

1 UNITED STATES OF AMERICA  
2 NUCLEAR REGULATORY COMMISSION  
3 \*\*\*  
4 BRIEFING ON SEVERE ACCIDENT  
5 MASTER INTEGRATION PLAN  
6 \*\*\*

7 PUBLIC MEETING  
8 \*\*\*

9 Nuclear Regulatory Commission  
10 Commission Hearing Room  
11 11555 Rockville Pike  
12 Rockville, Maryland

13  
14 Tuesday, October 14, 1997  
15

16 The Commission met in open session, pursuant to  
17 notice, at 1:03 a.m., the Honorable SHIRLEY A. JACKSON,  
18 Chairman of the Commission, presiding.

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20 COMMISSIONERS PRESENT:

- 21 SHIRLEY A. JACKSON, Chairman of the Commission
- 22 GRETA J. DICUS, Member of the Commission
- 23 EDWARD McGAFFIGAN, JR., Member of the Commission
- 24 NILS J. DIAZ, Member of the Commission

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1 STAFF AND PRESENTERS SEATED AT COMMISSION TABLE:

- 2 ANNETTE VIETTI-COOK, Assistant Secretary
- 3 KAREN D. CYR, General Counsel
- 4 BRIAN SHERON, NRR
- 5 MARK CUNNINGHAM, Office of Research
- 6 ASHOK THADANI, Program Oversight, Investigations &  
7 Enforcement
- 8 CHARLIE ADER, Office of Research
- 9 ROBERT PALLA, NRR

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

2 [1:03 p.m.]

3 CHAIRMAN JACKSON: Good afternoon, ladies and  
4 gentlemen. I am pleased to welcome members of the staff to  
5 brief the Commission on the status of the integration plan  
6 for closure of severe accident issues. The current element  
7 of this integration plan include, first, the severe accident  
8 research program, second the IEEE program and, third, the  
9 accident management plan.

10 The severe accident research program was initiated

11 in the early 1980s to develop an understanding of severe  
12 accident phenomena and to provide a technical basis for  
13 regulatory decisions. A number of key issues associated  
14 with our understanding of severe accidents have been  
15 resolved over the last several years or are close to  
16 resolution.

17 These issues include the liner melt for BWRs,  
18 boiling water reactors, and direct containment heating for  
19 pressurized water reactors. The research program has  
20 emphasized those specific severe accident phenomena that  
21 could result in early containment failure and code  
22 development and has benefitted from our cooperative  
23 agreements on severe accident research with other countries.

24 Today's briefing will focus on the status of and  
25 the progress in implementing the elements of the integration

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1 plan for closure of severe accidents. The briefing will  
2 cover the current status of the issues.

3 I would also request that the staff emphasize  
4 findings that have resulted from the research activities as  
5 well as closure plans for the remaining key severe accident  
6 issues. I understand that copies of the viewgraphs are  
7 available at the entrances to this room.

8 If none of my colleagues have questions or  
9 comments at this time, please proceed.

10 MR. THADANI: Thank you very much. Good  
11 afternoon.

12 With me at the table are Charlie Ader and Mark  
13 Cunningham, from the Office of Research and Brian Sheron and  
14 Bob Palla from NRR.

15 Could I have viewgraph number 2, please?

16 I will briefly go over the background and then we  
17 will jump right into the severe accident research program  
18 first and follow up with the status of IPSEE in particular  
19 as well as accident management.

20 Viewgraph number 3, please.

21 As you noted, the Commission's involvement in  
22 addressing severe accident issues has actually grown over  
23 the years, I'd say both in terms of scope as well as  
24 sophistication for treatment of severe accidents.

25 In the mid-'80s, the Commission issued a policy

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1 statement on severe accidents and concluded that the  
2 existing plants did not pose undue risk. However, there  
3 were two major questions that needed to be cleared up. One  
4 of the major questions had to do with plant-to-plant  
5 variation with the over 100 reactors of different designs.  
6 There was a question, could there be some outliers in terms  
7 of design implications. And that's what led to program on  
8 individual plant examination for internal events as well as  
9 for external events.

10 The other major program -- oh, by the way, that  
11 was -- the Commission noted that the licensees were best  
12 prepared to address those plant-specific issues.

13 On the other hand, it was recognized that there  
14 were some significant voids in our knowledge in terms of  
15 containment response as well as risk implications to public  
16 health and safety and the Commission had an ongoing,  
17 continued to work on this severe accident research program  
18 as well as the source program. Those were two major  
19 components it was recognized that the agency would be  
20 pursuing.

21 The idea to make sure that we look at issues in an  
22 integral manner was essential and in late '80s, as a matter

23 of fact -- could I have viewgraph number 3, please? -- it  
24 was clear there were some key elements -- I thought for a  
25 moment it wasn't there so I wanted to be sure.

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1 The key point to note here is that three major  
2 factors that we thought would lead to closure of severe  
3 accidents on operating reactors. One had to do with IPE and  
4 IPEEE as a very central element in that. And the two other  
5 important elements were the severe accident research program  
6 as well as the accident management program.

7 It was recognized that the -- it was essential to  
8 get early information on some key challenges to containment  
9 as part of the severe accident research program. Thus,  
10 containment performance initiative was one part of the  
11 severe accident research program, an important part of the  
12 program.

13 Since we have had some discussion about budget  
14 issues in the recent past, I thought I would like to share  
15 some of my thoughts with you up front and then we will pick  
16 up the specific as you asked us to address.

17 CHAIRMAN JACKSON: Okay. Let me ask you, as you  
18 are going through, to also talk about how you came to  
19 closure on the non-highlighted bullets here.

20 MR. THADANI: The --

21 CHAIRMAN JACKSON: On containment performance.  
22 The fact that you are not discussing them explicitly, you  
23 have them as arrows in the viewgraph material that we got.  
24 So I assume what you are going to focus on are things in  
25 bold face that are highlighted?

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1 MR. THADANI: Yes.

2 CHAIRMAN JACKSON: Now, that means you're not  
3 going to focus on the others. The question is, does that  
4 mean that you have come to closure on the others or that  
5 they are subsumed topics in the ones that are highlighted?

6 MR. THADANI: The individual -- let me address  
7 each of them.

8 CHAIRMAN JACKSON: Okay.

9 MR. THADANI: Individual plant examinations, we  
10 will cover very briefly but the focus will be on external  
11 events because that's where much of the work is going on.

12 In terms of containment performance and  
13 improvements, we will touch upon that as part of the  
14 briefing to indicate what some of the insights are that have  
15 come out of this.

16 Improved plant operations is our more or less  
17 day-to-day activities. Those are ongoing activities and  
18 they will continue to go on, continue to focus on  
19 operations. So that's why it is identified there because it  
20 is an important part of this continued oversight of  
21 operating reactors that plays -- gives one some sense of  
22 confidence. It's not like we've finished everything, we're  
23 not paying attention to operations. The idea here was it is  
24 essential that we pay continued attention to operations and  
25 that that will just keep going.

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1 CHAIRMAN JACKSON: All right.

2 MR. THADANI: In fact, I would like to -- having  
3 come from NRR in the recent past, in research, and in my  
4 current position here, I can reflect a little bit on some of  
5 the value of the program that I saw when I was at NRR and  
6 continued to believe in the importance of this effort.

7 We were faced with -- we have been faced with a

8 number of issues over time and you addressed a couple of  
9 them. The Mark I liner melt-through issue is quite  
10 significant. There was a lot of debate, a lot of interest.  
11 How do Mark I containments respond to severe accidents? And  
12 the initial thinking was that any accident that leads to  
13 substantial damage of the core could lead to melt through  
14 the liner and thus lead to significant early releases.

15 The research program has put that issue to bed.  
16 It required certain accident management strategies, a fairly  
17 simple strategy, actually, to deal with this issue and,  
18 quite frankly, had it not been for the program and the  
19 experiments and the analysis that were done through this  
20 program, one would be thinking about design changes and, in  
21 fact, we were thinking about design changes until we got  
22 better understanding of how one could in fact terminate  
23 corium movement through the liner.

24 You will hear some more about direct containment  
25 heating issue. Several years ago, there was this concern

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1 that one could have a high pressure core melt sequence that  
2 could potentially lead to almost an instantaneous failure of  
3 the containment from direct containment heating aspects.  
4 That has some geometry implications and so on and while the  
5 program on direct containment heating is not complete but  
6 much of the information has pointed out that certainly for  
7 large dry containments, this is not an important  
8 consideration. The probability of such conditions happening  
9 is pretty low and one could be quite confident about low  
10 risk and not high risk.

11 There are other examples. One that we were  
12 involved in had to do with containment venting for Mark I  
13 containments again and there were some design changes made,  
14 backfits were imposed because it as believed that the risk,  
15 early -- large early release probability may be fairly high  
16 unless one were to provide some hardened vent path and that  
17 would not only filter and reduce the activity level but also  
18 would reduce probability of accidents initiated by high  
19 containment pressure.

20 So these, and of course you have heard a great  
21 deal about NUREG 1465, the new source term, and the idea of  
22 rebaselining and looking at plants, where to go. So these I  
23 see are examples of the value of the program and I have  
24 tried in my mind to tie this concept with the increased use  
25 of risk-informed thinking in our decisions.

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1 In the policy statement on PRA, we said we should  
2 be using risk-informed thinking in all activities to the  
3 extent they can be supported, the analyses can be supported  
4 by data, methods and so on. So a careful use of this. And  
5 in that policy statement we also say that the analyses  
6 should be done as realistically as one can do and not in  
7 some conservative manner.

8 I think in my -- again, I see severe accident  
9 research program as helping us through development of codes,  
10 doing analyses in as realistic a manner as we can. And thus  
11 it seems to me it would continue to play an important part  
12 in the learning process.

13 Today, we are still at a point where we think  
14 there are a number of uncertainties in some challenges to  
15 containment which could lead to -- potentially lead to large  
16 releases. So I think selected parts of severe accident  
17 program, at least in my mind, are quite valuable. We are  
18 going to take a very hard look, we are taking a very hard  
19 look to see if we can develop some priorities in what we are

20 doing and in the priorities, we are also looking at what are  
21 some of the international implications if we were to  
22 terminate certain portions of the programs and so on. And  
23 we owe you that information, I believe, by the end of this  
24 month.

25 Another point I asked for some information on

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1 budget. The severe accident research program budget in  
2 fiscal year '95 was \$12.4 million NRC funds and \$4.6 million  
3 of funds that were provided by international community to  
4 us. In '96, \$9.7 million is our budget and \$2 million  
5 provided by other countries to us.

6 CHAIRMAN JACKSON: You say 9.7. That means 9.7 is  
7 the total program of which 2 million is international or is  
8 it 9.7 plus 2 million?

9 MR. THADANI: It's 9.7 plus 2 million.

10 CHAIRMAN JACKSON: Okay, that's all I wanted to  
11 know. Okay.

12 MR. THADANI: Again, in '97, NRC funding level was  
13 6.4 million and international funding provided to us was 2.5  
14 million.

15 In fiscal year '98, our initial budget was \$4.6  
16 million and it looks to us like we will have about 1 million  
17 from international community. That's a very uncertain  
18 accident. But that's the information I wanted to provide to  
19 you.

20 CHAIRMAN JACKSON: Commissioner McGaffigan.

21 COMMISSIONER MCGAFFIGAN: Provided by the  
22 international community? You mean, these are experiments  
23 that we participate in where others also participate and  
24 provide funds? No one is transferring funds to us.

25 MR. THADANI: No, some of it is actual transfer of

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1 funds that we can use in this country to conduct work that  
2 helps the overall severe accident program.

3 COMMISSIONER MCGAFFIGAN: How much is that as  
4 opposed to all of us participating in RASPLAN or  
5 something --

6 MR. ADER: If I can, the numbers that Ashok is  
7 citing for contributions, that's funding, actual funding  
8 contributed to the NRC for application to our severe  
9 accident programs, either codes, in some cases they are  
10 specific projects that we may be a bilateral with a country.  
11 But the majority of that is coming in under what we call the  
12 Cooperative Severe Accident Research Program, which is a  
13 number of bilateral --

14 CHAIRMAN JACKSON: It's actually dollars?

15 MR. ADER: That's actual dollars.

16 CHAIRMAN JACKSON: Right.

17 Why don't we do the following. We can't get into  
18 getting into all the details. Why don't you codify this  
19 information, if it is not already here at the Commission,  
20 just provide it and break it down because the focus here is  
21 to kind of understand where we are. We can take the dollars  
22 and decide that, you know, what has to happen. But it is  
23 important here for the Commission to understand what the  
24 program has accomplished, what questions have been answered,  
25 what issues have been closed out, what remains, you know,

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1 how significant are they. And if you can answer it what  
2 ones need to be done here or by us versus our being able to  
3 get the information from somewhere else, then let's just  
4 leave the dollars aside because we can go back and forth and

5 I would rather you have the exact information to provide to  
6 the Commission, okay?

7 MR. THADANI: Thank you.

8 With that, we will go to Charlie to go through the  
9 severe accident portion.

10 MR. ADER: Thank you, Ashok.

11 If I can have slide 5, please?

12 As was mentioned, severe accident research program  
13 over the years has provided a lot of information, has really  
14 been key to our understanding of risks for plants out there  
15 in doing probability risk assessments and moving into  
16 risk-informed regulation.

17 As you mentioned, a number of issues have been  
18 closed. Mark I liner was one of the issues that was  
19 mentioned. I guess the fundamental question, why have we  
20 been doing the research and the obvious answer is that the  
21 risk studies, WASH 1400, NUREG 1150 and the IPEs continue to  
22 show that severe accident is where the risk is to the  
23 public. That is the dominant contributor. And the early  
24 containment failure, as has been mentioned, is of that  
25 contribution primarily early containment failure.

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1 The understanding of severe accidents is going to  
2 be key and has been key in moving into the areas of  
3 risk-informed regulation. We have closed issues. Mark I  
4 liner was one of the containment performance improvement  
5 areas. At the time that the IPE program was started, there  
6 was not a real understanding of whether water addition would  
7 prevent a liner failure or not so licensees were holding  
8 back on accident management strategies, not sure to modify  
9 the plant to add water.

10 The program came to conclusions on -- you know,  
11 narrowed the uncertainties and had provided the information  
12 which was incorporated through a generic letter and through  
13 the IPE program to provide to licensees. They have  
14 subsequently been able to go forward in accident management  
15 with the strategy of adding water. DCH, which I will talk  
16 about in a minute, is another one of the key issues.

17 The experimental work or the severe accident  
18 program has really been a two-part. We have been trying to  
19 build the analytical capabilities, the codes to give the  
20 staff the capabilities to deal with issues as they arise, to  
21 resolve new issues that may come up and to respond to  
22 industry initiatives. In doing that, the experimental  
23 program has been important in providing data and information  
24 for validating the codes.

25 Where we are focusing now, we are trying to look

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1 at some of the areas of remaining uncertainty and those that  
2 are the biggest risk contributors. A lot of the experiments  
3 are geared toward providing the data. We continue to need  
4 to assess the models and provide better analytical tools for  
5 the Commission, for the staff.

6 The long-term question that we have been facing  
7 for a number of years is how do we maintain this expertise  
8 available either in house, out of house or through bilateral  
9 agreements so we have access to information and have the  
10 capabilities to respond when we need it.

11 CHAIRMAN JACKSON: Let me ask you a question. I  
12 mean, in terms of your second, third, fourth and fifth  
13 bullets, basically, the middle ones, is our current  
14 understanding of severe accidents sufficient to support our  
15 moving to risk-informed regulation from a technical  
16 perspective? Or at least moving in certain directions along

17 that path? Or is there, you know, a lot more additional  
18 work required either by us or others that we could draw on  
19 in order to support that?

20 MR. ADER: I think it has clearly provided the  
21 basis to move forward into risk-informed regulation. There  
22 will be areas that there are uncertainties in or estimates  
23 in. We will have to deal with those. It may mean that you  
24 cannot move as far as either industry or we might like  
25 because of residual uncertainties or remaining

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1 uncertainties. There may be some areas that we may not be  
2 ready to make a decision. I mean, they are going to be case  
3 specific.

4 CHAIRMAN JACKSON: Case specific.

5 MR. SHERON: An example of that is the steam  
6 generator area, which you will hear about hopefully in about  
7 a month.

8 CHAIRMAN JACKSON: Okay.

9 MR. SHERON: Where we found when we did the  
10 analysis that there was a large uncertainty in terms of the  
11 tube failure likelihood and the approach we are taking is  
12 basically to ask the utilities on a case-specific basis they  
13 will have to analyze their plants.

14 CHAIRMAN JACKSON: Okay. Commissioner Diaz?

15 COMMISSIONER DIAZ: Yes, when you talk about  
16 uncertainties that are, you know, significant so we might  
17 not be able to move in an area, you're talking about an  
18 order of magnitude, a factor of two, or would you like to  
19 be -- what is uncertainty?

20 MR. ADER: It obviously is going to be situation  
21 and accident scenario specific. The uncertainty in the  
22 steam generator case that was mentioned, the initial  
23 judgment of that uncertainty was fairly high. The early  
24 numbers and analyses that were coming out were showing a  
25 very high likelihood of tube failure. That was an area that

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1 we were able to build on our expertise and capabilities that  
2 we have today, refine the analysis, combine it with some of  
3 the material testing that was going on in a different part  
4 of research and provide information into NRR's regulatory  
5 analysis and narrow those uncertainties.

6 That one, it was more we were focusing on  
7 temperature, the temperature difference at which would lead  
8 to failure or not lead to failure. So it was not really an  
9 order of magnitude, it was just a few hundred degrees. But  
10 that was very key for that particular application.

11 MR. THADANI: If I may add to that, the key issue  
12 there was, in fact, temperature in the steam generator, hot  
13 gasses coming in, what temperature are we talking about.  
14 And that was a very sensitive parameter in terms of tube  
15 response. And the other factor that was critical also was  
16 the initial condition of the tubing material, if it had  
17 certain flaws, what type of flaws.

18 So there was -- there was the part here we're  
19 discussing in terms of severe accident research program was  
20 a thermal hydraulic aspects. The material aspects were  
21 dealt with through testing at Argonne National Laboratory.  
22 When I say "dealt with," at least we got better  
23 understanding of the material behavior.

24 Another example I could give you where we make  
25 clearly a very conservative assumption today, that if there

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1 is substantial core damage has taken place, we assume the

2 vessel will fail so the experiments were looking at trying  
3 to get information on geometry and heat transfer to see if  
4 in fact one can initiate accident management strategies,  
5 cooling the vessel from outside, downward heat transfer and  
6 so on to try to get better understanding of in fact could  
7 one maintain corium in vessel? I mean, it has two very  
8 significant things in my mind.

9 One is -- and I am not suggesting that we will end  
10 up with an answer that says, yes, indeed, one can maintain  
11 the damaged core in vessel. But the potential benefit is so  
12 significant, in terms of risk analysis, health effects and  
13 so on, because now even for severe accidents we can say  
14 we're not just relying on containment, we could maybe rely  
15 on pressure vessel itself as well.

16 COMMISSIONER DIAZ: Really, the direction of the  
17 question is I wonder if we would not serve the program and  
18 the NRC better if we wouldn't be talking of convergence of  
19 uncertainty rather than that uncertainty, per se. In other  
20 words, because of the difference in the phenomenology and  
21 the time-dependent processes, any one of these things will  
22 have significant uncertainties. I think what we are talking  
23 about is you perform analyses and experiments, you converge  
24 it to where you have a confidence and that uncertainty is  
25 within the bounds that you want.

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1 Twenty percent, okay, would be a very good  
2 estimate of what direct containment heating is and therefore  
3 we can estimate within 20 percent we are probably right. So  
4 I think it is how we converge rather than what the  
5 uncertainty value is.

6 CHAIRMAN JACKSON: That was my understanding of  
7 what you were saying.

8 MR. ADER: Clearly. I will go back to Mark I  
9 liner. At the time that issue came up, the experts that  
10 looked at it said that even with water on a molten core, the  
11 liner will fail. Other experts said it will not fail. The  
12 central estimate was somewhere in between but it was a  
13 bimodal type of it will or will not and the research came to  
14 conclusions on that. So we can move forward.

15 COMMISSIONER DIAZ: So you had convergence.

16 MR. ADER: Convergence, yes.

17 CHAIRMAN JACKSON: Maybe, Mr. Cunningham, you have  
18 some edifying comments in this discussion.

19 MR. CUNNINGHAM: Well, Charlie used a good example  
20 in the BWR Mark I liner, that that was an issue back in  
21 NUREG 1150 that the experts, we owed and got information  
22 from a lot of experts and there was a good bit of difference  
23 of opinion in some cases and it showed dramatically in the  
24 risk measure of conditional probability of containment  
25 failure, given a core melt. And the research they have been

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1 doing since then has really tackled that question directly.

2 CHAIRMAN JACKSON: I believe Commissioner  
3 McGaffigan had a question?

4 COMMISSIONER MCGAFFIGAN: Could I ask, it is  
5 related to Commissioner Diaz's question in a way, but how do  
6 the uncertainties today that you are dealing with compare to  
7 what they were in the early 1980s? I am trying to prepare  
8 for hard questions about, you know, how much is enough, but  
9 were the uncertainties much greater several years ago and  
10 now we are working on marginal uncertainties compared to the  
11 large uncertainties there were when we started spending,  
12 whatever it was, 100 million plus in this area?

13 MR. ADER: The uncertainties in the '80s, surely,



14 after TMI, were very large. We basically did not understand  
15 a lot of the phenomena. We did not understand how an  
16 accident would progress, what the challenges to containment  
17 were.

18 We are to the point that we have been able to  
19 incorporate it into risk studies. 1150 had an extensive  
20 process, it was an expert elicitation. And we have been  
21 able to move on and come to conclusions. Some of those have  
22 still had to be conservative and the question is, to the  
23 extent of conservatism, we may want to incorporate to  
24 account for these remaining areas. That is somewhat the  
25 question we are facing.

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1 The other one is maintaining the expertise so we  
2 can respond. Severe accident codes, I will address a little  
3 bit, are very complicated codes. They are not something you  
4 can put on a shelf and when you need them you pull off,  
5 somebody reads a manual and runs them and really can give  
6 you a good understanding. So the other portion is how do we  
7 maintain that capability in the staff.

8 COMMISSIONER MCGAFFIGAN: So this bullet, the  
9 fourth bullet, really should read, remaining internal work  
10 addresses areas of largest remaining uncertainty rather than  
11 implying that there is large uncertainty. Most of the  
12 uncertainties, the largest uncertainties at the start of the  
13 program have been whittled down.

14 MR. ADER: Correct.

15 COMMISSIONER MCGAFFIGAN: Now we have some -- you  
16 are, of course, as you did at the start of the program,  
17 looking at the largest remaining uncertainties and trying to  
18 whittle those down?

19 MR. ADER: Correct. That was one I looked at  
20 that, after I had time to look at it at leisure, I said I  
21 would have -- there are a couple bullets I would have  
22 rewritten. You caught one of them. I may not tell you the  
23 others.

24 CHAIRMAN JACKSON: Well, do go on.

25 MR. ADER: Slide six, please.

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1 The areas of emphasis that were covered in the  
2 Commission paper, and I will touch on each of these in the  
3 briefing. The codes I have mentioned, they are the key to  
4 the analytical tools for the staff. Direct containment  
5 heating has been mentioned. Most of these have been  
6 mentioned. Lower head, debris coolability.

7 Cooperative severe accident research program, I am  
8 going to jump right to the bottom, is kind of an umbrella  
9 program where we have been very active internationally. The  
10 U.S. program has been recognized for a long time as really  
11 the leader in severe accident research. Countries were  
12 coming to us for access to our information.

13 I will touch on each of these. I won't read the  
14 list.

15 CHAIRMAN JACKSON: Excuse me. Let me ask you a  
16 couple questions.

17 Were any of these severe accident issues dominant  
18 risk contributors in the IPE or IEEE in which containment  
19 failure was explicitly evaluated?

20 MR. ADER: DCA, direct containment heating, some  
21 of the IPEs have shown that as a contributor still. Fuel  
22 cooling interaction or steam explosions have been shown as  
23 contributors. In 1150, steam explosions and direct  
24 containment heating were contributors to the early

1           Some of these areas, some of the research has been  
2 directed toward issue resolution like direct containment  
3 heating. Other areas of research, lower head integrity,  
4 desbris coolability, is really focusing on trying to assess  
5 the effectiveness of accident management strategies that  
6 could potentially remove our perception of challenges to  
7 containment as we have now. As Ashok said, we may not be  
8 able to totally remove them but they are showing some  
9 promise. But we are a little ways away.

10           CHAIRMAN JACKSON: How has risk analysis been used  
11 in the prioritization or sunseting of severe accident  
12 research programs?

13           MR. ADER: DCH was one of the issues that came out  
14 of the draft 1150, early 1150. It was not a phenomena that  
15 was in NUREG -- or WASH 1400, as I remember it. So the risk  
16 studies and the perception back in late '80s, early '90s,  
17 was that was an area that was a challenge to early  
18 containment failure. The fuel/coolant interactions have  
19 been shown to be a contributor.

20           Now, albeit if you go back to 1150 and plants will  
21 meet the safety goals so they are not issues that we have  
22 gone out and said, you know, we don't have time to pursue  
23 and better understand. Generally, those are the areas that  
24 we focused the research on.

25           CHAIRMAN JACKSON: Are these in any kind of

1 priority order?

2           MR. ADER: I started to say that when asked that  
3 question before but cooperative severe accident research  
4 program is really kind of an umbrella type of program so I  
5 would not say that because it is the last thing it's the  
6 lowest priority. The codes clearly would be the top of the  
7 list and they are there for that reason. Direct containment  
8 heating, we are near resolution, hopefully near resolution  
9 on. Lower head integrity, desbris coolability, there is  
10 some order going down here but I wouldn't hold it as rigid.

11           CHAIRMAN JACKSON: See, the difficulty we have is  
12 this. The difficulty is, when you list out these topics, we  
13 don't have a sense, okay, of, to use Commissioner Diaz's  
14 terminology, how much the uncertainty has been narrowed. We  
15 don't have a sense of what things have shown up as dominant  
16 risk contributors in accident sequences or from IPE or IEEE  
17 considerations. And then once you've gotten that  
18 prioritization, that's why I asked the question about risk  
19 analysis being used to prioritize what we do. Once one has  
20 gotten that priority, then we don't have a sense of what's  
21 come to closure or what has narrowed the uncertainty to a  
22 point that we can live with it and what's still wide open,  
23 particularly what may be wide open higher up on the list.

24           I think this is what we are trying to get out of  
25 you and if you can tell us today, it would be useful for you

1 and useful for us. And I think that's really kind of what  
2 we need to know.

3           MR. THADANI: Yes, indeed. And I think as we go  
4 through the presentation, you will see some areas, for  
5 example hydrogen combustion area, what basically has been  
6 concluded.

7           CHAIRMAN JACKSON: Yes, but see, I want to know  
8 first what's most important. That's number one from a risk  
9 point of view. Does it vary with classes of plants, are  
10 they all equally important depending upon what classes of

11 plants I look at or are there some that are clearly  
12 standouts. That's number one. Number two, given those,  
13 what degree of closure do we have by whatever measure,  
14 whether it is narrowing uncertainties or just, you know,  
15 sufficiently we understand how to manage it, et cetera?  
16 That's the way one has to go through here, otherwise it is  
17 topics that have come up within the context of the severe  
18 accident research program that may hark back to TMI or some  
19 other accident but it's not possible just sitting here to  
20 extract from that where is the risk, what degree of closure  
21 do we have and are there things that have been found out  
22 recently or phenomena from abroad that have called into  
23 question the degree of closure we think we have on these or  
24 have they given us more comfort that there is more closure  
25 than we might have expected? That is the kind of thing, I

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1 think, it is important for the Commission to understand.

2 Then the last thing I wanted to ask you, which you  
3 may not be able to answer but, given there is a discussion  
4 within the context of plutonium disposition and discussion  
5 about renormalizing the source term, are there any  
6 subtleties there that come into play that would call into  
7 question our results relative to the rebaselining of the  
8 source term? I think it's very important.

9 So I don't know if you can tell us today or if you  
10 are going to put it in a paper but as much as you can tell  
11 us today I think is very important in terms of all these  
12 questions.

13 Commissioner Diaz.

14 COMMISSIONER DIAZ: Thank you, Chairman. That is  
15 just what I was going to point out. Maybe I can bring it  
16 back to when you were asked to give us a breakdown of the  
17 cost and things.

18 What I really think we need is really a three or  
19 four dimensional matrix that shows, you know, by emphasis,  
20 our understanding in this investment, you know, how is the  
21 emphasis correlated with the risk? How is it converged as a  
22 function of time to a value? And that will give us some  
23 priority.

24 MR. THADANI: Fine, I understand. I think we can  
25 address some of it today but not all.

27

1 CHAIRMAN JACKSON: I think you need to propagate  
2 something to the Commission that lays that out. I mean,  
3 otherwise -- and you should make it part of this paper that  
4 you have provided.

5 MR. THADANI: Yes, end of October, yes.

6 CHAIRMAN JACKSON: Commissioner McGaffigan?

7 COMMISSIONER MCGAFFIGAN: Just a point of  
8 clarification. We are defining severe accident research  
9 here and we have a bunch of items under it.

10 My recollection when the budget was presented to  
11 us was that for some reason or other, hydrogen combustion  
12 was separate from severe accident and we made two different  
13 decisions on it in the context of the upcoming budget.  
14 There was a little piece of hydrogen combustion I thought  
15 back buried in this section. Am I wrong on that?

16 MR. THADANI: I believe it was part of the severe  
17 accident program but I better check with Charlie to be sure.

18 MR. ADER: At least from my perspective, hydrogen  
19 combustion has been part of it.

20 COMMISSIONER MCGAFFIGAN: I may be forgetting.

21 The other thing, you know, you have this paper by

22 the end of the month. By December, you have a much broader  
23 paper due to the Commission that was going to look at, I  
24 believe, 39 different technical areas that you had --  
25 several of which are in the severe accident space and others

28

1 of which aren't, the majority of which. And you were going  
2 to use the matrix that you had given to us in the earlier  
3 paper that's out in the public domain and apply that to all  
4 the 39 areas.

5 Have you given any thought at all to the  
6 possibility of getting those two papers into better phase so  
7 that when we look at severe accident program, we can do it  
8 in a context? Or is that asking the impossible?

9 MR. THADANI: I will look into it but I would be  
10 surprised if, given, quite frankly, this morning, ACRS has  
11 asked for a meeting on November 4 to go over a number of  
12 issues related to research. They have asked some very good  
13 questions and he was telling me that it was going to be very  
14 difficult to meet on November 4 because we have so much on  
15 our plate that we have to do by the end of this month and  
16 early next month.

17 Given what he told me this morning, I am going to  
18 check with them but I believe it is going to be difficult.

19 MR. ADER: Let me move to slide 7. You asked the  
20 question of priority somewhat in what we need. There are  
21 issues of closure and there are issues of capability.

22 Severe accident codes bridges everything. It  
23 embodies the knowledge we have gained from years and years  
24 of research. With the exception of resolving a few issues,  
25 that's where we try to capture our understanding of severe

29

1 accidents. That's the analytical capabilities the agency  
2 would use in the future for dealing with issues as they come  
3 up, either risk informed or an issue like steam generator  
4 that came up that we need to deal with.

5 The codes are very involved, very complicated.  
6 There is a certain level of resources to have a capable code  
7 group available that -- I hate to put that in terms of  
8 closure and resolving an issue because that's just the  
9 fundamental -- I view it as a fundamental tool that we  
10 maintain.

11 CHAIRMAN JACKSON: How many NRC staff can, in  
12 fact, run, maintain or update the codes?

13 MR. ADER: Most of the code, the project managers  
14 I have, most of the code work is done at the national labs  
15 or maybe with some university support. Most of the project  
16 managers for the major codes, MELCOR several people can run  
17 it, VICTORIA -- I'm jumping ahead on the codes a little  
18 bit -- can run it.

19 Others have run the code in the past and more  
20 recently have been focusing on support for AP600 or  
21 something else and their capabilities have gotten a little  
22 rusty. We are trying to get back into the mode of being  
23 able to run and do the analysis work much more.

24 The modeling, we are much further away from being  
25 able to do the code development, the model development in

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1 the severe accident codes because of the number of different  
2 areas.

3 CHAIRMAN JACKSON: So aside from some ability to  
4 run the codes, we basically are dependent on outside  
5 sources?

6 MR. ADER: Heavily dependent at this time.

7 CHAIRMAN JACKSON: But you developed a plan to

8 migrate to in-house capability more and more, is that what  
9 you are telling me?

10 MR. ADER: We are trying to get more and more  
11 people and do more of the analysis in house. It has been a  
12 slow process due to competing demands and we really need on  
13 these codes to almost go away for a while and just work them  
14 and play with them and understand them.

15 MR. THADANI: My goal is very clear. It is the  
16 same here as we had in our thermal hydraulic analysis, core  
17 development analysis. The intention is to, in the long run,  
18 to make sure we can do the analysis, we can make the changes  
19 that are necessary to these codes. So that is the  
20 intention.

21 But we are not, as Charlie said, we are much  
22 further along in the thermal hydraulic codes than in severe  
23 accident codes in that area.

24 CHAIRMAN JACKSON: So have any of them been  
25 developed in house?

31

1 MR. ADER: No.

2 MR. THADANI: No.

3 CHAIRMAN JACKSON: How much of the work in this  
4 area -- and you can answer it later in terms of severe  
5 accident research more broadly -- have we committed to  
6 through bilateral agreements?

7 MR. ADER: The code work, we have one, one  
8 agreement, a code called GASFLO. It is a finite difference  
9 containment thermal hydraulic hydrogen distribution code.  
10 DOE is supporting it and FZK in Germany is supporting it.  
11 We are basically leveraging our resources at fairly low  
12 level to try to develop this as a tool that could be used in  
13 the future to replace or supplement the contained code which  
14 is the containment thermal hydraulics.

15 CHAIRMAN JACKSON: Okay.

16 MR. ADER: The other codes we are basically -- our  
17 contribution to the SESARP program that international  
18 countries are funding us to help develop the codes.

19 As far as running the codes, I will mention I had  
20 a discussion with my division director just this morning and  
21 he was telling me I need to really make sure we move this  
22 capability along. So I am getting that message loud and  
23 clear from several sources.

24 We currently are maintaining a two-tiered approach  
25 of the codes just through the capabilities. The MELCOR code

32

1 is an integrated code that will really cover from beginning  
2 to end of an accident. But not in the details of the SCDAP,  
3 RELAP and the contained code. Much more mechanistic and the  
4 capabilities are such that we can't put it all in one code  
5 at this time and have anything that really runs in a  
6 reasonable amount of time so we build on it.

7 Let me move on to a --

8 CHAIRMAN JACKSON: Let me ask you one quick and  
9 last question. How much access to experimental work is  
10 needed to keep the suite of codes current?

11 MR. ADER: You need the experimental work to  
12 assess the models that you are developing to take care of  
13 comments we've gotten from peer review processes or known  
14 weaknesses. Some of that is experiments that have been done  
15 but there are experiments going on worldwide and access to  
16 that data is key to being able to move the codes forward and  
17 to improve them.

18 CHAIRMAN JACKSON: Do we have to be part of the

19 groups experimentally in order to have access to the data?  
20 MR. ADER: In most cases, yes. We need to either  
21 be a participant or have a cooperative agreement. A certain  
22 amount of access, we can get by just us having the codes to  
23 trade. Some of the programs, the FARO program, I will  
24 mention later and the RASPLAV, those are pretty much, you  
25 belong to get the information or it is not available.

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1 If I could move to the next slide, 9?  
2 The steam generator is an example of a recent  
3 issue. It started out as an aging issue, it became rapidly  
4 a severe accident concern. The concern being a tube could  
5 fail in a severe accident situation leading to a containment  
6 bypass, which is an early containment failure.  
7 We used the SCDAP RELAP code both to provide the  
8 initial conditions for the material tests that were being  
9 done at Argonne and then to provide the test data coming out  
10 of the tube tests with the thermal hydraulic conditions to  
11 assess the likelihood or the probability of tube failure.  
12 This is a case where we built on the work that had been done  
13 for DCH. We had capabilities that we had put together  
14 through those studies that we were able to quickly turn  
15 around and access to respond to the needs of NRR. The  
16 MELCOR and VICTORIA codes were part of the analysis to look  
17 at the releases off site.

18 Move to slide 10.

19 Direct containment heating is an issue that came  
20 up in 1150. The concern that if the vessel failed at high  
21 pressure, the lower head would melt through, you would  
22 inject molten debris into the containment atmosphere, you  
23 would get rapid heat transfer and fail the containment due  
24 to overpressure and hydrogen combustion effects. From the  
25 draft 1150, here is an example. Here is a case where we

34

1 have narrowed uncertainties.

2 Even though the containment failure probability  
3 was low, the early failure was estimated to contribute 80  
4 percent of the early fatality risks. The final NUREG 1150  
5 partly because of the severe accident research and other  
6 issues that were looked at between draft and final, that  
7 estimate was 20 percent but it was still viewed to  
8 contribute 20 percent of the risk.

9 COMMISSIONER DIAZ: And directly what caused the  
10 reduction? What element was critical?

11 MR. ADER: From the severe accident end, the  
12 loading on the containment was not reduced that much but the  
13 assessment of the likelihood of failing another part of the  
14 primary circuit to depressurize, the hot leg failure based  
15 on a better understanding, a better assessment of the  
16 progression of a severe accident, lowered the probability of  
17 having DCH as an event that would challenge it.

18 At that point in time, the view was still that the  
19 loads could potentially fail the containment.

20 CHAIRMAN JACKSON: What is the range of early  
21 containment failure probability due to direct containment  
22 heating? What you have here is early fatality risk. I am  
23 interested in early containment failure probability.

24 MR. ADER: I don't remember the percentage from  
25 direct containment heating as opposed to bypass. I think

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1 the steam explosion was also a load for -- Mark was more  
2 involved in 1150.

3 MR. CUNNINGHAM: I believe, thinking back for  
4 Surrey, it was conditional probability of early containment

5 failure given a core melt, given all core melts, if you  
6 will. I believe DCH was a few percent, steam explosion was  
7 around -- let me back up. In the case of Zion, steam  
8 explosion was about the same amount, a few percent if you  
9 will, for the PWRs.

10 CHAIRMAN JACKSON: How much of our severe accident  
11 research has -- what's been the cross-feed between that and  
12 the IPE programs?

13 MR. THADANI: The generic letter that we issued  
14 and the guidance we gave the industry?

15 CHAIRMAN JACKSON: That's right.

16 MR. CUNNINGHAM: Going back though, the generic  
17 letter was issued in 1988 so we were still in the middle of  
18 finishing NUREG 1150. There was still a lot of this -- this  
19 change was still happening coincident with sending out the  
20 generic letter. So the -- I believe the licensees had the  
21 opportunity to make use of what was used -- what came out of  
22 1150 in their programs to say, if I think my plant is  
23 sufficiently similar to Surrey or Zion, that I could use  
24 that as a basis to say I do or I don't have any severe  
25 accident vulnerabilities or a piece of the basis to see

36

1 whether or not I have any severe accident vulnerabilities.

2 Other plants went a somewhat different route.  
3 They went, I would say, beyond 1150 but considered other  
4 factors and weighed factors that weren't weighed so heavily  
5 in 1150, for example from the -- some of the industry  
6 programs that were perhaps a little more or less pessimistic  
7 if you will about the probabilities of some of these events.  
8 So you had -- it was kind of a mixed bag at that time.

9 CHAIRMAN JACKSON: So I mean, I guess I am trying  
10 to get some sense of how often what we get quantitatively  
11 out of our severe accident work and what comes out of the --  
12 what has come out of the IPEs lineup with each other.

13 MR. ADER: Some of this, if I can, Mark, was  
14 timing. As Mark said, both DCH and liner melt through, when  
15 the IPE generic letter was put out, these were issues that  
16 there was not enough agreement on to really tell industry to  
17 analyze it based on these assumptions because there was such  
18 wide differences that these -- those two issues were kind of  
19 left to staff to resolve. It's been a couple years since I  
20 was directly involved with the IPE program but Mark I liner  
21 was an example.

22 I saw some IPEs where licensees took the 1150  
23 assumptions, which showed a reasonable probability of liner  
24 melt through, even with water on top, and characterized  
25 their plant that way. Other licensees took advantage of the

37

1 research results that have been published around that same  
2 time and dismissed liner melt through referencing the NUREG  
3 CRs that we had issued and came up with a different  
4 perception.

5 DCH, I don't remember them picking the results  
6 quite as much because it has been more of an ongoing and  
7 more of a recent program drawing to conclusion.

8 MR. THADANI: Two points. Number one, that the  
9 industry analyses were basically utilizing the results of  
10 research at that time, generally, I think. And that is  
11 basically what we indicated in the generic communication to  
12 the industry.

13 The second part is the one that Charlie is talking  
14 about. There are some very significant issues in terms of  
15 early challenges. Liner melt through was one of those,

16 where our understanding did change during that period and  
17 changed very significantly. At one time, people were  
18 talking about conditional probability being fairly close to  
19 one of liner melt through given core melt. And with  
20 accident management strategies and getting water in, in a  
21 reasonable type period, a certain amount, the conditional  
22 probability is fairly close to zero. We said something like  
23 10 to the minus 3 or some very low conditional probability  
24 of containment failure.

25 What we are doing as followup to the IPE reviews,

38

1 this is one of the action items that we are looking at to  
2 make sure that we go back to those plants if they, in fact,  
3 have -- do they have the strategies in place, accident  
4 management. If not, why not. My understanding is that they  
5 have the strategy in place but that it is an issue of  
6 calculations but we are going to follow up as a result of  
7 that, one of the IPE followup issues.

8 MR. ADER: Slide 11, please.

9 I guess the bottom line on direct containment  
10 heating or close to the bottom line, we have completed the  
11 testing, we have completed a lot of the issue resolution for  
12 the Westinghouse large drys and subatmospheric plants. We  
13 would like to say that that issue now, DCH does not  
14 challenge those containments. So we can even that 20  
15 percent to early fatality risk that was in 1150. We could  
16 eliminate that.

17 Now, I caveat that because I do need to mention we  
18 have a differing professional view in that we are reviewing  
19 if it is challenged or some of the analysis methods. So  
20 that came up just this summer and we are having to go back  
21 and look at that. If that had not come in, I wouldn't be  
22 able to tell you we have eliminated that challenge.  
23 Hopefully, we can still be to that point. We will have to  
24 wait and see.

25 CHAIRMAN JACKSON: So are you saying then that

39

1 there are no PWR containment types for which the direct  
2 containment heating is a threat?

3 MR. ADER: Well, the CE, B&W and the Westinghouse  
4 ice condensers, we are nearing resolution on. The results  
5 on the CE, B&W, they have a different cavity configuration  
6 is why they were separated out, is that DCH will still be  
7 for several plants a small challenge given the core melt,  
8 high pressure melt injection. But we have also gone back  
9 and revisited the likelihood of being in that situation and  
10 we are close, I think, to saying that we can resolve it for  
11 those plants without it being a serious challenge.

12 The ice condensers, because of their small size,  
13 there may be issues with hydrogen that even if DCH is  
14 eliminated, they have the problems with the hydrogen  
15 challenge resulting from the high pressure injection.

16 CHAIRMAN JACKSON: When you do this kind of  
17 analysis, you look at the kinds of things like the hole size  
18 of the reactor vessel and the composition of the melt and  
19 gas, et cetera?

20 MR. ADER: There are a number of what they call  
21 splinters where they will look at the amount of the corium,  
22 the content, metallic content versus acidic, looking at the  
23 hole size of the lower head, trying to characterize that.  
24 Potentially preexisting water in the cavity, preexisting  
25 hydrogen. So there are a number of issues that they will go

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1 through.



2           We had a peer review group to help go through the  
3 experiments and the design and the issue resolution that  
4 will deal with, you know, have we considered the issues,  
5 have we considered a wide enough range.

6           I would mention we do have -- we have completed  
7 most of the experiments. We have a very small effort, two  
8 experiments remaining out at Sandia National Laboratories.  
9 That is a cooperative program with the French and the  
10 Germans. They have come to us based on some questions they  
11 had. We have some issues we are going to pursue. They  
12 wanted to take advantage of our expertise and our facilities  
13 and are sponsoring two-thirds and we are sponsoring the  
14 remaining one-third. They are paying two-thirds of these  
15 additional tests.

16           This whole program, hopefully, will be wrapped up  
17 mid- to late summer of next year.

18           COMMISSIONER DIAZ: You are talking about  
19 depressurization, you are talking about the primary? When  
20 you talk about depressurization, are you talking about the  
21 primary?

22           MR. ADER: Primary system, yes.

23           COMMISSIONER DIAZ: Just the primary. This does  
24 not include the possibility of dumping the steam into the  
25 condenser and have that mitigating actually the releases?

41

1           MR. ADER: No.

2           Slide 12.

3           Another fairly recent issue over the last several  
4 years is an issue of lower head integrity. Can we retain a  
5 molten core in vessel? The TMI vessel investigation project  
6 found a hot spot in the lower head of TMI. There was about  
7 20 tons of molten material that was in the lower head. The  
8 analysis at the time said the lower head would have failed  
9 but it did not and they saw indications of some rapid  
10 cooling part way through.

11           The question is, can we understand that mechanism?  
12 Is there a way that we can go back and revisit the lower  
13 head and say, if you have water inside the vessel, you will  
14 not fail the lower head or what are the conditions.

15           Another part of this program is looking at can you  
16 cool the vessel from external flooding. AP-600 has proposed  
17 that as a management strategy. At least one IPE, as I  
18 remember, had proposed that. I think at the time they had  
19 proposed it, people weren't ready to entertain it because we  
20 didn't have the information.

21           The third piece of this program is, if you can't  
22 retain it in vessel, can you -- can we narrow the range of  
23 uncertainties in the failure size of the failure of the  
24 vessel because that is really a key to the subsequent  
25 phenomena in the containment, or can we confirm our

42

1           assumptions.

2           Go to slide 13.

3           CHAIRMAN JACKSON: What's the impact of not being  
4 able to -- I mean, so where do you stand on reducing that  
5 uncertainty further and what's the impact?

6           MR. ADER: Okay, this is somewhat of a two-part  
7 program. One is to just look at the uncertainty of the hole  
8 size, the failure. But right now the severe accident  
9 analysis assumes that you will melt through the lower head  
10 and you will fail, that you will disperse debris either high  
11 pressure or low pressure into the cavity. If it's in the  
12 lower cavity, you will eventually fail base mat through

13 core-debris interactions or you will overpressurize the  
14 containment due to the heat and the gaseous products coming  
15 off. That's what is in the current risk assessments and  
16 those are the assumptions we have been dealing with. So  
17 those would continue.

18 The hope would be here that there is a mechanism  
19 that shows you can avoid those containment challenges.  
20 There may be a mechanism that you can retain it in vessel  
21 through appropriate accident management strategies. So  
22 there is a resolution and there is an accident management  
23 component.

24 To deal with this type of issue, there are a  
25 number of questions that need to be looked at.

43

1 Moving to slide 13.

2 Heat loads internal to the vessel, the heat  
3 removal external to the vessel, can we explain this  
4 mechanism of what happened at TMI, is there a gap that  
5 formed to get cooling in between. And then the program to  
6 look at the lower head failure.

7 The OECD RASPLAV is a cooperative program. I  
8 think there was a recent Commission paper during the summer  
9 about Phase II of this program to go forward with three  
10 additional tests under the sponsorship of the OECD. We were  
11 looking at the in-vessel mechanisms in a program in  
12 cooperation with EPRI and a couple international partners  
13 out at Fauske Associates out in Chicago.

14 We have had a program at Penn State that is  
15 looking at the heat removal external to a vessel, the  
16 boiling on an atmosphere. And then the program at Sandia  
17 National Laboratories is looking at the failure under  
18 pressure temperature loads, how it will fail. Here is a  
19 case where we are trying, again, to get data that we can use  
20 to validate the models to predict lower head failure.

21 Lower head failure experiments at Sandia is  
22 another example of a program where the international  
23 community has looked at what we have done and said, we are  
24 very interested in that. There was a meeting last week that  
25 a deputy division director was at, at OECD, and there still

44

1 seems to be considerable interest to proceed with this as an  
2 OECD project, assuming that we are able to participate.  
3 Those discussions will happen over the next several months.

4 Moving to slide 14.

5 MR. ADER: As I mentioned, if you cannot retain  
6 the corium in vessel, and it fails, then you have what is  
7 currently in the risk assessments of late failure, late  
8 containment failure through either base mat meltthrough or  
9 overpressure of the containment.

10 The program we're involved in dealing with this  
11 again, it's an EPRI-sponsored program, a number of  
12 international participants called the MACE program, Melt  
13 Attack Coolability Experiments out at Argonne National  
14 Laboratory. The last experiment was run in January using  
15 prototypic corium, actually UO2 materials. There was  
16 evidence of several cooling mechanisms, both failure of the  
17 crust, water ingress, and bulk cooling. Discussions are  
18 under way regarding the next test in this series.

19 CHAIRMAN JACKSON: I know that the EPRI utility  
20 requirements document contained a spreading criterion for  
21 debris coolability. How does that comport with what the  
22 actual experimental results show?

23 MR. ADER: The results at this point in time  
24 are -- give indications of cooling. They are not conclusive

25 enough to conclude that you can or cannot cool.

45

1 MR. THADANI: Basically our view was that one  
2 could not really depend on the value in the EPRI  
3 requirements document, which I think was .02 meters squared  
4 per megawatt. So we did not --

5 CHAIRMAN JACKSON: How much per --

6 MR. THADANI: It was .02 meters squared per  
7 megawatt. I think that was the value. And given the  
8 available information, we couldn't say yes or no.

9 CHAIRMAN JACKSON: Okay.

10 MR. ADER: And this is another example of a  
11 program looking to assess the effectiveness of possible  
12 accident management strategies, and can we through something  
13 like this show that another what we perceive as a  
14 containment challenge is not going to happen, and  
15 eliminating another failure mechanism.

16 Slide 15.

17 Fuel coolant interactions. As we mentioned  
18 earlier, NUREG 1150, some of the IPs, especially some of the  
19 BWR, had steam explosions. Energetic fuel coolant  
20 interaction is one of the challenges to containment  
21 integrity. This is an area where the uncertainty in the  
22 understanding is still -- or the uncertainty is still large,  
23 the understanding is still not as good as some of the other  
24 areas. There's a lot of work going on internationally in  
25 this arena. We have been making progress trying to bound

46

1 and understand and eliminate some of the challenges. We  
2 have eliminated one of the major ones, but there are still  
3 the failures ex-vessel in a lower cavity that could  
4 challenge containment.

5 CHAIRMAN JACKSON: Is this going to require more  
6 elaborate coolant calculations?

7 MR. ADER: The codes for fuel coolant interaction  
8 are not very mature I guess would be the right term. It's  
9 not a very well understood phenomenon. Depending on which  
10 end you're coming from, some people say we understand it  
11 much better than we used to, but there's a lot we still  
12 don't understand as far as capabilities of predicting. The  
13 codes that you see, what's called international standard  
14 problems, where a number of countries, a number of codes,  
15 will try to reproduce experimental results, and you see some  
16 wide variations. They don't track as well as some of the  
17 thermal hydraulic codes, the containment temperatures,  
18 pressures, and others.

19 COMMISSIONER DICUS: It goes back to some of the  
20 questions that were asked very early on. I'm trying to  
21 prioritize what efforts are done, and with this particular  
22 one I'm looking at the bullet on Slide 15 in which you say  
23 steam explosions rupturing the reactor vessel and  
24 containment have been considered significant in risk  
25 assessments, and I guess my question is to define

47

1 significant, and in light of the fact you said this is also  
2 one of the areas where you still have a great deal of  
3 uncertainty. Does this mean this is one of the areas that  
4 needs to be emphasized?

5 MR. ADER: The significant, as Mark said earlier,  
6 the early failures for say example Surry were fairly low,  
7 and that plant met the safety goal. But the contributors to  
8 early failure, DCH was one of the major contributors, the  
9 steam explosion was one of the major contributors, bypass I

10 think is by far probably the largest contributor. So to the  
11 extent that we're trying to eliminate or understand early  
12 containment failures, as they are the risks significant,  
13 it's one of the more dominant contributors to the extent  
14 that it's a large contributor to risk. When you put it in  
15 terms of the safety goal it becomes, you know, the  
16 probability of failure is low.

17 MR. THADANI: If I may say, maybe in different  
18 words, and I think this goes partially towards the question  
19 you raised, also, Chairman, and that is you see a list of  
20 these issues. I think what we should have done was to have  
21 broken down the list in probably three categories: one that  
22 leads to -- potentially could lead to early containment  
23 failure and fairly significant health effects. Second  
24 category would be it's an issue with late containment  
25 failure and unlikely to lead to significant health effects.

48

1 The third category would be capability to actually analyze  
2 accidents and what might happen or not. And that is one or  
3 two of the issues that you see on the list, core  
4 coolability, I think the -- debris coolability, I mean -- is  
5 more of a late containment type issue. So intuitively one  
6 would assign it lower priority because of the lower  
7 consequences associated with that.

8 We will try and put some metrics together to cover  
9 these issues and tie them to the status where we are.

10 COMMISSIONER DIAZ: Restating that, you know, this  
11 Commission is getting very concerned about the word  
12 "significant." We like to know what lies between zero and  
13 significant and what lies above significant.

14 MR. THADANI: Thank you. Good comment.

15 COMMISSIONER MCGAFFIGAN: Could I --

16 CHAIRMAN JACKSON: Yes, please.

17 COMMISSIONER MCGAFFIGAN: One of the problems in  
18 this area I think, and you can correct me, is getting  
19 experimental data can be either straightforward if it's a  
20 small-scale thing or impossible, you know, or wildly  
21 expensive if it's -- how many of these areas is it -- have  
22 you made a judgment that you and probably the rest of the  
23 world, EPRI, DOE, your international colleagues that it's  
24 just too expensive to narrow this uncertainty, it isn't  
25 worth the large expense that, you know, a large-scale

49

1 experiment would involve to get the data?

2 MR. ADER: I think core melt -- what was called a  
3 core melt progression was the most recent experimental  
4 program that we stopped funding a couple years ago in the  
5 U.S. You were getting into issues where you needed  
6 reactors, you were taking actual fuel, you were focusing --  
7 the largest uncertainties were in the late phase of the  
8 core-melt progression, trying to understand what happened  
9 when you got a crucible of molten material that would fail  
10 and how that would interact. They were becoming basically  
11 prohibitively expensive, and we were finding we -- many of  
12 the issues like direct containment heating we were able to  
13 take kind of a bounding type of approach. We'd look at the  
14 extremes to deal with it. It was again, the value gained  
15 for the dollar, that was when we made a decision on it.

16 COMMISSIONER MCGAFFIGAN: Are any of the ones  
17 we're talking about today in similar situations where, you  
18 know, you could conceive of very expensive experiments which  
19 aren't worth it, therefore you've been -- you're taking  
20 bounding approaches but you're never going to get  
21 perfection, or --

22 MR. ADER: For the other areas we've moved much  
23 more into the real cooperative where there's still a fair  
24 amount of interest internationally. We can leverage our  
25 resources. A number of these experiments we could not fund

50

1 and we would not fund ourselves if we can leverage  
2 resources, you know, \$10 for \$1 or something on that order.  
3 You know, in the past we've judged the value gained, has it  
4 been worth the expenditure. That's clearly something we'll  
5 revisit.

6 COMMISSIONER DIAZ: The issue in modeling is  
7 always the problem of internal heat generation versus a  
8 standard, you know, thermohydraulic model with external heat  
9 generation. Is that what causes the problem in your  
10 modeling?

11 MR. ADER: For the last phase there's questions  
12 of, as you melt the zirconium and the steel do you get a  
13 blockage down below, will you get a debris bed which will  
14 form on top of that, well, you know --

15 COMMISSIONER DIAZ: This configuration is not the  
16 internal heat generation. It's just giving you --

17 MR. ADER: It's not a question of decay heat, it's  
18 more, you know, the material interactions, natural  
19 circulation, where you fail through sidewall as they did at  
20 TMI or will it melt through.

21 CHAIRMAN JACKSON: Go on.

22 MR. ADER: Moving on to Slide 16.

23 Very briefly, fuel-coolant interaction was an area  
24 that one of the main failure modes, the steam explosion  
25 in vessel that failed the upper head and failed containment,

51

1 which was a contributor in WASH-1400 and a contributor -- I  
2 will remove the word "significant" -- a contributor in  
3 NUREG-1150.

4 Research had progressed in that area enough for at  
5 least the experts to conclude that that was not a high risk.  
6 Here was a case of order of magnitude uncertainties.  
7 Earlier estimates were 10 to the minus 2, 10 to the minus 3,  
8 given a situation more recent experts went anywhere from 10  
9 to the minus 3 to physically unreasonable. I am not sure  
10 what number I would put on that but it is small.

11 They also indicated we didn't have a good enough  
12 handle on looking at the impacts of steam explosions in the  
13 lower head that may fail the lower head and challenge it, or  
14 exvessel in a reactor cavity and here is a program, the  
15 FARO/KROTOS program is a cooperative program. It's European  
16 Commission or European Union funded program at ISPRA in  
17 Italy that's using prototypic material. We leveraged  
18 ourselves in and are a participant in that program.

19 Then we have a small program at the University of  
20 Wisconsin and a program at Argonne looking at some of the  
21 chemical augmentation impacts of fuel-coolant interaction.

22 Slide 17, please.

23 Source term research is an area that a lot has  
24 been done over the years. The level we have right now is,  
25 that we are sponsoring is really fairly small.

52

1 Source term refers to the magnitude, the timing,  
2 the chemical form of fission products released, commonly  
3 referred to as the source term, but the source term is where  
4 the consequences come from -- the fission release and that  
5 understanding.

6 There's activities ongoing in the regulatory sense

7 in the re-baselining effort, taking all of that knowledge  
8 that had been built upon over the years, looking to move  
9 that into the licensing arena, taking the old TID 14-1844  
10 source term which was a very simplistic source term and  
11 trying to make it a little bit more realistic. It's still  
12 kind of a composite of severe accident sequences.

13 The main program ongoing internationally that we  
14 participate in is the PHEBUS program in France at Cadurache.  
15 Commissioner Diaz, I believe you have visited that recently.

16 We are supporting them or they are actually coming  
17 to some of our experts at Sandia to help them design the  
18 experiments and analyze the experiments.

19 This is more of a confirmatory program and it is  
20 confirming our understandings, but here is a program that  
21 three years ago, I believe, right when we were getting ready  
22 to issue NUREG-1465, the revised source term, there were  
23 some preliminary results that came out of PHEBUS that were  
24 announced at a press conference that said our understanding  
25 of iodine releases is different than what we were getting

53

1 ready to publish. If we had not been a participant of  
2 that -- I mean some of the people in the Branch sat in  
3 Ashok's office when he was at NRR -- and tried to assure him  
4 why we could go forward and issue the NUREG.

5 It was their expectations of iodine release that  
6 the numbers they got were much larger. They were within the  
7 range of what we had assumed but when they saw they were  
8 getting some elemental iodine as opposed to what they viewed  
9 as no iodine, this was -- I don't remember whether it was  
10 significant or unexpected -- but by being a participant we  
11 were able to react to it and move on.

12 CHAIRMAN JACKSON: Does using other than uranium  
13 oxide fuel change anything?

14 MR. ADER: There have been questions. We have not  
15 looked at the MOX question. There have been questions on  
16 high burnup fuel that we were planning on trying to go back  
17 and revisit over the next year or two, looking at either  
18 past experiments.

19 There are some proposed experiments in Japan and  
20 potentially in France that may look at the higher burnups  
21 that we would, our plan would be to get access to that and  
22 fold that in to what we would be doing.

23 CHAIRMAN JACKSON: Higher burnups of UO2, base  
24 field.

25 MR. ADER: UO2, correct.

54

1 CHAIRMAN JACKSON: No issues with MOX? I mean  
2 what are the French doing with that? They use the MOX.

3 MR. ADER: I'm not sure what they have done. They  
4 have a program called VERCOR and I would have to go back to  
5 look to see if they have had MOX in there.

6 It is an issue we have not been focusing on here  
7 recently.

8 CHAIRMAN JACKSON: Well, the reason I asked is it  
9 is a question that has been put to me in a number of fora  
10 relative to our support of it, what we might do vis-v-vis  
11 the use of MOX fuel in a plutonium disposition program, and  
12 so, you know, I mean is it not an issue?

13 MR. THADANI: I think we just looked back to see  
14 if Tom King was there.

15 CHAIRMAN JACKSON: He is there.

16 MR. THADANI: I think he's there, and my  
17 understanding is we are looking at the issue.

18 I am not sure we can answer the question.

19 CHAIRMAN JACKSON: Tom, what can you say?  
20 MR. KING: This is Tom King from Research.  
21 I know the French and the Japanese are doing  
22 extensive test programs with MOX. We have looked into what  
23 they are doing on reactivity insertion events and basic fuel  
24 performance.  
25 We have not at this point looked into their source

55

1 term activities related to MOX but that is something we will  
2 do as part of gathering information on MOX fuel, so I can't  
3 answer your specific question but I know that they do have  
4 extensive test programs.

5 CHAIRMAN JACKSON: Okay. How interested is the  
6 industry in using the revised source term for design basis  
7 accidents?

8 You said that it is being requested by operating  
9 plants, but how much interest is there?

10 MR. ADER: My sense is there has been a fair  
11 amount of interest. I think NRR has been a little closer to  
12 dealing with the licensees.

13 MR. SHERON: My understanding is that there are  
14 several plants that are very interested in using it.

15 MR. THADANI: And having had some discussions  
16 during Reg Information Conference, where we had break-out  
17 sessions on source term, by the number of utilities  
18 attending and having dialogue, I would say there was a fair  
19 amount of interest.

20 MR. ADER: Slide 18, please.

21 Hydrogen combustion is an area -- hydrogen has  
22 been considered a threat to containment. Plants have been  
23 inerted -- MARK Is, MARK IIs. Igniters have been installed  
24 on the ice condensers in the MARK IIIs.

25 I think the belief is that the threat to the large

56

1 drives is hydrogen and the global combustion has not been a  
2 threat.

3 Here was an area that some of the test program at  
4 high temperature at Brookhaven and the larger scale tests in  
5 the Russian Research Center RUT facility.

6 We are trying to confirm some of the understanding  
7 and narrow some of the uncertainties.

8 The new issue in hydrogen that has come up is the  
9 use of passive autocatalytic recombiners for combustion  
10 control for design base accidents. They have been proposed  
11 on AP-600.

12 There is a lot of activity internationally to use  
13 what is called PARS, so there's active research programs  
14 there with the activity -- I don't know if it is from AP-600  
15 or internationally but at least one utility has, I  
16 understand, has expressed interest in replacing some of  
17 their design base recombiners with passive autocatalytic  
18 recombiners.

19 I have been asked by others whether this is  
20 something we are accepting, and whether that means there is  
21 wide industry interest or limited industry interest I would  
22 not care to venture, but that is the new issue, where we are  
23 not trying to narrow uncertainties.

24 We are trying to understand the performance of the  
25 PARS, understand the issues that are involved in someone

57

1 using them as far as the mixing, the depletion rates, the  
2 performance, whether they could ignite hydrogen in a severe  
3 accident scenario even though they are being used in a

4 design base accident scenario, to try to provide at least  
5 the knowledge base to NRR to deal with applicants or  
6 utilities that propose to use them, so again it is not a  
7 narrowing of uncertainties but it is trying to deal with the  
8 issue.

9 CHAIRMAN JACKSON: When do you expect to actually  
10 complete these experiments at Brookhaven and the Russian?

11 MR. ADER: The experiments at Brookhaven are  
12 months away in the Spring, late Spring, although there had  
13 been interest by the Koreans to extend that experimental  
14 program to try to do some of the experiments that we were  
15 not going to do because -- and he was another area I think  
16 funding -- we had kind of chopped the program and they  
17 wanted to continue the matrix, so they were looking to  
18 either jointly or maybe fund part of it.

19 The Russian research was really over this year,  
20 although I think they were delayed a little bit, so it would  
21 be extending into the early part of next year.

22 The program at Cal Tech was a very small program,  
23 trying to maintain just some capabilities in that area, for  
24 a small amount to increase their knowledge incrementally.

25 The power testing we hope to be done with by

58

1 mid-summer unless new issues come up or NRR has new needs in  
2 the area.

3 Finally, the Cooperative Severe Accident Research  
4 Program, as I mentioned, is an umbrella program. We have  
5 roughly 19 countries. There are several that are  
6 renegotiating to renew. There are some other countries --  
7 South Africa is one that has expressed interest, I think  
8 Argentina is in the process of joining Brazil and Mexico  
9 have discussed potential membership, so the membership could  
10 go up or down depending on the renewals of some of the  
11 current members.

12 We have a meeting next Thursday, the day after the  
13 water reactor safety meeting. We have a one-week meeting in  
14 the spring and we have a one-day meeting in the fall, just  
15 to try to give them the status of our program, so there will  
16 be a number of international participants at that meeting.

17 This program, as I mentioned earlier, is bilateral  
18 arrangements. We get in-kind and funding through our  
19 program.

20 COMMISSIONER DIAZ: Is it ongoing? Do we know how  
21 many years are our agreements?

22 MR. ADER: I think originally it was a program  
23 that got started and had maybe a three-year renewal. The  
24 countries have come back and some have renewed for five  
25 years. Some have delayed renewal for a year and then they

59

1 renew for three, so they have started to get staggered.

2 That completes the briefing on severe accidents.

3 MR. CUNNINGHAM: The next five slides cover the  
4 IPEEE program and we hadn't intended to cover IPE  
5 specifically in these but perhaps this is a good time to go  
6 back and address the issue of closure on IPEs that Chairman  
7 Jackson asked earlier.

8 With respect to the IPE program, I think we  
9 defined closure accomplishing two things. First, we  
10 reviewed all of the submittals that came in from the  
11 licensees. There were 75 submittals. All but three of  
12 those are now done. We expect two of the remaining three  
13 will probably be done by the end of next year. We have one  
14 last one that is kind of dragging out a little bit. So we  
15 have looked at the individual submittals from the licensees.



16 We also have gone back and tried to look broadly at all of  
17 the submittals to see what they would tell us about  
18 perspectives from the frequencies of different types of core  
19 damaging accidents, are the generic issues that have been  
20 identified coming out of the program either -- are there  
21 generic issues that have been resolved or are there new ones  
22 coming up and that type of thing.

23 All of that type of general discussion has been  
24 embodied in the draft NUREG that we sent out about a year  
25 ago, NUREG 1560. The title was something like perspectives

60

1 on IPE programs or something like that. That was sent out  
2 last year. We had public comment on that, we had a public  
3 workshop in April I believe and now we are just finishing  
4 the final version of that document and it's coming, parts of  
5 it are coming up to the Commission as part of the quarterly  
6 update of the implementation, PRA implementation plan.

7 So between those two pieces, I think that is how  
8 we defined closure for that program. Individual reviews and  
9 then a generic look at everything. All of these submittals.

10 Now, there will be some items that Ashok mentioned  
11 earlier, what we call IPE followup actions, that are going  
12 to be tracked in the implementation plan that are specific  
13 items to either follow up on some generic issues that didn't  
14 seem to quite get addressed completely, to do some audits of  
15 the improvements that licensees said they were going to make  
16 to see if in fact they did make them and that type of thing.  
17 So there will be a few items like that but, by in large, we  
18 are not calling that necessarily the rest of the IPE  
19 program, they are just followup items.

20 So with that, I will turn to the IPEEE program.  
21 Supplement four to generic letter 8820 requested licensees  
22 to extend their IPEs out to consider plant-specific severe  
23 accident vulnerabilities that were initiated by what we call  
24 external events. That includes earthquakes, high winds,  
25 tornadoes, that type of thing, external flooding, floods to

61

1 the plant, and fires that are internal to the plant which,  
2 for a long legacy of bad reasoning is called an external  
3 event.

4 At any rate, supplement four was issued in 1991.  
5 Since then, licensees have been extending their IPEs to  
6 consider these other initiators. The last of those is due  
7 in in June of next year. We've gotten 63 so far, actually  
8 64 as of today, and we've got about 50 of those under  
9 review. Our goal now is to have the reviews completed by  
10 June of 1999.

11 In parallel with that, we have been developing  
12 what we call the IPEEE insights report, kind of the analog  
13 to what I talked about a few minutes ago as NUREG 1560. We  
14 have an interim report due to the Commission in November  
15 that will cover what we've seen from the first 24  
16 submittals. And the rest of the slides I have today are  
17 giving you a hint of what you will see in November in more  
18 detail.

19 Slide 22, please.

20 As we saw in the IPE program, most of the plants  
21 in the IPEEE program have proposed or identified and  
22 proposed and have made or are making improvements to their  
23 plant to deal with the not so much vulnerabilities but the  
24 core damage sequences that they see there, either initiated  
25 by seismic events or fires or others.

1 In the area of seismic, they are doing such thing  
2 as improving the anchoring of equipment such as motor  
3 control centers and that type of thing. They are going  
4 through and trying to pick up on certain relays that have  
5 been found to chatter, what's called chatter, in earthquakes  
6 and replace those types of relays, other things like that.  
7 Not major changes to their design but places where they, for  
8 relatively low cost, can improve the design.

9 Likewise, in fire, they are finding cables that  
10 they can move to other places to reduce the vulnerability to  
11 common cause failure of redundant cabling or something like  
12 that, improving their procedures. Getting portable  
13 equipment to cope better with fires and that type of thing.

14 Slide 23.

15 There are also a few things coming up in terms of  
16 plant improvements related to the other what we call the  
17 HFOs, the other type of external events. Most of the  
18 emphasis in IPEEE has really been on the seismic and the  
19 fire because people -- that's where people have seen  
20 significant core damage frequencies. HFOs are in there  
21 also. We have seen a few things such as people building up  
22 and improving the stacks on fossil units that happen to be  
23 adjacent to the nuclear units and that type of thing.

24 Out of this, out of the ones we have looked at so  
25 far, only two plants have identified vulnerabilities.

63

1 Again, in IPEs, IPEEEs as well as IPEs, we didn't come in  
2 and say here is the definition of vulnerability. The plants  
3 were allowed to define for themselves what vulnerability  
4 meant. At any rate, it was intended to be something that  
5 would be a fairly high scenario or a problem in the plant  
6 that had a fairly high associated core damage frequency.

7 Haddam Neck identified a seismic vulnerability  
8 related to some of the capacities of some of the equipment  
9 to take -- to -- or the capacity to perform in big  
10 earthquakes or not perform as the case may be. And Quad  
11 Cities identified a fire vulnerability. This is relating to  
12 fires in the turbine building either oil initiated, lube oil  
13 initiated or electrically initiated.

14 Some of the contributors to the vulnerability was  
15 the lack of separation of some redundant cabling in  
16 divisions. A reliance on equipment in the other unit to  
17 help shut down the plant during a fire and very much related  
18 to that a very complex, human-intensive way of having to  
19 shut the plant down safely in the event of certain fires.  
20 So it led to what they defined as a vulnerability.

21 They came to the staff in I believe February or  
22 March of last year. The licensee has identified three  
23 things, three programs, one of which they have initiated and  
24 two others they are working on now to reduce the core damage  
25 frequency from this fire vulnerability and to make the whole

64

1 process of coping with fire simpler in their plant.

2 Slide 24, please.

3 From a methods standpoint or an overall core  
4 damage frequency assessment standpoint, it is a little  
5 harder to say what we are saying from the IPEEEs relative to  
6 the IPEs because there is a greater variability in the  
7 methods that are being used to estimate the frequency, core  
8 damage frequencies from fires and earthquakes. So you see,  
9 it's a more complicated thing and some of the -- it's harder  
10 to compare something that was done with a five analysis, the  
11 EPRI-developed five method versus a standard PRA. So it is  
12 much more complicated in that respect.

13           However, we are seeing what we kind of expected to  
14 see, that we do have significant core damage frequencies  
15 coming from earthquake-initiated accidents and  
16 fire-initiated accidents. So it is kind of a confirmation  
17 of what led us to issue supplement four to the generic  
18 letter.

19           MR. THADANI: Bob?

20           MR. PALLA: Yes, okay. I wanted to talk about the  
21 status of the accident management program.

22           NRC has worked cooperatively with industry since  
23 1988 to develop guidance and strategies to respond to severe  
24 accidents. This effort has involved NEI, the owners group  
25 for each reactor design, INPO and EPRI. The efforts

65

1 culminated in generic severe accident management guidelines  
2 for each reactor design and related training materials and  
3 this, these guidelines embody many of the strategies that  
4 you've heard discussed a few moments ago such as  
5 depressurizing the reactor coolant system to avoid DCH and  
6 temperature-induced steam generator tube rupture, flooding  
7 the reactor cavity to try to enhance the potential for  
8 retaining core debris in vessel and preventing core/concrete  
9 interactions and adding water to the dry well of Mark I  
10 containments to prevent liner melt through.

11           These severe accident guidance, in effect, extends  
12 the scope of emergency guidance beyond the design basis in  
13 the current EOPs into the severe fuel damage regimes. The  
14 integration of these insights into each licensee's emergency  
15 response organization is the focus of the accident  
16 management program. Key elements of the program consist of  
17 preparing plant-specific severe accident management guidance  
18 and procedures. Training operators, technical support staff  
19 and managers in the guidance and procedures and maintaining  
20 accident management capabilities through periodic drills and  
21 refresher training.

22           Industry implementation is proceeding pursuant to  
23 a voluntary industry initiative. Commitments and schedules  
24 for completing implementation have been provided by each  
25 licensee on their dockets and approximately a third of the

66

1 sites will complete implementation by the end of this year.  
2 The balance of sites will complete implementation by the end  
3 of 1998.

4           COMMISSIONER DIAZ: You say voluntary?

5           MR. PALLA: The mechanism is one that NEI has  
6 undertaken. It involves the consent of 80 percent or more  
7 of their members. All of the industry's utilities are  
8 members. And approval of basically what they call a formal  
9 industry position, which articulates what they are  
10 committing to do. They brought this issue through that  
11 process and committed to undertake a course of action in  
12 this regard.

13           COMMISSIONER DIAZ: And that's where it is.  
14 Because I understood that voluntary was the other one in  
15 which they did not obtain 80 percent approval. This is,  
16 when they generate 80 percent approval is recommended  
17 action.

18           MR. THADANI: That's right. This is what I  
19 believe they call a binding initiative on the part of NEI  
20 and they have agreement and all licensees are going to  
21 implement accident management.

22           CHAIRMAN JACKSON: I think you meant voluntary, if  
23 I can paraphrase you, in the context that it was not done

24 pursuant to a regulatory requirement.

25 MR. PALLA: Correct.

67

1 CHAIRMAN JACKSON: And that's the difference.  
2 When he says "voluntary," he means it is not pursuant to a  
3 regulatory requirement. How industry organizes the response  
4 and what's voluntary and what's not within that context is a  
5 separate issue and that is what you were speaking to.

6 MR. PALLA: Slide 27.

7 The status of the programs.

8 In SECY 97-132, the staff outlined plans to assure  
9 the adequacy of licensee implementation and confirmed that  
10 licensee commitments have been met. This process involves  
11 information gathering visits at a number of plants, the  
12 completion of a temporary instruction for guiding an  
13 inspection of the implementation, pilot inspections for a  
14 limited number of plants and, finally, an inspection of  
15 accident management implementation at the remaining plants.

16 Toward the first step of better understanding the  
17 nature and status of industry activities to implement  
18 accident management, NRC staff participated in  
19 industry-sponsored public workshop on accident management  
20 implementation in March of this year and this was an  
21 industry forum on issues that have been -- have arisen as  
22 licensees proceed to implement the programs. It gave us an  
23 opportunity to hear first hand of the plant-specific  
24 approaches that are being used and some of the issues that  
25 licensees are encountering as they implement.

68

1 On the second item, we subsequently participated  
2 in accident management demonstration visits at two plants.  
3 These demonstration visits were organized by NEI and hosted  
4 by licensees whose implementation activities were  
5 substantially complete. Comanche Peak and North Anna were  
6 the two plans that volunteered for this, both being  
7 Westinghouse plants.

8 The demonstration visits included two key  
9 ingredients. The first was an overview of licensee  
10 activities to develop and implement their plant specific  
11 guidance and the related training materials and how that  
12 training was administered to the various cadre of staff  
13 because training that we are talking about is -- it is  
14 commensurate with responsibilities in a severe accident.  
15 There is some training for the licensed operators. There is  
16 proportionally more training, for PWRs, more training for  
17 technical support staff, people that would be relied on to  
18 make the assessments and provide recommendations. And then  
19 there is some training also given to decisionmakers. So  
20 this training is parsed out in a way that is an attempt to  
21 be commensurate with responsibilities using a systematic  
22 approach to training.

23 These demonstration visits are kind of the next  
24 step for bringing us up the learning curve to better  
25 understanding what is this industry effort actually

69

1 producing. The third item, we are continuing to monitor  
2 licensee implementation and to interact with NEI to address  
3 implementation issues.

4 Our interactions with industry remain principally  
5 through NEI. We have some interactions with the BWR Owners  
6 Group, as I will mention in a moment, with regard to review  
7 of the severe accident guidance for BWRs but principally we  
8 are working with NEI at this point in the program.

9 Let me just go to slide 28.

10 A key remaining action is to complete the review  
11 of the boiling water reactor, what's called the emergency  
12 procedure and severe accident guidelines. These guidelines  
13 will, when implemented, essentially supersede emergency  
14 procedure guidelines, REV 4, that is currently in place.  
15 Fundamentally, the emergency procedure and severe accident  
16 guidelines are the same as the emergency procedure  
17 guidelines REV 4 with regard to the earlier parts of the  
18 procedure but what the Owners Group has done is develop the  
19 transition point in which -- beyond that, they have provided  
20 additional information on severe accident guidelines. They  
21 have basically created a two-part document that consists of  
22 basically the EPGs as we know them today and then they  
23 connect up to the severe accident guidelines where  
24 additional information on severe accidents is contained.

25 The BWR Owners Group submitted REV 0 of the

70

1 emergency procedure and severe accident guidelines in August  
2 of 1996 and a high level audit type review is still under  
3 way. We expect to complete this review in early 1998.

4 On the second item, we also plan to conduct -- we  
5 had two demonstration visits. These both involved  
6 Westinghouse plants. We intend to conduct several  
7 additional accident management demonstrations for combustion  
8 engineering, B&W and BWR plants. These demonstration visits  
9 are considered necessary since the generic materials that  
10 licensees for these designs are provided are different in  
11 many regards. The training materials similarly have  
12 basically gone to different levels of sophistication and  
13 detail. So we want to get out there and see what the  
14 implementation looks like at the CE, B&W and BWRs to get a  
15 good overview of the industry as a whole, rather than being  
16 fixated on just Westinghouse plants. We know there are a  
17 lot of other plants out there.

18 We anticipate that these visits will occur in late  
19 1997 and will wrap into early 1998.

20 The last bullet regarding inspections of the  
21 plants, implementation. We plan to confirm the adequacy of  
22 licensee accident management implementation. As mentioned  
23 in SECY 97-132. Following completion of the demonstration  
24 visits, we will reassess the planned inspection approach and  
25 refocus that as necessary, if necessary. We would then

71

1 follow through with whatever inspection scope is deemed  
2 appropriate.

3 We anticipate that the inspections will be  
4 completed in the year 2000. Of course, this is dependent on  
5 resources to pursue it.

6 That basically concludes my comments.

7 CHAIRMAN JACKSON: Thank you very much.

8 Commissioner Dicus.

9 COMMISSIONER DICUS: Yes, just one question.

10 Recognizing, of course, that FEMA doesn't have any  
11 responsibility for the plants, that's our responsibility,  
12 but in light of what we are doing in discussing here with  
13 accident management and because it does have, and in source  
14 term as well, off-site, potential off-site implications,  
15 have we discussed this at all with FEMA, do you know? You  
16 may not be the right person for me to ask. I was just  
17 curious.

18 CHAIRMAN JACKSON: The question is on the table.

19 MR. THADANI: I don't know the answer but we will  
20 get the answer.

21 CHAIRMAN JACKSON: Commissioner Diaz?  
22 COMMISSIONER DIAZ: Yes. Just trying to put these  
23 things together, it just occurred to me that you started  
24 with kind of a defense of the severe accident program and I  
25 think that might need to be addressed.

72

1 What I keep hearing as a theme is that whatever  
2 you do you are actually ending up with some accident  
3 management guidelines, directives, scenarios, that can be  
4 put in practical terms to mitigate the consequences of  
5 accidents. And I think that's an important component of  
6 what this program should be achieving and it should be  
7 really kind of a bottom line of why the program exists  
8 because there is no regulatory basis for it, but it is a  
9 practical side in utilizing these things.

10 In fact, I might just mention one because I still  
11 at heart am an old mechanical engineer. Quoting, you know,  
12 something you said several times, this is a variety of  
13 cooling mechanisms that you always find. I would say that  
14 you would always find them in whatever you do in the plant,  
15 because there is no way to have anything that is hot that  
16 won't get cool and many times we just focus on a specific  
17 cooling mechanism but all the others are there.

18 You should leverage this knowledge and this  
19 information that has come out of these programs to apply  
20 them into many other areas that actually need to have  
21 updated models and things and I think you are doing yourself  
22 and maybe the Commission a disservice by narrowly looking at  
23 how the information is used for the severe accidents.

24 You are actually doing a great job in applying  
25 them in accident scenarios. I would say there is a lesson

73

1 in there that is broader than just the severe accident.

2 CHAIRMAN JACKSON: Well, thank you very much for a  
3 very informative briefing on the NRC's severe accident  
4 research program. In fact, I believe the staff should be  
5 commended for your efforts to date and your accomplishments  
6 as well as your international leadership in this area. I do  
7 want to emphasize the importance of establishing a clear  
8 criteria for bringing the remaining programs to closure and  
9 the Commission will look for this information and the other  
10 information that has been asked for in the course of the  
11 briefing, particularly relative to prioritization as an aid  
12 in decisionmaking.

13 But, having said that, I would also stress the  
14 continuing importance of engaging the international  
15 community in the analytical and experimental programs of  
16 when there is mutual benefit because it does allow the kind  
17 of leveraging that you have talked about.

18 So unless there are any further comments or  
19 questions, we're adjourned.

20 Thank you.

21 [Whereupon, at 2:51 p.m., the briefing was  
22 concluded.]

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