenarios and the plant response to the various scenarios? There is nothing that needs to be closed about that.

DR. WALLIS: If the scenario ends with no release, that's giving a message, is it not?

CHAIRMAN SHACK: I'm not sure what they want to consider as a result. We've discussed the sequences before in open meetings.

DR. BAHADUR: Yes.

CHAIRMAN SHACK: We haven't discussed the analysis of the sequences.

MR. YEROKUM: That's correct. I mean, there's nothing that precludes us from discussing the scenarios, the sequences and the progression to some extent. We just wouldn't get to the --

MEMBER ABDEL-KHALIK: The point of calculated consequences.

MR. YEROKUM: Right. Absolutely. We wouldn't get to the point of calculated consequences. We have to be very careful about that because when we do the MELCOR -- We cannot get as far as some MELCOR analysis in some cases and we get no source terms.

That's --

MEMBER APOSTOLAKIS: Is it possible to discuss the sequence that starts with a failure of the bus E-12 and go to some point where you can -- because that's where a lot of the questions were and that would clarify what you call a sequence and how you handled the various events. Because earlier, the other sequences we looked at, I don't think there were such major questions because it was not clear whether you should assume that RCIC is available. It's not available. Is that possible?

MR. YEROKUM: It's possible, but the preference would be to focus on the sequences within the threshold. We use the E-12 sequence as an illustrative example of all those issues and questions I came up with and we can include that. But we would like to at least focus on those.

MEMBER APOSTOLAKIS: One of the E-12 sequences is within scope. It's $2(10^{-6})$.

MEMBER CORRADINI: Not after the reanalysis.

MR. PRATO: After we reevaluated it, it was above the threshold.

MEMBER APOSTOLAKIS: It was up.

MR. PRATO: Yes sir.

MEMBER APOSTOLAKIS: So the idea of having not reporting the results is because they are preliminary. We don't want to issue anything or we don't want by going through the sequence give advice to terrorists? What does it matter?

DR. BAHADUR: It is not the security issue.

MR. PRATO: I don't think it is. The Commission has told us not to share any information until they know.

MR. YEROKUM: The primary reason for not wanting to release the results is because we don't have results. We have no results and the level of scrutiny we have to go to to have what we call results I mean we still have a ways to go. It's not peer reviewed and we don't want to have results out there that we will change when we have final results and then it gets into a public, you know, how do you explain things. It's just preliminary results. That's the basic reason, not a security matter.

CHAIRMAN SHACK: Can you at least identify the sequences that you're going to be using for the analysis and then we can discuss these sequences?

MR. YEROKUM: Yes. We've done that before as a matter of fact.

MEMBER CORRADINI: That's almost part of the starting point.

MR. YEROKUM: Right.

CHAIRMAN SHACK: Right. I think that would satisfy George's question that we could sort of see how the sequences were selected and the process to go through to get them in a little finer detail than we went through in July where we had the big picture. But I think it would be interesting here to focus on the sequence.

When am I going to lose quorum?

MEMBER APOSTOLAKIS: Three o'clock. You want to continue?

CHAIRMAN SHACK: Yes. I was just going to let them go through the ISLOCA.

MR. SULLIVAN: Could I just ask one question regarding the open meeting if that's permissible? This is Randy Sullivan.

I don't think there's any objection to discussing the emergency response parameters, is half a percent non-evacuees appropriate, is the timing appropriate, should it be changed, what about gasoline being available, all those kinds of things, I think, are appropriate for an open discussion.

The earthquake issue with the licensing

basis, issues associated with it, I really would like you to have the benefit of an OGC opinion on that. I realize you and they don't necessarily intersect. But if you would consider that, it would be appreciated. I don't know when I can get that to you or if I even have the mechanism to get that to you. But opening that issue in a public forum before we're ready could cause us some problems.

The LNT issue has already been discussed in an open forum and it surely could be addressed for the benefit of the Committee and the public again. Anyway, that's one opinion.

CHAIRMAN SHACK: That certainly does seem like an issue where it's a question of implementation and you may be able to get something from OGC on that.

MEMBER ABDEL-KHALIK: But weren't those scenarios selected from some general criterion that you have established based on frequency? It doesn't have anything to do with licensing basis or does it?

MR. SULLIVAN: Evaluating how a earthquake event cripples emergency response was a contested issue in the San Onofre and Diablo Canyon licensing hearings. There's a fair amount of case law on the subject which I didn't read to you and having the staff do a detailed analysis of that crippling effect essentially provides the brief that one could hand to the Ninth Circuit Court of Appeals to reopen the licensing basis. Did I say that -- I don't think I said that as clearly as this earlier.

So I would like to suggest that although I understand you're looking for technical truth, this licensing issue kind of needs to be examined before we open this in a public forum. Did that make sense?

CHAIRMAN SHACK: John.

MR. FLACK: Yes. I'm a little bit confused about two things. I think there are two pieces here that we're looking at. One is the analysis itself and how it's done and then there is the piece about how you display the results to the public, whether you use a threshold or LNT and how that makes a difference on how you roll out those results and the question is -- So there's really two sets of comments. One is on the analysis and how that was done and the technical parts and what was considered in that. And then the other is how do you display the results to the public and that's where you tie into the screening criteria and the doses and the thresholds and I just didn't know which part you'll be discussing at the full committee.

I mean if it's the threshold part I would think that can be discussed and I think --

CHAIRMAN SHACK: The issue I'm most worried about at the meeting is the one that we just discussed where we could, in fact, impact a licensing basis situation for an operating plant. And it may be -- My preliminary discussion was that some portion of this meeting could be closed. Some portion could be open. I'm not exactly sure how all of this is going to work out. You know, we've heard your concern. You'll obviously tailor your presentation for that. I'm not sure how controlled the discussion will be but you can clearly just close things off as you see fit.

I need some guidance from my Designated Federal Official.

MR. NOURBAKSH: The Federal Register notice is out I suppose if you wanted to -- And we put some portion may be closed only to safeguard and security issues. If it is not, then we have, if there are some other reasons we wanted to close it, we have to amend the Federal Register notice.

DR. BAHADUR: One of the factors that makes this slightly a bit more complicated case than usual is the extra-sensitivity of the information being pre-decisional. The original plan was for the staff to conduct these two plants and then in the meantime get some more volunteers so that we can continue to do at least a minimum of eight plants.

When we did these two plants, the volunteers did not come. We have no other plants on which you could conduct the study.

MEMBER CORRADINI: At all.

MR. PRATO: One additional one, the Sequoia.

DR. BAHADUR: Yes. So the thinking was maybe if we could make the results public let the plant see that it really isn't as frightening as it sounds.

MEMBER KRESS: And it may be useful.

DR. BAHADUR: Quite likely you may get some volunteers. So with that --

CHAIRMAN SHACK: But I don't think these results are a surprise to industry. I mean when I looked at the NEI questions one of their questions was what are you going to do when all these numbers come back to be zero.

DR. BAHADUR: Yes.

CHAIRMAN SHACK: I don't think there's any surprise here.

DR. BAHADUR: No. It's almost like going to Giant and taking your blood pressure every time you visit Giant because it's a free machine there. You stick your arm there and you take the blood pressure. What will you do if it's 125 or 128? Nothing. It's that kind of argument which just goes on and on. You got zero. So what are you going to do now?

But the idea was if we come up with these results make them out to public perhaps you might get some volunteers. So with that in mind, the idea was to go to the Commission and get their permission to share the results with you in the open meeting. That's why it makes -- It's not security and it's not safeguards. It's this sensitivity of the pre-decisional information that the Commission doesn't have the benefit to see.

MEMBER APOSTOLAKIS: The comments that the members have made were really the methodology --

DR. WALLIS: I think there is also a risk of being --

MEMBER APOSTOLAKIS: -- oriented and focused on how the process was implemented. I don't think that anybody really questioned anything about the results themselves. Did we? It was the methods and we can certainly address the methods and write a letter. If you guys can come up with one or two sequences.

DR. WALLIS: John says you can't manually control the turbine-driven pump. That is a real question.

MEMBER APOSTOLAKIS: Right. I call it a method and if they can come back with one or two sequences where these kinds of questions can be raised, then I think we would have a good meeting and we can write a letter.

DR. BAHADUR: And I think in the meantime we'll work with Dr. Nourbaksh and see if it's possible for us to maybe come up with some open and then maybe a couple of slides in a closed meeting.

CHAIRMAN SHACK: I think we have bigger fish to fry more than we can manually operate a pump.

MEMBER KRESS: Yes.

DR. WALLIS: I think probably. We normally have some other questions.

MEMBER APOSTOLAKIS: We need some discussion of the sequence system given to the members especially the ones who are not here an opportunity to understand what they have done and if some questions are raised, so be it. I don't think that's a major issue. Because if you just come in here and talk in the abstract --

CHAIRMAN SHACK: No, I do think we do want to talk about the sequences.

MEMBER APOSTOLAKIS: Yes. Something.

CHAIRMAN SHACK: Maybe about to the point where we're about to MELCOR.

MEMBER APOSTOLAKIS: This is a challenge for the next week or so, you know, how can we develop something that is not revealing too much.

DR. BAHADUR: I think we can come up.

CHAIRMAN SHACK: We can do that.

MEMBER APOSTOLAKIS: And then you will have the members who are not here talk for an hour and a half about the cutoff frequencies. So all this is academic really beyond to the 10^{-6} again.

MEMBER KRESS: Yes. Of course we will. But if you don't get any volunteers, is this project dead in the water?

MEMBER APOSTOLAKIS: Volunteers. What do you mean?

MEMBER KRESS: I mean plant volunteers.

MR. PRATO: We have an alternate approach to that. If we can't get volunteers --

MEMBER KRESS: You can do the SPAR models yourself and characterize them.

MEMBER APOSTOLAKIS: And then you will have many volunteers.

CHAIRMAN SHACK: I would like to sugest that we have accomplished a lot.

MR. YEROKUM: If I may add just one more thing regarding the topics for the full committee. I don't have a copy of the SRM with me, but I will take a look and get back to Hossein about that. There are some examples that the Commission provided us to lead to interact with the ACRS, you know the sequences, this and that. So there are some technical areas that would be worthwhile to focus on that we can discuss in an open forum. It's not just about the results. So I wanted to get those as examples, that it would be worthwhile to get feedback from the ACRS.

MR. NOURBAKSH: Actually, I'm quoting from SRM. "Commission is specifically instructed staff to 'work with the ACRS on technical issues, such as identification of accident scenarios to be evaluated, evaluation of source term, credit for operator actions, or plant mitigation systems, the modeling of emergency preparedness, modeling of offsite consequences and definition and characterization of analysis uncertainty.'"

MEMBER APOSTOLAKIS: That's doesn't say final results. That doesn't apply to an interim letter or an interim meeting.

MR. NOURBAKSH: No, as they work through they want us to --

MEMBER APOSTOLAKIS: There are two different issues. I mean, they did today. That's what they did. But the question is if you have an open meeting in December how much of that do you bring up.

MR. GILLESPIE: I don't want to catch anybody by surprise. But I just talked to Mike Thompson about open/closed meetings and SOARCA and he suggested that he needs to talk to you guys. But he suggested to me that would we consider the potential of not having a December meeting and postponing it until February until they work some things out?

DR. WALLIS: That's what I thought they'd say.

MR. GILLESPIE: And it's not just here. It's some of the issues that came up with the other committee, too, that they couldn't talk about certain details in open session. So Mike just caught me in the EDO staff meeting and said, "Could you guys keep an open mind and maybe have a full committee meeting more like in February when we might be able to be more open with material?" So he did -- That was as much as I got.

DR. BAHADUR: That's in the conversation what with what we just know were saying. It all depends as to what we do with the dose issue, whether we bring to a closure. We go to the Commission. We get the Commission approval. If we get it, there's a meeting. If we don't get it, then there is not.

MEMBER APOSTOLAKIS: The Commission --

DR. BAHADUR: And the more likely it will not be possible.

MEMBER APOSTOLAKIS: The Commission will not know where the ACRS is coming from until the final result.

MR. GILLESPIE: I think the idea was there is some preliminary questions you might need Commission feedback on even before you get to the final result. So that there might be more Commission interface right now on some of the threshold issues and if that's the case, then it would still be an ongoing interaction. So it's not like -- Mike just said we have some procedural steps to work out because of the lack of detail and some other things. MEMBER KRESS: The Commission might be interested in what the committee, how that committee feels about, say, the trust of thresholds.

MEMBER APOSTOLAKIS: Yes.

MEMBER KRESS: Is there some way we can communicate with them?

MR. GILLESPIE: The same way we couldn't close the full committee meeting. We probably can't keep any letter that's written closed either.

MEMBER APOSTOLAKIS: But we can certainly comment on a cutoff frequency. That's open.

MEMBER CORRADINI: Yes, that's open.

CHAIRMAN SHACK: The approach of using a cutoff frequency and I think it's something that's all public the fact that you're going to be selecting these things. I don't think there's a problem there.

MEMBER APOSTOLAKIS: But there are issues that can be discussed in an open meeting. There is no question about it. But if you want to --

CHAIRMAN SHACK: But again, that's sort of Research's call.

MR. GILLESPIE: Yes. Mike just asked could we use some forbearance in case. They may actually request to come in February as opposed to December.

CHAIRMAN SHACK: Sooner or later, we're going to have to discuss these things with the Commission. I don't think -- The threshold is not going to change between now and February and what we have to say about it probably won't change between now and February.

MEMBER CORRADINI: So you're saying that we ought to get our legal ducks in a row if they need two months to do it.

MR. GILLESPIE: They want to get their openness ducks in a row.

MEMBER CORRADINI: Openness ducks. What we say about emergency planning won't change between now and --

DR. WALLIS: You almost need a closed meeting with the Commission. We ought to have if that's legal.

CHAIRMAN SHACK: Why not?

MEMBER CORRADINI: So just one thing that George said in response to your -- What is -- The timing is that even the Surry/Peach Bottom results will not be completed. Let's not say open, but completed for a year from now given the internal review, given the sensitivities, the uncertainty analysis, I want to say Monte Carlo, but that's probably the wrong way you're going to do, but the multiple calculations to see the spread in the results, all of that is going to take another at least year?

MR. YEROKUM: It's going to be towards the end of next year or thereabouts.

MEMBER CORRADINI: At least a year from now.

MR. YEROKUM: About a year from now, at least. We talk about peer reviews and -- peer reviews to potentially --

MEMBER APOSTOLAKIS: What kind of peer reviews do you plan to have? An extended peer review?

MR. YEROKUM: Yes, we're thinking about that. That's not mapped out yet, but we need -- we're thinking at extended peer reviews on this also.

MEMBER APOSTOLAKIS: You must have money to spare. But then you don't have the resources to do a different kind of analysis. Right? That was a low blow.

(Off the record comments.)

MR. YEROKUM: We'll get back with our management and discuss this. But there are some topics that are being discussed --

MEMBER APOSTOLAKIS: There are certain things that we want to tell the Commission. I doubt that they would change by February. Might as well write a letter and you don't know. You've heard where we're coming from now, but it's one thing to hear a subcommittee and quite another to get a letter from the committee where you would have all the members. Most people may disagree with some of the ideas we expressed today. So I think that's a good idea. If you guys can talk about methodology in the open, let's go ahead and do it. Present a couple of examples. This is what we're planning to do, a sensitivity analysis. I mean, we can bring some stuff in and document our views.

If we had a meeting in January, I wouldn't worry that much. But February is -- You're talking about -- Where are we now? December? No, November. Two and a half months, three months from now. That's a long delay. You don't know what the Commission is going to say after they see our letter. Right?

CHAIRMAN SHACK: We don't even know what our letter is going to say.

(Laughter.)

MEMBER KRESS: Wait until you see the letter.

CHAIRMAN SHACK: We don't know what we're going to say until we see the letter.

MEMBER APOSTOLAKIS: That's right.

MEMBER KRESS: And how many added comments we may have.

CHAIRMAN SHACK: How many added comments we may have. We might be working on the letter in February even if we start doing the work.

MEMBER APOSTOLAKIS: We have precedent for that.

CHAIRMAN SHACK: We have precedent for that.

MEMBER APOSTOLAKIS: I am of an opinion that we should actually try to go ahead with the meeting in December.

CHAIRMAN SHACK: I'm inclined to do that.

MEMBER KRESS: The only thing you have to do is leave out the results.

MEMBER APOSTOLAKIS: Yes, and let the staff decide what they can talk about in an open meeting.

MEMBER KRESS: Yes. You can talk about the threshold. You can talk about the selection of sequences.

MEMBER APOSTOLAKIS: So do you want to go around and see what --

CHAIRMAN SHACK: Yes.

MEMBER APOSTOLAKIS: I vote for that.

MEMBER CORRADINI: I was trying -- This

side. You usually go to the side.

MEMBER APOSTOLAKIS: This is an easy decision. So he decided to start with you.

MEMBER CORRADINI: Okay.

CHAIRMAN SHACK: I knew George was warmed up.

MEMBER CORRADINI: I think as long as we talk about initial conditions, assumptions and what was already opened yesterday with ACNW I can't see how it would hurt and I think it would benefit Dennis and Otto and Jack. Right?

MEMBER APOSTOLAKIS: So?

MEMBER CORRADINI: Yes. Sorry. Excuse me.

MEMBER KRESS: We don't get to vote.

DR. WALLIS: We don't. I'm just a consultant.

CHAIRMAN SHACK: They're going to write us a report.

DR. WALLIS: No. It's a closed thing. I don't write the report.

MEMBER ABDEL-KHALIK: I think we ought to sort of go ahead with the open part of the meeting.

CHAIRMAN SHACK: The one that concerns me most is the emergency planning which again --

MEMBER CORRADINI: That doesn't --

CHAIRMAN SHACK: I came into this with three big issues. I'm still leaving it with three big issues and that one I'm more nervous that --

MEMBER CORRADINI: But that doesn't necessarily have to be discussed.

CHAIRMAN SHACK: Yes. I guess that's jus the answer. But I hate to leave it out of a letter.

MEMBER CORRADINI: I appreciate sensitivity but it doesn't have to be discussed.

MR. YEROKUM: We'll definitely get with the OGC to get some --

MEMBER ABDEL-KHALIK: The boundary between the the open part and the closed part will change with time. And wherever the boundary is December 5^{th} or December 6^{th}, let's just focus on that.

DR. WALLIS: There may be conceivably be leaks.

MEMBER KRESS: There could.

MEMBER ABDEL-KHALIK: But hopefully eventually the whole thing will be open.

CHAIRMAN SHACK: Not from the ACRS.

MEMBER KRESS: Mr. Chairman, I have a question. The consultants normally give you a consultant's report on these kind of meetings. This one looks like it has some sensitivity to it and rather than our usual full speed ahead, damn the results report should we be a little more careful with this?

DR. WALLIS: I would be. I would be happy to simply have expressed views at this meeting and not have to write something down.

MEMBER KRESS: Yes, that may be --

DR. WALLIS: Because that may get into the record somewhere and it might be quoted and --

MEMBER KRESS: Is there a --

MR. NOURBAKSH: It could be considered sensitive information.

DR. WALLIS: Yes.

CHAIRMAN SHACK: I -- Consistent with my staff, I think ACRS consultants' reports ought to be -- Those are private.

MR. NOURBAKSH: Yes, they are sensitive.

CHAIRMAN SHACK: They're sensitive.

(Several speaking at once.)

MR. NOURBAKSH: The ACRS' views only. I don't know whether they are forwardable or not.

MR. GILLESPIE: Bill, all this -- we had a transcription and this transcription was a closed meeting. It supposed to be a closed transcription.

DR. WALLIS: That's good enough.

MR. GILLESPIE: So I have a feeling the consultants' reports we deal with the same way we deal with the transcript from a closed meeting. It's not a full committee meeting. It's a report to the subcommittee. So if the consultants write a report, we can protect it in the same vein as the transcript.

MEMBER KRESS: We don't need to be constrained on what we say.

MR. GILLESPIE: No.

MEMBER APOSTOLAKIS: We can still email it.

MEMBER KRESS: Yes, that's a good question. Can we email it to you?

MR. GILLESPIE: Yes. This isn't security stuff.

CHAIRMAN SHACK: This isn't security stuff.

MR. GILLESPIE: It's kind of pre-decisional at this point.

MEMBER KRESS: Okay.

DR. WALLIS: You can email it or not?

MR. GILLESPIE: You can email it.

CHAIRMAN SHACK: But I mean we would like reports simply because we have other members who aren't here.

MEMBER KRESS: Yes, and you let them benefit from it or maybe not.

CHAIRMAN SHACK: Yes. Might not. I guess we can have them read the transcript.

(Laughter.)

CHAIRMAN SHACK: Even our consultants may reflect as they go back and --

MR. GILLESPIE: Yes. Traditionally what happens is when the SPAR report is issued, any documentation that was withheld as pre-decisional goes public at the same time the final report goes public. So the transcript from this meeting, everything at some point in the future will be actually --

DR. WALLIS: Will go public.

MR. GILLESPIE: Yes, it's not like it's withheld forever. Once the Commission makes it final decision, anything connected with that decision then is available to the public.

DR. WALLIS: That's very interesting.

(Laughter.)

MEMBER KRESS: Can we want to take anything back?

(Off the record comments.)

MR. GILLESPIE: Unless it's safeguards and securities. It's how the system works. Once a decision is made, anything that's important --

DR. WALLIS: But anything that's against that decision is also made public.

MR. GILLESPIE: It's also made public, yes. Anything associated with it is made public.

(Off the record comments.)

CHAIRMAN SHACK: I think we're losing steam here.

MEMBER CORRADINI: That would be a true statement.

CHAIRMAN SHACK: We all adjourn for the day. I thank the presenters for their patience in trying to deal with everything.

MR. PRATO: There really isn't anything left except for the status of the pilot plant for the ISLOCA.

CHAIRMAN SHACK: The ISLOCA, right.

MR. SCHAPEROW: Yes. Classic failure of a low pressure piping outside containment.

MEMBER APOSTOLAKIS: You have an agenda.

CHAIRMAN SHACK: We'll adjourn. Thank you. Off the record.

(Whereupon, at 3:14 p.m., the above-entitled matter was concluded.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on Reactor Safeguards

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Charles Morrison

Charles Morrison
Official Reporter
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