

1                   It's not substantiated by data. It is a  
2 plausible mechanism, and we could look for important  
3 differences, but, again, it won't be a highly faithful  
4 representation of actual events.

5                   DR. RANSOM: Well, the L/D limits that  
6 you're using in this representation I assume are  
7 derived from data that you've taken where you've shot,  
8 broke a pipe and had it shoot at directly some  
9 insulated component, I guess, right?

10                  DR. LETELLIER: That is correct. And on  
11 the next figure is a more quantitative representation  
12 of this information.

13                  DR. KRESS: Before you go to the next  
14 figure, I'm intrigued by your description of the  
15 guillotine break separating, which would form two  
16 cones. It seems to me like the conservative  
17 assumption would be, if that happens, you take twice  
18 this volume, because each cone is going to take out  
19 its fraction of the debris.

20                  DR. BANERJEE: At half the pressure  
21 though. There's only half the flow. I mean he's  
22 looking at impact pressure.

23                  DR. KRESS: I don't think so, because it's  
24 just a cone expanding out and you calculate that  
25 pressure.

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1 DR. LETELLIER: The correlations do  
2 account for that effect because they are a function of  
3 both separation and displacement, and I'm not  
4 personally familiar --

5 DR. KRESS: Is there some sort of  
6 correlation in there that accounts for that?

7 DR. LETELLIER: Yes, there is.

8 DR. KRESS: Okay. So you'll get a  
9 different zone factor --

10 CHAIRMAN WALLIS: When you say, "L/D," is  
11 that the pipe size or the break size, the "D"?

12 DR. LETELLIER: The length is the radius  
13 away from the break --

14 CHAIRMAN WALLIS: What's the "D"?

15 DR. LETELLIER: -- compared to the pipe  
16 diameter.

17 CHAIRMAN WALLIS: So it's really the break  
18 size?

19 DR. LETELLIER: Yes, assuming a guillotine  
20 break.

21 CHAIRMAN WALLIS: So for a double-ended  
22 guillotine break, is it square root of two times the  
23 diameter?

24 DR. LETELLIER: No, it's correlated to the  
25 diameter, actually the physical diameter of the pipe.

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1           The next slide, page 18, shows some more  
2 quantitative information, so that you have an  
3 impression of what the various vulnerabilities are.  
4 Higher damage pressures imply a more robust insulation  
5 application.

6           DR. FORD:   And this is based on just  
7 firing a jet at some things in the laboratory?

8           DR. LETELLIER:   That's correct.  
9 Unprotected fiberglass is perhaps some of the most  
10 vulnerable material, having damage pressures in the  
11 range of 6 to 10 psi.

12          DR. KRESS:   Is old insulation worse than  
13 new insulation?

14          DR. LETELLIER:   I can't comment on that.  
15 There are aging effects that affect the friability of  
16 this material. We have to look at other documents to  
17 answer that.

18          DR. BANERJEE:   So Min-K is fiberglass?  
19 What is Min-K?

20          DR. LETELLIER:   Maybe I could call on some  
21 industry help. Min-K is --

22          MR. HART:   It's a microporous insulation.

23          DR. LETELLIER:   It's a microporous  
24 insulation.

25          CHAIRMAN WALLIS:   What does that mean?

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1 Does that mean it's fiberglass?

2 MR. HART: No, it's microporous. It's a  
3 very low turbo conductivity material made of tiny --  
4 take a look at the exhibit -- formed into a thin mat,  
5 and they're hollow on the inside.

6 DR. LETELLIER: In the same category as  
7 Calcium-Silicate, which is a low-density, a low-  
8 thermal-conductivity material.

9 MR. HART: Yes, Calcium-Silicate is made  
10 from diatomaceous earth. Under the microscope it  
11 looks like a lot of little planktonic --

12 DR. LETELLIER: It represents a class of  
13 insulation.

14 DR. BANERJEE: So the Min-K is microporous  
15 silica or what? What is the material? What is the  
16 chemical composition of that?

17 MR. HART: I'm not certain.

18 CHAIRMAN WALLIS: It's not really Calcium-  
19 Silicate which is key here. I mean it depends on how  
20 it's bonded. You have these little whatever you  
21 called them --

22 MR. HART: Planktonic.

23 CHAIRMAN WALLIS: -- planktonic things,  
24 but if they're not bonded together, it's not going to  
25 have this 160 psi resistance.

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1 DR. LETELLIER: No. In fact, the robust  
2 nature of the Calcium-Silicate with the aluminum  
3 jacket was actually viewed to be a limitation of the  
4 existing BWR data. That's one of the reasons that we  
5 requested a test program, in cooperation with Ontario  
6 Power Generation, on the next figure.

7 MR. ROSEN: On that previous figure, is  
8 there any thermal lag in these containments?

9 DR. LETELLIER: I'm not sure the nature of  
10 your question. Obviously, there's thermal inertia.  
11 For what reason --

12 MR. ROSEN: Thermal lag, no. There is,  
13 and I didn't see it on this list. Is it a bad actor  
14 or a good actor?

15 DR. LETELLIER: I can't comment on that.

16 MR. ARCHITZEL: Fire-barrier materials,  
17 this is insulation material, I guess, is what we're  
18 dealing with here, but the fire-barrier material was  
19 also assumed to be looked at, but this chart here is  
20 just dealing with insulation material.

21 DR. LETELLIER: And, again, I would repeat  
22 that the test programs have never been intended to be  
23 comprehensive for every material type.

24 MR. ROSEN: But there's fire-barrier  
25 materials in containments, and they would be blasted

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1 apart, too.

2 DR. LETELLIER: Yes, they would.

3 DR. RANSOM: What are the units of these  
4 pressures?

5 DR. LETELLIER: Psi, stagnation  
6 pressure --

7 DR. BANERJEE: They're really impact  
8 pressures you're talking about.

9 DR. RANSOM: Is that taking all the  
10 velocity head out at that point, putting the thing  
11 there, and boom. Is that how you -- how do you  
12 measure that pressure?

13 DR. LETELLIER: I'm not personally  
14 familiar with the diagnostics of the jet pressures.  
15 They are intended to represent the stagnation pressure  
16 on an object, on an unyielding physical object.

17 CHAIRMAN WALLIS: My intuition says, if I  
18 take some household fiberglass and wrap a piece of  
19 pipe with it and direct a garden hose at it, it won't  
20 come off, and the pressure there is probably 40 psi.

21 DR. RANSOM: These must be one-half  
22 r-squared, I assume. Otherwise, they would be at  
23 least the containment pressure plus.

24 DR. BANERJEE: But if you put fire hose  
25 water on it, it probably will --

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1 MR. SNODDERLY: Excuse me, Bruce. This is  
2 Mike Snodderly.

3 I notice we're on slide 18 and you have 48  
4 slides that you would like to present.

5 CHAIRMAN WALLIS: There can't be 48. Are  
6 there really 48?

7 MR. SNODDERLY: Forty-four, sorry. What  
8 I would like to suggest is maybe we could take a few  
9 minutes just to maybe try to prioritize what we want  
10 to try to look at between now and, say, 4:30, quarter  
11 of 5:00, because I want to make sure that we give John  
12 Butler and NEI an opportunity to let the Committee  
13 know what they're doing.

14 For example, I notice that, when I read  
15 through the Reg. Guide, one of the big analytical  
16 models that jumped out at me was under "debris  
17 transport," 1.334, an acceptable analytical approach  
18 to predict debris transport was NUREG/CR-6772 and  
19 6773. I noticed that your slide 31 goes over those  
20 assumptions. So I think the Committee would be very  
21 interested in going over that.

22 Obviously, I think they would like to have  
23 some understanding of the debris transport chart, the  
24 work that you show in slides 27, 28, and 29.

25 So I would like to put it to suggest to

1 you, what do you think, to get to the point where in  
2 your conclusion, where you say, "These are the  
3 acceptable analytical models that we believe exist  
4 today," and the basis for them, and maybe summarize.

5 Does that sound fair, Dr. Wallis, or what  
6 do you think?

7 CHAIRMAN WALLIS: Well, I'm just thinking  
8 that this is all fascinating stuff, and we could go on  
9 all day, but I'm not sure it makes any difference to  
10 the conclusion. I mean this Reg. Guide can go out for  
11 public comment whether or not any of this makes any  
12 sense, because someone's got to do the analysis. This  
13 really requires it.

14 If we're going to have to review whether  
15 or not we believe your analysis, that's a whole  
16 different kettle of fish.

17 DR. LETELLIER: I think the purpose of  
18 this talk is to demonstrate that methods have been  
19 offered and that there is a technical basis to support  
20 the Reg. Guide.

21 CHAIRMAN WALLIS: There's no way that in  
22 this meeting we're going to bless these methods. We  
23 need to study the NUREGs and all that.

24 MR. SNODDERLY: Right, you're right, Dr.  
25 Wallis. The purpose is just to determine whether

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1 they're sufficient to be released now for public  
2 comment.

3 I think what I would like to accomplish is  
4 for the Committee to have as good an understanding as  
5 possible in the time remaining of what the methodology  
6 is that the staff has developed. So that when we hear  
7 from NEI, we can get an understanding of their  
8 analytical approaches or where they plan to go.

9 Then, again, as the Reg. Guide goes out  
10 and public comment occurs, when it comes back to us,  
11 we'll have some idea of what the state-of-the-art of  
12 the analytical methods are and where they'll go, and  
13 perhaps we can have some input into that.

14 CHAIRMAN WALLIS: Well, Mr. Butler is  
15 here, is he?

16 MR. BUTLER: Yes.

17 CHAIRMAN WALLIS: Would you be willing to  
18 stay later? If we go on for another half-hour with  
19 this, would that be all right with you?

20 MR. BUTLER: That's fine.

21 DR. LETELLIER: The questions of the  
22 Committee have been very relevant, and you have  
23 anticipated much of the presentation material. So if  
24 there are areas you would prefer to focus on, please  
25 let me know.

1                   Continuing a little bit more quickly with  
2 slide 19, we did attempt to remedy the deficiency in  
3 Cal-Sil data by starting a research program with  
4 Ontario Power Generation. They had a test facility of  
5 a limited volume --

6                   MR. ROSEN: You might want to click the  
7 slide. You're on 18.

8                   CHAIRMAN WALLIS: Yes, let's move along  
9 now.

10                  DR. LETELIER: Thank you.

11                  The test conditions are listed in the  
12 upper righthand corner. It was a small-volume tank  
13 with a fixed nozzle opening and an initial pressure  
14 somewhat lower than a PWR blowdown condition at a  
15 temperature somewhat lower.

16                  The blowdown history from the test  
17 apparatus is shown in the lower curve, the red curve,  
18 and predictions --

19                  CHAIRMAN WALLIS: Of course, RELAP is  
20 perfect.

21                  DR. LETELIER: Thermal-hydraulic  
22 predictions of the PWR are shown in black.

23                  CHAIRMAN WALLIS: Oh, I thought it was the  
24 red one.

25                  MR. ROSEN: The testing must be wrong.

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1 CHAIRMAN WALLIS: I thought it was the red  
2 one.

3 DR. KRESS: What is the vertical axis? I  
4 can't read it.

5 DR. LETELLIER: These are pascals.

6 DR. KRESS: Pascals?

7 DR. LETELLIER: The pressure versus time.

8 CHAIRMAN WALLIS: I thought the RELAP  
9 prediction for the test set was perfect.

10 DR. KRESS: It is.

11 CHAIRMAN WALLIS: Yes, so let's move  
12 ahead.

13 DR. LETELLIER: I'm illustrating the  
14 difference between the test configuration and the  
15 actual PWR blowdown, and the motivation for actually  
16 scaling the debris generation data for the effects  
17 of --

18 CHAIRMAN WALLIS: They direct this yet at  
19 a typical pipe?

20 DR. LETELLIER: That's correct.

21 And a couple of figures are shown,  
22 photographs, in pages 22, 23, and 24.

23 CHAIRMAN WALLIS: It's a before and after  
24 picture?

25 DR. LETELLIER: Yes. The basic

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1 conclusions are shown on page 21, which emphasizes  
2 that the OPG data had to be rederived or modified to  
3 account for the actual PWR accident condition.

4 The conclusions show a slightly increased  
5 zone of influence compared to damage zones derived in  
6 the BWR study. Again, for this accident scenario, we  
7 have a two-phase jet blowdown with important momentum  
8 effects in the droplets.

9 Zone of influence increased slightly for  
10 both Nukon and Cal-Sil, and we observed a higher  
11 fraction of small material or fines compared to  
12 earlier tests.

13 CHAIRMAN WALLIS: Are you going to show us  
14 the before and after very quickly?

15 DR. LETELLIER: Page 22 is the test item  
16 as applied in a jacketed fashion.

17 CHAIRMAN WALLIS: It's blasted head-on by  
18 a jet?

19 DR. LETELLIER: That's right, on the  
20 center line. It's positioned on the center line.

21 DR. RANSOM: Is that the jet over on the  
22 left side?

23 MR. ROSEN: The jet comes in perpendicular  
24 to that.

25 DR. RANSOM: Well, that orange thing over

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1 there, is that a nozzle?

2 DR. LETELLIER: One of these two pipes  
3 represents the nozzle. I'm not sure which one.

4 MR. ROSEN: The one below will miss it.

5 DR. LETELLIER: The perspective is  
6 difficult to see in the photograph. I believe this  
7 test article is positioned on the jet center line.

8 MR. ROSEN: There's an arrow there on the  
9 line, isn't there?

10 DR. RANSOM: That's the target.

11 MR. ROSEN: That's the target, I should  
12 say.

13 DR. RANSOM: I see, "X" marks the spot,  
14 right?

15 MR. ROSEN: It sure looks like it hit the  
16 spot.

17 DR. LETELLIER: You will also notice the  
18 orientation of the jacketing, so that the overlap on  
19 the stainless steel jacket is exposed to the jet.  
20 That represents a condition of vulnerability as  
21 opposed to rotated or oriented away from the jet.

22 This is a Calcium-Silicate blanket.  
23 Again, the nature of this insulation is basically low-  
24 density concrete. It has a very low thermal  
25 conductivity. It's very easy to mold and apply in

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1 different configurations.

2 After the test, you can see the extent of  
3 damage.

4 CHAIRMAN WALLIS: And then you collected  
5 all the pieces.

6 DR. LETELIER: And then they collected  
7 the pieces, and that's shown on page 24, at least the  
8 range of debris that could be recovered. The  
9 remainder that was not recovered is assumed to be in  
10 the fine, very transportable fraction, and a crude  
11 mass balance was attempted to proportion --

12 MR. ROSEN: It's in Lake Ontario.

13 DR. BANERJEE: How much of it went into  
14 fines compared to the total mass?

15 DR. LETELIER: If we look back on slide  
16 21 --

17 DR. BANERJEE: Oh, it's there? That's  
18 fine.

19 DR. LETELIER: Slide 21.

20 DR. BANERJEE: You don't have to go back.

21 DR. LETELIER: Approximately 30 percent  
22 of the material was generated in fine debris. Prior  
23 to this study, there had been no observed damage for  
24 Cal-Sil in jacketed configurations. We felt that  
25 those tests had been flawed, and so that's the reason

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1 we attempted to gain more empirical evidence.

2 DR. BANERJEE: Now this facility of  
3 Ontario Hydro or Power Generation is available for  
4 other tests as well or just --

5 DR. LETELLIER: We actually had a quite  
6 extensive test program planned with them, but we  
7 weren't able to conduct it to fruition because of some  
8 safety concerns with their thermal-hydraulics lab. So  
9 it was not made available to us as freely as we hoped.

10 DR. RANSOM: I notice some of the data,  
11 the fields of damage were like 12-D and you were using  
12 7 as the limit before. How do those two compare?

13 DR. LETELLIER: I'm not sure what  
14 you're --

15 DR. RANSOM: Well, on slide 21 you have  
16 slightly increased zone of influence, 12-D versus  
17 10-D, and before you were quoting 7-D, I thought, as  
18 the maximum L/D.

19 CHAIRMAN WALLIS: It's the affected  
20 sphere, though, isn't it?

21 DR. LETELLIER: Again, that sphere was  
22 meant as a representation to explain the  
23 vulnerabilities of different insulation types. I  
24 wouldn't try to relate it quantitatively.

25 DR. RANSOM: What values are used, then,

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1 I mean in your calculations? Are they the ones that  
2 you obtained from these experiments?

3 DR. LETELLIER: Yes.

4 DR. RANSOM: Okay.

5 DR. LETELLIER: Yes, the destruction  
6 pressures are based on observation. That's the only  
7 basis that we have.

8 To clarify, there is no predictive model  
9 of microphysics for debris generation for an impinging  
10 jet.

11 DR. RANSOM: Sure. Well, I was wondering  
12 where the value 7 came from that you talked about  
13 before.

14 DR. LETELLIER: I was simply counting the  
15 tick marks on the graphic.

16 DR. RANSOM: Okay.

17 DR. LETELLIER: Yes, it was meant as a  
18 representation.

19 CHAIRMAN WALLIS: Yes, but somebody has to  
20 put numbers on it if they're going to calculate  
21 anything.

22 DR. LETELLIER: And that has, indeed, been  
23 done in a tabular way.

24 Moving on to blowdown/washdown on page 25,  
25 again, we have no truly predictive model to determine

1 where this debris will go.

2 CHAIRMAN WALLIS: Well, the containment  
3 spray does a pretty good job of washing it down,  
4 doesn't it?

5 DR. LETELLIER: Yes, it does, but it is  
6 also true that it does not impinge on every vertical  
7 surface. There are significant fractions that are  
8 sheltered from direct spray, and in that case you have  
9 steam condensation in rivulet formation that can wash  
10 debris to the floor.

11 Because we have no predictive capability,  
12 we are looking at the conditions necessary for  
13 transport, the updraft velocities, for example; and  
14 the impingement of containment spray. We're looking  
15 at the water balance calculations provided by our  
16 volunteer plant, looking at the hold-up in pools on  
17 each floor of containment, and where the most likely  
18 return paths are; for example, stairwells and designed  
19 drainage features.

20 This information is being incorporated  
21 into a logic chart, very much like an event tree for  
22 an accident analysis, where we try to make defensible,  
23 conservative decisions about the fraction of each size  
24 of debris type that's either retained --

25 CHAIRMAN WALLIS: It seems to me you have

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1 no basis for it whatsoever. I mean, if you look at a  
2 stairwell and you try to predict how many of these  
3 rocks stop on the treads of the stairs, you can't do  
4 it just by talking about it like this.

5 DR. LETELLIER: There is actually  
6 empirical evidence of retention by gradings, actual  
7 debris --

8 CHAIRMAN WALLIS: So you put in actual  
9 numbers here?

10 DR. LETELLIER: Where we have information,  
11 of course, we do, and where the information is  
12 lacking, we make conservative assumptions. As I  
13 pointed out earlier, the retention factors are less  
14 than 50 percent.

15 CHAIRMAN WALLIS: At least it gives you a  
16 framework for filling in.

17 DR. LETELLIER: It does, and as I tried to  
18 make a list here, it lets you assess the degree of  
19 conservatism that can be compared to the plausibility  
20 of these physical mechanisms.

21 This is on Figure 27, which is a schematic  
22 of the logic chart, but in the next two pages, 28 and  
23 29, you can see that you can get carried away with  
24 this level of detail.

25 CHAIRMAN WALLIS: It's the debris that

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1 gets carried away.

2 (Laughter.)

3 DR. LETELLIER: Touche!

4 CHAIRMAN WALLIS: Wow, it's an eye test  
5 (referring to the chart).

6 DR. LETELLIER: This type of analysis is  
7 very easy. The PRA tools have been adapted to look at  
8 the various transport mechanisms.

9 CHAIRMAN WALLIS: Okay.

10 DR. LETELLIER: Please don't spend any  
11 time studying this. It's simply an illustration.

12 CHAIRMAN WALLIS: Yes.

13 DR. BANERJEE: But do you actually use  
14 something like this?

15 DR. LETELLIER: We are actually using this  
16 to assess its value for our volunteer plant analysis.  
17 We're trying to --

18 DR. BANERJEE: Do you think this level of  
19 detail is appropriate? I mean, it's like having too  
20 many significant figures in a number.

21 DR. LETELLIER: Well, as I said, we've  
22 already learned the key element.

23 DR. BANERJEE: Right.

24 DR. LETELLIER: We've discovered that we  
25 cannot rationalize a reduction factor of more than 50

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1 percent. It's not a factor of a hundred or a  
2 thousand, as some people would like to claim,  
3 actually, that the fine particulates will be carried  
4 to every surface in containment, and they will never  
5 come down. We cannot rationalize that from a  
6 conservative engineering perspective.

7 DR. BANERJEE: But do you need this level  
8 of detail to do that?

9 DR. LETELLIER: The answer is no.

10 DR. BANERJEE: I mean, is this  
11 illustrative or it is something which is in some NUREG  
12 that somebody can attack and say, "This doesn't make  
13 any sense."?

14 DR. LETELLIER: This is illustrative and  
15 it's also educational, if you will. It lets the  
16 plants prioritize where to put their analysis effort.

17 MR. ROSEN: You know, it's not that  
18 educational to me because I can't read the event  
19 states at the top. Would you just sort of read a few  
20 of them to me, so I know what they say?

21 DR. LETELLIER: Let's go back to the  
22 schematic.

23 CHAIRMAN WALLIS: He can't read it,  
24 either.

25 (Laughter.)

1 MR. ROSEN: Which one are you looking at?

2 Right now you're --

3 DR. LETELLIER: This is on page 27.

4 MR. ROSEN: Well, you've got page 26 up  
5 there.

6 DR. RANSOM: It's slide No. 27.

7 CHAIRMAN WALLIS: So there's bullets would  
8 appear as stages in this tree diagram?

9 DR. LETELLIER: It basically walks you  
10 through the disposition of a debris fragment depending  
11 on its size, whether it's initially deposited on the  
12 floor, on a vertical surface, on a horizontal surface;  
13 whether it's impacted by sprays, direct impingement,  
14 or condensation; whether it is subject to secondary  
15 motion through pools on elevations, different  
16 elevations of the plant, and, eventually, whether it's  
17 deposited into the pool.

18 MR. ROSEN: And that's what this ghastly  
19 one does?

20 DR. LETELLIER: That's the end state.

21 MR. ROSEN: It takes it from one step to  
22 another to another, to a third perhaps --

23 DR. LETELLIER: That's correct.

24 MR. ROSEN: -- and, ultimately, down into  
25 the sump?

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1 DR. LETELLIER: That's correct.

2 DR. BANERJEE: So you've done more details  
3 of each of these?

4 DR. LETELLIER: Yes. And what we've  
5 learned by this exercise is that there's not a great  
6 return to be gained by the plants investigating this  
7 in detail.

8 For example, you mentioned earlier, if you  
9 did a full computational fluids model of a break jet  
10 in a specific location, you might argue that there was  
11 very little debris generation for a particular break.  
12 I don't think you could get the same savings in this  
13 aspect of the accident sequence, largely because of  
14 the uncertainty in the initial conditions. You  
15 physically just don't know where every piece of debris  
16 will go.

17 You can talk about it generically, and you  
18 can argue it conservatively, but, ultimately, as we  
19 sum up all the end states in this event diagram, we  
20 see that between 70 and 90 percent of the debris  
21 eventually comes back to the pool.

22 MR. ROSEN: Well, it's a great  
23 simplification.

24 CHAIRMAN WALLIS: Then let's design for a  
25 hundred percent and forget about it.

1 MR. ROSEN: Yes, it makes sense. It's  
2 very valuable. It's a great simplification. You  
3 don't have to trace each particle's path. You know  
4 where it started and you know where it's going to end.  
5 You're not that interested in what it does in between.

6 DR. LETELLIER: But the key point is we  
7 needed to perform this exercise to reach that  
8 conclusion. Now it's available for the industry's  
9 evaluation.

10 Moving on to pool transport on page 30 and  
11 31 --

12 DR. BANERJEE: So are you going to say in  
13 the Reg. Guide or is one of the accepted things going  
14 to be, if you say 80 percent is going to get down,  
15 fine; if not, do you prove that below whatever this --

16 CHAIRMAN WALLIS: If they can't prove it,  
17 they're supposed to assume 100 percent, aren't they?

18 DR. JAIN: That's what we have in the Reg.  
19 Guide right now.

20 DR. LETELLIER: That default position is  
21 stated in every aspect of the accident scenario in the  
22 Reg. Guide.

23 CHAIRMAN WALLIS: Okay, can you move along  
24 quickly through this one?

25 DR. LETELLIER: Certainly. For pool

1 transport, we were very concerned about debris  
2 mobility in the pool.

3 CHAIRMAN WALLIS: Yes, because it hides in  
4 corners. It hides in stagnant areas.

5 DR. LETELLIER: It does. There is a  
6 potential that it may.

7 Initially, we needed to characterize the  
8 mobility of debris types, whether it's a paint chip or  
9 a crumble of foil or a flock of fiber that's one inch  
10 or five inches. So we conducted a separate effects  
11 test in a flume to look at incipient flow velocity,  
12 settling rates, et cetera.

13 The second phase of analysis was to  
14 introduce this debris into an integrated tank. It was  
15 a scale model, a one-tenth scale, of a PWR  
16 configuration. We looked at the disposition of debris  
17 both during fillup and also at the recirculation  
18 phases.

19 It was difficult to preserve momentum  
20 scaling in this study, so we looked at it as an  
21 integrated test that introduced rotational flows and  
22 opportunities for settling.

23 In fact, we did collect debris on both a  
24 vertical and a horizontal screen, and the most  
25 important conclusion was that, perhaps not surprising,

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1 is that individual fibers are indefinitely suspended,  
2 and they eventually migrate to the screen.

3 We also observed that in regions of  
4 splashing, where water would return to the pool, there  
5 is a degradation mechanism that will continue to shred  
6 flocks of insulation that actually reach that zone.  
7 That's a very important thing to learn.

8 MR. ROSEN: Because it floats?

9 DR. LETELLIER: No, because of the  
10 recirculation patterns around a splash, material is  
11 actually collected; it's drawn towards that area. An  
12 initially large flock of one inch perhaps, which might  
13 remain stationary, if it's entrained in the splash, it  
14 will be shredded into individual fibers.

15 CHAIRMAN WALLIS: Something that white  
16 water canoers have experienced, too.

17 MR. ROSEN: Getting shredded?

18 (Laughter.)

19 DR. LETELLIER: That's correct. So the  
20 primary conclusion of the integrated tank test is that  
21 velocity maps and regions of localized turbulence are  
22 important to assessing the final transport fraction of  
23 debris in the pool.

24 On page 32 are some computational fluid  
25 dynamics results of a splash introduced in one of the

1 steam generator compartments. That gray circle  
2 represents splashing water on the floor. We're  
3 looking at the velocity maps that are generated to  
4 determine whether or not it exceeds the incipient flow  
5 velocity for different debris types.

6 DR. BANERJEE: Is this a plan view?

7 DR. LETELLIER: It is. It is a plan view  
8 at the floor level of a representative of --

9 CHAIRMAN WALLIS: So you're saying the red  
10 area gets scoured? Is that what you are saying?

11 DR. LETELLIER: That's correct.

12 DR. KRESS: That depends on the amount of  
13 flow going into that splash area?

14 DR. LETELLIER: Yes, it does, and it's  
15 very geometry-specific. That's the other conclusion  
16 to take.

17 DR. BANERJEE: But you just integrated  
18 over the height, right? You didn't actually do a 3-D  
19 CFD simulation?

20 DR. LETELLIER: Yes, this is a 3-  
21 dimensional pool calculation, and this is the slice at  
22 the floor level.

23 DR. BANERJEE: I see.

24 DR. LETELLIER: There are representative  
25 horizontal velocity components at the floor.

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1 DR. BANERJEE: It seems overkill. But,  
2 anyway, go ahead.

3 MR. ROSEN: So tell me, what does it tell  
4 me, all of the orange?

5 DR. LETELLIER: The figure on the right  
6 has been scaled to a maximum velocity of .2 feet per  
7 second. From the individual effects test, that's sort  
8 of a rule-of-thumb threshold for debris movement. If  
9 it exceeds .2, it's very likely to be mobile. If it's  
10 less than .2, there's an opportunity for settling.

11 So you can see that in the cavities  
12 opposite the break there is an opportunity for  
13 settling, but much of the remainder of containment is  
14 turbulent and it will be moving debris.

15 CHAIRMAN WALLIS: Yes, more than often.

16 DR. LETELLIER: And that's exactly the  
17 perspective that we hope to use. We're not hoping for  
18 a predictive capability of debris transport. We're  
19 looking at the fractions of containment area that are  
20 subjected to potential transport and applying that in  
21 a crude way, a 50 percent, a 30 percent --

22 CHAIRMAN WALLIS: Well, you're also  
23 getting expertise with which to review whatever  
24 industry gives you.

25 DR. BANERJEE: Of course, if you had two

1 sumps now, you would have one in a low-flow and one in  
2 a high-flow area, right?

3 DR. LETELLIER: If they had the luxury of  
4 redesigning with forethought, perhaps they would.  
5 Every containment design has a single-sump location  
6 that's more or less co-located. There are examples of  
7 multiple-sump outlets, but they are on one side of  
8 containment. They are in one location.

9 DR. BANERJEE: But both trends start  
10 basically from the same area?

11 DR. LETELLIER: That's correct.

12 DR. RANSOM: Where is the sump in this  
13 case?

14 DR. LETELLIER: The sump is --

15 DR. RANSOM: And how deep is the layer of  
16 fluid?

17 DR. LETELLIER: In this simulation I  
18 believe it is 24 inches, which is in the range of a  
19 plausible pool depth. Again, it is not a perfect  
20 scaling, but it's an example of an analysis technique  
21 that could be used.

22 CHAIRMAN WALLIS: Can we move on now?

23 DR. LETELLIER: The next slide just simply  
24 shows the dependence on geometry. The patterns are  
25 completely different if the break is in a different

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1 quadrant.

2 CHAIRMAN WALLIS: So you're going to run  
3 10,000 Monte Carlo simulations?

4 (Laughter.)

5 DR. LETELLIER: We hope to run four, one  
6 for a break in each steam generator cavity, and look  
7 at the fractions to decide whether they're  
8 substantially different or not.

9 Slide No. 34 is a simple schematic of how  
10 the information from velocity maps and separate  
11 effects testing can be combined to estimate an  
12 ultimate transport fraction in the pool. Again, these  
13 conclusions will be cast in the form of 30 percent, 50  
14 percent, based on the intuition that we've established  
15 from calculation.

16 You can read some of these observations  
17 regarding CFD. I would just remind you that we are  
18 not attempting to do a predictive model of debris  
19 transport. We're not looking at the microphysics of  
20 drag, settling, entrainment. We are trying to use  
21 this as a tool for velocity maps.

22 DR. LETELLIER: You're using it like PRA,  
23 to gain insights and --

24 DR. BANERJEE: But you have some  
25 experiments, right? I mean, you're not depending on

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1 this CFD code?

2 DR. LETELLIER: That's correct. We've  
3 actually run calculations and bench-marked them  
4 against our tank tests under the test conditions.

5 DR. BANERJEE: But, you know, you can make  
6 a CFD code fit anything. So you need some  
7 experiments.

8 DR. LETELLIER: That's correct, and we did  
9 observe good, qualitative agreement between the models  
10 and the tank experiments.

11 The reason that we're not pushing for,  
12 again, the reason we're not trying to develop a  
13 predictive capability is captured in the last bullet:  
14 The uncertainties in the location and the timing of  
15 debris introduction, they just limit the need for  
16 high-fidelity modeling. We simply don't know when and  
17 where this material will return to the pool.

18 CHAIRMAN WALLIS: Now this next bit, head  
19 loss, ought to be the easiest part.

20 DR. LETELLIER: From the point of view of  
21 testing, I believe that is accurate. There is a  
22 substantial amount of information in the literature  
23 regarding head loss of various debris compositions,  
24 bed thicknesses, et cetera.

25 In the BWR study in NUREG-6224 that

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1 information was captured in a correlation based on  
2 theory for porous media and validated against  
3 experiment for the correlation coefficients, for very  
4 specific test conditions.

5 Some of the features of importance are the  
6 water temperature for dynamic viscosity, the media,  
7 the composition of the bed, its thickness, and the  
8 flow velocity through the bed. Those are all  
9 important parameters of the correlation.

10 CHAIRMAN WALLIS: The mysterious one looks  
11 like page 40 -- other than what you might expect.

12 DR. RANSOM: What is "UNM"?

13 DR. LETELLIER: University of New Mexico.

14 DR. RANSOM: Okay.

15 DR. LETELLIER: The Civil Engineering  
16 Department has been helping us conduct these tests.

17 CHAIRMAN WALLIS: What is this page 40?  
18 Can you go to that?

19 DR. LETELLIER: Slide No. 40 is an  
20 illustration of the head loss correlation applied over  
21 a range of debris volumes, fiber volumes. You can see  
22 that there is a sharp transition at low fiber volumes  
23 where the bed begins to deteriorate. Essentially, you  
24 punch holes in the fiber mat, and the flow starts to  
25 escape through the screen. And that's the reason that

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1 the head loss does not --

2 CHAIRMAN WALLIS: It depends very much on  
3 the structure of the fibers. Some of them are  
4 reinforcing. They squash down and they may get  
5 tighter. Other ones open up.

6 DR. LETELLIER: Bed compaction is --

7 CHAIRMAN WALLIS: The fibers bend around  
8 the screen, is what happens, isn't it, here?

9 DR. LETELLIER: Yes, that's the effect  
10 that you're seeing.

11 MR. ROSEN: You're going online.

12 MR. ARCHITZEL: Focus on that slide with  
13 the perspective of removing all the fiberglass can  
14 still be a problem or can create a problem.

15 CHAIRMAN WALLIS: This indicates it isn't  
16 as simple as you might think. You need more fibers to  
17 reduce the pressure?

18 DR. LETELLIER: There is a  
19 counterintuitive behavior where thick beds are  
20 actually more porous. Thick beds of fiber can provide  
21 more flow area than a thin bed, simply because of the  
22 interstitial gaps between the fibers. If they are not  
23 compressed, as he mentioned, they will allow more  
24 water to pass through.

25 A very thin mat that's arranged in a very

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1 regular fashion, and the interstitial gaps are blocked  
2 by particulate, is very effective at ending flow.

3 CHAIRMAN WALLIS: I think there's a  
4 hysteresis with this. I mean, if you have laid down  
5 a very uniform bed without holes in it, you get a  
6 different curve, and if you begin to build it up and  
7 then it breaks down, then you build it up some more.  
8 There's a time effect with this whole thing.

9 DR. LETELLIER: That effect is very  
10 evident. I actually deleted a slide that showed that.

11 The test that we're interested in is  
12 taking, for example, a one-inch mat of fiber and  
13 gradually increasing the flow velocity so the bed  
14 compresses. As we relax the velocity, the bed does  
15 not re-expand. There is a hysteresis effect.

16 DR. BANERJEE: Does this contain any  
17 particulate matter as well or just fiber?

18 DR. LETELLIER: The various curves  
19 represent the amount of particulate that is present:  
20 300 pounds, 200 pounds, et cetera.

21 The qualitative behavior is the same.

22 DR. BANERJEE: I can't get a feel for what  
23 those pounds mean, but is that sort of -- how many  
24 feet squared are we on?

25 DR. LETELLIER: I'm not sure exactly what

1 the conditions were for this calculation. It's  
2 offered as a representation of proper use of the  
3 correlation. Between 100 and 300 pounds is a  
4 reasonable value for particulate in PWR containment,  
5 and there's work currently ongoing to quantify that.

6 DR. BANERJEE: But that would depend on  
7 the surface area of the filters, right?

8 DR. LETELLIER: Very much so.

9 DR. BANERJEE: Okay.

10 DR. LETELLIER: The head loss effect  
11 depends greatly on the surface area.

12 CHAIRMAN WALLIS: Okay, can we move on?

13 DR. LETELLIER: I think that you've gotten  
14 a good impression of the detail to which we have  
15 examined the various aspects of the accident sequence.  
16 Ultimately, each component has to be integrated into  
17 a vulnerability assessment from beginning to end, that  
18 is, from debris generation to ultimate head loss.

19 The final slides on page 42 illustrate  
20 some of the tools that LANL has used to gain insights  
21 into these effects and the methods that are being  
22 offered to the industry as a starting point for their  
23 own analysis.

24 In particular, I would point you to bullet  
25 two, the Knowledge Base Report, which is forthcoming,

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1 is a compilation of all existing test data and  
2 analysis methods.

3           Bullet 3 is a comprehensive plant analysis  
4 which is currently ongoing to help us gauge  
5 appropriate level of detail and help us assess the  
6 validity of plant responses to the Generic Letter.

7           CHAIRMAN WALLIS: If every plant had to do  
8 as much work as you've done, it would be much cheaper  
9 just to make a bigger screen.

10           DR. LETELIER: Certainly, but, actually,  
11 I don't think the NRC would have been comfortable  
12 making that judgment unless we had gone to this level  
13 of detail.

14           DR. BANERJEE: But would a bigger screen  
15 work if there was a lot of fiber? I mean, that's  
16 really the bottom line here.

17           DR. LETELIER: Of course, there are  
18 limits to engineering solutions.

19           DR. BANERJEE: Right.

20           DR. LETELIER: And if they simply don't  
21 have space, they will have to take advantage of other  
22 concepts. For example, in the BWR screens, they  
23 arranged stacked disks or crenelated surfaces to allow  
24 for perpendicular flow components. The bulk flow  
25 moves in one direction; the filter draws flow in a

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1 transverse direction, and that establishes a very low  
2 penetration velocity, which in turn gives you very low  
3 head loss.

4 So there are important design  
5 considerations that should be incorporated into --

6 CHAIRMAN WALLIS: Is it a fluted type of  
7 screen?

8 DR. LETELLIER: I'm sorry?

9 CHAIRMAN WALLIS: A fluted sort of screen?

10 DR. LETELLIER: You can imagine different  
11 geometries.

12 CHAIRMAN WALLIS: Folded screen?

13 DR. LETELLIER: Yes, folded arrangement,  
14 stacked disks. Your imagination is the only limit.

15 I would point out one important difference  
16 between -- the BWR screens are primarily perforated  
17 plates. They have circular openings stamped into  
18 stainless steel. PWR screens are primarily wire mesh,  
19 rectangular wire mesh arrangements.

20 The head loss testing that we performed  
21 demonstrates that the correlation is applicable to  
22 both configurations, and we are refining the  
23 coefficients of this correlation to apply, best apply,  
24 to Calcium-Silicate, which wasn't available before and  
25 also mixed debris beds of Calcium-Silicate and fiber

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1 and Calcium-Silicate and RMI.

2 DR. FORD: Bruce, you mentioned the  
3 correlation between BWRs and PWRs, and you've been  
4 three years doing this work for PWR steam generator  
5 breaks. How much more work would it be to do a head  
6 penetration on a PWR, if a head penetration, if a CRDM  
7 housing was ejected, and you had damage to the  
8 insulation on the top head?

9 DR. LETELLIER: I think it was already  
10 mentioned that that scenario would be treated as a  
11 medium-break LOCA, and it would be --

12 DR. FORD: Maybe I was not here at the  
13 time. Sorry.

14 DR. LETELLIER: Yes. Depending on the  
15 break opening, it would be very much the same,  
16 perfectly analogous as far as debris generation and  
17 transport.

18 DR. FORD: And the data to support that?

19 DR. LETELLIER: Would be the blowdown  
20 calculations from a code like RELAP, thermal-  
21 hydraulics, in comparison to debris-generation data  
22 that were produced.

23 DR. FORD: Okay.

24 CHAIRMAN WALLIS: From the point of view  
25 of cost-effective regulation, we've seen that one

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1 could have made a decision some years ago not to do  
2 all this work, but simply to make a decision. This  
3 would have improved safety. Now nothing is being done  
4 while the work is being done. So there has been no  
5 effect on safety while all this has been going on.

6 DR. LETELLIER: I will say one thing.  
7 This is a typical level of detail that was pursued in  
8 the BWR resolution. As to the regulatory decisions,  
9 I'll defer that comment.

10 MR. LEHNING: Just before we go through --  
11 this is John Lehning from NRR -- before we can pursue  
12 in a regulatory way any issue, we have to prove that  
13 it's credible and that we have a basis to go forward.  
14 That's kind of what --

15 CHAIRMAN WALLIS: This is integrated  
16 effects of five years of CFD, which is 170 times what  
17 you thought it was. It's a pretty big safety impact.  
18 I'm sure that's exaggerating, but if you look at the  
19 cost of not doing anything all that time, it's  
20 probably significant.

21 MR. LEHNING: Some of the work that we did  
22 was used to get that risk analysis and to do that  
23 parametric studying and to get those numbers. So we  
24 didn't have that at the beginning, you know, way back  
25 five years ago.

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1 MR. DORMAN: In fact, if I remember  
2 correctly, we treated the BWRs first based on the  
3 operating experience that had been observed, and there  
4 was some judgment at that time, absent the information  
5 that's been developed here, that there was not an  
6 expectation that this was going to be a big problem  
7 for the PWRs. So that some of the information that's  
8 been developed in the GSI-191 program regarding debris  
9 generation and transport, that has brought us to where  
10 we are.

11 MR. ARCHITZEL: But I would come back to  
12 that reg. analysis on the USI A-43. Those costs were  
13 not unsubstantial at that time. There were benefits  
14 at that time, and they were fairly significant. The  
15 decision was made the cost/benefit didn't warrant  
16 backfit, and that's the flipper. I mean we had a  
17 cost/benefit done already. It was a good benefit and  
18 it was a very expensive fix.

19 CHAIRMAN WALLIS: Does the Subcommittee  
20 have other questions for this group of presenters?

21 MR. ROSEN: What's this last slide that's  
22 43? What does it tell me?

23 DR. LETELLIER: As I said, ultimately,  
24 each component of the analysis has to be integrated  
25 together. If you look at debris generation, this

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1 figure on 43 looks at the vulnerability of a specific  
2 sump to a challenge of various combinations of fiber  
3 and particulate. This is the threshold for failure  
4 where they exceed their NPSH margin.

5 If you combine this failure threshold with  
6 all of the debris sources, you can generate the last  
7 figure, which shows you the range of pool -- well, of  
8 total transport that would be required to induce  
9 failure of the screen.

10 CHAIRMAN WALLIS: If you have no fibers at  
11 all, though, to get back to Sanjoy's point, then the  
12 product will just go through?

13 DR. LETELLIER: Yes, they will.

14 CHAIRMAN WALLIS: So then you have no  
15 fiber. Then you have infinite number of particles,  
16 and it doesn't make a difference. Some of these are  
17 low fiber volume.

18 DR. LETELLIER: Again, these dots on this  
19 Figure 44 do not represent particulates. They  
20 represent scenarios.

21 CHAIRMAN WALLIS: No, I was looking at the  
22 one before, 43.

23 DR. BANERJEE: It would be interesting to  
24 see what the back-up slides were.

25 (Laughter.)

1 DR. LETELLIER: You're right, of course.

2 At the far lefthand corner --

3 DR. BANERJEE: It's a log scale, Graham.

4 CHAIRMAN WALLIS: I know we never got  
5 there, but, I mean, you get a very small amount of  
6 fiber when you get --

7 DR. LETELLIER: At the far lefthand corner  
8 of this figure --

9 CHAIRMAN WALLIS: That's ten to the zero  
10 feet cubed there? One cubic foot?

11 DR. LETELLIER: That's correct.

12 CHAIRMAN WALLIS: What's the scale here?  
13 There's a blip. Units of ten? A tenth of a cubic  
14 foot? I don't believe it.

15 DR. LETELLIER: This is a representation  
16 of a screen. Depending on the area and the approach  
17 velocity, there are plant configurations that could be  
18 blocked with one cubic foot of fiber and some amount  
19 of particulate. That's not a generic statement.  
20 That's very plant-specific.

21 CHAIRMAN WALLIS: It's true, okay.

22 DR. LETELLIER: Now your comment about the  
23 threshold, at the far left there is a missing line  
24 that essentially extends vertically upward.

25 CHAIRMAN WALLIS: It falls straight down.

1 DR. LETELLIER: And that represents the  
2 minimum fiber necessary to induce the thin bed effect.

3 MR. ROSEN: I'm having trouble seeing the  
4 exponents. On the bottom what is that, 10 squared  
5 or --

6 DR. LETELLIER: Ten to the zero. That's  
7 one cubic foot.

8 MR. ROSEN: At one cubic foot. Now go up  
9 and intersect the line. It says that -- what is that,  
10 a tenth of -- at one cubic foot of fiber you get a  
11 tenth of a cubic foot of particulate.

12 CHAIRMAN WALLIS: That doesn't make any  
13 sense. It doesn't make any sense. It's a pocketful.  
14 I mean it's crazy.

15 MR. ROSEN: Compared to the thousands or  
16 hundreds at least of cubic feet that are in the  
17 containment and are affected by these events we're  
18 discussing.

19 DR. LETELLIER: Again, it's not worthwhile  
20 to dissect this particular example, but --

21 CHAIRMAN WALLIS: Well, I think we should  
22 because we're establishing credibility.

23 DR. LETELLIER: It is illustrative of  
24 plant conditions with very high approach velocities  
25 and very small screen areas.

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1 MR. DORMAN: Yes. I think when you  
2 translate an actual relatively small screen area to  
3 something on the order of an eighth of an inch of  
4 fiber bed over that area, the point here is that it  
5 takes a relatively small volume of fiber to create  
6 sufficient bed to then trap the particulate and have  
7 substantial head loss.

8 MR. ROSEN: The only thing I'm taking away  
9 from this chart is, if you have a very, very adverse  
10 screen configuration, sump configuration, you can plug  
11 it with a little of fiber and a little of particulate.

12 DR. LETELLIER: That is correct, but the  
13 point of this slide is to demonstrate that the  
14 licensees need to assess their own vulnerabilities in  
15 much the same way. They need to have an understanding  
16 of transport and head loss in order to respond to the  
17 Generic Letter.

18 CHAIRMAN WALLIS: This is for an existing  
19 screen and a real reactor, a real containment, this  
20 figure?

21 DR. LETELLIER: No.

22 CHAIRMAN WALLIS: No, it's not, no.

23 DR. LETELLIER: This is a representation  
24 of a screen that was taken from the parametric case  
25 evaluation.

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1 CHAIRMAN WALLIS: Okay.

2 MR. DORMAN: But it is typical of a screen  
3 that may be found out in an operating reactor today.

4 CHAIRMAN WALLIS: It is?

5 DR. LETELLIER: This is a particular case  
6 study from the parametric report.

7 DR. BANERJEE: How many square feet --  
8 because the volumes don't tell me anything unless I  
9 know how big the screen was here. How big was it?

10 DR. LETELLIER: I don't recall.

11 DR. BANERJEE: I mean, if you have a  
12 screen this big, of course, one-foot square is a lot.

13 DR. LETELLIER: There are some cases of  
14 very small screen areas like 10 to 12 square feet.

15 DR. BANERJEE: I see. Okay.

16 CHAIRMAN WALLIS: Okay, anything else?

17 DR. LETELLIER: Thank you for your  
18 interest and your time.

19 CHAIRMAN WALLIS: We would like to thank  
20 you all for very interesting presentations.

21 Would the Committee be willing to continue  
22 now, just keep going? I'm sorry to keep you waiting.

23 MR. BUTLER: No problem.

24 MR. ROSEN: I think that was a good  
25 presentation. It was very useful. Thank you.

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1 MR. BUTLER: May I use this overhead  
2 projector?

3 Shall we proceed?

4 CHAIRMAN WALLIS: Yes, please.

5 MR. BUTLER: First off, my name is John  
6 Butler. I'm a Project Manager at the Nuclear Energy  
7 Institute in Washington.

8 What I would like to do is give you a  
9 little bit of an overview of what the industry  
10 activities are in this for GSI-191.

11 One of the points I want to make from the  
12 start is that we have been active observers in the NRC  
13 activities in this area, enough to become convinced  
14 ourselves that this is really an issue that we need to  
15 take on. So we are actively pursuing addressing the  
16 issue at PWR plants, independent of the NRC activities  
17 to issue a Reg. Guide or a Generic Letter.

18 Our activities, our schedules have been  
19 developed independent of that. The schedules that the  
20 staff has pursued in developing and issuing that  
21 guidance has the potential to impact our already-  
22 stated schedule, but that is something we'll just have  
23 to evaluate as things progress. But I did want to  
24 make the point that we are taking this issue  
25 seriously.

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1 CHAIRMAN WALLIS: So you're taking the  
2 lead? It must mean that Los Alamos is behind?

3 MR. BUTLER: Consider it a baton pass-off.  
4 Research had the lead, ran with it, and has passed the  
5 baton to us. The end result is we have to finish the  
6 race, and I think at some point NRC is going to stop  
7 and turn it over to us.

8 What I'm going to try to cover in a  
9 very --

10 MR. ROSEN: I don't think so. I think the  
11 utilities have to finish the race.

12 MR. BUTLER: I'm speaking for them.

13 MR. ROSEN: But they have to do something  
14 in the plants.

15 MR. BUTLER: Yes.

16 What I would like to do is address, in a  
17 general fashion and fairly quickly, who is involved in  
18 this activity, what activities we currently have  
19 underway and what we're trying to accomplish, and when  
20 we expect to have that completed.

21 First off, who is involved?

22 CHAIRMAN WALLIS: The usual suspects.

23 (Laughter.)

24 MR. BUTLER: Well, the important thing to  
25 point out here is that it's not just NEI, a typical

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1 NEI task force where we go off and grab some people  
2 and we sit around and talk. We've actively involved  
3 all three of the PWR owners' groups. They have their  
4 own resources. In fact, it's the owners' groups that  
5 are actively funding the development activity for  
6 this.

7 We also, as almost in an advisory  
8 capacity, have a Task Force that has involvement of,  
9 again, PWR utility representatives, EPRI. We also  
10 have, at their request, allowed EDF to join our  
11 activities.

12 You touched on it briefly in the prior  
13 discussions, what the international activities are.  
14 The French are actively involved, and they are very  
15 actively trying to see what the U.S. is going to do.  
16 It's not clear to me right now who is going to take  
17 the lead in this resolution, but, again, our  
18 activities have to run independent of what the  
19 international community is doing. We have to proceed  
20 to close this issue out.

21 But we are very interested in following  
22 what the French and other European nations or other  
23 international representatives are doing to address  
24 this issue. So we're trying to stay connected with  
25 that. Having somebody from EDF on the Task Force

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1 helps us there.

2 We have a number of consultants who have  
3 expertise in various areas actively participating on  
4 the Task Force, and we're thankful for that because  
5 their participation is done gratis. We're lucky to  
6 have them participate.

7 What I have tried to do here is kind of  
8 outline that there's three general areas of activity  
9 that are currently underway. The first area there is  
10 really trying to get our hands around all the data  
11 that has been collected, all the research we've  
12 conducted, some of it contradictory to prior research.  
13 So it's a lot of information, a lot of research, a lot  
14 of data.

15 CHAIRMAN WALLIS: So you call NUREGs data,  
16 too? I mean, they're information.

17 MR. BUTLER: Information, yes. I mean a  
18 lot of the NRC-funded activity and test data is  
19 documented as part of NUREGs.

20 A lot of research that has been done is  
21 not directly applicable to the conditions of PWR, so  
22 there's clearly an effort in evaluating that data to  
23 make sure that it's directly applicable or the range  
24 of applicability to PWRs, and where it's not, what of  
25 that information can be used. So there is a

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1 significant effort just taking the data that's  
2 available and assessing how we can best use that data.

3 Beyond the test data, there's also a need  
4 to better understand PWR plants. You're already  
5 familiar somewhat with the guidance we issued this  
6 past spring for plants to go out, as part of our  
7 analysis, to assess what the debris sources are, to  
8 just get a better understanding of their containments.

9 A lot of the information, a lot of our  
10 understanding was based simply on their design  
11 drawings, and this provided an opportunity or the  
12 impetus to go into their containments and either  
13 confirm that their understanding of their plant was  
14 correct or, where it wasn't, to correct it.

15 So knowing what the plants have in their  
16 containments is needed in order to, once we have the  
17 evaluation methodology, to then jump-start the final  
18 step, which is to implement the resolution on a plant-  
19 specific basis.

20 The main task, as you might expect, is  
21 developing the methodology itself. I guess I'm  
22 getting ahead of myself.

23 CHAIRMAN WALLIS: What do you see for a  
24 methodology? Do you see sort of a general computer  
25 program where you fill in bits that are characteristic

1 of your particular plant and then the machine runs and  
2 out comes some number at the end which says you're  
3 okay or you're not?

4 MR. BUTLER: No, that would be a  
5 possibility if there were more similarity among all  
6 the PWRs, but the condition that we have is there is  
7 a very wide variability of the PWRs.

8 CHAIRMAN WALLIS: That's what concerned me  
9 from the start, when we looked at this the last time,  
10 is that every utility is going to have a different  
11 situation. You can see all the amount of work that  
12 Los Alamos has been doing, and you can't do all that  
13 for every plant.

14 MR. BUTLER: No, and what I anticipate,  
15 with the guidance of the methodology, would be  
16 primarily is a framework. I'll use a number of words  
17 here. A framework, you'll have to address the problem  
18 in pieces: a regeneration piece, a transport piece,  
19 an accumulation piece, the same pieces that are  
20 addressed in the Reg. Guide.

21 You'll have a number of tools that you can  
22 use to assess each of those pieces. How you use  
23 those tools depend upon your particular situation.

24 There will be options to take a  
25 conservative approach with its incumbent impact on the

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1 final analysis or to put more resources into a higher-  
2 fidelity approach. So the guidance will provide  
3 guidance or options on how you can resolve those  
4 individual pieces with some information on what the  
5 potential impacts of each approach would be, so that  
6 plants could make an informed decision on which was  
7 the best approach.

8 We all know that there's always a quick  
9 approach, and I wouldn't call it a "dirty approach,"  
10 but a very expensive approach just to assume that all  
11 the debris is generated; it's all transported to the  
12 sump, and install the largest sump you can get away  
13 with. I'm not even sure that all plants could get  
14 away with that, even if they had unlimited resources,  
15 because of just the configuration of their lower  
16 containment may not allow as large a sump as they  
17 would need under that assumption.

18 Free area may be large, but contiguous  
19 free area in that lower containment is not necessarily  
20 a large value.

21 DR. KRESS: What do you think of this  
22 sphere of influence to get the amount of debris in the  
23 first place?

24 MR. BUTLER: Pardon me?

25 DR. KRESS: This sphere of influence based

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1 on the pressure, stagnation pressure, do you think  
2 that's sort of the direction you'll take in the NEI?

3 MR. BUTLER: I imagine so, yes. I mean,  
4 as you discussed, there are pros and cons to that  
5 approach. The hope is that it can be demonstrated to  
6 be conservative.

7 We already know that in a lot of cases it  
8 will not impact the final result because it takes very  
9 little debris and very little fiber material and very  
10 little particulates to make a difference. So whether  
11 or not you assume a large value or half that large  
12 value, you still --

13 DR. KRESS: You've still got to deal with  
14 it.

15 MR. ROSEN: Yes, precisely. So I've  
16 already made that recognition, which I believe you  
17 just said you have. Is the industry thinking about  
18 replacing some of these fiber and particulate  
19 insulations with RMI?

20 MR. BUTLER: We have not advocated that.  
21 We have not put that forward as a position that a  
22 plant should take, but I think you're correct in that  
23 some plants have been making corrective changes in  
24 their insulation.

25 MR. ROSEN: Because there's two ways to go

1 with this problem. One is to build a big sump to take  
2 more junk. But if you have already determined you  
3 can't build a big enough sump, given all of the stuff  
4 you have up in the containment, the next way to do it  
5 is to remove some of that and use some other kinds of  
6 insulation.

7 CHAIRMAN WALLIS: It's about the only  
8 thing you can do. And if you can't make a bigger sump  
9 and you know that the present stuff is going to get  
10 there, 50 percent or 70 -- it doesn't make any  
11 difference; you've got much more than enough to clog  
12 the sump no matter how big you make it, then go do  
13 something else.

14 DR. BANERJEE: How did the BWRs do it?  
15 Because they made pretty conservative assumptions, and  
16 they seemed to have solved, at least from what we  
17 heard --

18 MR. BUTLER: The BWRs, No. 1, they  
19 benefitted from the fact that there is a high degree  
20 of similarity of all the BWRs, or at least they are  
21 broken down into two generally highly similar types.  
22 So they could work on a single solution that could be  
23 applied generally by everyone.

24 In the end, I think it is fair to  
25 characterize their solution to be install the largest,

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1 most effective strainer that you can get away with,  
2 and that allows you some freedom to accept some  
3 highly-conservative assumptions and to not be forced  
4 to investigate some areas of high uncertainty.

5 DR. BANERJEE: But what we heard -- now I  
6 don't know the details -- was they didn't just install  
7 large strainers; they installed clever strainers.

8 MR. BUTLER: Highly effective.

9 DR. BANERJEE: Right.

10 MR. BUTLER: That's what I mean by  
11 effective, yes.

12 DR. BANERJEE: Yes. So that, in fact, you  
13 didn't have to put very large strainers, but you did  
14 it in a clever way because it had this power of the  
15 slow paths and you had the velocity normal instead of  
16 tangential, or whatever, going through; I don't know.

17 But, anyway, the upshot of all this was  
18 that they solved the problem in a very effective way,  
19 from what I heard. Now is it that you cannot  
20 accommodate that amount of strainer in a PWR?

21 MR. BUTLER: I imagine some plants can.  
22 I mean, again, I made the point that the BWRs  
23 benefitted from the fact there's a high degree of  
24 similarity --

25 DR. BANERJEE: Right.

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1 MR. BUTLER: -- among all their designs.  
2 What we have to recognize in developing  
3 our methodology is some plants will be able to  
4 accommodate that as a solution; other plants will find  
5 that much more difficult. So we want our guidance to  
6 provide enough flexibility or enough options to  
7 utilities in how they address the problem.

8 Some may address it in a design fashion by  
9 installing an effective, large sump. Others may  
10 address it by trying to reduce their debris generation  
11 source, you know, changing their insulation type.  
12 Others may try to do it through analysis and showing  
13 that they don't transport material to the sump.

14 CHAIRMAN WALLIS: I think there would be  
15 a lot of pressure to do that, and a licensee finds a  
16 real box and doesn't have a big sump confidence,  
17 strainers at work, if he makes the extreme  
18 assumptions, you know, he's going to say, "Let's find  
19 some consultant who is going to cut back on all these  
20 conservative assumptions and prove that it isn't  
21 really so bad."

22 DR. BANERJEE: Was NEI involved with the  
23 BWR solution?

24 MR. BUTLER: No. That was done under the  
25 guidance of the BWR owners' group.

1 DR. BANERJEE: Because they have many  
2 different generations of containment. Each one is  
3 completely different from the other.

4 MR. BUTLER: The degree of differences  
5 among the various generations is not as significant --

6 DR. BANERJEE: I see.

7 MR. BUTLER: -- as the differences that  
8 you would see in PWR containments in terms of the  
9 insulation types that are used, the configurations,  
10 the volumes, the sump types that are used. There's a  
11 very high degree of variability among PWRs.

12 Well, I think I've addressed a number of  
13 these slides.

14 CHAIRMAN WALLIS: Well, it seems to me  
15 it's not just getting all this data. Someone's got to  
16 do some really creative engineering analysis to figure  
17 out how they make the right predictions. Los Alamos  
18 has been working at that for some time. Are you guys  
19 going to mount a similar effort?

20 MR. ROSEN: Not before September 2003.

21 CHAIRMAN WALLIS: I doubt it, yes, no way.  
22 So I was just wondering, has this begun to be a rather  
23 superficial thing by September 2003 in terms of  
24 technical analysis? I mean, it may point the way to  
25 what's out there, but in terms of your own analysis,

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1 I don't think you have time to do it.

2 MR. BUTLER: Well, the guidance  
3 methodology is not going to include the CFD analysis  
4 that someone would need to calculate transport  
5 fractions. That would be part of the implementation  
6 because you need plant-specific data. It's a plant-  
7 specific resolution item to perform those  
8 calculations.

9 Our methodology would only go to the point  
10 of identifying what you would need to look at to  
11 address as part of that CFD analysis, guidance on what  
12 transport fractions for different materials makes  
13 sense, the inputs to that analysis, like the actual  
14 plant model needed to calculate results for a  
15 particular plant are a plant-specific resolution item  
16 and would follow issuance of our methodology.

17 MR. ROSEN: Let me ask a question of the  
18 staff. How long is it, in your -- and maybe it's in  
19 the Generic Letter and I haven't understood it -- how  
20 long is it before you expect the plants to make either  
21 appropriate fixes or be able to show that they're okay  
22 with what they have?

23 DR. WEERAKKODY: As I recall, we don't  
24 specify an exact date, but we have specified certain  
25 timelines for initial assessments and then

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1 evaluations, and then getting enough information.

2 The reason we don't necessarily like to do  
3 that is, as some of you had sometimes thought, the  
4 particular plant does the initial assessment and then  
5 concludes that they want to jump in and do a fix.  
6 They can do that, like Davis-Besse did.

7 But there may be another plant that  
8 determines that they have enough -- that their plant  
9 is not susceptible based on the initial assessment,  
10 and then it will take them, I think, to collect the  
11 data, some of the data they need from the containment,  
12 they might do that during an outage. So it might be  
13 a couple of years. So the time that it would take to  
14 take this issue to a total completion could be very  
15 plant-specific.

16 MR. ROSEN: You have a large tolerance for  
17 delay. My fuse is somewhat shorter than yours.

18 DR. KRESS: Especially with 170 CFD  
19 increase.

20 MR. ROSEN: Yes.

21 DR. WEERAKKODY: Is that 170 percent or  
22 170 times?

23 MR. ROSEN: A hundred and seventy times.

24 DR. WEERAKKODY: Yes, the 170 times core  
25 damage frequency, that is a conservative number. If

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1 you really thought the core damage frequency of the  
2 plant's 170 times higher, this would be an issue that  
3 would require something like an audit.

4 We take that PRA number as an upper bound  
5 and take the issue very seriously. Now in terms of  
6 the timeframe, we don't have a large tolerance. What  
7 I'm trying to get across is each plant, when they get  
8 the Generic Letter, they will be required to do an  
9 initial assessment. As a result of that initial  
10 assessment, it will be their responsibility to  
11 conclude whether they are susceptible or not.

12 If they conclude that they are susceptible  
13 with relative certainty, then we would expect them to  
14 take relatively quick action because --

15 MR. ROSEN: So what's relatively quick?  
16 I mean, it seems to me if it's not -- it sounds like  
17 I didn't miss it in the Generic Issue; it's not in  
18 there.

19 Is there a date that the staff has in mind  
20 for when they want to have all the PWRs with this  
21 problem behind them?

22 DR. WEERAKKODY: The furthest date we can  
23 anticipate I can't recall off my mind. Even if a  
24 plant decides that they are not vulnerable, I think it  
25 can then go up to like 2007, but that sort of plan,

1 you know, they have done the evaluation and have  
2 concluded that they are not susceptible.

3 MR. ROSEN: Well, if they're not  
4 susceptible, they don't have a problem today. So, I  
5 mean, I'm just saying there's two ways to get a way  
6 through this problem. One is to prove that you're not  
7 susceptible, and I think there will be some plants  
8 that can do that. Plants, for example, with very  
9 large containments with lots of reflective metal  
10 insulation and very little of the other kind, and very  
11 big sumps, will probably be able to show that they're  
12 okay.

13 Then there will be plants that couldn't  
14 show it no matter what, and they'll have to make a  
15 fix, either take out some of the other insulation they  
16 have and put in some reflective metal insulation or  
17 put in bigger sumps, or both. Those plants will have  
18 -- it will take some time, clearly, to do that.

19 I don't think they'll be able to do that  
20 in one outage unless they shut down and stay down for  
21 a long time. They'll have to get to work on it.  
22 Every bit of that kind of insulation that's not good  
23 that they take out during an outage is a good thing,  
24 and replace with the reflective metal insulation.

25 So it seems to me you need to get on with

1 it for the plants that do have a problem. The idea of  
2 not having a drop-dead date to me is puzzling.

3 CHAIRMAN WALLIS: It gets back to this  
4 whole Generic Letter being too polite in sort of  
5 saying, "Take a look at it and let us know, and then  
6 maybe we'll figure out what to do."

7 MR. ROSEN: If you say you have a problem,  
8 it seems like the regulator ought to say, "Okay, we  
9 understand it's a probablistic, stochastic process,  
10 and it's probable you won't this have problem during  
11 'X' amount of number of years," but we need to say  
12 that we're going to limit our liability and our  
13 vulnerability by saying everyone won't have this  
14 problem by "X" date and having picked that on some  
15 basis.

16 DR. WEERAKKODY: I think if you go to the  
17 pages where we discuss specific requests for  
18 information or action, we do specify specific due date  
19 for each of those. I can't remember the exact date  
20 for each of them, but we say, when you receive this  
21 letter, you know, by a certain date do this.

22 MR. ROSEN: Well, I'll study it some more.

23 CHAIRMAN WALLIS: Well, there's a 90-day  
24 response time.

25 MR. LEITCH: We're at the stage where

1 we're sort of a plan for a plan rather than actual  
2 physical changes.

3 DR. WEERAKKODY: The Generic Letter does  
4 take you through several steps. In fact, what we have  
5 done is, if you go to the Generic Letter, page 9, in  
6 Item 1 we say, within 90 days of the date of the  
7 Generic Letter the licensees are expected to provide  
8 certain information.

9 Then if you go to Item 2, we say, within  
10 90 days of the date of completion of the requested  
11 evaluation of the susceptibility that the ECCS  
12 basically can function, the plants are required to  
13 provide us information.

14 CHAIRMAN WALLIS: I think they're going to  
15 be in a real bind to do it in these two 90-day  
16 periods.

17 MR. ROSEN: But even so, if they could do  
18 it, then that's 180 days, and then you get to 2(b), as  
19 in "bravo." It says, "if any plant modifications are  
20 identified as being necessary to assure compliance  
21 with regulations, that other regulatory requirements  
22 will not be implemented until a future scheduled  
23 outage described in the interim compensatory  
24 measures."

25 DR. WEERAKKODY: Okay.

1 MR. ROSEN: It sounds to me like you might  
2 put them all in during the next outage. Is that the  
3 implication?

4 DR. WEERAKKODY: No, I think what we are  
5 doing here is, you know, there may be plants out  
6 there, when they look at this information, they might  
7 be looking at information and the analysis they need  
8 to do within the first 90 days, and conclude that  
9 their ECCS is degraded but operable, and within the  
10 regulation that takes them to the instructions that we  
11 give them under Generic Letter 91-18. So they would  
12 be required to take interim compensatory measures  
13 while they are taking care of the issue.

14 MR. ROSEN: They absolutely should do that  
15 now. But it seems that 2 "bravo" or the next one,  
16 2(c), ought to say something like, "All required  
17 modifications should be complete by" -- and you pick  
18 a date and say, "or provide justification for not  
19 meeting that date."

20 MR. LEHNING: Kind of the problem with  
21 that is, like when you request an action, you have to  
22 have a regulatory basis for doing that, a  
23 cost/benefit, but at the time we're asking someone to  
24 do that, but say if a licensee is just barely out of  
25 compliance, they have just this one piece of

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1 insulation, and if they have just one break, it's a  
2 real low probability. So we can't tell them, you  
3 know, we don't have a basis to say, "You need to do it  
4 right away." If a plant has a really bad  
5 configuration --

6 MR. ROSEN: I didn't say right away. I  
7 said pick a date.

8 MR. LEHNING: Or even to pick a date, we  
9 can't say you have --

10 MR. ROSEN: I didn't say right away.  
11 Don't overreact. What I said is, pick a date, a date  
12 certain, which we then could say, okay, now we can  
13 calculate the vulnerability of the fleet, assuming  
14 everybody waited that long. Otherwise, it's not  
15 bounded.

16 CHAIRMAN WALLIS: Let's see, this draft  
17 has not been given to NEI, this Draft Generic Letter?  
18 So they don't know what we're talking about?

19 DR. WEERAKKODY: Dr. Rosen, what we can do  
20 is we will think about your comment and some of the  
21 reasons --

22 CHAIRMAN WALLIS: I think what is going to  
23 happen is, if you extend this out even without the  
24 tightness that my colleague wants you to add to it,  
25 that it may well be that the industry is going to come

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1 back and say, "We can't do it." They'll scream, you  
2 know, this is an unreasonable thing.

3 They'll have comments on the letter, and  
4 then you'll have to fight them, if you believe what  
5 Los Alamos has been telling us about this being a real  
6 problem with all this debris, and it only takes a  
7 bucketful of fibers to plug a screen, and so on.

8 MR. ROSEN: Well, I'm not arguing for  
9 precipitous action. What I'm arguing for is  
10 definitive -- a definitive timeframe, a definitive  
11 framework that everyone knows about.

12 CHAIRMAN WALLIS: Well, I don't think that  
13 your NEI guidance is going to be available in time,  
14 it's going to be deep enough technically to satisfy  
15 the NRC the way that they're going. So this Generic  
16 Letter is going to go out, and then the licensees are  
17 going to be asked to do something, and they won't know  
18 how to do it. The only thing they can do is adopt the  
19 Los Alamos approach.

20 MR. ROSEN: But, Mr. Chairman, we have got  
21 to decide what we're going to say to the full  
22 Committee.

23 CHAIRMAN WALLIS: And it's going to be  
24 interesting.

25 MR. ROSEN: And maybe we should allow Mr.

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1 Butler --

2 CHAIRMAN WALLIS: Yes, I think we should  
3 let Mr. Butler -- we're sort of talking among  
4 ourselves. Maybe we should let you finish your  
5 presentation, and then we will decide.

6 I thought you would come up here more sort  
7 of saying how the industry will respond to the kind of  
8 thing that they're going to be asked to do, and  
9 whether or not they can manage to do it.

10 MR. BUTLER: We'd be glad to do that after  
11 we have seen it.

12 CHAIRMAN WALLIS: See, you can't do that  
13 until you've seen it, right?

14 MR. ROSEN: And I'm complaining about what  
15 I see as not being definitive enough.

16 MR. ARCHITZEL: I think I would like to  
17 make a comment that, you know, this is really still  
18 considered an industry initiative, and we're  
19 responding to that initiative.

20 CHAIRMAN WALLIS: Well, it's an  
21 industry --

22 MR. ARCHITZEL: That's the premise behind  
23 that Generic Letter. There is an industry initiative  
24 that we presume is going to be acceptable. If that  
25 premise isn't good, it's still industry's action and

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1 it's their responsibility to --

2 CHAIRMAN WALLIS: Yes, but your Reg. Guide  
3 is very specific about what it wants done.

4 MR. ROSEN: Well, it may be an industry  
5 initiative, but it is a regulatory matter, and it  
6 isn't up to the industry what the staff of the  
7 Commission does. Industry's participation and  
8 cooperation has been good. That's wonderful. But at  
9 some point I'm arguing that -- and I'm speaking to the  
10 staff and to my colleagues -- that this has gone on  
11 long enough without a date certain.

12 CHAIRMAN WALLIS: Well, there are two 90-  
13 day stages here, which even then they're going to put  
14 a lot of pressure on industry.

15 MR. ROSEN: For analysis, yes. Collecting  
16 data and analysis, but --

17 CHAIRMAN WALLIS: And having a plan of  
18 what they're going to do.

19 MR. ROSEN: And then all I'm asking for is  
20 them doing it. You know, if you put a date certain on  
21 the end of it, all the other things have to start  
22 backing up, and pretty soon you're able to decide  
23 whether you can use those other dates in any  
24 reasonable way. It may be just what you say, but if  
25 you put a date certain on it --

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1 CHAIRMAN WALLIS: Well, NEI must be pretty  
2 close to the pulse of industry. I mean, they've got  
3 a letter saying they've got to come up with -- 90  
4 days/90 days, that's not very long. It's half a year.  
5 By that time, they're going to know what they're going  
6 to do to fix the problem? Do you think that's a  
7 realistic thing to ask industry to do?

8 MR. BUTLER: If you're asking me what  
9 would be the best time to issue the Generic Letter and  
10 start that 90-day clock, it would be when we have the  
11 methodology and have agreement with the staff on that  
12 methodology.

13 CHAIRMAN WALLIS: Well, I don't see --  
14 you've shown us no methodology. So I don't have any  
15 faith in you having it in half a year either.

16 MR. LEHNING: Mr. Chairman, may I make a  
17 comment? I think there's just some misunderstanding  
18 about the two 90-day periods. The first 90 days is  
19 the 90 days after the receipt of the letter, and then  
20 the second 90 days would be --

21 CHAIRMAN WALLIS: Yes, but you're not  
22 going to send the letter out, you see. You're going  
23 to wait and wait and wait and wait.

24 MR. LEHNING: It would be 90 days after  
25 the licensee completed the evaluation, not 90 days

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1 after the first submittal --

2 CHAIRMAN WALLIS: So when is this letter  
3 going to go out realistically?

4 MR. LEHNING: The schedule? I think it's  
5 planned for the summer.

6 CHAIRMAN WALLIS: So it's pretty soon?

7 MR. LEHNING: For the final, for the final  
8 version of the Generic Letter. The draft is planned  
9 I think in March or April, yes, for the draft, for  
10 public comment.

11 MR. DORMAN: The clarification that needs  
12 to be made here is that the first 90-day period is  
13 measured from the issuance of the Generic Letter. At  
14 that time the licensee provides a plan, and that plan  
15 includes when they propose to complete their analysis.  
16 Then the staff has an opportunity to determine whether  
17 that timeframe is appropriate and acceptable.

18 CHAIRMAN WALLIS: But if they don't have  
19 the NEI guidance or analysis, how are they going to  
20 plan to complete their analysis?

21 MR. DORMAN: That would, obviously, impact  
22 them. But the second 90 days, then, doesn't start  
23 from their first response. The second 90 days start  
24 from completion of the analysis in accordance with  
25 whatever plan they presented after 90 days. So the

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1 second 90-day report is not 180 days after the Generic  
2 Letter. It's probably something longer than that.

3 CHAIRMAN WALLIS: I just thought, my  
4 intuition is it will take NEI years. You're asking  
5 for days. It isn't compatible. Maybe I'm wrong.  
6 Maybe you guys are really ready to issue a guidance  
7 and everything's worked out.

8 MR. BUTLER: My concern really comes at it  
9 from a different point of view. I mean, I agree that  
10 there is uncertainty with the September date. I mean  
11 you just have to accept that with any kind of effort  
12 that addresses this many issues, as many issues as  
13 this one does.

14 But my concern would come from a  
15 postulated schedule where a Generic Letter comes out  
16 in final form, starts a 90-day clock. Every PWR  
17 utility then looks at it and says, "I've got to have  
18 this methodology right now to begin my evaluation."  
19 That then puts a high degree of pressure to complete  
20 that very quickly and get it out to industry, and  
21 during a time when discussions are probably at a  
22 critical stage with NRC staff, you're trying to  
23 complete everything.

24 We would basically be forced to try to  
25 complete the methodology with too many cooks in the

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1 kitchen, and that will cause some problems in itself.  
2 That's one of my main concerns.

3 CHAIRMAN WALLIS: Well, I'm concerned  
4 about your having any cook. I think you're going to  
5 have a Task Force which is thinking about it and  
6 talking about it, and you don't have any cooks cooking  
7 in the kitchen at all.

8 A cook is going to actually produce this  
9 guidance. You know, here's some analytical method;  
10 it's based on fundamentals and data and engineering,  
11 and so on and so on, and here's the justification for  
12 it.

13 MR. BUTLER: Oh, we do have --

14 CHAIRMAN WALLIS: Do you have all that  
15 stuff?

16 MR. BUTLER: The primary contractor on the  
17 methodology is Westinghouse.

18 CHAIRMAN WALLIS: And they have this  
19 methodology there? They just have to unveil it?

20 MR. BUTLER: We are working on it. I  
21 mean, we are working on it. We've got a fair, a high  
22 degree of completion on the regeneration portion of  
23 it, looked at drafts of other portions, of debris  
24 transport and the different phases.

25 CHAIRMAN WALLIS: So if we advise the

1 staff to go ahead, send this out, and as fast as they  
2 can implement it, you guys can respond?

3 MR. BUTLER: As far as issuing it for  
4 draft, a draft for comment, once it's issued for a  
5 draft to comment, one of the comments we'll provide is  
6 on the schedule and some of the concerns of how that  
7 schedule can impact or interplay with the guidance  
8 development, some of the same concerns you've  
9 expressed.

10 CHAIRMAN WALLIS: Well, without seeing  
11 anything from Westinghouse, there's no way I can  
12 assess this guidance that you have as a hope.

13 DR. WEERAKKODY: I do want to make one  
14 comment. Hopefully, at least partly, this is Dr.  
15 Rosen's question or concern.

16 One of the things we have, or we are  
17 trying to accomplish with the Generic Letter, is  
18 within the 90 days, before the licensees do a full-  
19 blown evaluation, ask them to either put interim,  
20 compensatory measures in place that could reduce this  
21 aspect of it significantly.

22 In fact, the Generic Letter, we do  
23 identify some of the known interim, compensatory  
24 measures for this activity in the Generic Letter  
25 itself.

1 MR. ROSEN: I understand you're going to  
2 ask them for interim, compensatory measures. My  
3 problem with them is that, while I am sure the  
4 utilities can do that and define them and write  
5 procedures, operating procedures, and train operating  
6 crews to, in fact, implement those interim,  
7 compensatory measures, given the phenomenology we've  
8 heard about today, I'm not sure that they'll work.  
9 I'm not sure they'll be effective, interim,  
10 compensatory measures.

11 CHAIRMAN WALLIS: Well, I think this is  
12 very interesting. I think we're setting a stage for  
13 quite a drama.

14 (Laughter.)

15 MR. ROSEN: We're talking about a low-  
16 probability event.

17 CHAIRMAN WALLIS: Yes, maybe it will go  
18 away.

19 MR. ROSEN: But, still, we have to assess,  
20 under this very stressful phenomenology, that  
21 operators take these extraordinary interim,  
22 compensatory measures, including shutting off  
23 recirculation, or whatever those measures are, things  
24 that are counterintuitive to them.

25 But even if they did them, would that let

1 -- I presume that's to let all the particulates and  
2 filterable materials settle out, and then they can  
3 start it up again. But would that really de-suspend  
4 them or not? I'm not sure that I've been shown data  
5 that shows that that would be effective.

6 DR. KRESS: I thought the pool CFD  
7 velocity possibly showed that they would settle out in  
8 the sump, but they would make it to the filter anyway,  
9 even if you cut them off and then wipe them and  
10 suspend, and turn it back on. So I don't think that's  
11 a compensatory measure that would be acceptable.

12 DR. BANERJEE: How many plants are at sort  
13 of risk compared to -- and cannot apply a filter  
14 solution like the BWR solution? Because that, we know  
15 the area of the filters. So how many plants have low  
16 areas or how many plants are at risk? If we can do  
17 this assessment fairly rapidly -- the Los Alamos  
18 people probably already did it. How many are we  
19 talking about?

20 DR. WEERAKKODY: I know some of the  
21 information that was published in the Los Alamos  
22 report. I think we may be mixing up the risk aspect  
23 of this analysis, the concept of the risk analysis,  
24 with the establishment of the credible concern here.

25 What the Los Alamos study showed was that

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1 this is a credible concern, and in the process they  
2 did the risk assessment with some considered  
3 assumptions and showed that the core damage frequency  
4 could go up by a very significant factor.

5 I think the part where Los Alamos  
6 concluded that this is a credible concern is mainly  
7 based on deterministic. In other words, we did not  
8 factor in the probability of the breaks. We did not  
9 factor in the probability of different events  
10 happening or not. We just concluded that, based on  
11 all the information, this can happen.

12 DR. BANERJEE: Yes, but it's not a very  
13 huge thing. We are talking of plants which have  
14 insulation with particulate matter in it because we  
15 were told fiber is always there, and then it's filter  
16 area per megawatt after that, more or less.

17 If that can give you then which plants,  
18 you can change the filter to a BWR-type filter and  
19 which ones have to do something different. Right? I  
20 mean it's not a huge problem. I mean it may be a huge  
21 problem for the plants that cannot do it, but there  
22 must be just a handful of these.

23 CHAIRMAN WALLIS: I think we'll get this  
24 perspective. If these things go out, this perspective  
25 will have to be developed, won't it?

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1 DR. BANERJEE: Right. So you're saying  
2 let it happen?

3 CHAIRMAN WALLIS: Well, we have Mr. Butler  
4 here still, and we've got ourselves talking among  
5 ourselves. But do you have any wisdom for us on these  
6 matters?

7 MR. BUTLER: Just key points to not  
8 forget: There is no single answer to this. Because  
9 of the high degree of variability of all the PWRs,  
10 there are, in effect, 63 different answers to the  
11 problem. There is a whole range of sizes and PWR  
12 sumps, and you could probably identify 10 plants that  
13 have the smaller sumps, but those also may be the 10  
14 plants that have a low probability of debris transport  
15 or a high degree of RMI.

16 You know, there aren't plants that stand  
17 out because of the worst circumstances in all relevant  
18 aspects; there is just a high degree of variability.  
19 Because of that, we need to provide the plants with  
20 the tools and the options and the time for them to  
21 address it in the most appropriate fashion for their  
22 plants.

23 CHAIRMAN WALLIS: Well, I was sitting here  
24 listening to Los Alamos. I don't see, from what they  
25 presented, which was very interesting and had an awful

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1 lot of things, I don't see a clear path which says,  
2 knowing what they have told me, I can see the way to  
3 developing guidance for a plant. Maybe you guys are  
4 much smarter.

5 Knowing all the stuff they presented  
6 today, if you're going to consider all that stuff, I  
7 can't see my way through the thicket to say, "This is  
8 the way I would develop a guidance for a plant." I  
9 would probably have to fall back on something  
10 conservative.

11 MR. BUTLER: And in some areas we will  
12 likely have to do that.

13 CHAIRMAN WALLIS: And it might be very  
14 conservative.

15 MR. BUTLER: Well, we're trying to address  
16 some of the major conservatisms as part of our  
17 guidance upfront in discussions with staff. You are  
18 already aware of some of those discussions in the LBB  
19 area. We think the current GDC-4 regulation allows us  
20 to exclude the regeneration for LBB-qualified --

21 CHAIRMAN WALLIS: Do you want an opinion  
22 of this Committee on the LBB issue? It hasn't been  
23 brought up today.

24 MR. BUTLER: I wasn't going to bring it up  
25 in my discussion. I'm not sure I want to ask the

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1 question if I'm not willing to live with the answer,  
2 but I'll leave it to you to express your opinion or  
3 not.

4 MR. ROSEN: Well, I would like to come  
5 back to this date thing. I think I've read this more  
6 carefully, and I think it actually is in there, but I  
7 want to verify that with you and the staff, not you,  
8 John, because you haven't got it in front of you.

9 But the staff says there are two 90-day  
10 periods, and the second 90-day period, it says,  
11 "Within 90 days of the date of completion of the  
12 requested evaluation of the susceptibility, provide  
13 the following: a description of the actions taken,"  
14 et cetera, et cetera.

15 Then it goes on to "a general description  
16 of an expected implementation schedule for any plant  
17 modifications that are necessary to ensure the  
18 availability of the ECCS and CSS recirculation  
19 functions under the postulated debris loadings. If  
20 required modifications will not have been completed by  
21 the end of the subsequent refueling outage, provide  
22 justification."

23 So that, very simply to me, adds two 90-  
24 day periods -- that's a half a year, 180 days, half a  
25 year -- plus a typical refueling outage schedule or

1 refueling cycle, like another 18 months.

2 MR. LEITCH: The two 90-day periods are  
3 not back to back necessarily.

4 MR. ROSEN: They're not back to back.  
5 Even if they were --

6 MR. LEITCH: The second 90-day clock can  
7 start a year after the end of the first one.

8 MR. ROSEN: But even if they were -- let's  
9 just say that's the minimum --

10 MR. LEITCH: Yes, right.

11 MR. ROSEN: The minimum would be a half a  
12 year plus a year and a half. So that's two years.  
13 That's the minimum but not the maximum. So I think my  
14 question stands.

15 MR. LEITCH: Yes.

16 CHAIRMAN WALLIS: Why are they not back to  
17 back?

18 MR. DORMAN: Because the first one  
19 requests a schedule --

20 CHAIRMAN WALLIS: Yes.

21 MR. DORMAN: -- for their evaluation, and  
22 then they do the evaluation. When they complete the  
23 evaluation, the second 90-day clock starts.

24 MR. LEITCH: They haven't prescribed the  
25 time to do the evaluation.

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1 MR. DORMAN: So it allows for the licensee  
2 to propose a time period for the evaluation.  
3 Obviously, if they came in with five years -- maybe  
4 that's a hard part over that.

5 CHAIRMAN WALLIS: Okay. So you've got  
6 April 1st, 2004. It can also be within 90 days of the  
7 completion of the containment surveillance, or am I --

8 MR. ROSEN: Whichever is later.

9 CHAIRMAN WALLIS: Yes, whichever is later.  
10 Well, okay.

11 So what happens? These things go out for  
12 public comment? Is that the way it goes?

13 DR. WEERAKKODY: Yes.

14 CHAIRMAN WALLIS: Now how long does that  
15 take? Sixty days? Then by then you get the comments,  
16 and then you make a decision in how long?

17 MR. LEHNING: The final issuance?

18 CHAIRMAN WALLIS: Yes.

19 MR. LEHNING: Is that what you're asking,  
20 what the final issuance? It is planned for, I think,  
21 the fall.

22 MR. ARCHITZEL: I've got a schedule here.  
23 Particular dates, we've got it laid out.

24 So the question is, when does the final  
25 Generic Letter go out?

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1 CHAIRMAN WALLIS: Yes.

2 MR. ARCHITZEL: Okay, the final, it's  
3 currently scheduled for August.

4 MR. DORMAN: Yes, and for the regulatory  
5 guidance, it's scheduled for September.

6 CHAIRMAN WALLIS: Yes, okay.

7 MR. ARCHITZEL: But, remember, this hasn't  
8 been through the CRGR yet, and so the process could  
9 slip.

10 MR. ROSEN: You may be asking too hard a  
11 question for the ACRS. The ACRS is trying to figure  
12 out how you're managing this, and we don't --

13 CHAIRMAN WALLIS: That's right. I think  
14 there's so many imponderables about whether CRGR is  
15 going to approve it or how much slack you get from  
16 industry, and all that, that I think the only thing  
17 that we can really do at this stage is to go into a  
18 sort of caucus now and say, "Go ahead, issue these  
19 things for public comment."

20 MR. ROSEN: Well, we can do that for sure.

21 CHAIRMAN WALLIS: It's too early for us to  
22 get involved in the melee here.

23 MR. ROSEN: Right, but we can certainly  
24 express our angst about not having a schedule with an  
25 end date, if that's the will of the Subcommittee and

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1 the full Committee.

2 CHAIRMAN WALLIS: I guess we could write  
3 a Larkinsgram, and then we could put in a sentence or  
4 two about needing an end date or something.

5 See, if we want the Committee to write a  
6 letter, then we're going to have to ask these folks to  
7 come before the Committee in two days, and we're going  
8 to have to schedule it and squeeze it into a schedule  
9 which is already full.

10 MR. ROSEN: Well, aren't they supposed to?  
11 It's already scheduled?

12 CHAIRMAN WALLIS: But it's a short thing.  
13 It's only 15 minutes or something.

14 MR. SNODDERLY: No, no, no. Right now  
15 there's an hour and a half scheduled.

16 CHAIRMAN WALLIS: Oh, it's an hour and a  
17 half scheduled?

18 MR. SNODDERLY: Excuse me. This is Mike  
19 Snodderly.

20 Right now there is an hour and a half  
21 scheduled from 10:30 to 12:00 on Thursday.

22 CHAIRMAN WALLIS: But if it were a  
23 Larkinsgram, it would simply be a discussion with this  
24 Committee, maybe half an hour with the full Committee,  
25 saying that there are things that we have learned

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1 today and we just will share it with our colleagues,  
2 but it wouldn't be that this would go into a letter  
3 where they would they have to make their own  
4 decisions.

5 MR. ROSEN: But, typically, Larkingsgrams  
6 were used to go out and to say, you know, it's okay to  
7 release it for public comment. But I have a more  
8 substantive concern, which is that this is, I think,  
9 an important problem potentially in some plants, and  
10 that there seems to be no clear resolution date at  
11 least proposed in the Generic Letter.

12 DR. KRESS: I share that concern, and that  
13 would take a Committee letter?

14 MR. ROSEN: Right.

15 CHAIRMAN WALLIS: It would take a  
16 Committee letter? You can't put that in a Larkingsgram  
17 because the whole Committee has to --

18 DR. KRESS: We normally don't put that  
19 substantial of comment --

20 CHAIRMAN WALLIS: All right, so the whole  
21 Committee would have to confront the issues, and they  
22 would have to have a presentation?

23 DR. KRESS: I think so.

24 CHAIRMAN WALLIS: And they would have to  
25 come up-to-speed. So they would have to have a

1 shorter version of what we heard today.

2 DR. KRESS: Now be aware that any members  
3 that aren't here, at least two of them that sit over  
4 here are well up on this issue and went through the  
5 BWR part of it, and are quite aware of the problems  
6 and the ramifications. So it's not like they need  
7 extensive educating.

8 CHAIRMAN WALLIS: Well, I think the staff  
9 already knows this Subcommittee is concerned about  
10 this business of dates, and so on. Do we need to have  
11 the authority of the whole Committee invoked?

12 MR. SNODDERLY: Graham, if I can make a  
13 suggestion, I would like to say that this could be  
14 discussed at the P&P tomorrow, and in the meantime we  
15 ask the staff to prepare a presentation for the full  
16 Committee and we would get back to them before  
17 Thursday.

18 But, as of right now, we would prepare,  
19 have them condense their presentation for an hour and  
20 a half on Thursday from 10:30 to 12:00, with emphasis  
21 on the schedule of the Generic Letter, what is  
22 requested, and when they think that would be  
23 anticipated.

24 MR. ROSEN: When they think that would  
25 lead to fixes in the plants that need it?

1 MR. SNODDERLY: Right, and whether there  
2 would be a final date or not, and also to reflect, I  
3 guess, on page 7, because it seems to be very  
4 contingent upon NEI developing this subsequent  
5 guidance by September 2003. Because when you send in  
6 your 90-day letter to say what kind of an evaluation,  
7 you might say, well, I'm going to do it in accordance  
8 with the methodology being developed by NEI. So if  
9 that goes beyond --

10 MR. ROSEN: Almost certainly every plant  
11 will do that.

12 MR. SNODDERLY: Right, right. So that  
13 seems to be a key.

14 CHAIRMAN WALLIS: Well, I have very little  
15 in there being a methodology.

16 MR. SNODDERLY: Right. So that would go  
17 with your concern and Dr. Kress' that this does  
18 appear, and Dr. Rosen, that there isn't this end-all  
19 date or a closeout date.

20 And then you could decide at the P&P  
21 whether you want to discuss that --

22 CHAIRMAN WALLIS: That's why I think that  
23 before we go to the P&P, I think this Subcommittee has  
24 to decide what they want and tell the P&P that's what  
25 they advise them to do.

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1 MR. ROSEN: But two members of the P&P are  
2 here.

3 CHAIRMAN WALLIS: But, you see, my  
4 inclination was to say there's enough here; it's going  
5 to stir up enough stuff that you could send out a  
6 rough direct letter and the Reg. Guide, and there may  
7 be a few details like discussed here to be fixed up,  
8 but that can be fixed up when the public comments come  
9 back. Send this out, and that's going to start the  
10 ball rolling.

11 It's going to put NEI on the spot. It's  
12 going to put some of the licensees on the spot, and  
13 it's going to put LANL on the spot to be more specific  
14 about what they're recommending to the staff. Then  
15 things will happen.

16 MR. ROSEN: Well, I think what we're  
17 talking about is a procedural question, which I think  
18 maybe we could get some help from the staff.

19 CHAIRMAN WALLIS: What I was hoping --

20 MR. ROSEN: Can we put that put that much  
21 into the Larkinsgram?

22 CHAIRMAN WALLIS: Well, what I was  
23 thinking, that we simply have a Larkinsgram saying we  
24 have no objection to these going out for public  
25 comment. They will then go out for public comment.

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1 That's all we need to say. Everything else will take  
2 its course. It has to. It just follows on from --

3 MR. ROSEN: Not if we don't say something  
4 about the schedule.

5 CHAIRMAN WALLIS: We'll see it again. It  
6 comes back from --

7 MR. ROSEN: No, no, I'm saying, not unless  
8 we put a burr under the saddle. I mean, it will  
9 continue to do what it's been doing, which is moving  
10 ahead like an iceberg.

11 CHAIRMAN WALLIS: I thought these 90 days  
12 were not moving ahead at a snail's pace, but maybe I'm  
13 under some illusion.

14 MR. LEITCH: I have no problem with  
15 recommending that we send it out for public comment in  
16 its present form. I think that it addresses one  
17 refueling outage or no later than whatever it says,  
18 one fuel cycle. I think that's a reasonable approach  
19 to send it out for public comment that way.

20 You know, there may be some changes in  
21 that as a result of the comments, but I think that's  
22 a reasonable approach. I am frustrated that it's  
23 taken this long to get to this point, but that's  
24 behind us now. I mean we can't recoup that time.

25 I mean, I think this whole issue is an

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1 issue where striving -- what's the saying? Perfection  
2 is the enemy of good enough. I think we've killed  
3 this thing trying to analyze it. I think we've got  
4 some plants out there that we know are much more  
5 susceptible to this than other plants, and we just  
6 ought to get on with it and get those plants fixed.

7 But we've taken an awful lot of time with  
8 this, and we can't do anything to recoup that time at  
9 this point. There may be some lessons learned from  
10 how long this has taken, but what I'm saying is I  
11 think now the thing to do is, without further delay,  
12 get the Generic Letter out for public comments or,  
13 yes, get the thing out for public comments.

14 CHAIRMAN WALLIS: And the Reg. Guide.

15 MR. LEITCH: The Reg. Guide, yes.

16 DR. KRESS: Well, yes, and I agree pretty  
17 much with what you said, but I see it as somewhat  
18 analogous to the control rod drive cracking issue.  
19 Some plants are a lot more vulnerable than others. So  
20 that when the NRC went out with the Generic Letter on  
21 this issue, they gave those that were less vulnerable  
22 more time, and those that were very vulnerable, they  
23 said, hey, you had better get on with it here, and  
24 especially these, these, these.

25 Now I think the Generic Letter I see gives

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1 all plants equal time to assess their vulnerability  
2 and make a plan and go on. But I think that there's  
3 a missing ingredient, and that is how vulnerable are  
4 they; how urgent does it have to be when they're  
5 vulnerable, and can we give the ones that aren't  
6 vulnerable more time?

7 CHAIRMAN WALLIS: I don't think it helps.  
8 If they're not vulnerable, they just come back with a  
9 short answer: We're not vulnerable.

10 DR. KRESS: Yes, well --

11 CHAIRMAN WALLIS: There's no reason to get  
12 into all the topics.

13 DR. KRESS: I think there are gradations  
14 of not vulnerable.

15 CHAIRMAN WALLIS: But that's information,  
16 though. I think the NRC needs to know how vulnerable  
17 they are.

18 DR. KRESS: Yes.

19 CHAIRMAN WALLIS: They don't know it until  
20 they've got these answers.

21 DR. KRESS: Yes, once you find some that's  
22 very vulnerable, I think you need the answers faster  
23 and you can do something better with those. But I  
24 guess I'm coming down on the side of just going ahead  
25 and saying: Issue these Generic Letters, the drafts,

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1 and the Reg. Guide, and then let's worry about this  
2 other part when the answer is due in on vulnerable.

3 CHAIRMAN WALLIS: Do we need their  
4 presentation before the full Committee by the staff?

5 DR. KRESS: No, not if we just write that  
6 Larkinsgram.

7 MR. ROSEN: Well, here's what I would like  
8 to have them talk about at the full Committee: Focus  
9 on very basic phenomenology without getting into too  
10 much of it, and then get into the schedule and assure  
11 the full Committee, and me, that this will move  
12 forward, given whatever it is you say in the Draft  
13 Generic Letter.

14 Is that all right with the staff?

15 CHAIRMAN WALLIS: What do the other  
16 members of the Subcommittee have to offer for advice?

17 DR. FORD: Well, I agree with the issuance  
18 of the Generic Letter for public comment now, and  
19 that's the essence of the Larkinsgram. Where we're  
20 sticking is, do we put in this question of the timing?

21 As you know, I get very impatient when  
22 things drag on. So, inherently, I'm behind Steve on  
23 this one. Whether that needs to have a full meeting,  
24 I'm not at all sure.

25 MR. ROSEN: Well, it's on the schedule

1 already.

2 CHAIRMAN WALLIS: When does this come back  
3 to the ACRS? Doesn't it come back? When does it come  
4 back? Are you going to bring it back to us after the  
5 public comments and before you issue these things?

6 MR. ARCHITZEL: Well, the Generic Letter  
7 would not necessarily come back if there weren't  
8 significant public -- certainly, if you want it, it  
9 will come back. We were planning to come back when  
10 the guidance was evaluated by us and we were accepting  
11 it or had the significant differences in it. So  
12 that's really the next time when I thought we would  
13 come back, is when the guidance is in place.

14 CHAIRMAN WALLIS: You haven't really had  
15 comments on the Guide.

16 MR. ARCHITZEL: We don't have the guidance  
17 yet.

18 MR. DORMAN: We're expecting to --

19 CHAIRMAN WALLIS: The Guide, the Reg.  
20 Guide.

21 MR. DORMAN: We're expecting to come back  
22 in July to talk about the public comments on the Reg.  
23 Guide and how we expect to resolve those. That's to  
24 support the September issuance.

25 CHAIRMAN WALLIS: I think that that would

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1 be appropriate for us to ask at that time what  
2 happened with the Generic Letter. They sort of go  
3 together, don't they? I think you would probably want  
4 to come back with both. So we get another crack at  
5 you, and you know our concern with timeliness.

6 MR. DORMAN: Uh-hum.

7 CHAIRMAN WALLIS: We've got the majority  
8 of the Committee.

9 (Laughter.)

10 DR. KRESS: Three members missing, I  
11 think.

12 CHAIRMAN WALLIS: Yes.

13 MR. ROSEN: Five members missing, two of  
14 which know of this issue in detail.

15 CHAIRMAN WALLIS: I'm bothered about the  
16 ACRS writing a letter on what's after all a draft  
17 before we see the evidence. I wanted to stir up these  
18 replies from industry, so we can see what's going on,  
19 and then we can come to them with advice. At the  
20 moment it is more: Send it out, find out more about  
21 the problem, and get on with it. That's what we're  
22 asking for.

23 MR. ROSEN: I could live with that.

24 CHAIRMAN WALLIS: So we'll make a  
25 Subcommittee report? We won't ask the staff to come

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1 back to the full Committee? Or do you want the staff  
2 to come back to the full Committee?

3 MR. ROSEN: I think the staff should come  
4 back and talk about the Generic Draft, Generic Letter,  
5 and the schedule that it requires.

6 CHAIRMAN WALLIS: So then we could put it  
7 to our colleagues, would you like a Larkinsgram or --

8 MR. ROSEN: Or at that point we could say  
9 we suggest a Larkinsgram, but we're concerned about  
10 the schedule. We want to get on with it.

11 CHAIRMAN WALLIS: That's okay, too.

12 DR. FORD: Do I understand that the  
13 sticking point is, if it is a Larkinsgram, we cannot  
14 put in the question of scheduling, our concern about  
15 scheduling?

16 CHAIRMAN WALLIS: We can't add that in as  
17 a sentence?

18 DR. FORD: That's what I'm understanding.

19 DR. KRESS: I think that level of comment  
20 could probably go into a Larkinsgram.

21 CHAIRMAN WALLIS: Yes, why not? But then  
22 it does have to come to full Committee. If there's  
23 going to be a comment, it probably has to come before  
24 the full Committee. But I don't think we need an hour  
25 and a half. You guys can do, put the essence of it

1 out in half an hour, and we won't go into the LANL  
2 stuff.

3 DR. KRESS: John's agreeing that we could  
4 do it, because it has to be voted on by the full  
5 Committee, but --

6 CHAIRMAN WALLIS: So we could put it in a  
7 Larkinsgram saying it will go out for public  
8 comment --

9 DR. KRESS: Yes.

10 CHAIRMAN WALLIS: -- and then say that  
11 there should be consideration about the schedule.

12 DR. KRESS: Yes, it's only appropriate for  
13 the full Committee to vote on it if they've heard the  
14 details of what our concern is.

15 CHAIRMAN WALLIS: Yes.

16 DR. KRESS: So we'll have to have enough  
17 for that.

18 MR. ROSEN: That's why I asked the staff  
19 to talk about the schedule. It's in the draft --

20 DR. FORD: I think Tom brought up a good  
21 analogy to the VHP situation. The degree of urgency  
22 is dependent on some sort of assessment of risk.

23 MR. ROSEN: Sure, and we don't know what  
24 that is.

25 DR. FORD: And we don't know what that is,

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1 but that, presumably, from what I'm hearing from  
2 LANL's staff coming out with, is saying that they're  
3 moving towards that assessment of risk.

4 CHAIRMAN WALLIS: Well, maybe it's going  
5 to be conditional, that when they get this information  
6 from the first 90 days, then they can decide if there  
7 isn't a need to move faster on the plants that have  
8 problems.

9 DR. FORD: Yes.

10 MR. ROSEN: And I think we should take the  
11 conservative position that it is likely, that it is  
12 possible that we will get some reports that say it's  
13 a problem, and that, therefore, it will then be seen  
14 to have been appropriate to have pushed to get on with  
15 it.

16 CHAIRMAN WALLIS: We talked about the  
17 letter. So we're asking the staff to come before the  
18 full Committee and discuss the letter, just the  
19 letter.

20 Do we want them to come and discuss this  
21 Reg. Draft Guide?

22 MR. ROSEN: I don't want them to.

23 CHAIRMAN WALLIS: Well, I think that it  
24 might be at least a couple of minutes because it is  
25 fairly -- I don't think you should go into details,

1 but I think you need to point out that there is a  
2 Draft Reg. Guide, that it does ask for all the  
3 specific things. You might just have one slide that  
4 says what are those specific things. It's got to be  
5 the sources of debris and debris transport, the effect  
6 on -- they could analyze those things, and so on.

7 MR. DORMAN: It gives context to the --

8 CHAIRMAN WALLIS: You could summarize the  
9 Reg. Guide in one slide?

10 MR. DORMAN: Yes, it gives context for  
11 what we're asking for in the Generic Letter.

12 CHAIRMAN WALLIS: Because the two go out  
13 together. Without the Reg. Guide, how can you send  
14 this out?

15 DR. WEERAKKODY: I have a question. When  
16 we come in front of the full Committee to talk about  
17 the Generic Letter, we probably would need at least a  
18 few more slides to do the context unless each member  
19 who is not here is already familiar with the issue.  
20 I would assume that's the case.

21 CHAIRMAN WALLIS: We don't need too much  
22 history.

23 DR. WEERAKKODY: Not too much, just we'll  
24 focus on the letter, but have a few --

25 CHAIRMAN WALLIS: Well, they're all

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1 familiar with this to some degree.

2 DR. KRESS: At least four out of the five  
3 are very familiar with this issue.

4 CHAIRMAN WALLIS: Well, there are six of  
5 us here. So there are five more --

6 DR. KRESS: Five missing, yes.

7 CHAIRMAN WALLIS: Now NEI wants to come  
8 again?

9 MR. BUTLER: To the full Committee  
10 meeting?

11 CHAIRMAN WALLIS: Yes.

12 MR. BUTLER: It won't be me. I'll be in  
13 San Diego. If you need somebody --

14 CHAIRMAN WALLIS: I think if NEI comes,  
15 what I will be interested in is really, how is  
16 industry going to take this and what's going to be the  
17 effect? Are they going to be able to do it? They  
18 don't know what is in it yet. So, okay, so you can't  
19 really comment on something you haven't seen, no. So  
20 you don't need to come back.

21 MR. SNODDERLY: I think we would also need  
22 some clarification about future ACRS interactions  
23 because I thought I heard Gary Holahan had said this  
24 morning that the opportunities for future ACRS review  
25 would be when the Generic Letter was final and also

1 when the Reg. Guide, the associated Reg. Guide, was  
2 final.

3 So I think we would want to know, and then  
4 I thought I heard Ralph say that we would not  
5 necessarily see the Generic Letter again.

6 MR. ARCHITZEL: Mike, I would clarify  
7 that. You always get to see the -- you make a choice.  
8 The ACRS makes a choice on it. We distill the  
9 comments and provide them because we met on the  
10 Generic Letter. When the comments come in, we can  
11 meet again.

12 The point is, this issue, you have to meet  
13 on again no matter what. You have to agree on the  
14 issue, the generic safety issue, and it could be at  
15 the Generic Letter stage.

16 CHAIRMAN WALLIS: We have to sign off on  
17 something, do we?

18 MR. ARCHITZEL: On the generic safety  
19 issue, you have to meet on that, yes.

20 CHAIRMAN WALLIS: But if there's no change  
21 from this draft, no significant change from these  
22 documents, I think it could be a very short meeting.

23 MR. ARCHITZEL: Exactly.

24 MR. SNODDERLY: Or waive the meeting. We  
25 have to come back to you, no matter what, to get a

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1 waiver in that meeting.

2 CHAIRMAN WALLIS: Are you expecting a  
3 storm of comments back from industry or are they just  
4 going to say, "This is fine," we go out and do it?  
5 Have you tested the waters?

6 MR. ARCHITZEL: No, I think we'll get the  
7 comments on the leak-before-break and things like  
8 that, but not a storm of comments, no, just the  
9 schedule comments.

10 CHAIRMAN WALLIS: You haven't asked any  
11 guidance on the leak-before-breaks.

12 MR. ARCHITZEL: Well, we've already got a  
13 letter that the staff considers regarding a  
14 decision --

15 CHAIRMAN WALLIS: You've already made a  
16 decision.

17 MR. ARCHITZEL: That's our current  
18 position.

19 CHAIRMAN WALLIS: It's the end of this  
20 meeting. So I can adjourn? Is that the appropriate  
21 word?

22 MR. SNODDERLY: I think, Graham, yes, and  
23 at the beginning of the meeting we had to make two  
24 decisions. The first was decide on the need for  
25 presentations by the staff at the February 6th date.

1 CHAIRMAN WALLIS: And we decided, yes,  
2 they would do it.

3 MR. SNODDERLY: And we've decided that  
4 they will present from 10:30 until 12:00.

5 CHAIRMAN WALLIS: About the letter with  
6 this or the summary slide on the Reg. Guide.

7 MR. SNODDERLY: Okay, and then our  
8 recommendation to the full Committee would be whether  
9 the Draft Generic Letter and associated Draft Reg.  
10 Guide can be issued for public comment. Then we would  
11 have a Larkinsgram.

12 CHAIRMAN WALLIS: There may be a further  
13 sentence about schedules. That's probably the way it  
14 is headed.

15 MR. SNODDERLY: Okay.

16 CHAIRMAN WALLIS: There may be members of  
17 the Committee who want to write a long letter.

18 MR. SNODDERLY: Then I think we can  
19 adjourn.

20 CHAIRMAN WALLIS: All right, so we're  
21 ready to adjourn. Any objection?

22 (No response.)

23 We're adjourned.

24 (Whereupon, the foregoing matter adjourned  
25 at 6:12 p.m.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on  
Reactor Safeguards Thermal-  
Hydraulic Phenomena  
Subcommittee

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

*Rebecca Davis*

---

Rebecca Davis  
Official Reporter  
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United States Nuclear Regulatory Commission

**GSI-191**  
**“ASSESSMENT OF DEBRIS**  
**ACCUMULATION ON PWR SUMP**  
**PERFORMANCE”**

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Office of Nuclear Reactor Regulation  
Director Division of Systems Safety and Analysis  
February 4, 2003



United States Nuclear Regulatory Commission

**GSI-191 Presentation**

- RES Study Concluded that PWR Sump Concerns were Credible but Need to be Addressed on Plant Specific Basis
  - More and finer debris could be generated by a HELB
  - Sump clogging due to more and finer debris
- ACRS Involvement requested
  - MD 6.4 role to Advise the Staff on the processes and methodologies for addressing Generic Safety Issues
  - OL 701 Role to Review selected CRGR Generic Communication packages before Public Comment Stage



## United States Nuclear Regulatory Commission

### GSI-191 Presentation

- **Justification for Interim Operation**
  - Low probability of LOCA requiring recirculation
  - Higher frequency LOCAs more time to or no recirculation, less debris, operator recovery potential
  - Likelihood qualified piping will leak before break
  - Margins in NPSH available, uncredited containment overpressure, cavitation operation potential
  - PWR containment/sump compartmentalized configuration
  - Ongoing industry actions to improve sumps and increase containment cleanliness
  - Ongoing configuration assessment walkdowns

ACRS T/H Subcommittee  
February 4, 2003

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## United States Nuclear Regulatory Commission

### Resolution Process for GSI-191

- **Activities include**
  - Revise Regulatory Guide 1.82
  - PWR Industry Initiative to Develop Guidance for Plant Specific Evaluation
  - Genenc Letter
- **Plant specific assessment needed to assure the reliability of ECCS in recirculation**
- **PWR industry to develop guidance acceptable to NRC to evaluate configurations**
- **Oversee evaluations of recirculation adequacy**
  - Review genenc letter responses
  - Sample audits of evaluations
  - Temporary instruction to allow inspection oversight of activities

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February 4, 2003

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**United States Nuclear Regulatory Commission**

**STATUS AND PROPOSED  
RESOLUTION OF GSI-191  
“ASSESSMENT OF DEBRIS  
ACCUMULATION ON PWR SUMP  
PERFORMANCE”**

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Office of Nuclear Reactor Regulation  
Division of Systems Safety and Analysis  
Plant Systems Branch

February 4, 2003



**United States Nuclear Regulatory Commission**

**OVERVIEW**

- Generic Safety Issue (GSI) - 191
- Generic Issue Program Stages
- Technical Assessment
- Regulations and Guidance Development
  - Generic Letter –John Lehning
  - RG 1.82 Rev 3 – B. P. Jain
  - Industry Evaluation Guidelines John Butler
- LANL Support Activities
- Industry Meetings/Initiatives
- Current Plans and Schedules
- GSI-191 Resolution/Closure



## United States Nuclear Regulatory Commission

### Generic Safety Issue GSI -191

- 10 CFR 50.46 (b)(5) and Appendix A to 10 CFR 50, Criterion 35 Require Long Term Emergency Core Cooling
- Debris Blockage of Sump Screens may Prevent the Injection of Water into the Reactor Core or Containment Spray
- USI A-43 Examined Emergency Sump Performance
  - closed in 1985 (Generic Letter 85-22; Reg Guide 1.82 Rev. 1)
- GSI -191 Re-Assesses Effect of Debris Accumulation on PWR Sump Performance due to
  - Events at BWRs
  - New information identified since USI A-43 closure, including BWR resolution

ACRS T/H Subcommittee  
February 4, 2003

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## United States Nuclear Regulatory Commission

### Generic Issue Program Stages

(Management Directive 6.4)

- 1 Issue Identification
- 2 Initial Screening
- 3 Technical Assessment
- 4 Regulation and Guidance Development  
(Development of GL and RG DG -1107)
- 5 Regulation and Guidance Issuance
- 6 Implementation
- 7 Verification

ACRS T/H Subcommittee  
February 4, 2003

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## United States Nuclear Regulatory Commission

### Technical Assessment (Stage 3)

- Parametric evaluation to determine if loss of ECCS NPSH margin due to sump clogging was a credible concern.
  - Modeled plant specific parameters based on NEI survey information (e.g., ECCS flow, debris types, etc.)
  - Did not have sufficient information to model plant piping layout and insulation debris locations.
  - Calculated a range of likely amounts of debris that could accumulate on sump screen and the associated head loss. This head loss was compared to the NPSH margin to determine the likelihood of clogging.



## United States Nuclear Regulatory Commission

### Technical Assessment (Cont.)

- **Confirmed Recirculation Performance is a Credible Concern for PWRs**
  - More and finer debris could be generated by a HELB
  - Sump clogging due to thin bed effect
  - Upstream (inventory loss) and downstream blockage (HPSI throttle valves) concerns
  - Other effects such as loads on screens from debris beds at design conditions



## United States Nuclear Regulatory Commission

### Technical Assessment Conclusions

- Plant Specific Analyses should be conducted to determine whether debris accumulation in PWR containments will impede or prevent ECCS operation during Recirculation
- Appropriate Corrective Action, as necessary, should be implemented on the basis of these plant-specific analyses
- The Industry and the ACRS were briefed on the study findings in July and September, 2001, respectively.
  - ACRS agreed with potential issue; developing guidance for plant-specific analyses if needed, and requested review of proposed final disposition

ACRS T/H Subcommittee  
February 4, 2003

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## United States Nuclear Regulatory Commission

### Regulations and Guidance Development (Stage 4)

- NRR Action Plan Developed to Address GSI Resolution
- Revise Regulatory Guide 1.82
- PWR Industry (NEI) to Issue Guidance for Plant Specific Evaluation (Fall 2003)
- Generic Letter

ACRS T/H Subcommittee  
February 4, 2003

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## United States Nuclear Regulatory Commission

### LANL Support Activities

- NRR Contracted LANL for technical support
- Provides continuity of GSI issue and related technical support
- Completing a set of calculations for volunteer plant
- Commenting on Industry Evaluation Guidelines
- Addressed testing or knowledge base uncertainties
- Evaluated potential operator recovery actions to complement parametric study results



## United States Nuclear Regulatory Commission

### Industry Meetings/Initiatives

- NEI PWR Sump Performance Task Force 1997
- Regular Meetings and Conference calls
- Since completion of Technical Assessment:
- March 28, 2002
  - NRC Action Plan addressed
  - Industry Initiative 6 Step program
    - No submittal but will coordinate with NRC
    - Regulatory Implementation for NRC action



## United States Nuclear Regulatory Commission

### NRC/PWR Industry Meetings (cont.)

- May 30, 2002
  - Presentation/discussion of Condition Assessment Guidelines (NEI-02-01)
- July 2, 2002
  - Review of potential interim actions and regulatory assessment
- July 30-31, 2002
  - NRC attended/presented at NEI PWR Sump Performance Workshop



## United States Nuclear Regulatory Commission

### NRC/PWR Industry Meetings (Cont.)

- August 29, 2002
  - Revision of Condition Assessment Guidelines (NEI-02-01) for NRC comments and Industry experience
  - Addition of HPSI throttle valve blockage to scope
- October 24, 2002
  - Status of action plan/GL
  - Discuss draft NEI Evaluation methodology ground rules
  - Discuss PCI letter concerning head loss due to fiber/particulate combinations
- November 18, 2002 - ANS Winter meeting session



## United States Nuclear Regulatory Commission

### NRC/PWR Industry Meetings (cont.)

- December 12, 2002
  - Additional ground rules sections presented
    - General Technical
    - Debris Generation
  - Discussed NRC perspectives on Design and Testing for GSI-191 Resolution
- Planned March 4, 2003
  - Status of action plan/GL/Operator Recovery TLR
  - Discuss NRC comments on NEI Evaluation methodology ground rules received
  - NEI present additional ground rules sections
  - Visit UNM Thermal Hydraulics laboratory

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## United States Nuclear Regulatory Commission

### Current Plans and Schedules

- Issue Draft Regulatory Guide (DG-1107) for Public Comment (February, 2003)
- Issue Regulatory Guide 1.82, Rev. 3 (September 2003)
- Issue Draft Generic Letter for Public Comment (First Quarter, 2003)
  - Following CRGR review
  - Draft GL is predecisional pending CRGR approval
- Issue Generic Letter (Summer 2003)
- Industry (NEI) to Issue Guidance for Plant Specific Evaluation (Fall 2003)

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## United States Nuclear Regulatory Commission

### GSI-191 Resolution/Closure

- Implementation (Stage 6) begins following Guidance development Fall 2003
  - Completes action plan and focus shift to plant specific MPA activity
- Verification (Stage 7) planned through a combination of Audits, inspection activities and GL response reviews
- Leads to effective closure of GSI-191



United States Nuclear Regulatory Commission

**PROPOSED GENERIC LETTER 2003-XX  
"POTENTIAL IMPACT OF DEBRIS  
BLOCKAGE ON EMERGENCY  
RECIRCULATION AT  
PRESSURIZED-WATER REACTORS"**

John Lehning, General Engineer  
[Jxl4@nrc.gov](mailto:Jxl4@nrc.gov) (301) 415-3285  
Office of Nuclear Reactor Regulation  
Division of Systems Safety and Analysis  
Plant Systems Branch  
February 4, 2003



United States Nuclear Regulatory Commission

**Package for CRGR Review**

- Memorandum to CRGR Chairman
- Attachment 1, Proposed Generic Letter
- Attachment 2, Required Information for CRGR Review
- Attachment 3, Risk Considerations and Benefits Associated with GSI-191
- Attachment 4, Cost Analysis for GSI-191

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## United States Nuclear Regulatory Commission

# Purposes of Generic Letter

- Apprise PWR licensees of NRC research identifying the potential susceptibility of PWRs to containment recirculation sump screen blockage
- Apprise PWR licensees of additional adverse effects due to post-accident debris blockage
- Request that PWR licensees evaluate the ECCS and CSS recirculation functions, and, if appropriate, take additional actions to ensure their reliability
- Require that PWR licensees inform the NRC of the extent to which they will take the requested actions



## United States Nuclear Regulatory Commission

# Background

- During initial plant licensing, a 50%-blockage assumption was made in assessing the adequacy of sump screens
- USI A-43 research demonstrated the non-conservatism of this assumption in the mid-1980s, but backfitting operating plants was not justified
- BWR ECCS strainer clogging events and research in the mid-1990s justified backfitting for BWRs
- Research and analysis for Generic Safety Issue 191 indicates that generic action is also justified for PWRs



## United States Nuclear Regulatory Commission

# Phenomenology

- Debris Generation
  - Primarily jet impingement
  - Secondly temperature/humidity, flooding
- Pre-existing Debris Sources
- Debris Transport
  - Washdown from spray and break flows
  - Transport within pool if turbulence is sufficient
- Debris Accumulation
  - Suspended debris
  - Sliding debris



## United States Nuclear Regulatory Commission

# Concerns Addressed in Generic Letter

- Sump screen debris blockage
  - Potential loss of NPSH margin to ECCS and CSS pumps
  - Potential deformation of sump screens
- Upstream debris blockage at flow restrictions in containment drainage paths
- Downstream debris blockage at flow restrictions in ECCS and CSS



## United States Nuclear Regulatory Commission

### Requested Actions

- Perform a mechanistic evaluation of the susceptibility of the ECCS and CSS recirculation functions to debris blockage
- Assess necessity of, and, if appropriate, implement interim compensatory measures to mitigate the potential for sump clogging prior to performing evaluation
- Implement any plant modifications necessary to restore compliance with NRC regulations



## United States Nuclear Regulatory Commission

### Basis for Action Request

- GL invokes compliance exception to the Backfit Rule to ensure that PWR licensees are in compliance with:
  - 10 CFR 50.46, which requires long-term core cooling
  - licensing-basis requirements for the CSS
- Simplified cost-benefit analysis justifies compliance backfitting



United States Nuclear Regulatory Commission

## Information Request

- GL cites 10 CFR 50.54(f) to require response
- Response is requested in two parts
- Purposes of information request:
  - To ensure PWR licensees have timely plans to perform requested actions
  - To ensure potential risks associated with sump clogging are being adequately managed
  - To elicit information concerning the results of the requested evaluation in support of resolving Generic Safety Issue 191

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## Coordination with Industry

- NEI is developing guidance for licensees to evaluate sump screen adequacy
- NEI addressed staff comments concerning guidance for containment surveillances
- NEI evaluation methodology guidance may be more challenging for reaching agreement
- GL tentatively endorses NEI guidance, but provides for potential disagreements

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**United States Nuclear Regulatory Commission**

**Draft Regulatory Guide, DG-1107  
“Water Sources for Long-Term  
Recirculation Cooling Following A  
LOCA”**

**Dr. B. P. Jain**  
**[bpj@nrc.gov](mailto:bpj@nrc.gov) (301.415.6778)**  
**Office of Nuclear Regulatory Research**  
**Division of Engineering Technology**  
**February 4, 2003**



**United States Nuclear Regulatory Commission**

**OVERVIEW**

- Reg. Guide Issuance Process
- Historical Background – Reg. Guide 1.82
- Regulatory Position
- Acceptable Analytical Approaches
- Contributions of GSI-191 Research
- Current Plans and Schedules
- Conclusions



## United States Nuclear Regulatory Commission

### Reg. Guide 1.82, Rev. 3 Issuance Process

- Brief ACRS
- Issue DG -1107 For Public Comment
- Resolve Public Comments
- Brief CRGR/ACRS
- Resolve Comments
- Issue Reg. Guide 1.82, Rev. 3



## United States Nuclear Regulatory Commission

### DG -1107(Reg. Guide 1.82, Rev. 3)

#### Background

- Revision 0 – Issued June 1974
  - NPSH Calculations Based on 50% Blockage of Sump Screen
- Revision 1 – Issued November 1985
  - Guidance Based on USI A-43 Resolution
- GL 85-22 Concluded that RG. 1.82 (Rev.1)
  - Would Not Apply to Any Plant Then Licensed to Operate or Under Construction
  - Would be Limited to Conduct 10 CFR 50.59 Reviews Dealing with Change/Mod of Thermal Insulation
- Revision 2 – Issued May 1996
  - Revised Guidance for BWRs
  - Requested Licensee to Implement Measures to Ensure ECCS Functions Following LOCA (NRC Bulletin 96-03)
- Revision 3 – Issue September 2003 (Planned)
  - Revised Guidance for PWRs



## United States Nuclear Regulatory Commission

### Regulatory Position

Key Revisions In  
DG -1107(Regulatory Guide 1.82 Rev.3)

- Primarily, PWR Sections Revised to Enhance Debris Blockage Evaluation Guidance
  - Consistent with BWRs Guidance in Rev.2, and,
  - Insights gained from Research Performed Under GSI -191
- Minor Editorial Changes to BWR Sections  
(Consistent with Staff's Position in Safety Evaluation on BWROG's Response to NRC Bulletin 96-03)
- Includes Guidance Previously Provided in Regulatory Guide 1.1, "Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal

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System Pumps"

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## United States Nuclear Regulatory Commission

### Insights From GSI-191 Research Debris Sources and Generation

- Industry Insulation Survey (1999)
  - Fibrous
  - Reflective Metal Insulation
  - Calcium-Silicate
- Amount of Debris Generation Depends Upon
  - Type of Insulation Material (Different Destruction Threshold Pressure for Different Materials)
  - Proximity and Orientation of the Insulation Relative to Postulated Pipe Break Location
  - Insulation Installation (Jacketing, reinforcement)

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## United States Nuclear Regulatory Commission

### Insights From GSI-191 Research Debris Transport

- Substantially More Debris is Transported to Sump Screen Relatively Soon After Switchover to Recirculation
- Fine Fibers are Transported Easily and Remain Suspended for Long Time and Eventually Transported to the Sump Screen
- Fraction of Debris Transport is More for Shallower Sump Pools Than the Deeper ones
- Position (Location & Orientation) of Sump Relative to Break Location Affects the Fraction of Debris Transport
- Narrow Flowpaths (Channels) Accelerate Flow and Enhance Debris Transport

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Debris Curbs Affect Local Flow and Impede Forward Motion of Debris Sliding and Tumbling Along the Floor 42



## United States Nuclear Regulatory Commission

### Insights From GSI-191 Research Debris Accumulation and Head Loss

- Fine Debris Accumulates Uniformly
- Debris Transported Along the Floor
  - Accumulates Uniformly on Horizontal Screen
  - Accumulates Near the Bottom of a Vertical Screen Initially
- PWR Head Loss Data is Consistent with the Correlation in NUREG/CR-6224 (BWR Parametric Study, 1995) with Adjustment to Material Property Parameters
- Fibrous Bed in Combination with the Particulate Debris (corrosion Products, Paint Chips, Concrete Dust, Calcium - Silicate) Results in Higher Head Losses

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## United States Nuclear Regulatory Commission

### Acceptable Analytical Approaches

- DG – 1107 describes Analytical Approaches Acceptable to the staff
- LANL Presentation of Analytical Approaches
- Licensee can Propose Alternate Approaches
- Current Knowledgebase of Research on BWR Strainer and PWR Sump Screen Clogging Issue (NUREG/CR)



## United States Nuclear Regulatory Commission

### Contributions of GSI-191 Research Program

- Confirmed the Credibility of the Generic Safety Issue
- Supported Agency's Performance Goal of Maintaining Safety by Gaining Knowledge Regarding the Effect of Debris Accumulation on PWR Sump Performance
- Periodic Meetings with the Public, Industry, ACRS, and Other Stakeholders
- Developed Tools (Computer Programs, e.g., CASINOVA, BLOCKAGE) for Staff and Industry Use



## United States Nuclear Regulatory Commission

### Contributions of GSI-191 Research Program (cont.)

- Developed NUREG/CRs and Regulatory Guide to Provide Valuable Insights for Resolution of GSI-191
- Developed a Knowledge Base Report Summarizing US and International Research on BWR strainer and PWR Sump Screen Clogging Issues
- Plan to Interact and Share Knowledge on Sump Clogging Issue with the International Community and Other Stakeholders in an International Conference (November 2003 - Tentative)



## United States Nuclear Regulatory Commission

### Current plans and Schedules

- Issue Draft Regulatory Guide (DG-1107) for Public Comment (February, 2003)
- Issue Regulatory Guide 1.82, Rev. 3 (September 2003)
- Industry (NEI) to Issue Guidance for Plant Specific Evaluation (Fall 2003)



## United States Nuclear Regulatory Commission

# CONCLUSIONS

- GSI-191 Resolution Process at Regulation and Guidance Development Stage
- Draft Reg. Guide is Scheduled for Public Comment
- Final Reg. Guide Issuance is Planned and Scheduled
- Implementation of Regulations and Verification will Follow
- Lead to Effective Closure of GSI-191



# Acceptable Analytical Approaches for ECCS Sump Vulnerability Assessment

*Dr. Bruce Letellier*  
Probabilistic Risk Analysis Group  
Los Alamos National Laboratory

Advisory Committee on Reactor Safeguards  
Rockville, Maryland  
February 4, 2003



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## Overview

- Introduction
- Debris Generation
  - Break Location
  - Zone of Destruction
- Debris Transport
  - Blow Down/Wash Down
  - Pool Transport
- Debris Accumulation/Head Loss
- Integrated Vulnerability Assessment



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# Introduction

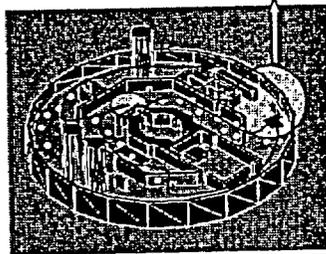
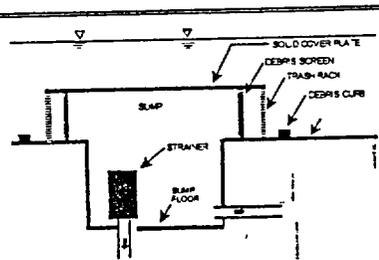
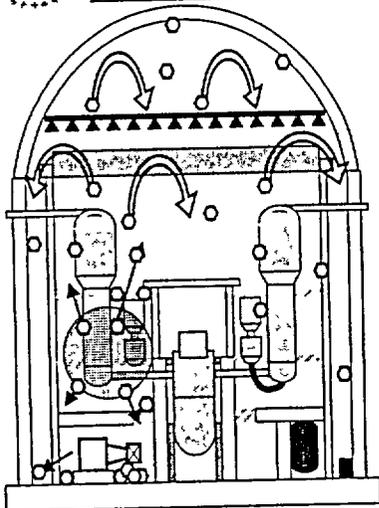


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# Accident Progression



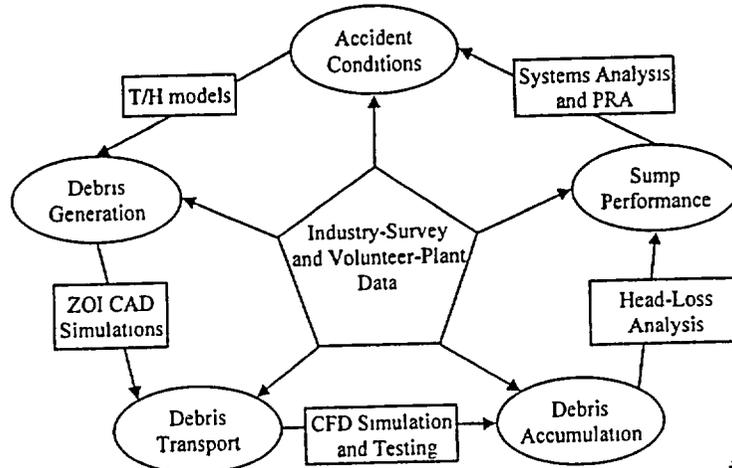
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## GSI-191 Program Overview



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## GSI-191 Documentation

- Thermal-Hydraulic Response of PWR Reactor Coolant System and Containments to Selected accident Sequences (NUREG/CR-6770)
- Separate-Effects Characterization of Debris Transport in Water (NUREG/CR-6772)
- The Impact of Debris Induced Loss of ECCS Recirculation on PWR Core Damage Frequency (NUREG/CR-6771)
- Parametric Evaluations for Pressurized Water Reactor Recirculation Sump Performance (NUREG/CR-6762, Vol. 1)
- Summary and Analysis of U.S. Pressurized Water Reactor Industry Survey Responses and Responses to GL 97-04 (NUREG/CR-6762, Vol. 2)
- Development of Debris Generation Quantities in Support of the Parametric Evaluation (NUREG/CR-6762, Vol. 3)
- Development of Debris Transport Fractions in Support of the Parametric Evaluation (NUREG/CR-6762, Vol. 4)
- Knowledge Base for the Effect of Debris on PWR ECCS Performance
- The Impact of Recovery from Debris-Induced Loss of ECCS Recirculation on PWR Core Damage Frequency



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## Debris Generation: Break Location



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## Guidance

- **Break Locations to be Considered:**
  - Hot leg, cold leg, intermediate leg, and (if needed) main steam, and main feedwater with the largest amount of potential debris
  - Large breaks with largest variety of debris (two or more types)
  - Breaks in areas with most direct path to sump
  - Medium and large breaks with largest particulate to fiber mass ratio
  - Breaks that lead to a minimum uniform bed (1/8-inch) to filter particulate debris



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## Spatial Plant Model Needed for Debris Source Issues

- Realistic spatial configuration of insulated piping and equipment is important:
  - Proper distribution of potential break sizes (debris volume)
  - Defines regions of high insulation density (debris volume and composition)
  - Presence of structure and equipment offers confinement and sheltering (debris volume)
  - Spatial correlation between insulation types and break sizes (debris composition)
  - Break location relative to sump (debris transport)
- A flexible, efficient model can be used for parameter studies: insulation type, effective damage volume, directional impingement, postulated break location, barriers, etc.



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## CASINOVA Source-Term Analysis

- Containment Accident Sequence INSulation Outcome Verification Analysis (CASINOVA) model:
  - Accepts spatial pipe and equipment data cross referenced by reactor system, insulation type, and pipe diameter (ASCII data files)
  - Discretizes insulated pipes into linear segments that are then represented as point targets on the centerline
  - Discretizes equipment blankets into panels represented as point insulation targets
  - Maps spherical damage pressure zones on spatial insulation data
    - BWR URG correlations specific to each insulation type and breakdiam
  - Postulates Guillotine breaks at any set of locations
    - Table of welds correlated with specific pipe sizes and reactor systems
  - Performs CAD-like simulations and compiles statistics on break size, reactor system, debris volume, and debris composition.
  - Developed in MATLAB® to run on a high-end desktop PC
    - Potential for standalone distribution, GUI development, C++ interface

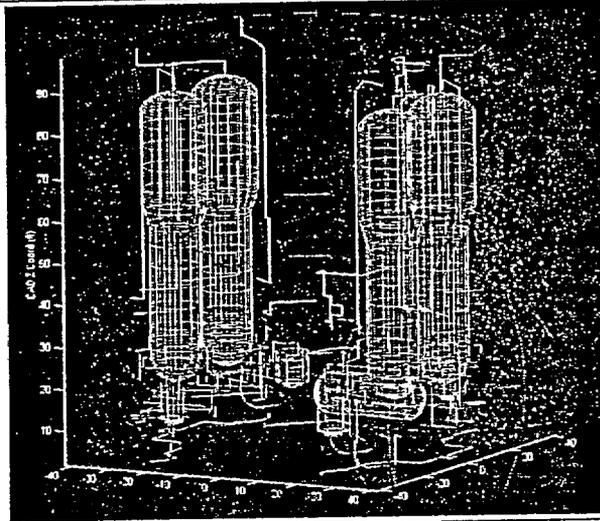


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# CASINOVA Debris Simulation

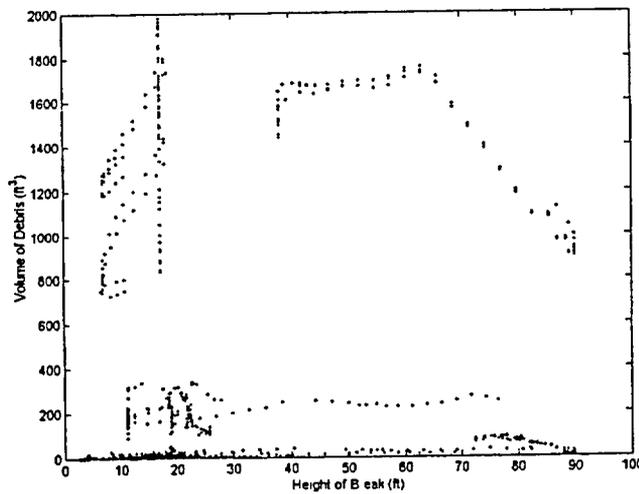


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# Break Locations

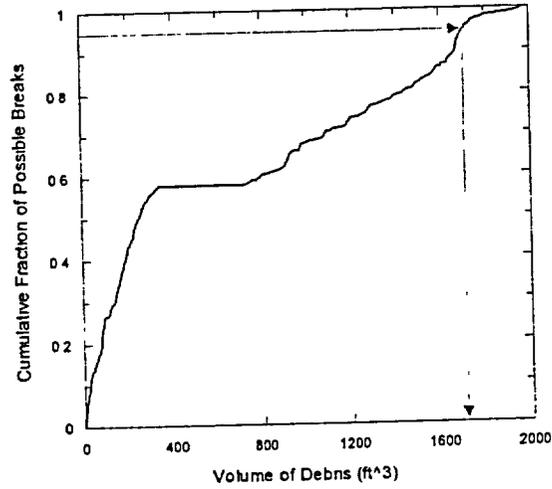


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# Dist. of LLOCA Debris Volumes

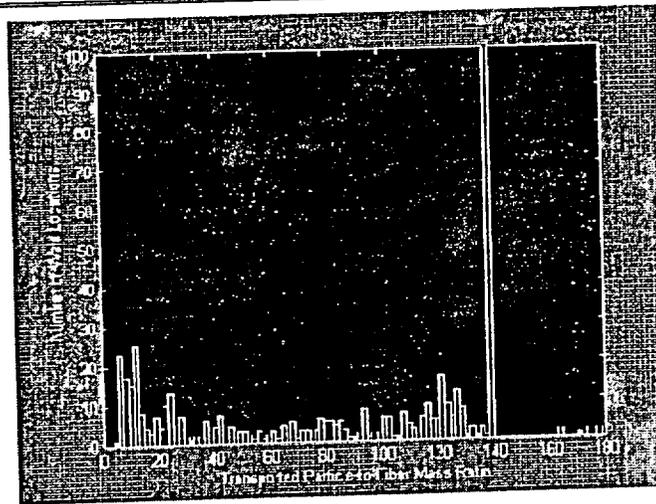


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# CASINOVA Summary Statistics



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## Debris Generation: Zone of Destruction



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## Guidance

- Spherical Zone of Influence (ZOI) defined by destruction pressure of each insulation type
  - Examples provided in NUREG/CR-6224 and BWROG URG and Staff Evaluation of BWROG response to NRC bulletin 96-03
- The size and shape of ZOI should be supported by analysis or experiments specific to break size and target (destruction pressure)
- The volume of debris contained in ZOI should be used to estimate the amount of debris generated
- The size distribution of debris should be determined by analysis or experiment
- The shock wave and subsequent jet should be the basis for estimating amount and size generated in ZOI (pressure equivalent spherical volume)



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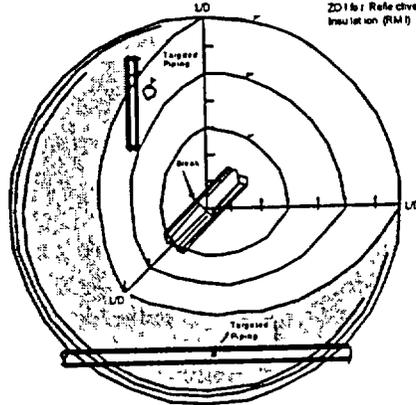


# Pressure Equivalent Spherical ZOI

ZOI for Fiberglass

ZOI for Calcium Silicate

ZOI for Reflective Metallic Insulation (RMI)



Note:  
L = Distance from break to top  
D = Diameter of broken pipe



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# BWROG Data

Selected Insulation Destruction Pressures

Insulation Material	BWROG Recommendation	NRC Confirmatory Analysis Recommendation
Calcium Silicate with Aluminum Jacket	160	150
K-Wool	40	40
Temp-Mat with SS Wire Retainer	17	17
Knauf®	10	10
Jacketed NUKON®	10	6
Unjacketed NUKON®	10	6
Min-K	4	<4

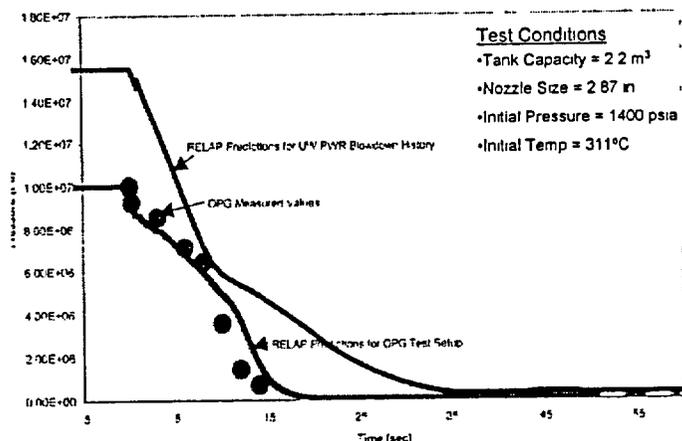


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## OPG Calcium-Silicate Tests



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## Scaling Analysis

- **PWR blowdown begins @ 2300 psig**
  - Initially flashing water ( $x \sim 0$ ) at stagnation
  - After 10 s stagnation  $x = 0.2$ . Jets are steam continuum with suspended droplet field
- **Scaling must account for**
  - Higher stagnation pressure compared to BWR
  - Lower quality compared to MSLB of BWR
- **ANSI/ANS-58.2 and EPRI models formed the basis for scaling**



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## Rederived ZOI for Cal-Sil

- Rederived using OPG data and analysis approach similar to BWR study
- Slightly increased ZOI size
  - Nukon: 12-D (PWR) vs 10-D (BWR)
  - Cal-Sil: 8-D (PWR) vs 6- D (BWR)
- Higher fraction of fines
  - Nukon: 29% (BWR) vs 40% (PWR)
  - Cal-Sil:  $\approx$  0% (BWR) vs 30% (PWR)

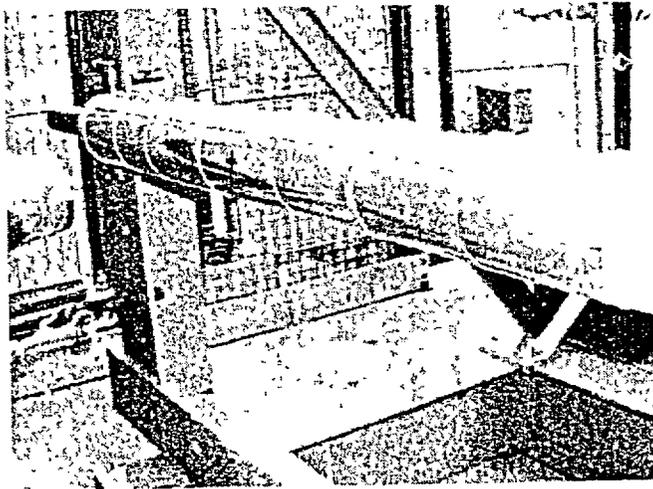


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## OPG Calcium-Silicate Tests

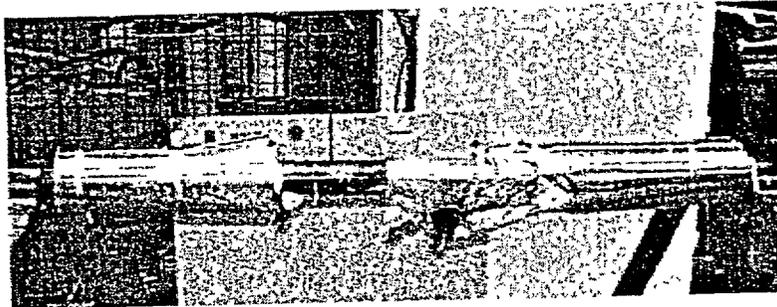


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# OPG Calcium-Silicate Tests

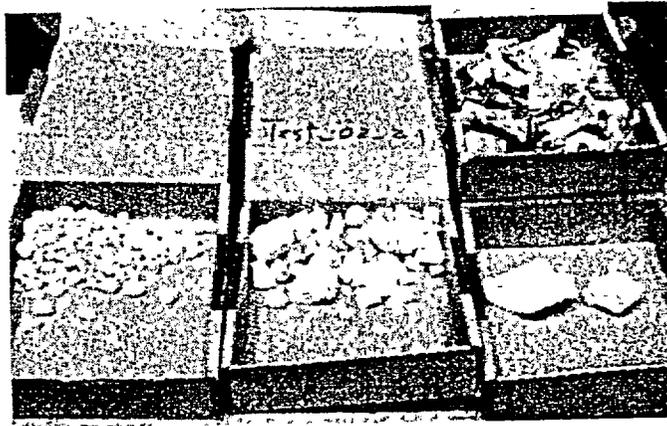


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# OPG Calcium-Silicate Tests



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## Blow-Down/Wash-Down Debris Transport



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## Blowdown/Washdown Transport of Debris to Sump Pool

- Debris Initially Dispersed Throughout Containment by Depressurization Flow
  - Primary Modes of Debris Deposition
    - Inertial Capture When Flows are Dynamic (e.g., near break)
    - Gravitational Settling as Flows Slow and Turbulence Dissipates (e.g., dome region)
- Transport by Containment Spray Drainage
  - Spray Transport Processes
    - Capture of Remaining Airborne Debris
    - Debris Washed from Structures
      - Some Areas of Containment Not Directly Impacted by Sprays
    - Debris Entrained by Drainage Flows
    - Entrained Debris Can Be Trapped (e.g., Floor Drains)
    - Trapped Fibrous or Particulate Debris Subject to Erosion

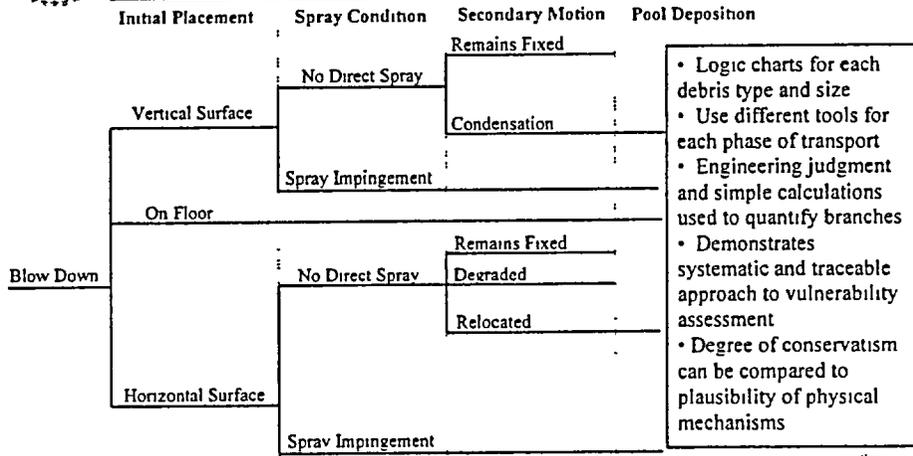


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## Logic Chart for Transport Fractions (NUREG-6762 Vol 4)

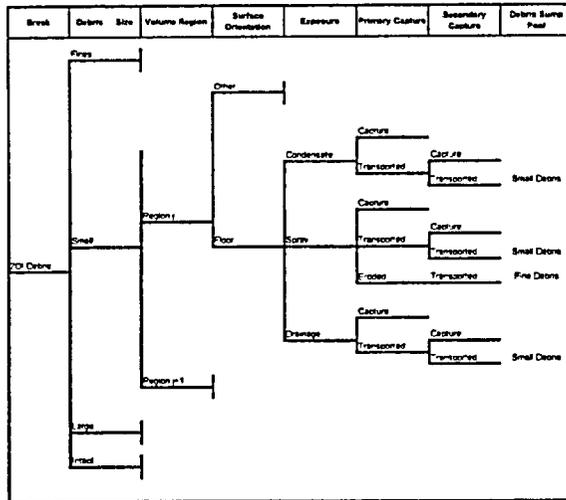


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## Example Section of Debris Transport Chart



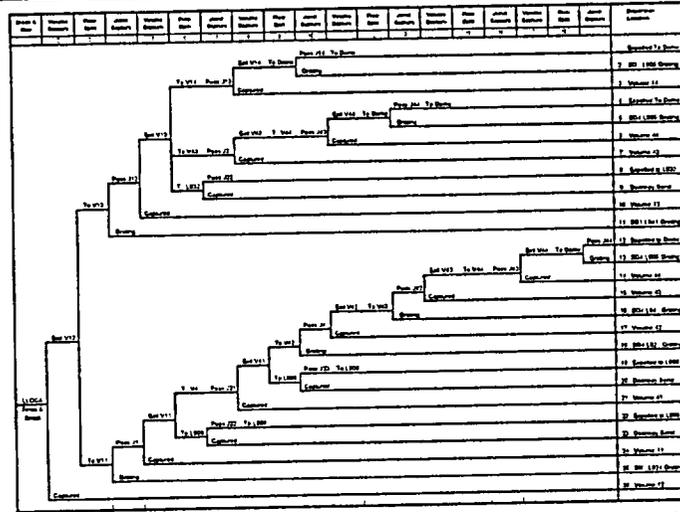
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## Transport Chart for Steam Generator Compartment with Break



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## Pool Transport



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## Debris Transport Analysis (NUREGs 6772 and 6773)

### Basic Assumptions:

1. Linear flume tests characterized the incipient flow and settling velocities of various debris types and sizes
2. CFD can predict local water velocities (speed and direction)

### Approach: (for a given debris size and initial location)

1. Consider contiguous areas with velocities higher than incipient velocity as regions susceptible to transport
2. Conservatively assume migration to boundary of the incipient velocity contour and release from pool surface
3. Consider settling time from surface as an opportunity to drift into another contour or into a stagnant zone (velocity < incipient)
4. Any debris reaching the contiguous contour surrounding the sump is assumed to eventually collect on the screen



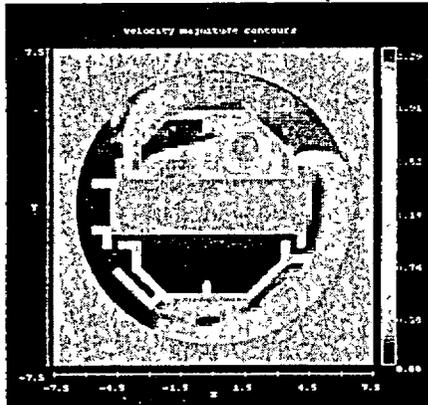
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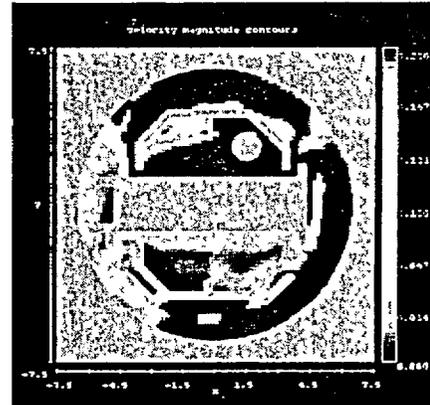


## Steady-State Velocity Maps (Upper)

Auto Scale Max Velocity



Max Velocity 0.2 ft/s



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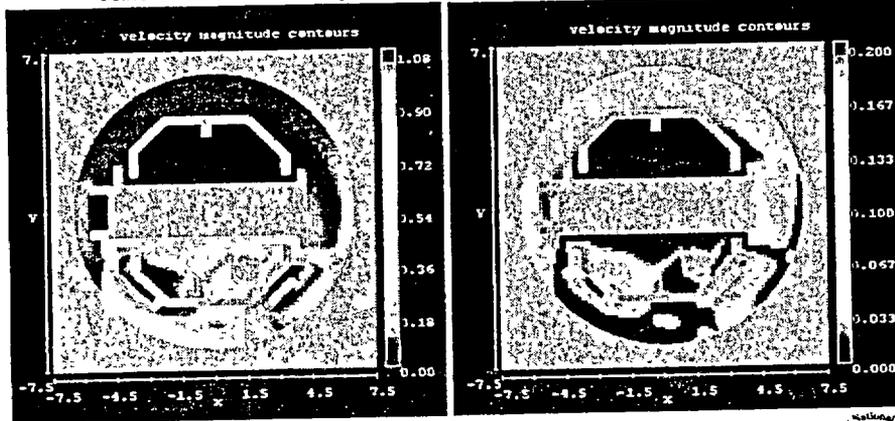




## Steady-State Velocity Maps (Lower)

Auto Scale Max Velocity

Max Velocity 0.2 ft/s

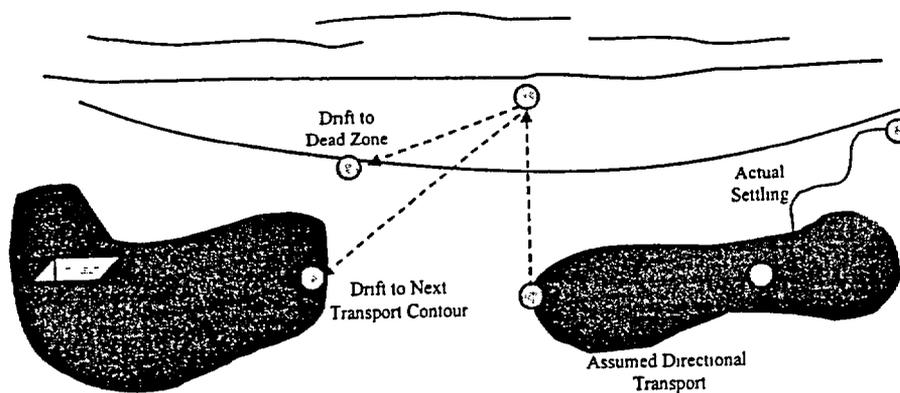


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## Schematic of Pool Transport



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## Observations Regarding CFD

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- Good qualitative agreement between CFD models of fill/steady-state velocities and Tank Experiments
- Ancillary sources representing containment spray return paths should be added
  - Particular interest in effect of annular wash down of walls to pool
- Current suite of desktop PCs will permit ~10 break simulations per volunteer plant
- Quantitative flow maps provide access to an approximate, yet tractable estimate of transport fraction
  - Logic maps and engineering judgment will be needed to consider fractions and characteristics of debris returned to the pool via various paths
- Uncertainties in location and timing of debris entering pool limit the need for a high fidelity model of debris transport



## Debris-Bed Head Loss





# UNM Head-Loss Testing



- Confirmed that BWR head-loss correlation is robust
  - Vertical screens
  - Square mesh vs perforated plate
- Obtained additional data
  - Cal-sil
  - Aluminum RMI
  - Al RMI + fiber
- Provided template of analytic technique and accessible facility
- MUST use appropriate material properties for head-loss estimates
  - Sludge density
  - Bed porosity
  - Interstitial velocities

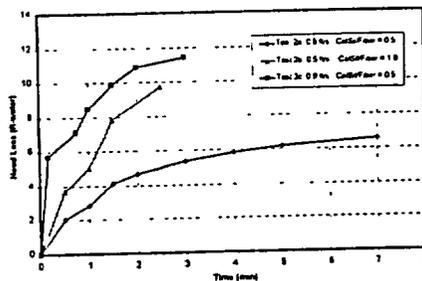


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# Cal-Sil + Fiber Head Loss



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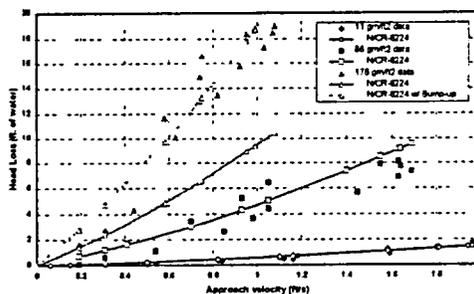
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## BLOCKAGE Head-Loss Estimation

- BLOCKAGE PC-utility useful for assessing sump-screen vulnerability as a function of debris composition, volume and flow velocity
- Assumes debris bed of uniform thickness and composition
- Head-loss correlations in current BLOCKAGE being updated to include recent tests of additional debris types
- All head-loss correlations in BLOCKAGE will also be incorporated in CASINOVA

Empirical Head-Loss Correlations for Calcium Silicate

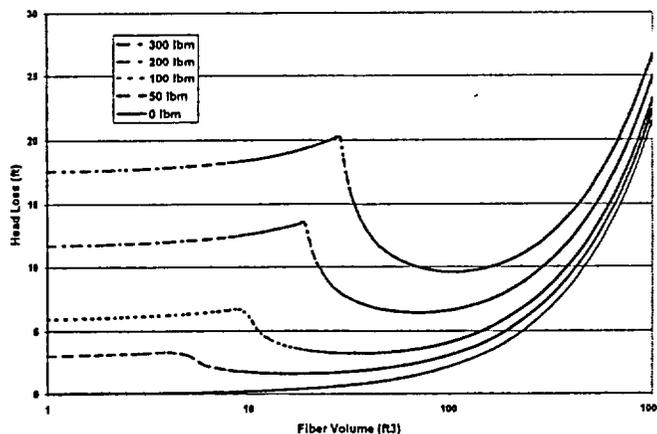


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## BWR Head-Loss Correlation (NUREG-6224)



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## Integrated Vulnerability Assessment



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## Available Analysis Resources

- Debris Generation and Transport Test References
- Knowledge-Base Report (Sump-Blockage Source Book)
- Comprehensive Composite Plant Analysis
  - Spatial Logic Diagrams
  - CFD examples
  - Application of Transport Estimation
  - Application of CASINOVA and BLOCKAGE
- CASINOVA Debris Volume Simulation
- BLOCKAGE Head-Loss Estimation Utility



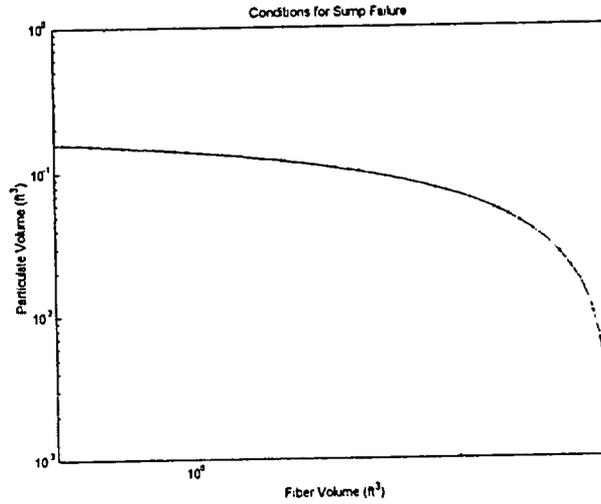
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## Conditions for Sump Failure

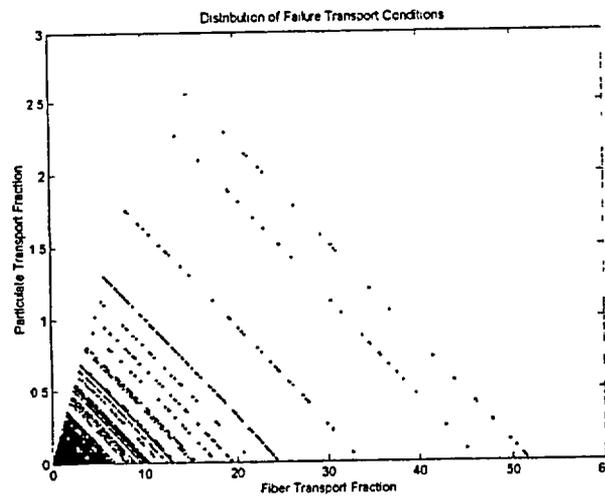


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## Transport Required for Failure



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## **Industry Activities to Address PWR ECCS Sump Performance**

Advisory Committee on Reactor Safeguards  
Thermal-hydraulic Phenomena Subcommittee  
February 4, 2003

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## **Industry GSI-191 Activities**

- PWR industry is taking the lead in developing methodology for plant-specific assessments of ECCS sump performance
- Presentation will address:
  - Who is involved in industry activities?
  - What activities are underway?
  - When activities are scheduled to be completed?



## Industry GSI-191 Activities

- Industry activities are a coordination of efforts
  - NEI PWR Sump Performance Task Force
  - WOG/CEOG
  - B&WOG
- NEI Task Force includes representatives from
  - PWR Owners Groups
  - PWR utilities
  - EPRI
  - EDF
  - consultants



## Industry GSI-191 Activities

- Activities currently underway fall into three general categories:
  - Coordination, collection and evaluation of data applicable to ECCS sump performance
  - Development of ECCS sump performance evaluation methodology for application by PWR plants
  - Communication of industry and regulatory activities to PWR plant operators



## Data Collection and Evaluation

- Coordination, collection and evaluation of data applicable to ECCS sump performance is an ongoing effort performed in parallel with methodology development
- Research data (Industry, NRC, International) must be evaluated to determine its applicability to U.S. PWR conditions
  - Identified data gaps will need to be filled by obtaining additional data or be addressed in conservative manner



## Data Collection and Evaluation

- Plant data covering debris sources, programs and designs are needed to support methodology development as well as plant-specific implementation of guidance
  - NEI 02-01, Condition Assessment Guidelines: Debris Source Inside PWR Containments addresses potential debris sources



## **NEI-02-01, Debris Sources Inside PWR Containments**

- Issued to all PWR plant operators
- Document offers guidance to:
  - Identify, locate and characterize potential sources of debris that could challenge the post-accident operability of the containment sump
  - Perform containment walkdown surveys to verify or supplement design or maintenance documentation
- Revision 0 issued in April 2002
  - Pilot application at several plants
- Revision 1 issued in September 2002
  - Addressed comments received from pilot plants and NRC



## **NEI-02-01, Debris Sources Inside PWR Containments**

### **Purpose**

- Document information to support plant-specific sump performance assessments
- Identify potential debris sources inside containment resulting from affected design basis events
- Perform supporting walk-downs:
  - Verify current as built conditions
  - Focus on location and amount of insulation materials, unqualified coatings, foreign materials



## **ECCS Sump Performance Evaluation Methodology**

- **Guidance will address methods for assessment of sump performance and actions that can be taken to address assessment findings**
  - Develop analytical tools, methods and guidance for debris generation, debris transport, debris accumulation and pressure drop across the sump screen
  - Perform sensitivity analysis
  - Develop decision analysis tools



## **ECCS Sump Performance Evaluation Methodology**

- **Completion of Evaluation Methodology is scheduled for September 2003**
  - Plant-specific implementation would follow
- **Frequent status meetings held with NRC during development period**
- **“Ground rules” provide outlines of methodology development to facilitate discussions**
- **Impact of Regulatory Guide and Generic Letter on methodology development and schedule will be evaluated following release for public comment**



## Industry Communication

- **Written correspondence:**
  - Provides updates on ongoing task force and regulatory activities
  - Distribute draft documents for comment and review
  - Issue finalized guidance along with recommendations for use
- **PWR Sump Performance Information Forum website**
  - Internet based website used to augment more traditional communication tools
  - Provides benefit of easy access by all staff levels within a company
  - Facilitates distribution of GSI-191 research reports and NEI PWR Sump Performance Task Force guidance materials
  - Provides a forum for discussion among PWR plant operators



## Industry Communication

- **Industry Workshops**
  - Workshops are being conducted to provide forums for instruction and use of guidance and transfer of information
  - First workshop conducted July 30-31, 2002 and focused on NEI 02-01
  - Second workshop tentatively scheduled for Summer 2003
  - Implementation workshop following issuance of evaluation methodology being considered

