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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS) 506th MEETING

+ + + + +

WEDNESDAY, OCTOBER 1, 2003

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Advisory Committee met at 8:30 a.m. at  
the Nuclear Regulatory Commission, Two White Flint  
North, Room T2B3, 11545 Rockville Pike, Dr. Mario V.  
Bonaca, Chairman, presiding.

COMMITTEE MEMBERS:

MARIO V. BONACA	Chairman
GRAHAM B. WALLIS	Vice Chairman
GEORGE E. APOSTOLAKIS	Member
THOMAS S. KRESS	Member
GRAHAM M. LEITCH	Member
DANA A. POWERS	Member
VICTOR H. RANSOM	Member
STEPHEN L. ROSEN	Member
WILLIAM J. SHACK	Member
JOHN D. SIEBER	Member

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1     ACRS STAFF PRESENT:

2     JOHN T. LARKINS             Director  
3     SHER BAHADUR             Associate Director  
4     SAM DURAISWAMY           Technical Assistant

5

6     ALSO PRESENT:

7     WILLIAM BURTON, NRR  
8     JOE COLACCINO, NRR  
9     DAN FREDERICK, Conax  
10    SUDESH GAMBHIR, OPPD  
11    MIKE MAYFIELD, RES  
12    JOE MUSCARA, NRR  
13    SELIM SANCAKTAR, Westinghouse  
14    JAMES SCOBEL, Westinghouse  
15    JENNIFER L. UHLE, NRR  
16    BERNIE VAN SANT, OPPD  
17    RON VIJUK, Westinghouse

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## I-N-D-E-X

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

(10:17 a.m.)

CHAIRMAN BONACA: Good morning. The meeting will now come to order. This is the first day of the 506th meeting of the Advisory Committee on Reactor Safeguards.

During today's meeting, the committee will consider the following: Final review of the Fort Calhoun license renewal application; interim review of the AP1000 design; proactive material degradation assessment program; preparation for meeting with the NRC commissioners; and proposed ACRS reports.

A portion of this meeting will be closed to discuss the proposed ACRS reports on safeguards and security. This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Dr. John Larkins is the designated federal official for the initial portion of the meeting.

We have received no written comments or requests for time to make oral statements from members of the public regarding today's sessions. A transcript of portions of the meeting is being kept. It is requested that the speakers use one of the microphones, identify themselves, and speak with

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1 sufficient clarity and volume so that they can be  
2 readily heard.

3 Before we get into the agenda, I would  
4 like to point your attention to items of interest we  
5 have in front of you. There are no speeches in it  
6 this time, but there are a number of issues about  
7 operating events and NRC information notices.

8 And in the back, you have also printed out  
9 the metrics from the RFP inspection finding summaries.  
10 It may be of interest to you.

11 With that, if there are no further  
12 comments from anybody regarding the introduction here,  
13 I would like to move to the first item on the agenda.

14 I am responsible for this item. So this  
15 is the final review for the Fort Calhoun license  
16 renewal application. And we have in front of us the  
17 Fort Calhoun people. So Mr. Gambhir?

18 MR. GAMBHIR: Thank you very much, Mr.  
19 Chairman. And thank you very much for the opportunity  
20 to come and speak before this committee about the Fort  
21 Calhoun application.

22 With me today -- let me start out with the  
23 introductions -- I have Tom Matthews here, who is the  
24 licensing lead for us on this project; and Bernie Van  
25 Sant. Bernie has been the project manager on the

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1 license renewal project. And Joe Gasper I think you  
2 all know. He was the original project manager and has  
3 been the program manager for us. Also we have Mike  
4 Fallin back there. Mike is with the Constellation  
5 Nuclear Services. And they have done an extremely  
6 good job for us on putting the application together.

7 As far as our presentations are concerned,  
8 they will be brief. I am aware of the time limits we  
9 have here, and I think much of the presentation will  
10 be made by the NRC team. I will be very brief and  
11 introduce Bernie for his presentation.

12 Just to start out with the plant operating  
13 status, we are in the middle of the refueling outage  
14 right now. This was 468-day breaker-to-breaker run  
15 for us. Since '97, Fort Calhoun has improved the  
16 reliability of the unit significantly. And this is  
17 our third breaker-to-breaker run in four cycles.

18 We are fully aware of the fact that when  
19 good things happen to you, you need to start paying  
20 attention to little things. As you will see on my  
21 next slide, that is precisely what we are doing.

22 All NRC performance indicators are green.  
23 The inspection we had from the NRC in our corrective  
24 action program, the problem identification and the  
25 resolution program, there were no green or higher

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1 findings. In general, the program is well-run.

2 We were recognized for industrial  
3 operating excellence by INPO earlier this year. So  
4 overall Fort Calhoun performance has been pretty good.

5 I mentioned earlier that the performance  
6 improvement program started back in '97. We have a  
7 vision of keeping the nuclear option alive to 2033 and  
8 beyond. And with that, what it means is even though  
9 Fort Calhoun is a small unit and also is fully  
10 one-third of the power we produce at OPPD, but it's an  
11 important mix. And that's the biggest value that we  
12 have for Fort Calhoun station.

13 We introduced what we call a six factors  
14 formula. You call it a CHOICE. And we have been  
15 emphasizing the critical self-assessments and the  
16 broad and lasting corrective actions, human  
17 performance, making the operations event-free, and  
18 focusing on the high visibility issues and also being  
19 a cost-effective producer and then ensuring excellence  
20 in material condition. Let me speak to that.

21 I talked about the reliability of the  
22 unit. Our board of directors has recently authorized  
23 several upgrades for Fort Calhoun station. We have a  
24 contract that is signed by MHI for the replacement of  
25 the steam generators, reactor vessel head. And since

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1 we will have to make a hole in the containment to do  
2 those things, we also have approval to go ahead and  
3 take out the pressurizer. So we will be the first one  
4 to replace the pressurizer. We do have a contract  
5 with MHI.

6 Those are just three examples that I  
7 decided for you of several projects that we have. We  
8 are in the process of buying a new simulator from CAE.

9 So the board has shown confidence. We are  
10 making investments in there. And there are a lot of  
11 other improvements that we will be making in the unit.

12 VICE CHAIRMAN WALLIS: What's the time  
13 scale? Are you going to do all of these changes for  
14 this --

15 MR. GAMBHIR: The steam generators, the  
16 reactor vessel head, and the pressurizer will go in  
17 2006 outage. We will be also replacing the condenser  
18 in 2005 outage. So there is a lot of things that  
19 we're doing to improve the reliability of the unit.

20 MEMBER LEITCH: Sudesh, I noticed at the  
21 beginning of the current outage, there was a fuel  
22 assembly that was dropped. I was wondering if that  
23 was an equipment problem or a human performance  
24 problem and just what your reaction is to that  
25 situation.

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1 MR. GAMBHIR: Yes. We have completed  
2 preliminary root cause analysis on that. The root  
3 cause that we have identified was a human performance  
4 issue.

5 Now, there are some other contributing  
6 problems. None of those are material condition  
7 issues. But there were some others, you know, for  
8 example, not using effectively operating experience.

9 Previously we had handled a few ourselves.  
10 For the last three outages -- this will be the third  
11 -- we have brought in a vendor to handle the fuel  
12 during the outage. And I would say it's a human  
13 performance, but this is a human performance issue  
14 that could have been prevented.

15 Those are the things that we will be  
16 working on now, the long-term corrective action.

17 MEMBER LEITCH: Now, the fuel handling has  
18 to be done with an individual with an SRO at your  
19 facility. Now, that's not the vendor. In other  
20 words, you have an SRO responsible for the fuel  
21 handling as well?

22 MR. GAMBHIR: It's the supervision. There  
23 has to be supervision. Actually, engaging the bundle  
24 can be done by the contractor.

25 MEMBER LEITCH: But the supervision?

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1 MR. GAMBHIR: Yes, we have the  
2 supervision. There are a lot of contributing causes  
3 there that we are still working on, but it was a human  
4 performance issue.

5 MEMBER LEITCH: Okay. Thank you.

6 MR. GAMBHIR: Joe, do you want to add  
7 anything to that?

8 DR. GASPER: No. I think you covered  
9 everything.

10 MR. GAMBHIR: Okay. If there are no other  
11 questions, then I will turn it over to Bernie. Bernie  
12 is going to go for the implementation. Are you okay  
13 here, Bernie?

14 MR. VAN SANT: As Sudesh said, I want to  
15 cover two topics. One is to go over some of the  
16 inspections that we have been doing on two of our RCS  
17 components. And then I also want to talk about  
18 license renewal implementation.

19 Two components that I will be going over  
20 are the CEDM drive mechanisms and the reactor vessel  
21 head. I will give you a little background. In the  
22 early '90s, Fort Calhoun had a leak in our upper CEDM  
23 housing. Shortly after that, Palisades, who has a  
24 similar design, CEDM housing, and dry mechanism  
25 started having leaks in their drives.

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1           As a result of that, OPPD committed to  
2     developing a CEDM material reliability plant. That  
3     plant consists of going in on an outage basis and  
4     doing inspections on the welds, on the CEDM upper  
5     housing, and on the CEDM seal housings for all the  
6     drive packages, taking those, a group, at a time,  
7     every outage until we get a good identification of  
8     what the cause of the cracking is, mechanisms, and how  
9     to implement a program to ensure that we don't have  
10    any in the future.

11           We have committed that whatever comes out  
12    of this plan, which would be mutually agreeable  
13    between NRC and OPPD, that we have committed to carry  
14    that program into the period of extended operation as  
15    one of the commitments we made for license renewal.

16           I will get into the inspection results in  
17    2002. We inspected the seal housings for the control  
18    and the dry mechanisms using eddy current testing  
19    methodology.

20           We tested eight seal housings and found no  
21    indication in any of the eight seal housings. We then  
22    attempted to use a robotic UT measurement machine on  
23    the upper housing welds. We did this because of the  
24    high-dose area involved in examining the housings.

25           Unfortunately, this was somewhat of a

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1 prototype machine and didn't perform like we had  
2 anticipated. So we ended up having to go back in and  
3 manually do UT on some of these welds. As a result,  
4 we only had two welds that we ended up achieving a UT  
5 reading on. Both of those were acceptable.

6 This outage we're going back in with a new  
7 style of UT machine we hope to have a much better  
8 success rate on. We have completed the --

9 MEMBER SHACK: Excuse me. What are you  
10 inspecting with the eddy current system?

11 MR. VAN SANT: The seal housing on the dry  
12 package. The way our seal housings are set up may be  
13 a little different than what you are used to. We have  
14 an upper housing, which is essentially a ten-foot tube  
15 that goes from the reactor vessel nozzle up to the  
16 control element dry package and in the control element  
17 dry packages where the seal housing is.

18 So the upper housing has three welds on  
19 there that are susceptible to cracking that we are  
20 inspecting. And then inside the control element dry  
21 package, there's a seal housing that we inspected that  
22 a current --

23 MEMBER SIEBER: And the entire tube is a  
24 pressure boundary?

25 MR. VAN SANT: Yes.

1 MEMBER SHACK: And this is all 347?

2 MR. VAN SANT: The control element upper  
3 housing is a 316, I believe. And the dry package, I  
4 think that is a 347, but I can't say for sure.

5 As I said, we just now have started this  
6 week attempting the robotic inspection of the UT on  
7 the upper housing welds. So I don't have any results  
8 to report on it as of yet, but that should be done by  
9 the end of this week.

10 The reactor vessel head, we did a bear  
11 head inspection in 2002, again with the robotic visual  
12 inspection. I did not identify any buildup of boric  
13 acid or any leakage around any of the nozzles.

14 We repeated that again this outage, the  
15 same results, haven't seen any buildup of boric acid.  
16 We have compared the digital pictures from 2002 with  
17 the pictures we take in this outage, in 2003, and  
18 there's little, if any, change in the condition of the  
19 head. It's clean, in good shape. So we're very happy  
20 with that.

21 MEMBER LEITCH: Bernie, are you able to  
22 fully comply with the NRC order in your 2003  
23 inspection?

24 MR. VAN SANT: Currently, we are at just  
25 under 12 EFPY. So the bear-head and visual inspection

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1 both comply with the current order. We will have to  
2 do a volumetric in '05.

3 MEMBER LEITCH: In '05, yes.

4 MR. VAN SANT: We are replacing the head  
5 in '06. And based on the results of the inspections  
6 and the planned replacement in '06. We are  
7 considering going in for an exemption on the  
8 volumetric on '05, but we are planning to do that.

9 MEMBER LEITCH: Okay. Thank you.

10 VICE CHAIRMAN WALLIS: While we're on the  
11 RCS, I noticed you have a crack in your pressurizer  
12 lower shell instrumentation nozzle.

13 MR. VAN SANT: Yes.

14 VICE CHAIRMAN WALLIS: And I was rather  
15 surprised to see this is going to be managed entirely  
16 by calculating things. I would think that you would  
17 want to inspect as well.

18 MR. VAN SANT: The nozzle will be  
19 evaluated for TLAA. We have imposed a fix on that  
20 nozzle. And the TLAAs address the --

21 VICE CHAIRMAN WALLIS: This is  
22 calculations, isn't it?

23 MR. VAN SANT: Yes. But we are replacing  
24 it in '06.

25 VICE CHAIRMAN WALLIS: Yes.

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1 MR. VAN SANT: This nozzle as part of the  
2 pressurizer will be --

3 VICE CHAIRMAN WALLIS: You are relying  
4 entirely on the theoretical work to ensure that it is  
5 okay?

6 MR. VAN SANT: We won't be relying on the  
7 theoretical work for the new license at all because it  
8 is going to be replaced in '06.

9 VICE CHAIRMAN WALLIS: Between now and  
10 '06, it's there.

11 MR. VAN SANT: Right.

12 DR. GASPER: Between now and '06, the  
13 pressure boundary weld was moved to the external side  
14 of the pressurizer.

15 VICE CHAIRMAN WALLIS: So you have another  
16 pressure boundary.

17 DR. GASPER: And that, then, was  
18 incorporated into the ISI program as required by the  
19 code.

20 VICE CHAIRMAN WALLIS: Right. So it  
21 really doesn't need much management because you've got  
22 a new pressure boundary?

23 MR. VAN SANT: Right.

24 DR. GASPER: That is correct.

25 VICE CHAIRMAN WALLIS: Thank you.

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1 MEMBER SIEBER: Does the code allow a  
2 repair like that?

3 DR. GASPER: Yes. We either have or will  
4 be submitting to the NRC. The code also requires a  
5 submittal to the NRC. And I do not know the exact  
6 status, whether that's --

7 MEMBER SIEBER: You're probably relying on  
8 a code case, right?

9 DR. GASPER: Yes. I don't remember --

10 MEMBER SIEBER: Because a code itself,  
11 that's not adequate repair.

12 DR. GASPER: Yes. I don't remember the  
13 exact details.

14 MEMBER SIEBER: There have been other  
15 places that have used a code case.

16 DR. GASPER: Yes. But a number of CE  
17 design plants have implemented this fix.

18 MEMBER SIEBER: Okay. Thank you.

19 MR. VAN SANT: The analysis that we were  
20 talking about was only for the period of extended  
21 operation. We currently have the analysis in place  
22 for the weld as it exists now.

23 MEMBER ROSEN: Have you had a look at the  
24 reactor vessel bottom head yet?

25 MR. VAN SANT: We have no nozzle

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1 penetrations in our bottom head. So the answer is no,  
2 we have not looked at that.

3 MEMBER ROSEN: You have no  
4 instrumentation, thimble heads, or --

5 MR. VAN SANT: No.

6 DR. GASPER: All our instrumentation is  
7 top-mounted. All the NCOR instrumentation comes in  
8 through the top of the reactor vessel.

9 MEMBER ROSEN: So the bottom head is  
10 completely smooth? There's no --

11 DR. GASPER: Yes. There are no  
12 penetrations in the bottom head.

13 MEMBER ROSEN: Okay.

14 MR. VAN SANT: Continue on? The next  
15 topic I wanted to cover was our license renewal  
16 implementation. One of the things I wanted to  
17 emphasize was that in preparation of the license  
18 renewal application, we performed our scoping in  
19 accordance with 10 CFR 54.4.

20 What that means is we looked at all SSCs  
21 in our plant. We did not screen any components based  
22 on safety classification, went back and looked through  
23 the database for all the license renewal components.

24 There are a significant number of  
25 components that are not safety-related. If my memory

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1 serves, it was approximately 16 percent of the  
2 components that we have in our database are not the  
3 safety-related classification, did not have a  
4 safety-related classification.

5 The other bullet that I have here is to  
6 identify that we are updating our configuration  
7 control procedures for modifications and engineering  
8 changes to incorporate the requirements of 10 CFR  
9 54.37.

10 We will be using the same criteria for  
11 evaluating configuration changes that we used in  
12 scoping for the license renewal application. If we  
13 identify a component that meets the criteria for the  
14 scope of license renewal, we will be including aging  
15 management programs, applying those programs to those  
16 components the same as we did in the license renewal  
17 application.

18 I wanted to talk a little bit about the  
19 commitments we have made as part of our license  
20 renewal application. We have the commitments listed  
21 in the SER as well as in our USAR supplement.

22 These commitments consist of three  
23 different types of commitments. One is for new  
24 programs that we have had to develop; program  
25 enhancement to existing programs, where we have had to

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1 do additional work to satisfy the requirements of the  
2 GALL and the NRC; and then, finally, commitments to  
3 perform TLAA evaluations for components prior to  
4 entering the period of extended operation.

5 These commitments will be tracked in the  
6 Fort Calhoun station regulatory commitment tracking  
7 system, the same as we track all of our regulatory  
8 commitment items. In that system, we have assigned  
9 orders and established commitment dates for those  
10 items to ensure that they are completed on time.

11 Finally, for those programs that we have  
12 credited for license renewal, all of those programs  
13 have implementing procedures to carry out the  
14 requirements of the program. In those implementing  
15 procedures, we have annotated either the whole  
16 procedure or the steps in the procedures that are  
17 required to comply with the needs of the aging  
18 management program.

19 So it's obvious to anyone using the  
20 procedure or trying to change the procedure that these  
21 steps are commitments to the NRC and need to be  
22 treated accordingly.

23 MEMBER LEITCH: Do you have any idea how  
24 many of those programs either are or will be  
25 implemented short-term versus waiting until you're 39



1 and a half, so to speak, before implementing them or  
2 --

3 MR. VAN SANT: We're in the process of  
4 implementing the changes now. The goal is within the  
5 next few years to have those all implemented. We're  
6 not waiting until 2013 in the period of extended  
7 operation to get those implemented. We need to get  
8 them in process and get them off our books, basically  
9 to move on. We don't want to come on 2013 and try and  
10 figure out what it is we committed to.

11 MEMBER LEITCH: Right.

12 MR. VAN SANT: So we're going forward with  
13 those now.

14 MEMBER LEITCH: Yes. That's good. We're  
15 concerned not only about your resources if you wait  
16 until the last minute but NRC inspection resources as  
17 well. This could be a very high peak load if  
18 everybody were to just wait until the last minute. So  
19 I'm pleased to hear you're moving towards implementing  
20 those programs.

21 DR. GASPER: As part of the implementation  
22 of the new procedures, we will have training for all  
23 of the engineers that will be doing configuration  
24 changes that could impact the license renewal  
25 application commitments.

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1           OPPD also will be training any new  
2 engineers that come on board. They have to be  
3 qualified to perform certain tasks. Those people that  
4 will be qualified to perform configuration change  
5 activities will receive training on the procedure,  
6 which will include training on the license renewal  
7 commitments and the process of scoping and screening  
8 for license renewal.

9           We also will have the plant equipment  
10 database updated to reflect those components that are  
11 part of the license renewal commitments that were  
12 scoped in as part of license renewal. This combined  
13 with the procedure annotation to identify those  
14 commitments and the training we feel will ensure that  
15 we maintain our commitments to the NRC throughout the  
16 period of extended operation.

17           CHAIRMAN BONACA: I have a question.

18           DR. GASPER: Yes?

19           CHAIRMAN BONACA: In the late '80s, you  
20 did experience movement of the thermal shield, some  
21 vibration.

22           DR. GASPER: Yes.

23           CHAIRMAN BONACA: And I think in 1992, you  
24 replaced 11 pins.

25           DR. GASPER: That's correct.

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1 CHAIRMAN BONACA: And then the vibrations  
2 were reduced essentially to normal. Okay? Now, if I  
3 remember, you are proposing to continue to monitor  
4 thermal shield vibration to this thermal shield  
5 monitoring program.

6 Now, if I understand, that's essentially  
7 inspections but is not -- I guess where I am going is,  
8 how do you identify the vibrations? What is a normal  
9 level of vibration? What isn't normal? You do not  
10 have a loose part monitoring system, right?

11 DR. GASPER: Right.

12 CHAIRMAN BONACA: And you are claiming  
13 that you don't need to have one to monitor this. So  
14 if you could elaborate on that?

15 DR. GASPER: The monitoring is done using  
16 neutron noise analysis. We do neutron noise analysis  
17 on start-up from every refueling. And, actually, when  
18 we detected the original motion on that thermal  
19 shield, it was detected in neutron noise analysis such  
20 that we determined that we needed to go in and do  
21 visual inspections.

22 And we're going to be continuing that  
23 program because we fully recognize that those pins can  
24 certainly relax again. And it was successful  
25 previously, but we weren't able to identify that

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1 sudden motion was starting and we needed to go in and  
2 inspect those pins.

3 CHAIRMAN BONACA: Okay. I understand how  
4 you did that. And that's the basis for saying we  
5 don't need a loose part monitoring system?

6 DR. GASPER: Yes. Basically, our feeling  
7 is that if we detected it would be a loose part, it  
8 would probably be too late. We would potentially have  
9 damage to the shield. So that is why we are using  
10 neutron noise.

11 CHAIRMAN BONACA: The other question I had  
12 was regarding CEDM, just a clarification of your  
13 presentation. You said you had leakage from the CEDM  
14 package. If I understand it, this is the package  
15 above, directly over the head.

16 DR. GASPER: Right.

17 CHAIRMAN BONACA: Okay. Now, you're  
18 replacing the head in 2006, which gives us comfort  
19 insofar as leakage from the CEDM there, but the other  
20 leakage you are still monitoring through normal means,  
21 I guess, right, for the foreseeable future? You're  
22 not changing your upper package?

23 MR. GAMBHIR: We're changing the CEDM  
24 housing also.

25 CHAIRMAN BONACA: You're changing the

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1 upper housing. Okay.

2 MR. GAMBHIR: The leak we had, it was a  
3 spare penetration that we had. And that was out of  
4 the housing itself.

5 DR. GASPER: Yes. That was actually that  
6 ten-foot pipe basically. And it was due to stress  
7 corrosion cracking due to the fact that those were not  
8 vented. So we tracked oxygen in them.

9 CHAIRMAN BONACA: And you are replacing  
10 those?

11 DR. GASPER: Actually, the ones that are  
12 cracked, those have been removed.

13 MEMBER ROSEN: Going back one slide to  
14 your license renewal implementation discussion on  
15 slide 10, I think you are appropriately identifying  
16 training as important and also that you're going to be  
17 implementing some of these requirements beginning soon  
18 and not waiting until the end and embedding those  
19 requirements in your procedures.

20 All of those things are good, but what are  
21 your thoughts about putting this program under the  
22 control of one person who is identifiable as the  
23 license renewal guru or do you feel that you don't  
24 need such a person in an ongoing manner that just  
25 using a broad scope procedural approach would be

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1       satisfactory?

2               MR. VAN SANT: Our belief is that if you  
3       haven't properly documented the procedure, that  
4       doesn't mean you have a license renewal guru, so to  
5       speak, to be able to address it. You should have an  
6       adequate procedure guidance that can walk somebody  
7       through the evaluation to determine if they have an  
8       impact on the commitments or license renewal  
9       application.

10              MEMBER ROSEN: This is different than some  
11       other licensees who have appeared before us and been  
12       granted license renewal. Some of the licensees have  
13       identified site points of contact, for example, on  
14       license renewal, someone who is the keeper of the  
15       knowledge that was gained during the review and knows  
16       where all the pieces of the program are and who can  
17       teach new people and examine issues as they come up  
18       separate from the procedural network.

19              That gave me some comfort in that I felt  
20       that the program was less than automatic. There was  
21       someone who was guiding and able to guide and who had  
22       the history and could respond to issues as they came  
23       up if they had a tangential or even a direct impact on  
24       license renewal activities.

25              MR. VAN SANT: We have people who will be

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1 available to support that, but the recognition was  
2 that in going forward, at some point, you are going to  
3 lose that historical knowledge, that you need to have  
4 that control in procedures such that you are not  
5 dependent on people to provide that function.

6 MEMBER ROSEN: I think that is a little  
7 bit of a red herring. I'm not talking about being  
8 dependent on people and not having it in the  
9 procedures. I'm suggesting that, in addition to  
10 having it in the procedures and in addition to the  
11 training was some comfort to me to be advised by a  
12 licensee or several licensees that they had someone  
13 who could be pointed to by management and say, "The  
14 license renewal implementation is your bag. You're  
15 the guy who has to be thinking about that as part of  
16 your job."

17 MR. GAMBHIR: Let me address that. I  
18 think that's a good point. Here are the lessons  
19 learned personally for me over the years, that people  
20 change, conditions change. So you do need to have a  
21 strong documentation background so we can move  
22 forward.

23 One of the things that we did at Fort  
24 Calhoun was -- this is back when we did the design  
25 basis reconstitution -- we also developed what we call

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1 the program basis documents.

2 We have very detailed program basis  
3 documents. They're not part of the license. I mean,  
4 they were not done for this. They have been done  
5 since many years. And things like steam generators,  
6 erosion corrosion programs, the relief valves, the  
7 safety valves, I mean, all of these things, you wanted  
8 to preserve the knowledge.

9 Bernie, correct me if I am wrong. We are  
10 looking at a program basis document on the license  
11 renewal. So we will have a program basis document on  
12 the license renewal also because that will be the  
13 master document that retains all of the knowledge.  
14 It's in there.

15 And I'm sure there will be a sponsor  
16 assigned. Each of the documents has a sponsor  
17 assigned. So indirectly I think we will have what you  
18 are talking about, and then each of the procedures  
19 then implement it.

20 MEMBER ROSEN: I think that's fine. You  
21 have a go-through guide and a program basis document  
22 that is really the intent of my comment that I think  
23 --

24 MR. GAMBHIR: We'll have that. And your  
25 point is valid. I mean, there are so many things in

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1 these that you can't write in every procedure. And  
2 then sometimes things do get mixed up. And so we will  
3 have.

4 The program basis documents in general  
5 have served us extremely well. We preserve from year  
6 to year how many man-hours were used, what did we  
7 find. We had a change of system engineers on steam  
8 generators and weren't able to just switch over to the  
9 next person. So that's the same concept we'll have in  
10 the license --

11 MEMBER ROSEN: It said knowledge  
12 management issue.

13 MR. GAMBHIR: Right.

14 MEMBER ROSEN: I think what you have  
15 described now would go a very long way to giving me  
16 the same kind of comfort that, for instance, the site  
17 point of contact approach has given me in the past.  
18 I thank you.

19 VICE CHAIRMAN WALLIS: I have a question  
20 about FAC, flow-accelerated corrosion or flow-assisted  
21 corrosion. You have had thin walls because of  
22 corrosion. You actually had one that ruptured.

23 DR. GASPER: In '97.

24 VICE CHAIRMAN WALLIS: So as these  
25 machines get older, the pipes, walls get thinner, may

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1 rupture. That apparently is okay because they're  
2 managed by checkworks and all that kind of stuff. And  
3 as you monitor these pipes, they're replaced when you  
4 have to replace them. And, therefore, they're not an  
5 obstacle to renewing the license and that public  
6 perception might be that as these things get older and  
7 they wear out, then that's a bad thing.

8 But the fact that you can renew these  
9 pipes makes it okay. Is that really sort of putting  
10 it in the kind of everyday terms? Is that the way FAC  
11 works?

12 DR. GASPER: Yes. Typically checkworks is  
13 used in a predictive method to identify where the  
14 maximum wear is occurring. That's confirmed basically  
15 with your inspection program. You are then selecting  
16 the sites that have the maximum rates and going and  
17 inspecting those.

18 As we get to replacements, typically right  
19 now we are trying to the best of our ability to  
20 replace with FAC-resistant material in order to cut  
21 down the amount of inspections and stuff, we've got to  
22 do that. That's an outage expense every year.

23 So the relative costs of replacing with  
24 FAC-resistant material versus continuous inspections  
25 leads you towards at least in our case to replace with

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1 resistant material.

2 So that's right now basically our  
3 philosophy. We are trying to replace with resistant  
4 material where we can.

5 MR. GAMBHIR: In addition to that, for the  
6 condenser that we're putting in, that will have  
7 titanium tubes. And that allows us to do better  
8 chemistry management also. So we're kind of looking  
9 at it from that point of view, too.

10 MR. VAN SANT: We're also replacing  
11 feedwater heaters. As we go in and replace the  
12 feedwater heaters, at that time, when we're cutting  
13 into the extraction lines, we're looking at what  
14 piping we can replace as part of that.

15 VICE CHAIRMAN WALLIS: Yes. Those  
16 extraction lines have historically given you problems.

17 MR. VAN SANT: Right. That's the danger  
18 area.

19 MEMBER ROSEN: And the material for the  
20 construction of the feedwater heaters is?

21 MR. VAN SANT: It's going to be stainless  
22 steel tubing. It's currently stainless steel tubing  
23 right now. And we'll replace with stainless steel  
24 tubing.

25 CHAIRMAN BONACA: Would you be doing all

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1 of this work if you were not planning for license  
2 renewal?

3 MR. VAN SANT: No.

4 MR. GAMBHIR: I think what it is is that  
5 part of the justification is that the operation to  
6 2013 becomes uneconomical. We solved it. For  
7 example, we are doing condenser inspections. It's  
8 going to cost about \$7 million just to inspect those.

9 The condenser has been a source of problem  
10 for us in the past. So the economic case that we have  
11 put together is that we need these things for going to  
12 2013 even. But it would have not been economical if  
13 we were going only to 2013.

14 So the fact that we can go to 2033 -- this  
15 is where I believe strongly that license renewal adds  
16 to the safety of the plant because what we are doing  
17 is this is going to help improve the reliability of  
18 the unit and, in turn, improve the safety of the unit.

19 MEMBER ROSEN: And not have a long,  
20 lingering period where you're managing to get through  
21 and then shut down in 2013. Instead of that, taking  
22 a proactive approach, improving the material condition  
23 of the plant across the board, and planning to go on  
24 for a longer period.

25 MR. GAMBHIR: That is correct.

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1 MEMBER SIEBER: Have you purchased the  
2 condenser tubes yet?

3 MR. VAN SANT: No, not yet. We're going  
4 out for bid shortly.

5 MEMBER SIEBER: I presume that you are  
6 aware that the moment of inertia of titanium tubes is  
7 different than what you now have and they are prone to  
8 vibration. And you may be in a situation where you  
9 have to stake the condenser because the tube support  
10 plates are too far apart. Just so you are aware of  
11 that and spend --

12 MEMBER ROSEN: I think that is well-known,  
13 Jack. I think that places where titanium condensers  
14 have been installed to replace, for instance,  
15 Admiralty brass, Monell metal have been successful.

16 MEMBER SIEBER: Some have. Some haven't.

17 MEMBER ROSEN: My own experience has been  
18 that it's very satisfactory.

19 MR. VAN SANT: We're not just re-tubing.  
20 We're replacing the entire module.

21 MEMBER SIEBER: Oh, really? Okay. So you  
22 all have new support plates.

23 MR. VAN SANT: Right.

24 MEMBER SIEBER: Okay. That solves that  
25 problem.

1 CHAIRMAN BONACA: Okay. Any other  
2 questions?

3 (No response.)

4 CHAIRMAN BONACA: If not, then we will  
5 hear from the staff. Thank you.

6 MR. KUO: Thank you, Dr. Bonaca.

7 My name is P. T. Kuo. I am the Program  
8 Director for the License Renewal and Environmental  
9 Impacts Program. Butch Burton is going to make the  
10 presentation. He's the project manager, as you know.

11 And, briefly, just a status report that  
12 during the top of SER with open items, we had 11 open  
13 items. By the time that we finished the subcommittee  
14 meeting, we had only one left, which had to deal with  
15 the changing of tables by the applicant in the  
16 application. And since then, even this issue has been  
17 resolved already. Butch is going into the details of  
18 that.

19 And I also want to mention that given Fort  
20 Calhoun being the first GALL plant, we have a number  
21 of lessons learned. We are trying to incorporate  
22 these lessons learned into the future application  
23 reviews. Butch is also going to go over some of the  
24 lessons we have learned.

25 So with that and if he is ready, then I

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1 will turn it over to Butch.

2 MR. BURTON: All right. Thanks, P. T.

3 MR. KUO: Sure.

4 MR. BURTON: Can everybody hear me okay?

5 First, one housekeeping item. The slides that I am  
6 going to have up here, I had to make some last minute  
7 changes to them. The committee members have the  
8 correct slides. For some of the folks in the  
9 audience, you are going to find very minor differences  
10 between the slides I have up here and what you have;  
11 again, very, very minor.

12 Thank you for allowing me another  
13 opportunity to talk with you about the staff's review  
14 of the Fort Calhoun license renewal application. Let  
15 me start with a very brief overview. I know it looks  
16 like a lot of slides, but I intend to move through  
17 them fairly quickly.

18 The application was actually submitted by  
19 letters dated January 9th and April 5th. And as I go  
20 through, I will explain to you a little bit about how  
21 and why that happened in two submittals, as opposed to  
22 one.

23 As you know, it's CE PWR located just  
24 north of Omaha, Nebraska. Current license expires in  
25 August of 2013. They're requesting a 20-year

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1 extension of the license. We issued our SER with open  
2 items in April. We had our subcommittee in June. And  
3 we issued the final SER in September.

4 We also had a brief session with the full  
5 committee -- I believe that was in March -- to try and  
6 familiarize you all with the application since it was  
7 the first to utilize GALL.

8 VICE CHAIRMAN WALLIS: This SER, we have  
9 had comments on SERs in the past, license renewal. My  
10 impression is that it's, for me anyway, much more  
11 complete than the earlier ones. It goes over the  
12 history and how the RAIs were resolved, there were not  
13 inspections, and so on, gives much more explanation as  
14 to why you reached the decisions that you did. And I  
15 found that very useful.

16 MR. BURTON: Good, good. I'm glad to hear  
17 that. We thought that it was important that we  
18 communicate to our stakeholders some of the background  
19 of GALL, how it was developed because it was the first  
20 one to understand how things were structured and how  
21 we performed our review. So we did try to include all  
22 of that. I am glad to hear that you found it helpful.

23 One of the things that I know that you all  
24 are always interested in is how this application  
25 compared to previous ones. As I mentioned, it's the

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1 first application to fully implement the GALL process.

2 If you remember, St. Lucie applied  
3 portions of GALL, but we were the first ones to  
4 actually look at an application that instituted the  
5 full process.

6 As a part of that, we had to do some  
7 re-engineering of our review process. And I have some  
8 lessons learned with that. One of them was that it  
9 was the first plant where we actually did a  
10 confirmation of their claim of consistency with GALL  
11 for the aging management programs. And we actually  
12 included that as part of the AMR inspection. Again,  
13 there were some lessons learned associated with that  
14 that I will talk about.

15 It was also the first plan to utilize an  
16 SER template. What we tried to do was we tried to  
17 make the review a little bit more consistent from a  
18 stakeholder's point of view to be able to consistently  
19 document how we did what we did. And so we actually  
20 developed a template. And we have actually used that  
21 concept with applications after Fort Calhoun. So  
22 those are some of the things that were different from  
23 some previous applications.

24 Okay. I'm actually going to begin at the  
25 end. I am going to start with the staff's

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1 conclusions. Ten CFR Part 54 lays out what has to be  
2 met in order to issue a renewed license. There are  
3 basically three requirements that are documented in  
4 54.29.

5 One is that actions have been identified,  
6 have been or will be taken. You have heard this  
7 language before. This is basically the reasonable  
8 assurance finding associated with the safety review.

9 The second item is basically that we have  
10 to look at the environmental impacts and make sure  
11 that there are -- if you have seen the conclusion  
12 there, it is very legalistic, but it basically says  
13 that environmentally we have not found anything that  
14 would prevent them from implementing this license  
15 renewal option if they choose to; and then, finally,  
16 matters raised under 2.758, which is basically a  
17 hearing. And there were no requests for hearings or  
18 petitions to intervene. So that last requirement has,  
19 in fact, been met.

20 So these are the conditions. Basically,  
21 most of the rest of my presentation is how we came to  
22 reach this first finding, this first reasonable  
23 assurance finding.

24 Okay. The first thing that the staff  
25 looks at is the methodology. The reasoning behind

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1 that is that if the methodology is not sound, you  
2 can't trust the results. So the first thing is they  
3 have to look at what they're doing and make sure their  
4 methodology is sound.

5 Specifically, we're looking to make sure  
6 that the methodology meets the requirements of the  
7 rule and that it is consistent with how it is  
8 described in the application. So that is what we are  
9 looking at.

10 We supplement the staff review with a  
11 methodology audit. That's normal procedure for us.  
12 As a result of the review and the audit, we had four  
13 requests for additional information having to do with  
14 methodology.

15 I've identified functional realignment.  
16 You know that always comes up. And so that's one of  
17 the things that we always look at. One of the things  
18 that came up, we had a question with regard to  
19 functional realignment.

20 For those who may not be aware of what  
21 that means, it's basically when you take the functions  
22 of one system and actually functionally, not  
23 physically but functionally, associate them with  
24 another system. The one that comes up most often has  
25 to do with containment isolation. Often you will have

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1 systems that they would have no other in-scope  
2 function except for containment isolation.

3 And so what some applicants have done is,  
4 rather than bringing that whole system in scope, they  
5 will take that particular component that does that  
6 in-scope function and actually functionally realign it  
7 to a new system that is normally called in this case  
8 containment isolation.

9 But from a methodology point of view, all  
10 of that needs to be clearly laid out and described.  
11 What we found was that when you looked at some of the  
12 documentation, it wasn't real clear how all of that  
13 was done.

14 When we find those kind of apparent  
15 discrepancies, what we do during the inspection is we  
16 say, "Okay. The paperwork, the description doesn't  
17 seem to be in line with what you're claiming. Let's  
18 sit down, and you go through with us exactly what you  
19 did in order to do this functional realignment."

20 What we found is that they, in fact, did  
21 it correctly. The problem was just in the  
22 documentation. In fact, that was one of the RAIs  
23 associated with it. And they came back and made a fix  
24 that clearly described that methodology.

25 There were no open items. We had one

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1 confirmatory item, which we resolved, which had to do  
2 with the realignment. So from a methodology point of  
3 view --

4 CHAIRMAN BONACA: In the process of  
5 scoping and screening, did you identify other items  
6 that should be in scope?

7 MR. BURTON: Yes. In fact, after we  
8 looked at the methodology, then we looked at the  
9 scoping and screening results. And that's what's  
10 going to come up in the next slide.

11 CHAIRMAN BONACA: Okay. And you'll tell  
12 me how many systems and also if these were part of the  
13 interim staff guidance?

14 MR. BURTON: Sure, absolutely.

15 CHAIRMAN BONACA: I guess where I am going  
16 is if we have the application, we see that there is a  
17 significant number of components and systems that are  
18 included in the scope after the staff reviews and  
19 finds that there are discrepancies.

20 I would expect that once GALL becomes  
21 fully institutionalized in the applications and a  
22 member of -- I mean, there shouldn't be the need for  
23 the staff to come in and identify all of these  
24 components. Okay? So how can we say the methodology  
25 is adequate if, in fact, it doesn't lead to have two

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1 reviewers coming to the same conclusion?

2 MR. BURTON: Right. And, actually, that  
3 is a very good question, and the staff has looked at  
4 that. When you find that the results -- if there are  
5 a number of things that had not been brought into  
6 scope, then you question the methodology, which is  
7 basically what you are saying. And, in fact, during  
8 the inspections, we did look at that and ask for some  
9 explanation. And often what it was is that -- you  
10 will see this in some of the RAI responses -- it's not  
11 that they missed it.

12 It's that they looked at it and made a  
13 determination for various reasons that the RAIs will  
14 talk about the details, why they made a conscious  
15 decision not to scope it in. And the staff would have  
16 a disagreement. And that is part of what some of the  
17 discussions were. And a lot of that is documented in  
18 the RAIs and the subsequent SER.

19 We would have been particularly concerned  
20 if it was something where they just completely missed  
21 it. And what we found was when we questioned them  
22 about that.

23 For instance, I'll give you a for instance  
24 about the scoping: the circ water tunnel. One of the  
25 issues that came up when we were doing the review was

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1 the circ water tunnel was not initially included in  
2 scope. Let me just say that. And so we said, "Well,  
3 what if the tunnel failed? Could it not block raw  
4 water discharge?" because it all goes through that  
5 tunnel.

6 And our first thought was, "Well, the  
7 applicant just missed it."

8 And, in fact, when we started to talk to  
9 them, they said, "No. We did not miss it. We did  
10 look at that and consider that, but we found that if  
11 the tunnel collapsed, there would still be room for  
12 raw water discharge to get through."

13 So we got into those discussions. And  
14 ultimately what they did decide to do was to actually  
15 bring the tunnel in scope and actually made it part of  
16 the intake structure, which was already in scope.

17 And then when something comes into scope,  
18 we bring all of the associated aging management  
19 information with it. But what we found was that when  
20 you looked at concrete, steel, whatever the structural  
21 components were that were associated with the tunnel,  
22 they were already captured in the intake structure.

23 So when all was said and done, there  
24 really was nothing that really changed other than  
25 bringing that additional tunnel into scope.

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1 Does that answer your question?

2 CHAIRMAN BONACA: Yes, it does. I mean,  
3 my main concern is to see progressively as we move  
4 through these license renewals, that the guidance is  
5 clear and that you will come to the same conclusion  
6 and there isn't the need for the staff to identify all  
7 of these additional components because whenever there  
8 is a discrepancy, I'm left to the question, how many  
9 things have been missed by both the staff and the  
10 licensee?

11 MR. BURTON: Right. You're absolutely  
12 right. Yes, we do expect that that kind of thing will  
13 be reduced and eventually go away as we go on,  
14 certainly.

15 So, anyway, in terms of scoping and  
16 screening methodology, when all was said and done, we  
17 found that the methodology was adequately described  
18 after some of the discussions and the commitments to  
19 make some modifications to the functional realignment  
20 description but other than that, that they were, in  
21 fact, meeting the requirements in terms of  
22 methodology.

23 Now, once we went through the methodology,  
24 then we looked at the results. Okay? We did a staff  
25 review here in headquarters supplemented by a scoping

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1 and screening inspection, which, again, is what we  
2 normally do. Exactly 69 RAIs came out of the scoping  
3 and screening review and inspection.

4 After going through the responses to the  
5 RAIs, we found that there were three that carried over  
6 as open items, all of which have been resolved.

7 And I do want to add that during the  
8 subcommittee meeting in June, when we looked at the  
9 exact status of all the open and confirmatory items,  
10 at that point, everything had already been resolved  
11 with one exception, which I will talk about.

12 So in terms of the specifics of the open  
13 items, we had already discussed them at the  
14 subcommittee meeting. And they were resolved at that  
15 point. Later on, I do have several slides. I won't  
16 go into detail, but it gives a list of all of the open  
17 and confirmatory items, what the issues were, what the  
18 final resolution was.

19 MEMBER LEITCH: Assume the ISGs were not  
20 fully promulgated at this time. Would you think that  
21 if he had been, that a number of these RAIs would have  
22 been greatly reduced?

23 MR. BURTON: I don't know about greatly  
24 reduced. It certainly would have impacted on the  
25 number. There's no question. Because you're right,

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1 at the point that we started our review, many of the  
2 ISGs had not been issued. In fact, even now, like,  
3 for instance, seismic 2/1, that takes us back to  
4 Hatch. There's been a long development and issue  
5 process with that.

6 The one thing that I can say, not only  
7 with Omaha Public Power but with some of the other  
8 applicants, is that it doesn't look like the industry  
9 is waiting for the final ISG to be issued. If they  
10 can address it in the development of their  
11 application, they seem to be trying to do that. If  
12 they are too far along in the development of their  
13 application or if they application is already  
14 in-house, they know that they can expect RAIs. And  
15 they're ready for them.

16 So we find that even when the ISGs are  
17 still in development, they look at what the staff's  
18 initial position is. And they do try to address it.

19 So yes, a lot of the scoping and screening  
20 review results, we had three open items, one of which  
21 was the tunnel that I had just talked about, and no  
22 confirmatory items.

23 Okay. One issue that came up during the  
24 subcommittee meeting and has since been mentioned, I  
25 understand, at St. Lucie and I know it came up at

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1 Robinson yesterday has to do with the pressurizer  
2 spray nozzle. I tried to kind of summarize where we  
3 are with that.

4 The way it started off was the staff  
5 identified an issue with the spray nozzle. From our  
6 point of view initially, we said, "Well, the spray  
7 pattern is really critical. It would seem to us that  
8 the spray pattern is critical to meeting the  
9 depressurization as far as reaching cold shutdown for  
10 Appendix R. And on that basis, it seems to us that  
11 the spray head should be in scope."

12 Applicant came back and said, "No.  
13 Actually, the spray pattern is not critical to meeting  
14 Appendix R and depressurizing and reaching shutdown."

15 What they had done was they had done a  
16 study and found that the pattern is not so important  
17 as the fact that you get the water in the pressurizer.  
18 It's not as efficient clearly, but in order to get the  
19 thing shut down in, I believe it is, 72 hours, it may  
20 not be the most efficient way to do it, but as long as  
21 you can get that water in there, you will get there.

22 So what is in scope, what is in scope, is  
23 the pressurizer in the piping that ensures that the  
24 water can get in there. The problem is that when we  
25 documented this in the SER with open items, it didn't

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1 come across that way because in their response, they  
2 also talked about alternate ways of reducing pressure.

3 Our conclusions, the way it sounded, it  
4 sounded like the basis for our finding was that they  
5 had all of these alternate means of reducing pressure.

6 I guess it would be similar to everybody  
7 says with the spent fuel pool cooling, they always  
8 say, "If push comes to shove, we can run a garden hose  
9 in there to keep the fuel covered."

10 That's fine. That's good. That's nice.  
11 That's not a basis for reaching any kind of safety  
12 finding. And I think our SER sort of read that way.  
13 And you guys called us --

14 VICE CHAIRMAN WALLIS: Your SER is a  
15 little confusing because the statement in there is  
16 "The pressurizer spray head has no intended function."  
17 Well, obviously it has a function or it wouldn't be  
18 there.

19 What you should say is it has no necessary  
20 safety function or something.

21 CHAIRMAN BONACA: Yes, for the license  
22 renewal.

23 VICE CHAIRMAN WALLIS: It obviously has a  
24 function.

25 CHAIRMAN BONACA: Yes, yes.

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1 MR. BURTON: Okay. Yes. I understand  
2 where you are going with that, but for license  
3 renewal, intended function has a specific function.  
4 An intended function is a function that is needed to  
5 --

6 VICE CHAIRMAN WALLIS: It depends on the  
7 context, yes.

8 MR. BURTON: Yes.

9 VICE CHAIRMAN WALLIS: But this is too  
10 sweeping a statement, it seems to me. If someone just  
11 reads this, it doesn't make sense and has no intended  
12 function. All parts there have some intended  
13 function.

14 MR. BURTON: Okay.

15 VICE CHAIRMAN WALLIS: But they're not  
16 relevant to this particular issue. That's all.

17 MR. BURTON: Okay. Yes. And these kinds  
18 of things may come up again. I guess what I will say  
19 is if there is still something in the SER that is  
20 still not clear, that certainly may be one of them.

21 If we need to make any of those final  
22 changes, we still have another shot of doing that  
23 because we can make changes in the SER and then put it  
24 in the NUREG. And that is the final.

25 So if you feel that that clarification is

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1 needed, I think we can still do that.

2 CHAIRMAN BONACA: Well, I think this is  
3 helpful, what you're presenting, then, because when I  
4 read it the first time, I pulled up this issue, to me,  
5 it was really like, you know, yeah, when I go down my  
6 highway, if I failed my brakes, I can still use my  
7 hand brake to bring my car to a stop. Yeah, you can  
8 do that, but that really is the sense I got.

9 And so I was saying, well, the primary  
10 means of cooling here is pressurizer head. Do we want  
11 to really present the operator with a situation where  
12 he doesn't have it?

13 I guess it's a bigger question than  
14 general. You made another example before of the --  
15 what was it, the canal, the discharge canal, where  
16 still the ability of discharging groundwater through  
17 a collapsed canal.

18 I understand the license renewal is very  
19 specific and focused on the design basis, but we don't  
20 want to get to the point where you have plants which  
21 you are not taking care of.

22 So if you have spray head failing, for  
23 example, would you have loose pieces up there? Where  
24 would they go? You know, there are issues there that  
25 come up.

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1           So that gives an impression that by  
2           focusing summarily on the design basis, in arguing  
3           about including or not including, there are almost  
4           some cavalier actions about the rest of the plant.

5           And none have been raised. It's just that  
6           that the impression it leaves.

7           MR. BURTON: I understand exactly what  
8           you're saying. And you're right because because  
9           something is not in scope or not subject to an AMR,  
10          that certainly does not mean that an applicant is just  
11          going to let it fall to pieces.

12          CHAIRMAN BONACA: Yesterday, we heard  
13          another applicant, who said that the reason why they  
14          were not put in the scope was a different one, was  
15          because they had looked at operating experience. And  
16          they had seen nobody having problems with the  
17          pressurizer spray head.

18          Well, to that, I can say, in 30 years of  
19          operation now, we are talking about 30 more years for  
20          other plants. How can you project the same  
21          performance in the future?

22          So there are issues there that leave you  
23          puzzled about it.

24          MEMBER ROSEN: Well, now that you have  
25          developed substantial expertise in the issue of

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1 crediting the pressurizer spray nozzle to meet  
2 Appendix R, along comes 50.48(d), risk-informed fire  
3 protection rules, which, by the way, changes the  
4 waterfront on this issue because now you don't have to  
5 go to cold shutdown. You can stop at hot shutdown.

6 And so now, whether or not you need the  
7 pressurizer nozzle spray to get to hot shutdown timely  
8 starts the debate over again for plants that take the  
9 voluntary road to use implementing 50.48(d).

10 MR. BURTON: You're absolutely right. As  
11 you well know, currently the whole license renewal is  
12 not yet risk-informed. But you're absolutely right.  
13 And it's something that we are all aware --

14 MEMBER ROSEN: But that's the current  
15 licensing basis. And the current licensing basis  
16 would be changed for a plant that voluntarily  
17 implements 50.48(d). So now you're going to have to  
18 go back when that happens.

19 And in some cases, like this one, I think  
20 it might relax this requirement of a pressurizer  
21 spray. In some other cases, it might have other  
22 impacts.

23 CHAIRMAN BONACA: Relax it even further.  
24 I mean, it's not in scope.

25 MR. BURTON: What you're saying, we



1 totally agree with, and the staff is aware of it. And  
2 P. T. may want to speak to it.

3 MEMBER ROSEN: The general message is that  
4 as regulations that affect the current licensing basis  
5 change --

6 MR. BURTON: Change, right.

7 MEMBER ROSEN: -- then one has to think  
8 what the impacts are for regulatory actions that have  
9 been taken in the past that were fundamentally based  
10 on the licensing basis.

11 MR. BURTON: Absolutely, absolutely. I  
12 agree with you. I don't know if --

13 MR. KUO: Mr. Rosen, whenever the licensee  
14 wants to change the current licensing basis, they have  
15 to submit an amendment for staff review. So it has to  
16 go through the regulatory review considering whether  
17 it would be a factor, what we impacted, before the  
18 licensing basis can be changed.

19 MEMBER ROSEN: That's right. And if they  
20 don't discuss this one, a plant that is adopting  
21 50.48, you have an RAI.

22 MR. KUO: Correct.

23 MR. BURTON: Absolutely. Absolutely. So  
24 going back to Dr. Wallis, we will definitely go back  
25 and take another look at that and see if we can get

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1 that clear because we don't want to send the message  
2 that because the spray head is not in scope that,  
3 therefore, its function is not important..

4 VICE CHAIRMAN WALLIS: It says it has "no  
5 intended function." It doesn't say anything about  
6 importance. It says not at all.

7 MR. BURTON: Right.

8 VICE CHAIRMAN WALLIS: You may as well  
9 throw it away.

10 CHAIRMAN BONACA: Well, you want to add  
11 "in license renewal" into the --

12 MR. BURTON: We'll clear that up.

13 Okay. So, again, our conclusion after  
14 looking at the scoping and screening results, again,  
15 there are two things: whether all of the structure  
16 system and components that should be within the scope  
17 of license renewal have been identified. And that's  
18 54.4(a).

19 We have found that all of them have been  
20 identified and that the structures and components that  
21 are within scope that should be subject to an aging  
22 management review again, passive long-lived  
23 components, that those have been identified. And,  
24 yet, the requirement is 54.21(a)(1). And we found  
25 that all of those had been identified.

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1           Next, after scoping and screening comes  
2   aging management. I have this in two parts. First,  
3   talk about the aging management programs. And I've  
4   got basically what amounts to I guess just some  
5   statistics or whatever, but staff thought that its  
6   review -- again, it was supplemented by an AMR  
7   inspection and audit.

8           And what we have done, for those of you  
9   who were at the Robinson presentation, after Fort  
10   Calhoun, we re-engineered the process, where the  
11   confirmation of consistency with GALL is now done by  
12   a separate aging management program audit team that  
13   goes out, starting with Robinson.

14           We didn't have that. We actually tried to  
15   incorporate that consistency check in the AMR  
16   inspection. What we found was that it was really a  
17   really big burden on the inspection team because they  
18   had to do everything that they have always done, and  
19   then we added this on top of it.

20           It was quite a lot. And for that reason  
21   as well as some others, we decided to pull that out.  
22   That seemed to be a function that we could handle  
23   within projects. And so that's what we're going to be  
24   doing in the future.

25           VICE CHAIRMAN WALLIS: One thing these

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1 inspectors looked at was the containment protective  
2 coatings. I just wonder how they handle something  
3 like this, which is sort of a matter of present  
4 concern. I mean, there's a bulletin out there. There  
5 is a NUREG guide. There is debate among the agency  
6 about how to handle sump blockage and all of that.

7 How do they deal with something which is  
8 a current issue like that, which isn't in GALL in the  
9 same way because GALL is based on what is done in the  
10 past or it was developed before these things were of  
11 current interest?

12 MR. BURTON: Okay. Let me answer it in  
13 two parts. First of all, let me talk specifically  
14 about coatings. OPPD did not take credit for  
15 coatings. Okay? What they said is the underlying  
16 metal and its management is what we're going to do.  
17 Having the coatings is a help, but --

18 VICE CHAIRMAN WALLIS: But it might be a  
19 hindrance. If they come off, they're bad.

20 MR. BURTON: Right. But what they are  
21 hanging their hat on is the management of the  
22 underlying component is what they are going to  
23 maintain. That is what they are hanging their hat on.

24 Now, again, this is right back to what you  
25 were saying before. That is not saying that they're

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1 not going to take care of the coatings and look at  
2 them and all that kind of thing, but for license  
3 renewal, in terms of what they are crediting, they are  
4 not taking credits for the coatings. They are  
5 credited with managing the component itself.

6 Now, the broader issue of issues that come  
7 up, that's part of what we do. That's part of what  
8 the ISGs are for. As we do our reviews and the  
9 reviewers who are working on the license renewal are  
10 the same reviewers looking at current operating  
11 issues, I mean, I don't see how you could do it any  
12 other way and still be on top so that license renewal  
13 would be relevant. So that same reviewers do both.

14 And that is how we identify the issues  
15 that may need to be addressed in license renewal. The  
16 documentation of that whole resolution process for  
17 license renewal is what the ISGs are. And we have 15  
18 ISGs at this point, either issued or in draft, or --

19 MR. KUO: Total number, 20.

20 MR. BURTON: Twenty. So there is a whole  
21 range of issues that were actually identified by  
22 reviewers or sometimes by inspectors, like with the  
23 fuse holders I'm sure you all are familiar with,  
24 current operating issues that may have an impact on  
25 license renewal. And we have a whole process in place

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1 to try and evaluate and reach resolution and  
2 incorporate those resolutions into our guidance  
3 documents. Am I answering?

4 Okay. Aging management programs, 24  
5 total. Fourteen of the 24 are what we call common  
6 amps. And by that, where we are now is we break up  
7 the systems into six broad what we call system  
8 structural groups.

9 There are some aging management programs  
10 that apply across those groups. The one that usually  
11 comes to mind is chemistry. Chemistry is a program  
12 that's applied to reactor systems. It's applied to  
13 auxiliary systems. It's applied to ESF systems. Each  
14 of those is a separate system group. Nonetheless, a  
15 common amp is something that applies across those  
16 system groups. We have 14 of those.

17 There were also ten system-specific  
18 groups. For instance, the reactor vessel internals  
19 inspection applies specifically to reactor systems.

20 Anyway, here is just a breakdown for each  
21 of the two major groups. We had five that were  
22 completely consistent with GALL common amps, seven  
23 that were consistent with some deviation, two that  
24 were non-GALL. Under the ten, you can see a similar  
25 breakdown.

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1 We had a total of 22 systems that were  
2 consistent with GALL, either completely or partially.  
3 We had one aging management program, non-EQ cables,  
4 but when they initially submitted the application, it  
5 was a non-GALL amp.

6 This is one of those situations where we  
7 were issuing GALL and certain aspects of GALL. And  
8 one of them that came sort of on the back end was  
9 11(e)(1), (e)(2), and (e)(3), management of cables.

10 And so we got into a thing where they were  
11 not really being consistent with the GALL amp. And  
12 through some discussions and interactions, they went  
13 and reformulated that amp. And now they are  
14 consistent with GALL.

15 Number of amps that are consistent but  
16 with some deviations, there were 13 of them. And this  
17 seems like such a basic thing. I am using the term  
18 "deviations," but specifically what you see in the  
19 application, the deviations came in three forms,  
20 clarifications, exceptions, and enhancements,  
21 something very simple. Well, what exactly do each of  
22 those mean? And that was never defined.

23 So we even had an RAI just to say,  
24 "Exactly what do you mean by these terms?" So we got  
25 that clarified. And, as you can see, these are the

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1 number of aging management programs that have one or  
2 more.

3 Number of GALL amps that are referenced in  
4 the LRA, total of 33. Sometimes you had a  
5 plant-specific amp that said they were consistent with  
6 one or more GALL amps. But when you totaled them all  
7 up, there were 33 of them.

8 We have 38 RAIs from the amp review, no  
9 open times, one confirmatory item. Again, that was  
10 resolved. We also reviewed for each of the aging  
11 management programs the USAR supplement, which  
12 ultimately is going to go into the USAR and what is  
13 going to be living on after license renewal.

14 One of the issues that always comes up is  
15 one-time inspections. Okay? At Fort Calhoun, at the  
16 time, the one-time inspection program had not yet been  
17 developed. So what we did was because it wasn't  
18 developed, what we had to look at was to make sure  
19 that when it is developed, that all the right things  
20 are there.

21 So what we did during the review and the  
22 inspection is to go through and say, "Okay. What is  
23 it that when it is developed needs to be there?" and  
24 make sure that their commitment tracking system had  
25 those elements in it. So that's what we did. And

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1 also those commitments are in Appendix A of the SER.

2 Staff will review fulfillment of  
3 commitments in inspection procedure 71003. This is  
4 where we talked before about these commitments that  
5 they make. How are we going to make sure that they  
6 actually implement them? It's going to be in this.  
7 And, actually, this procedure is being revised to --

8 MR. KUO: That procedure has been issued.

9 MR. BURTON: It's been issued. Okay.

10 Good.

11 MEMBER SHACK: This is new, right? I  
12 don't recall this coming up in other license renewals.  
13 The one-time inspection programs were defined.

14 MR. BURTON: Yes. I don't want to say --  
15 okay. Right. You're right. At some of the previous  
16 applications, the amp was developed more than what we  
17 saw at Fort Calhoun. And, frankly, we were a little  
18 surprised by that. But, nonetheless, that was a  
19 situation that was presented to us.

20 So we had to go back and say, "Okay.  
21 Given the fact that they are making a commitment to  
22 development, just having a promise that it is going to  
23 be developed is not enough. We need to at least have  
24 an understanding that when it is developed, what is it  
25 going to cover, such things as small-bore piping?"

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1           You know, there are certain one-time  
2       inspections that from our own experience, we know  
3       previous applicants have committed to and that kind of  
4       thing, not to say that they weren't, but we had to be  
5       sure that it was documented.

6           So that's when we went to the  
7       commitment-tracking system. And we wanted to see  
8       something more than a commitment to develop a one-time  
9       inspection. We wanted to see what will be in there.  
10      And, in fact, that's what we did.

11           When all was said and done, we felt we  
12      were satisfied with that. And those commitments,  
13      those specific commitments, what will be in that amp,  
14      you see you can see in Appendix A of the SER.

15           CHAIRMAN BONACA: You have still 25 slides  
16      to go. I would suggest that whatever you have, just  
17      a counting of issues that --

18           MR. BURTON: Okay. Let me just go to the  
19      conclusions. Okay. Conclusions for the aging  
20      management programs, basically that the programs are  
21      adequate to manage aging. That's 54.21(a)(3).

22           54.21(d) requires that there be an  
23      adequate description of the programs and activities.  
24      We found that to be the case. So you're okay there.  
25      Okay. I will try not to be so long-winded.

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1 MEMBER ROSEN: I think the point is you  
2 don't need to go through the accounting. You can do  
3 it, but you don't need to go --

4 MR. BURTON: You're all right? Okay.  
5 Good. Good. Okay.

6 CHAIRMAN BONACA: On this one-time  
7 inspection, however, wait a minute. I'm still  
8 reflecting.

9 MR. BURTON: Okay.

10 CHAIRMAN BONACA: I mean, they committed  
11 to the GALL approach. So we expect that that would  
12 have implementation of one-time inspection, as  
13 identified by GALL, unless they had made an exception  
14 already to you now.

15 MR. BURTON: Right. You're right. And  
16 that is basically what the commitment was. We're  
17 going to develop a one-time inspection in accordance  
18 with GALL.

19 CHAIRMAN BONACA: So you have some idea.  
20 I mean, the GALL, the ten attributes, et cetera, is  
21 already somewhat defined, which you expect.

22 MR. BURTON: But even beyond that, there  
23 were some other things where they were saying, you  
24 know, this can be covered in a one-time inspection,  
25 saying, "Well, okay. Let's make sure we get it in

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1 there."

2 CHAIRMAN BONACA: Right.

3 MR. BURTON: Okay. Skip to which one? I  
4 think I skipped to TLAA 16, slide 16. I put this up  
5 because I know it came up at St. Lucie. And it also  
6 came up yesterday at Robinson. So we thought it was  
7 important to put it in here.

8 One of the TLAA's, reactor vessel neutron  
9 embrittlement, upper shelf energy, and pressurized  
10 thermal shock, for both, we did independent  
11 calculations. In both cases, the applicant used TLAA  
12 option 2, which was to extend the analysis to the end  
13 of the extended operating period.

14 Minimum limit for upper shelf energy is 50  
15 foot-pounds. We did independent calculations to  
16 confirm that they did not go below that minimum limit.  
17 We used reg guide 1.99. And the lowest value was 54.6  
18 foot-pounds for 48 EFPY, which is the end of the  
19 extended term. So we did independent calculations to  
20 ensure that --

21 MEMBER ROSEN: What capacity factor is  
22 assumed?

23 CHAIRMAN BONACA: Capacity factor?

24 MEMBER ROSEN: To say that 48 EFPY is  
25 adequate.

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1 MR. BURTON: Yes. I don't know the  
2 details of that. I don't know. Do you know, Barry?

3 MR. LOIS: Eighty percent.

4 MEMBER ROSEN: Isn't that an issue? I  
5 mean, this plant is running breaker-to-breaker whole  
6 three out of the last four cycles. So they're not  
7 going to be running 80 percent capacity factors. So  
8 they're going to get to many more EFPY by the end of  
9 the license term, the extended license term, 48, I  
10 would suspect.

11 MR. LOIS: Most likely they're making up  
12 for what they lost in the past. In the past, 25 years  
13 or 30 years, the load factors were much less than 80  
14 percent. So most of them, it would come up on the  
15 average about 80 percent.

16 MEMBER ROSEN: How sensitive is this  
17 lowest projected value of 54.6 for 48 EFPY? What if  
18 you had 50 EFPY? Would you be below 50 foot-pounds?

19 MR. LOIS: My name is Lambros Lois,  
20 Reactor Systems Branch for the PTS.

21 In the case that they do exceed or do  
22 something different than predicted, they are required  
23 to come back and give us a report.

24 MR. ELLIOT: I would just like to answer  
25 the question about capacity factor. This is simple

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1 arithmetic. Sixty years, 48 divided by 50 is the  
2 capacity factor. That's what they're projecting.

3 It isn't the capacity factor that is  
4 critical here. It's the neutron fluence. They  
5 estimate the neutron fluence. And they have to keep  
6 track of it to see if there is a deviation from what  
7 they predict.

8 If there is a deviation from what they  
9 predict, they have got to do the calculations all over  
10 again. This is a projection based upon where they  
11 will be in 2033. If that changes, the numbers change.

12 Now, how much of an impact is this?  
13 First, can you go back to the previous slide? This is  
14 not a limit. This is a screening criteria. And as  
15 the fluence goes up, I don't have the exact number,  
16 but it's going to have to be a lot to go below 50.  
17 Even if it goes below 50, there are still things they  
18 can do. There is analysis they can do to show the  
19 plant can still operate below 50. So that's the  
20 critical issue here.

21 The next slide is probably more critical.  
22 And that's the PTS screening criteria slide. In this  
23 one here, they're just below the limit. So if they do  
24 increase the capacity factor for this plant as a  
25 result of better operation, they could wind up over

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1 the screening criteria.

2 But they have to tell us that as part of  
3 the PTS rule, that if something changes that  
4 significantly changes their result, they have to come  
5 back in here and tell us what the impact is.

6 VICE CHAIRMAN WALLIS: So if they have a  
7 PTS rule --

8 MR. ELLIOT: And this number is based on  
9 the fluence that they give us that they project. Now,  
10 if that number changes, according to the PTS rule,  
11 they have to come back in and do flux reduction or  
12 provide some additional analysis to show that they can  
13 still operate the plant.

14 My name is Barry Elliot, by the way.

15 VICE CHAIRMAN WALLIS: It would be really  
16 tardy of the NRC not to revise the PTS rule by them.

17 MR. BURTON: Okay. Dr. Rosen, are you  
18 okay with that? Thanks, Barry. Thanks, Lambros.

19 Okay. So, again, conclusions for the  
20 TLAA. For all of the applicants' TLAA evaluations, we  
21 found that they have demonstrated that it will be met  
22 by one of the three options given in the rule, which  
23 is that either the evaluation as it currently is is  
24 good for the extended period that they projected to  
25 the end of the extended period, found things

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1       satisfactory, or they have concluded that aging  
2       effects will be managed for the period of extended  
3       operation. We found that one of these three options  
4       for each of the TLAA evaluations and found them to be  
5       acceptable.

6               I will move faster. Okay. Inspections  
7       and audits.

8               VICE CHAIRMAN WALLIS: If this is just  
9       history, do we need to go through this part or --

10              MR. BURTON: Not if you don't want to.  
11       It's no problem. Again, the bottom line is all of the  
12       audits and all of the inspections, you know, if we did  
13       find some issues, we generally expanded our sample to  
14       get to the bottom of why we were finding anything that  
15       we found. Ultimately everything was found to be  
16       acceptable.

17              At the end, there were no loose ends that  
18       needed to be tied up in an optional third inspection,  
19       which you know is part of our process.

20              MEMBER LEITCH: I guess already I'm  
21       confused between this and Robinson, but the inspection  
22       to verify compliance with GALL was not done in the  
23       field, right? That was --

24              MR. BURTON: No, no. It was. It was. It  
25       was actually part of the aging management review

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1 inspection. This is where for Fort Calhoun, we  
2 checked their claim that they're consistent with GALL.  
3 We actually did that as part of the AMR inspection.

4 As I mentioned before, the inspection team  
5 had to do all of its normal work that it has  
6 traditionally done plus that. And we found that it  
7 really was a significant burden.

8 We had a very good inspection team,  
9 probably the most comprehensive we have ever had.  
10 Normally our inspection teams are four or five people.  
11 We had eight for one, nine for the other.

12 We have the current operating project  
13 manager. We have one of the current resident  
14 inspectors. We had two former senior inspectors at  
15 that plant, very comprehensive inspections.

16 But even with all of that talent, it was  
17 a lot of work to do what we normally do plus  
18 confirmation and consistency with GALL for the amps.  
19 And that's one of the reasons why we pulled it out and  
20 now we do that and have a separate amp audit. Okay?

21 MEMBER LEITCH: Okay.

22 MR. BURTON: I won't dwell on this, just  
23 to say I already mentioned the commitment-tracking  
24 system is one of the things that we looked at during  
25 the inspection. They actually have a couple of

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1 programs: an ongoing commitment program as well as a  
2 commitment-tracking system.

3 With regard to the aging management  
4 programs that had to have been fully developed, we  
5 looked to make sure that if ultimately these things  
6 were tracked in the tracking system, that it said all  
7 the right things in the system, it identified all the  
8 right things to be done.

9 These next few I can definitely skip over.  
10 Eleven open items, the breakdown for confirmatory  
11 items, breakdown, everything is resolved. The only  
12 issue was one open item, 3.0-1, which was open at the  
13 time of the subcommittee meeting.

14 What that was was when they responded to  
15 RAIs, they had also made a number of changes to some  
16 of the tables in the application. At that point in  
17 the review, we didn't have time to run all of those  
18 down before we issued the SER with open items. So we  
19 just put a placeholder there as an open item.

20 Since then we went back and were able to  
21 track all of those down and found everything  
22 acceptable. So at this point, everything has been  
23 resolved.

24 The next few slides, 22 through 25, I  
25 won't go into those. It's just a laundry list of

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1 exactly what all the open and confirmatory items are.

2 License conditions. Basically there were  
3 no plant-specific license conditions that came out.  
4 So the only ones you'll see we're going to have in the  
5 license are the two standard ones, which basically say  
6 that the next available opportunity, you're going to  
7 update the USAR to include the supplement and that any  
8 of the inspections that you have committed to before  
9 the end of the current term, you'll do it.

10 Okay. Lessons learned. First one. There  
11 were about five or six of them. I'll go through them  
12 real quick. The first had to do with linkage. During  
13 the development of GALL, including the demonstration  
14 project, we had worked with the industry and concluded  
15 that there didn't need to be a link between the  
16 plant-specific information in section 2 and the  
17 generic GALL information in section 3. And that is  
18 how the January submittal came in.

19 But when a lot of the reviewers saw that,  
20 they had a real problem. They said, "I cannot make a  
21 reasonable assurance finding if I don't understand how  
22 the plant-specific information is tied to a specific  
23 GALL AMR and AMP."

24 So we asked them to go back and put this  
25 linkage in, which they did. And that was submitted in

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1 April. That's why there were two license renewal  
2 applications, one of the reasons that there were two  
3 separate submittals.

4 As a result of what we found with Robinson  
5 and Ginna and some of the ones after, they have this  
6 linkage now. So that was one of the lessons learned.  
7 And the applicants were able to respond quickly and  
8 actually make those changes.

9 The next lesson learned. There were some  
10 structures and components that were not addressed in  
11 GALL, but, nonetheless, the applicant found that they  
12 could take credit for managing those structures and  
13 components, take credit for GALL to do that.

14 However, when we saw the application, it  
15 wasn't real clear which ones they were and which ones  
16 they weren't. So we went back and asked them, "Those  
17 ones that you are going to take credit for GALL, even  
18 though GALL didn't address those structures and  
19 components, pull them out. Put them in a separate  
20 table." So they did that. And that was also part of  
21 that April 5th submittal of additional information.

22 Now, you won't see a third table for  
23 Robinson and all the folks who came after. What they  
24 did was they went back and said, "Well, we don't want  
25 to do a third table. Let's just try and make our

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1 first two tables, identify them better." And  
2 apparently that was done. So that's sort of a  
3 one-time thing that you won't see again.

4 Definition of what is consistent with  
5 GALL. When we first started, we all assumed that we  
6 were all on the same page in terms of what consistent  
7 meant. However, we found out that was not the case.  
8 And it wasn't even so much with Omaha Public Power but  
9 with some of the later applicants.

10 We found that, I guess in the worst case  
11 -- and I can't remember which one it was -- when they  
12 said, "consistent with GALL," that meant that they had  
13 the same structure or component. That's it. It might  
14 be a different material, different environment,  
15 different aging effect, but, yet, they called it  
16 consistent. So right away we said, "We've got a  
17 problem here."

18 Since then we have had some interactions  
19 with the industry. We have reached agreement on  
20 exactly what consistent means. And certainly with  
21 Farley, which has just come in, this problem has  
22 definitely gone away or should have definitely gone  
23 away. But you may still see some issues with  
24 Robinson, Ginna, Summer, Dresden, Quad because they  
25 were too far in the queue to really address this.

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1 And yesterday when you were asking about  
2 why Robinson had so many RAIs, some of that was  
3 because of this, because we still had to ask RAIs to  
4 get all of that consistency sorted out. And you may  
5 see that with some of the other applications. Okay?

6 Another lesson learned. The environments  
7 were not always clearly defined, even what's internal  
8 versus what's external. So we had at least one RAI  
9 having to do with that. They responded. We got it  
10 all clarified.

11 Since then, part of the LRA format more  
12 clearly defines the environments. Again, Farley was  
13 the one that you should see the full implementation of  
14 that.

15 Okay. This is what I already mentioned:  
16 the verification of consistency of the applicant's  
17 aging management programs with GALL. We tried to do  
18 it with the AMR inspection. We got through it.

19 The actual result of that is that of the  
20 24 aging management programs, we only had time to  
21 actually look at 19 of them, which is unusual for us  
22 because we try to get through all of them.

23 That was one of the indications where we  
24 said, "Well, we're going to have to think about doing  
25 this a little bit differently." And one of those is

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1 that now we have these audit teams. I think, as  
2 mentioned yesterday, the audits need to work to look  
3 at all of the aging management programs.

4 Okay. Overall, usefulness of GALL. We  
5 found that GALL basically did work. As Mr. Leitch  
6 pointed out at the subcommittee meeting, though, the  
7 benefits weren't as extensive as we had originally  
8 hoped for some of the reasons that I have already  
9 mentioned.

10 So it was obvious that further process  
11 improvements were needed. We have already --

12 VICE CHAIRMAN WALLIS: These sweeping  
13 statements, like the first one, we have heard that  
14 about other things that the staff has done. It's not  
15 clear what metrics you are using or whether this is a  
16 kind of a hopeful statement. You had a bigger  
17 inspection team than usual. You had a longer SER than  
18 usual. Maybe there was more work than usual. Maybe  
19 it was less efficient in some ways. What's the --

20 CHAIRMAN BONACA: More RAIs than usual.

21 VICE CHAIRMAN WALLIS: Right. More RAIs  
22 than usual. What's the measure of efficiency?

23 MR. BURTON: You're absolutely right, like  
24 I said. And that's why we said it wasn't as effective  
25 as we had hoped. But what we found is that GALL --

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1 VICE CHAIRMAN WALLIS: Maybe they were  
2 happier, but does that mean it's efficient?

3 MR. BURTON: Well, let me explain that.  
4 And we gave a little bit of ground on this review.  
5 Because it was the first time, we were using a very  
6 different approach. With some of the reviewers, the  
7 truth is that they were a little skeptical about the  
8 process.

9 So we gave them a little bit of leeway to  
10 say, "Okay. If there is something that you are really  
11 not convinced that GALL is really addressing, we will  
12 let you go on and explore that a little bit."

13 And that's why, at least in the Fort  
14 Calhoun case, we have probably more RAIs than I  
15 certainly think we could have had because we did give  
16 them some leeway. Even with that, we could see that  
17 GALL will work. And I think probably the best  
18 evidence for those folks who were here at Robinson,  
19 the next plant, where people were now more comfortable  
20 with GALL and how to look at it and that kind of  
21 thing, were really starting to see some benefits. So  
22 that's what I mean.

23 So in terms of metric, we are ultimately  
24 looking at the reduction in the number of RAIs, the  
25 review times perhaps, the number of open items. I

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1 think you all see that now we're coming to you, even  
2 at the subcommittee stage, with most open items  
3 resolved. So we are seeing progress. But, like I  
4 said, there is still room for improvement.

5 A lot of the implementation's improvements  
6 we have already begun with Robinson. We expect all of  
7 the benefits we should see with Farley. And we really  
8 expect to see a lot of improvement there. So we think  
9 we're heading in the right direction.

10 CHAIRMAN BONACA: Could you go back one?

11 MR. BURTON: Back one? Sure.

12 CHAIRMAN BONACA: I'm still concerned  
13 about this one here, verification of consistency. I  
14 mean, take the one-time inspections. They have not  
15 defined when they are going to do them, how they are  
16 going to do them. Okay?

17 How can you verify consistency of these  
18 one-time inspections with whatever is in GALL? For  
19 example, small-bore piping, I mean, you want to  
20 inspect to determine whether or not you have aging  
21 effect, irrespective of risk significance.

22 Okay. So where does that come in later on  
23 with a problem that says we are going to use purely  
24 ISI and that's based on a risk-informed approach and  
25 you disagree with that now?

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1 I mean, you say now we are going to verify  
2 later on and discuss it later on. When are you going  
3 to do all of this work?

4 MR. BURTON: When? Are you saying when?

5 CHAIRMAN BONACA: Yes.

6 MR. BURTON: Well, that's part of that bow  
7 wave that you guys have kind of put out in front of  
8 us.

9 CHAIRMAN BONACA: Yes. But it used to be  
10 a bow wave, and now it seems to be like an enormous  
11 bow wave because everything is being put off.

12 MR. BURTON: Everything is being put off.

13 CHAIRMAN BONACA: Who is going to do the  
14 verification? Who is going to --

15 MR. BURTON: You're right.

16 MR. ELLIOT: I just want to talk about the  
17 small-bore piping.

18 CHAIRMAN BONACA: Yes. Just an example.

19 MR. ELLIOT: Specifically, when Butch did  
20 the audit of the small-bore piping, he came back with  
21 the audit results. We reviewed those audit results.

22 What they were doing was they were  
23 consistent with GALL for small-bore piping. And what  
24 it says is for the small-bore piping, you ought to do  
25 a volumetric examination, in addition to the regular

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1 ISI.

2 So they were committed to that. Where we  
3 found that they were short was that they didn't say  
4 where they were going to do it. So we were concerned  
5 about that. In fact, the GALL is sufficient in that  
6 area.

7 So we went back to them in this area. And  
8 we told them they have to do an evaluation of where  
9 their susceptibility is, stress corrosion cracking or  
10 thermal fatigue-type problems.

11 They committed to do that as part of their  
12 future evaluation. That gave us the assurance that  
13 they would be picking the right location. So they are  
14 going to do an engineering evaluation as part of it to  
15 pick the right location.

16 CHAIRMAN BONACA: But do you feel  
17 comfortable that you looked at all of the issues?

18 MR. ELLIOT: Well, the two issues that we  
19 were concerned about were small-bore piping with the  
20 thermal fatigue issue --

21 CHAIRMAN BONACA: I understand.

22 MR. ELLIOT: -- and the stress corrosion  
23 cracking.

24 CHAIRMAN BONACA: But there are other  
25 one-time inspections. And for each one of them, you

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1 have to go back and do this kind of communication.  
2 And then it's back to --

3 MR. ELLIOT: I can't speak for all. I  
4 just can speak for the small-bore pipe.

5 CHAIRMAN BONACA: I understand.

6 MR. BURTON: But what you're saying is  
7 true. What Barry just expressed in terms of  
8 small-bore piping we did with other things as well.

9 CHAIRMAN BONACA: Yes.

10 MR. BURTON: And that is what we have  
11 documented in Appendix A of the SER in the commitment  
12 table. And what we confirmed is in their  
13 commitment-tracking system, to that level of detail  
14 for small bore as well as other systems.

15 CHAIRMAN BONACA: Now, GALL doesn't  
16 specify that. Do you feel that at some point the GALL  
17 has to be revised to include more detail since --

18 MR. ELLIOT: We are revising GALL to have  
19 a small-bore piping separate document.

20 CHAIRMAN BONACA: It seems to be generally  
21 appropriate because there is such a reliance on GALL  
22 for a description of programs such that they can say,  
23 "Yes. We'll meet GALL." Then there has to be some  
24 definition of the concern that staff has. And we'll  
25 continue to use --

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1 MR. ELLIOT: And this came up because of  
2 the audit and the inspection. And we fixed it, I  
3 think, fixed it for this application. And for future  
4 ones, we're changing GALL to include that type of  
5 direction.

6 MR. KUO: And, Dr. Bonaca, this is also  
7 one of the ISG issues.

8 CHAIRMAN BONACA: Okay.

9 MR. KUO: It's being developed.

10 MR. BURTON: That's basically it in terms  
11 of a summary of the safety inspections. Very quickly,  
12 we did the environmental review. We found everything  
13 to be okay. We didn't find anything that we saw could  
14 be a problem to prevent them from pursuing the license  
15 renewal option.

16 As I mentioned before, there were no  
17 requests for a hearing or petitions to intervene. So  
18 we met 2.758. And, last slide, -- we actually made it  
19 -- where I started off, the three conditions for  
20 granting a renewed license. All three have been met.

21 CHAIRMAN BONACA: I have a question for  
22 the applicant. We heard before that at some point,  
23 you will have all of these commitments and procedures.

24 And Mr. Rosen here pressed for the issue  
25 of, will you have a person who coordinates that and

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1 keeps the memory of this program? And you said no,  
2 maybe yes, you will have some.

3 It seems to me that there is a lot of work  
4 to be done still. So do you have a project right now  
5 that would stay alive until everything is in place?

6 MR. GAMBHIR: Yes, we do have that. As a  
7 matter of fact, I have a copy of all of the actions  
8 that we have identified. And in there, there are  
9 hours that have been identified, the duration, how  
10 long it will take. We are supposed to do that.

11 CHAIRMAN BONACA: The project will  
12 continue. Right now --

13 MR. GAMBHIR: Right. The project will  
14 continue. What we are calling on is now -- I didn't  
15 mention that earlier, but my responsibility is to run  
16 all the projects that we are doing, all the big ones  
17 we're doing.

18 And one of the new projects that we have  
19 identified is we are calling that a license renewal  
20 implementation project. So it has its own budget for  
21 next year. The idea is that I am aware of the fact  
22 that people walk away when the project is done. We  
23 have celebrated success. And then we will move on.

24 The dirty work still needs to get done.  
25 Somebody has to update the drawings and those kinds of

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1 things. So the answer is yes. The project will  
2 continue next year.

3 As a matter of fact, Ken Henry, who works  
4 for Dr. Gasper, has responsibility to get all of  
5 these things done and implement the project.

6 CHAIRMAN BONACA: What do you do with the  
7 requirements for license renewal in the procedure? Do  
8 you flag it as an LRA requirement?

9 MR. GAMBHIR: Yes. That's our normal  
10 process.

11 CHAIRMAN BONACA: You press it back to  
12 this master document that you keep with that so that  
13 you have an understanding of where it came from?

14 MR. GAMBHIR: That is correct. What we do  
15 is you bracket the commitments. And then there is a  
16 reference on the back, simple thing that works for us.

17 VICE CHAIRMAN WALLIS: Can I ask the  
18 applicant if they have found that this GALL-centered  
19 process was particularly helpful or was it a pain or  
20 what?

21 DR. GASPER: It was certainly a learning  
22 experience.

23 MR. VAN SANT: It was helpful in that it  
24 did make clear on a lot of the programs that we use  
25 what the expectations of the commission are. So from

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1 that aspect, we knew going in what our programs needed  
2 to do. And it did help from that aspect.

3 Being the first plant, it was a lot of  
4 lessons learned coming out of it. But it was  
5 definitely worthwhile.

6 CHAIRMAN BONACA: One last question I had  
7 would be, do you find that GALL was helpful to you,  
8 not the process itself but just the whole GALL report,  
9 in clarifying issues, for example, the expectation  
10 that the staff has that?

11 MR. VAN SANT: Yes. Like I said, it made  
12 it very clear what the expectations were for the  
13 programs.

14 CHAIRMAN BONACA: And insofar as the  
15 discrepancy in scoping determination, I mean, you had  
16 a methodology and you concluded that the component is  
17 not in scope. Staff came in using the same  
18 methodology and concluded that the item should be in  
19 scope.

20 Do you feel that there is a problem there  
21 in general or more guidance should be needed for you  
22 to converge?

23 MR. VAN SANT: I think every plant is  
24 going to have gray areas. We're not a standardized  
25 design.

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1 CHAIRMAN BONACA: I understand that. Yes.

2 MR. VAN SANT: That's where these come up.

3 CHAIRMAN BONACA: Yes.

4 MR. VAN SANT: Our position was  
5 essentially not to argue over the gray areas. And it  
6 came up as an issue with the commission. We basically  
7 accepted their position and went forward with it.

8 CHAIRMAN BONACA: But you find that the  
9 guidance is adequate?

10 MR. VAN SANT: Yes.

11 CHAIRMAN BONACA: Thank you.

12 MR. BURTON: Thank you. I appreciate it.

13 CHAIRMAN BONACA: Any other questions?

14 (No response.)

15 CHAIRMAN BONACA: None? I thank you for  
16 a very informative presentation, as always.

17 MR. BURTON: A little too informative.

18 CHAIRMAN BONACA: No. You really stayed  
19 within the time. We gained five minutes. So we will  
20 now take a recess for lunch. And we will meet again  
21 at 1:00 o'clock.

22 (Whereupon, at 11:56 a.m., the foregoing  
23 matter was recessed for lunch, to  
24 reconvene at 1:00 p.m.)

25 CHAIRMAN BONACA: We are resuming the

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1 meeting. The next item on the agenda is Interim  
2 Review of the AP1000 design and Dr. Kress will lead us  
3 in the presentation.

4 MEMBER KRESS: I don't know if "lead  
5 through" the presentation is the right word or not,  
6 but this is another one of our interim meetings to be  
7 sure we keep AP1000 certification on our front burner  
8 and in front of us.

9 It's to deal with some of the items that  
10 we had asked for additional information on before, in  
11 particular, squib valve reliability and containment  
12 lambda and a few other things like remind us of the  
13 design features and some of the open items in the SER.

14 But at this moment I don't anticipate a  
15 letter, unless one of you guys come up with some sort  
16 of burning issue that you think has to have a letter  
17 to document it.

18 VICE CHAIRMAN WALLIS: It's more likely to  
19 be a cooling issue rather than a burning issue.

20 MEMBER SHACK: If there's a failure of  
21 cooling, then it will be a burning issue, won't it?

22 MEMBER KRESS: But anyway, with that  
23 unless some of you fellows want to make statements,  
24 I'll turn it over to -- Mike, did you want to say a  
25 few words first?

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1 MR. CORLETTI: No, today's presentation is  
2 going to be Ron Vijuk, our Engineering Manager, on the  
3 AP1000.

4 MR. VIJUK: I'm Ron Vijuk. It's nice to  
5 be here. What we plan for today, to give you the  
6 status report on where we are on the design cert.  
7 review on AP1000 is first to go quickly through an  
8 overview of the plant design to refresh our memories  
9 there and then get into the design certification  
10 status and in particular, talk about the open items  
11 that we're working on with the staff to get resolved  
12 in the near term.

13 And finally, a couple of technical  
14 presentations on specific topics that we've heard  
15 there's interest on from ACRS, one on the ADS4 squib  
16 valves and one on post LOCA aerosol deposition  
17 calculations.

18 A little bit about AP1000, I think the  
19 main thing here is that the AP1000 -- we've tried to  
20 keep the design, the plant design and its features as  
21 close to the AP600 design as possible. And this  
22 allows us to take advantage of all the engineering  
23 work that went into the AP600 in the 1990s and apply  
24 it to the AP1000. So we view the AP1000 essentially  
25 an uprate of the AP600.

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1           It is an integrated plant design. That  
2           is, we're looking at the total plant, not just the  
3           nuclear side of the plant, but the total plant and  
4           that's important as a design to plant and especially  
5           in the way they do the physical arrangement of the  
6           plant.

7           The AP1000 has a simplified reactor  
8           coolant system loop compared to our traditional PWR  
9           plants by using canned motor pumps and we keep all the  
10          primary loop piping above the reactor core.

11          We use simplified, passive safety systems  
12          which you've all heard about in previous meetings and  
13          I'll go over it briefly. Of course, in the control  
14          room and in the I&C area we're using digital  
15          technology. An important aspect of the passive safety  
16          systems are that we have no requirement for outside AC  
17          power. Everything is either self-actuated or powered  
18          from batteries, AC powered.

19          MEMBER KRESS: Just one question on your  
20          canned motor pumps?

21          MR. VIJUK: Sure.

22          MEMBER KRESS: Have you used canned motor  
23          pumps this size before? Have they been in use?

24          MR. VIJUK: The history on canned motor  
25          pumps is that they are used extensively by the Navy

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1 and we're even using some of the early plants like  
2 Shippingport. The size of pump we're using in AP1000  
3 is bigger than the size we've applied in those  
4 applications.

5 Yes, so it is --

6 MEMBER KRESS: Does their PRA have a  
7 reliability number?

8 MR. VIJUK: The pump really doesn't come  
9 into the PRA. It's a normal operating thing. The  
10 pumps are actually, when the safety systems are  
11 actuated, the pumps are tripped.

12 MEMBER KRESS: I was thinking about a loss  
13 of coolant just by losing the pump itself as an  
14 initiating event.

15 MR. VIJUK: I guess in that sense it does  
16 come into the PRA and a loss of flow event, these kind  
17 of things and there's a probability assigned to that,  
18 but yes, it's factored in in PRA in that way, yes.

19 CHAIRMAN BONACA: We are resuming the  
20 meeting. The next item on the agenda is Interim  
21 Review of the AP-1000 design and Dr. Kress will lead  
22 us in the presentation.

23 MEMBER POWERS: You still have the  
24 problem.

25 MEMBER KRESS: How do you know what the

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1 reliability is?

2 MEMBER POWERS: How do you get that  
3 probability? Pull one out of the air?

4 MEMBER KRESS: I guess that's a PRA issue  
5 and we'll bring it up again when we get to the PRA, if  
6 we haven't viewed it.

7 MR. VIJUK: Shall we go on? Okay. The  
8 control room is a compact control room taking  
9 advantage of digital technology there as well.

10 Another important feature of the design is  
11 that we've made extensive use of modular construction  
12 techniques, so the way we put the structures together  
13 is a bit different than previous plants.

14 The primary system is made up of  
15 convention components, if you will, but in a slightly  
16 different configuration in the typical Westinghouse  
17 PWR, with the canned motor pumps and the loop piping  
18 above the core, but the basic components, the reactor,  
19 the steam generators, the pressurizer are all  
20 basically the same as today's plants with the  
21 upgrades, if you will, from lessons learned over the  
22 years.

23 The canned motor pumps, of course, as  
24 we've just discussed is a new feature on modern plants  
25 at least.

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1           The reactor design is -- we use 14-foot  
2   fuel and it's very similar to South Texas in that  
3   sense and to the two plants in Belgium that use  
4   exactly this core size, 157 assemblies and 14-foot  
5   fuel.

6           Steam generators are bigger than a typical  
7   Westinghouse --

8           MEMBER ROSEN:   Before you get off that  
9   point, you're still on a bullet of proven reactor  
10  design fuel.    You've got no bottom mounted  
11  instrumentation. What do you do about -- you need to  
12  do plug profiles and things like that?

13          MR. VIJUK:    We have fixed in-core  
14  detectors.    They come in from the top.   This -- a  
15  typical Westinghouse plant has moveable in-cores  
16  coming from the bottom, but in this design there's no  
17  penetrations in the bottom head.

18          MEMBER SIEBER:   What kind of detectors are  
19  they, gamma thermometers or fission chambers?

20          MR. VIJUK:    These are -- I want to say the  
21  material, but -- rhodium or vanadium.   The combustion  
22  engineering plants use these routinely.

23          MEMBER SIEBER:   Okay.

24          MEMBER KRESS:   Does anybody use gamma  
25  thermometers at all?

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1 MEMBER SIEBER: Pardon?

2 MEMBER KRESS: I didn't think anybody used  
3 gamma thermometers.

4 MEMBER SIEBER: They use them in Europe,  
5 but they were trying to market them here and I don't  
6 know whether anybody picked up on it or not.

7 MR. VIJUK: The basic story here is that  
8 this equipment is basically the same, very similar to  
9 operating plants, except the canned motor pump.

10 MEMBER KRESS: Was the canned motor pump  
11 to get rid of the pump seal LOCA problem?

12 MR. VIJUK: Well, actually, it's driven  
13 more by reliability.

14 MEMBER KRESS: Reliability.

15 MR. VIJUK: And when we were first putting  
16 the design together with the utility people, there  
17 were a lot of people with Navy experience and at that  
18 time, at least, people were having problems with the  
19 shaft shield pumps and there was a lot of influence  
20 from these people to adopt these kind of pumps for  
21 this redesign. That's where it came from.

22 AP1000, just like the AP600, uses passive  
23 safety systems and we use passive processes only, so  
24 we don't need diesel generators and big equipment,  
25 rotating equipment to operate the safety systems.

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1 This reduces the dependency on operator reactions and  
2 with these passive systems, we can mitigate the design  
3 basis accidents, but we still have the backup from the  
4 active systems as another level of defense for beyond-  
5 design-basis accidents.

6 MEMBER SHACK: Actually, if you could use  
7 the backup systems, an operator would prefer to do  
8 that rather than go through the passive?

9 MR. VIJUK: That's right, and for most  
10 kinds of events, the normal systems will reactor to an  
11 event and take care of the plant.

12 MEMBER SHACK: Right.

13 MR. VIJUK: And the operator will use  
14 those. These are the normal operating systems.

15 MEMBER SHACK: Right.

16 MR. VIJUK: And some of the features of  
17 the passive system, this is the passive decay heat  
18 removal system which is a heat exchanger located in  
19 the large IRWST in containment refueling water storage  
20 tank. There's inside containment and it operates by  
21 natural circulation from the hot leg and returning to  
22 the channel head of the cold side of the steam  
23 generator to set up a natural circulation loop to  
24 remove decay heat for transient events, basically,  
25 non-LOCA type events.

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1 MEMBER KRESS: Now what does your active  
2 system look like for doing that same function?

3 MR. VIJUK: It would be the emergency  
4 feedwater system, feeding the steam generator and  
5 removing the heat through the steam generator.

6 MEMBER KRESS: Steam generator?

7 MR. VIJUK: And we do have an active, we  
8 call it the start up feedwater system.

9 We do have a normal feedwater and what we  
10 call a start up feedwater system that functions in  
11 much the same way as an emergency feedwater system,  
12 but it's designed mainly for normal conditions.

13 MEMBER SIEBER: You also have diesels,  
14 right?

15 MR. VIJUK: Yes, we have two emergency  
16 diesels that power the loads in a blackout situation  
17 or a loss of off-site power situation.

18 Safety injection systems is made up of a  
19 series of tanks at different pressures. The core make  
20 up tanks is two of these. These are large tanks,  
21 inside containment at full system pressure and can  
22 naturally circulate to the primary system in the event  
23 you need emergency makeup. In a LOCA situation, if  
24 the level drops down to the level of the cold legs,  
25 then they will drain by steam flowing up this line and

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1 water flowing into the vessel. So this is both like  
2 an emergency boration system for transient events and  
3 high head safety injection make up for LOCA events.

4 And then we have two accumulators, very  
5 much like traditional plants that provide rapid  
6 reflooding of the vessel after a large LOCA and these  
7 are at 700 psi.

8 And then we have a very large tank, the  
9 in-containment refueling water storage tank which  
10 provides a low head safety injection by gravity  
11 feeding to the reactor vessel. This is longer term  
12 makeup from this tank to the reactor in a post-LOCA  
13 situation.

14 And we get the pressurization through the  
15 ADS system which is -- there are four stages. Three  
16 are under pressurizer where these are opened up  
17 sequentially. Once you have a signal that there's a  
18 LOCA, you get that by the core makeup tank starts to  
19 drain and it reaches a set point and actuates the ADS.  
20 And this brings the pressure down in a controlled  
21 fashion so the accumulators can help inject and  
22 finally the fourth stage of ADS coming off the hot  
23 legs brings you down to near the containment pressure  
24 so that the head of water in the IRWST can feed the  
25 reactor vessel.

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1 MEMBER KRESS: Does your IRWST have a  
2 closed lid?

3 MR. VIJUK: There's a floor on top of this  
4 with vents in it, so it's a covered tank.

5 MEMBER KRESS: It's a vented --

6 MR. VIJUK: It's open to the atmosphere of  
7 the containment essentially through the events. It's  
8 a big pool with a cover.

9 MEMBER KRESS: And you have ways to duct  
10 the containment condensate back into that tank?

11 MR. VIJUK: Yes. And ultimately the  
12 containment floods up, the design can flood up so that  
13 the level in the containment in the long term and this  
14 is several hours after a local is up to about the  
15 reactor vessel's flange level and then this pool can  
16 continue through these recirc screens, continues to  
17 feed the reactor from the pooling containment and this  
18 way you set up a -- you're steaming the containment  
19 through the ADS pads, condensing in containment. We  
20 have a gutter system that drains the water back to the  
21 pool in containment or the IRWST. So we set up a  
22 continual process of feeding the core.

23 MEMBER RANSOM: Have you done anything  
24 special as far as possible debris plugging in the  
25 IRWST and also the research screens?

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1 MR. VIJUK: Yes, these are designed  
2 specifically to address the potential for debris  
3 plugging, yes, and they're much bigger than current  
4 plants, sump screens and this is one of the items  
5 we've been discussing with the staff and we are  
6 basically following what's happening with the  
7 operating plants, but we're in much better condition  
8 because of the bigger screens and lower velocities  
9 that we had in this design.

10 MEMBER KRESS: You have all reflective  
11 insulation?

12 MR. VIJUK: We have all reflective  
13 insulation in areas that can be affected by LOCA.

14 MEMBER KRESS: That's what I meant.

15 MR. VIJUK: The ultimate heat sink is the  
16 passive containment cooling system and we had the  
17 containment for this plant is a steel pressure vessel  
18 and we cooled the outside of this pressure vessel with  
19 gravity flow of water from a tank on the roof of the  
20 chill building that puts a film of water on the  
21 outside of this steel vessel and then natural  
22 circulation of air flowing up through, alongside the  
23 containment vessel, sets up an evaporative cooling  
24 process that removes heat through the shell that's  
25 coming from the decay heat steaming into the

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1 containment and condenses. And then the steam  
2 condenses on the inside, flows back into the IRWST or  
3 the pooling containment.

4 MEMBER ROSEN: How do you provide normal  
5 containment atmosphere cooling?

6 MR. VIJUK: We have fan coolers,  
7 conventional type system. A little bit about PRA,  
8 just like most plants that have been through design  
9 certification, the redundancy and diversity and  
10 reliability that we can design into the plant and give  
11 us a very good result in terms of the core damage  
12 frequency.

13 We've addressed severe accidents in AP1000  
14 just as we did in AP600. We had to do some extra work  
15 for AP1000 to configure the insulation. In fact, this  
16 is a little bit out of date. We have run heat  
17 transfer tests to improve the heat transfer capability  
18 on the bottom of the vessel by streamlining the  
19 insulation designed to get a good flow path for water  
20 cooling on the outside of the vessel. And the  
21 automatic depressurization system helps with issues  
22 like high-pressure core melt. We have igniters in the  
23 system dealing with hydrogen and the ADS and in-vessel  
24 retention also help deal with the issues of steam  
25 explosions and severe accidents.

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1 MEMBER POWERS: Can I understand better  
2 about in-vessel retention? That means that you're  
3 going to try to keep the core debris on the lower  
4 head?

5 MR. VIJUK: Yes, the idea is that the core  
6 debris, if you lose all cooling on the inside of the  
7 vessel, core debris will eventually end up in the  
8 lower head and with the cooling on the outside, the  
9 heat transfer is sufficient to maintain the thickness  
10 of vessel head here to support the core debris.

11 MEMBER POWERS: How do you determine what  
12 heat flux you need to be able to extract with that  
13 water?

14 MR. VIJUK: By analysis of the molten  
15 pools.

16 MEMBER POWERS: I see. And what does that  
17 analysis entail?

18 MR. VIJUK: I'll have to ask Jim Scobel to  
19 speak to that a little bit.

20 MR. SCOBEL: Hi, this is Jim Scobel. We  
21 looked at two different debris -- lower head debris  
22 bed configurations. Our base case was metal over  
23 oxide debris bed, similar to what we did for AP600 and  
24 as a sensitivity case we looked at a debris bed with  
25 heavy metal uranium-zirconium-steel configuration at

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1 the bottom with a large fraction of decay heat in that  
2 lower layer and also concluded that that would not  
3 fail the lower head.

4 MEMBER POWERS: What did you use for the  
5 heated solution?

6 MR. SCOBEL: It was assumed to be much  
7 less than the amount of decay heat that we had in the  
8 --

9 MEMBER POWERS: I'm not sure what that  
10 means.

11 MR. SCOBEL: Bottom metal layer. We made  
12 a very strong assumption of the amount of heat that  
13 was from the decay heat and the other heat sources  
14 were considered to be secondary to that amount of heat  
15 that was from the decay heat.

16 MEMBER POWERS: I guess I don't understand  
17 what you mean by that. Decay is being produced at  
18 some rate, right?

19 MR. SCOBEL: Yes.

20 MEMBER POWERS: And what did you take at  
21 the rate at which heat was being generated by  
22 materials dissolving in the melt?

23 MR. SCOBEL: Well, you have an oxidation  
24 reduction reaction which is going to --

25 MEMBER POWERS: Where is this oxidation

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1 reduction reaction taking place?

2 MR. SCOBEL: It would be in the oxide  
3 layer.

4 If you had metallic zirconium and molten UO2 in  
5 contact with each other, you would have an oxidation  
6 reduction reaction which is at most mildly exothermic.

7 MEMBER POWERS: I would be more concerned  
8 with the heat evolved as I dissolved my lower head.

9 MR. SCOBEL: Well, that was not  
10 considered.

11 MEMBER POWERS: That's where your critical  
12 phenomenon on cooling is taking place, isn't it?

13 I mean it doesn't matter what's going on  
14 really in the oxide.

15 MR. SCOBEL: I'm sorry, say that again?

16 MEMBER POWERS: The critical issue is  
17 what's going on at the lower head and so if you have  
18 a metallic metal attacking a metallic solid and  
19 dissolving that solid and that is involving heat, that  
20 gives you the chance for self-propagating attack and  
21 that's the thing you need to worry about and I'm  
22 asking what you took for that?

23 MR. SCOBEL: Nothing.

24 MEMBER POWERS: That's probably not  
25 conservative, is it?

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1 MR. SCOBEL: Well, there were additional  
2 analyses done to support ex-vessel steam explosion  
3 core-concrete interaction and those --

4 MEMBER POWERS: That's not the issue here,  
5 is it?

6 MR. SCOBEL: No, but it's --

7 MR. VIJUK: The issue is whether a crust  
8 forms on the pool?

9 MR. SCOBEL: No, you don't have a crust  
10 forming on the pool in the metal layer.

11 MR. VIJUK: In the bottom metal layer.

12 MR. SCOBEL: In the bottom metal layer.

13 MEMBER POWERS: You'll get a metallic melt  
14 down there and it could crust, but won't last very  
15 long and it would self-dissolve or in dissolving the  
16 metal, you're paying the price of heat of melting, but  
17 you're getting it back from the heat of dissolution,  
18 except you didn't in your calculation, because you  
19 only paid the price of melting the vessel head metal.

20 MR. VIJUK: It seems like we might want to  
21 talk about this off-line a bit.

22 MEMBER POWERS: Or we could talk about it  
23 on-line.

24 (Laughter.)

25 What's the metal you had down there? You

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1 told me that you took a uranium-zirconium rich heavy  
2 metal and put it down.

3 MR. SCOBEL: Right.

4 MEMBER POWERS: What does the phase  
5 diagram look like on that system?

6 MR. SCOBEL: It didn't have a phase  
7 diagram for that system.

8 MEMBER POWERS: Well --

9 MR. SCOBEL: We made some conservative  
10 assumptions with respect to melting temperature for  
11 the vessel head.

12 MEMBER POWERS: I guess there are what,  
13 five primary papers and at least one review paper on  
14 the system in the literature and they'll show you have  
15 a very, very large inter-metallic lattice phase there  
16 with a very strong heat of reaction. So now what's  
17 the justification for taking no heat of solution?

18 MR. SCOBEL: As I said, we assumed that it  
19 was much, much less than the amount of decay heat in  
20 that metal layer which we took a very high value for.

21 MEMBER POWERS: It seems like you have a  
22 pretty strong assumption here. Are you going to do an  
23 experiment to validate this?

24 MR. SCOBEL: No.

25 MEMBER KRESS: Decay heat is distributed

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1 through the melt and dissolution heat is localized  
2 right at the interface so even if it were smaller, it  
3 could have a bigger effect on whether or not -- the  
4 issue is whether or not in-vessel retention is  
5 actually a reality or whether you penetrate the  
6 vessel.

7 I think Dana has really a legitimate  
8 point. I don't know how much credit you're taking for  
9 in-vessel retention in terms of -- of course, it never  
10 arises in design bases accident phase at all, but it  
11 arises -- comes about in PRA space and risk space and  
12 I guess we were wondering what effect that would have  
13 on your LERF, for example, calculation.

14 If your CDF is in need of 4 times  $10^{-7}$  it  
15 may not make any difference. But I think it's a  
16 legitimate question if you're really relying on in-  
17 vessel retention.

18 MR. SCOBEL: Well, in terms of LERF, it  
19 really doesn't make an impact just because from an ex-  
20 vessel steam explosion point of view which would be  
21 the primary method for filling the containment early.

22 MEMBER KRESS: That's another issue. I'm  
23 not sure we know how to do ex-vessel steam explosions  
24 very well and so I'd have to look at your calculations  
25 for that also.

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1 But in risk base it may not be an issue  
2 because you have such a good CDF and I guess it would  
3 arise as a potential issue if we had rules that talk  
4 about balance between LERF and CDF.

5 MEMBER ROSEN: Things like rules called  
6 defense-in-depth.

7 MEMBER KRESS: Yes, but we don't have any  
8 rules. We just have some main guidance.

9 MEMBER POWERS: The question I'd ask you,  
10 Tom, is suppose that I came in and said  $F + 1/2$  MA.

11 (Laughter.)

12 But it's okay, it doesn't make any  
13 difference in risk base. But it's offensive to the  
14 soul.

15 (Laughter.)

16 MEMBER KRESS: I can understand that very  
17 well.

18 MEMBER POWERS: There's a point where you  
19 say, look, you've got to do a technically defensible  
20 job on these things. I don't care what the risk is.

21 CHAIRMAN BONACA: We are resuming the  
22 meeting. The next item on the agenda is Interim  
23 Review of the AP-1000 design and Dr. Kress will lead  
24 us in the presentation.

25 MEMBER ROSEN: One of our Members once

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1 made a distinction between things that were  
2 nonconservative and things that were just plain wrong.

3 (Laughter.)

4 MEMBER KRESS: Was that Graham Wallis?

5 MEMBER ROSEN: I believe it was the  
6 professor on the ACRS staff.

7 MEMBER KRESS: Anyway, the thought we'd  
8 like to leave with you. We won't have a letter on  
9 that at this time. We'll have it in the notes.

10 MR. VIJUK: I think we understand the  
11 question.

12 MEMBER FORD: At the last July meeting, I  
13 brought up four related questions, two of them have  
14 been answered.

15 There was another part that relates to  
16 this diagram. The core shroud barrel is presumably  
17 going to be made, as I understand it, from 316L cold  
18 wet, serial welded which in the high flux areas  
19 increased high flux areas is likely to crack or could  
20 crack. That in itself would maybe not be so bad, but  
21 I understand the diagrams correctly, during a severe  
22 accident, we'd have a lot of cold water impacting on  
23 that maybe cracked core shroud.

24 I know you've addressed this question.  
25 Could you give us the answer very briefly?

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1 MR. VIJUK: I'm not sure I really  
2 understand the question. We're cooling the outside of  
3 the reactor vessel in this scenario.

4 MEMBER FORD: From some of the diagrams.  
5 It's not shown on this diagram. But during an  
6 emergency cooling situation --

7 MR. VIJUK: During a LOCA situation --

8 MEMBER FORD: You've got a whole lot of  
9 cold water impacting on that core shroud. Is that  
10 correct or was I misreading the diagram.

11 MR. VIJUK: The core barrel injection  
12 comes in here and there's a core barrel --

13 MEMBER FORD: Core barrel. I was using  
14 PWR -- sorry. Core barrel.

15 MR. VIJUK: Yes, the injection water  
16 impacts on the core barrel.

17 MEMBER FORD: Which could be cracked.  
18 What's the impact of that severe accident situation?

19 MR. VIJUK: I don't have the answer to  
20 that and I don't think we have the material expert  
21 here to deal with it right now.

22 MEMBER FORD: But I know you are  
23 addressing that issue.

24 MR. VIJUK: This is the last one on the  
25 plant. This is just to show a comparison to the

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1 Sizewell plant in terms of what the passive systems  
2 allow you to do in terms of getting the safety systems  
3 into a compact arrangement.

4 Now we'll move on to where we are in the  
5 design certification process and what issues we're  
6 doing with. These first 5-mile stuns as you can see  
7 we've been through and this is pretty much the  
8 schedule that we sent out at the beginning of the  
9 project back beginning of 2002.

10 The staff issued their draft SER on June  
11 16th with 174 open items and we're now in the process  
12 of working through those open items to resolve them  
13 and the next few slides we'll go through the  
14 particulars of that.

15 The key issues are listed here. Thermal  
16 hydraulic issues associated with small-break LOCA and  
17 I'm going to go through that in more detail. The rest  
18 of these I'll just talk about from this slide.

19 Structural design of nuclear island  
20 critical structures, the open item was to do more  
21 detailed analysis of some of the structural and  
22 seismic analyses. We've completed that. There will  
23 be a meeting with a technical audit meeting with the  
24 staff next week in Pittsburgh to review the results of  
25 that.

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1 Acceptance of leak-before-break for  
2 AP1000. The basic issue here was the amount of piping  
3 analysis necessary of design certification stage to be  
4 able to identify which piping systems were eligible  
5 for leak-before-break and we have submitted some  
6 additional analyses of certain piping areas and  
7 provided the rationale for evaluating the rest of the  
8 leak-before-break piping arrangements. And this will  
9 be discussed in a technical meeting tomorrow with the  
10 staff.

11 Miscellaneous PRA items. There were a  
12 number of open items in the PRA and mainly clean-up  
13 items but some involved additional sensitivity studies  
14 and evaluating sensitivity to squib valve reliability  
15 which we'll talk more about today.

16 Sump performance. This is the issue we  
17 talked about a little bit before about the current on-  
18 going issue for the operating plants with regard to  
19 potential sump blockage and we've responded to these  
20 items and are continuing to follow what's happening  
21 with the operating plant discussions.

22 Security. The new design basis threat  
23 came out earlier this year. In AP1000 we've tried to  
24 deal with the items that could impact the plant design  
25 itself and factor that into our design certification

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1 documentation. Most of the security issues are  
2 related to the plant operator and will be dealt with  
3 at the combined licensed stage.

4 Dose analysis. The control room  
5 methodology, the staff recommended methodology has  
6 changed since AP600 and there's a NUREG guide on that  
7 with a different methodology. We have redone our  
8 analysis for AP1000 with that methodology and  
9 submitted it to staff. 10 CFR 50.44 is the hydrogen  
10 combustible gas rule which we had anticipated actually  
11 in the AP1000 design documentation in that we don't  
12 have recombiners for design basis accidents, but we do  
13 have some passive recombiners in the system.

14 And then there were miscellaneous ITAAC  
15 items where there were open items on addressing  
16 specific comments about how the ITAACs were written or  
17 their content.

18 I'll get into the thermal hydraulic items  
19 which was a main topic for the subcommittee meetings  
20 we had in July in Pittsburgh.

21 And then there's three basic issues  
22 involved in the open items in this area: upper plenum  
23 and hot leg entrainment which has been an issue in  
24 this area; COBRA/TRAC modeling for long-term cooling  
25 and boron precipitation during long-term cooling and

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1 we'll talk about what we're doing on each of these  
2 items.

3 The entrainment issue derived from when we  
4 were doing studies before we submitted our design  
5 certification application, we did precertification  
6 review, if you'll recall where we looked at the  
7 testing and codes that we used for AP600 and assess  
8 their applicability to AP1000. And in particular, we  
9 looked at the test programs that were done for AP600  
10 and assessed their scaling relative to AP1000 and  
11 concluded that the AP600 tests were appropriately  
12 scaled even for the AP1000 conditions, but the issue  
13 that came out at that time and we'd been working on  
14 since was basically with the higher power in AP1000,  
15 we could higher steam velocities above the core and in  
16 the upper plenum hot legs and this could affect the  
17 amount of liquid that gets discharged through the ADS  
18 system and therefore have an effect, potentially have  
19 an effect on core cooling.

20 So ultimately the staff wrote a letter  
21 saying we want to see test data and we've completed  
22 some testing at Oregon State University in a facility  
23 called APEX-1000. This is the same facility that was  
24 used for AP600. It was modified to represent the  
25 AP1000, more heaters put in. Or bigger heaters put in

1 to represent the power and some of the components were  
2 changed to reflect the changes that were made in going  
3 from 600 to 1000 in the real plant.

4 We have submitted to the staff a series of  
5 reports describing the facility, the scaling  
6 assessment test reports and data for five tests and  
7 our conclusion from these tests is that the behavior  
8 for APEX-1000 is essentially the same as it was for  
9 APEX-600 in terms of the overall performance of the  
10 passive systems.

11 And we've also submitted to the staff  
12 NOTRUMP simulation of two of the APEX-1000 tests and  
13 the simulations show good agreement like we had on  
14 AP600 and these tests showed no core uncovering for the  
15 design basis accident testing.

16 Several other things we've done and  
17 discussed with the thermal hydraulic subcommittee at  
18 the last meeting and we submitted these to the staff  
19 and the staff is having the chance to review them. We  
20 did a sensitivity study with our small break code,  
21 NOTRUMP, where we assumed that all of the flow beyond  
22 the core exit going through the ADS core pipe behaved  
23 in a homogenous way and this way tried to bound the  
24 effects of entrainment in the upper plenum and hot leg  
25 so that you get as much water out of the system as you

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1 can.

2 And even with this assumption, we got no  
3 core heat-up from -- in the analysis.

4 Kind of a side validation, the question  
5 came up about what's the void fraction profile in the  
6 reactor core under these low pressure conditions when  
7 you're making up from the IRWST and from the sump and  
8 so we looked at the void fracture models that's used  
9 in the NOTRUMP code and compared it to the full scale  
10 rod bundle data from years past to validate the void  
11 model used in NOTRUMP.

12 And then we did kind of a first principles  
13 analysis that we called the simple model or the Bill  
14 Brown Model, some people call it, to assess what is  
15 the quasi-steady condition after you depressurize the  
16 primary system and you're feeding by gravity on one  
17 side and discharging the decay heat through the ADS  
18 four paths on the other side, what is the quasi-steady  
19 condition that you would expect the system to come  
20 through based on just looking at conservation of the  
21 energy and mass and momentum?

22 And this simple model allows us to look at  
23 that and during the conditions when you're going from  
24 -- when you open the final stage of ADS on the hot  
25 legs and the pressure is coming down the last little

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1 bit and you're starting to get injection from a head  
2 of water stored in containment.

3 And we did some sensitivity studies with  
4 this to -- some parameters in the model that represent  
5 the void equation like a ZC row parameter and recently  
6 we've done one to look at the effective of slip ratio,  
7 the base model used homogenous flow and then we looked  
8 at some slip conditions to see the impact of that and  
9 the conclusions from this is that the system behavior  
10 that we're seeing in the test and in the NOTRUMP code  
11 is to be expected based on the first principles --

12 VICE CHAIRMAN WALLIS: Now in this  
13 interesting period of time, the pressure has dropped  
14 in the detection line, the pressure head valve for  
15 that is balanced by the pressure drop through the ADS4  
16 system, head of water and pressure drop in the lines,  
17 pressure drop out of the break. And to get this  
18 pressure drop out of the break you've got to get the  
19 pressure drop through this rather strange set of pipes  
20 that has Ts and bends and all those things which we  
21 don't how to model very well.

22 I think one of our issues was how do you  
23 assess the behavior of that kind of strange geometry  
24 that you have between your hot leg and your actual  
25 ADS4 valve.

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1 MR. VIJUK: Yes. A couple of things we're  
2 doing to address that is one, we have test results now  
3 from APEX-1000.

4 VICE CHAIRMAN WALLIS: So APEX-1000 has  
5 tried to model really well, all these details of those  
6 bends and Ts.

7 MR. VIJUK: It represents the geometry in  
8 the plant. Whether we have it to the level of detail  
9 that would make you happy, I'm not sure, but we do  
10 have the riser pipe and the horizontal and the exit --  
11 the basic geometry is there, yes.

12 So that gives us some information to deal  
13 with what is the pressure drop through the ADS4 under  
14 various two-flage conditions.

15 The other interesting that we've done  
16 recently is looked back at the ATLAS test that Steve  
17 Bajorek and company ran at OSU, also where they did  
18 air water tests with feeding water in the hot leg and  
19 you have restriction on the other end so you can have  
20 a wave coming back and look at the entrainment they  
21 measured in those tests and the phenomena occurring  
22 there. And we found some other data that supports the  
23 idea that bi-modal operation where you have vapor for  
24 a while and then it cycles and you have liquid for a  
25 while.

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1 VICE CHAIRMAN WALLIS: It's an oscillatory  
2 behavior.

3 MR. VIJUK: Right. So we have data to  
4 deal with the issue.

5 VICE CHAIRMAN WALLIS: Does the APEX have  
6 two ADS4 valves?

7 MR. VIJUK: It simulates the two pipes as  
8 one.

9 VICE CHAIRMAN WALLIS: In one, doesn't it.  
10 So the flow division between the pipes is not  
11 simulated in any --

12 MR. VIJUK: On each side. On one side,  
13 it's --

14 VICE CHAIRMAN WALLIS: On the one side,  
15 coming out of the hot leg you have the vertical riser  
16 and then there's only one valve at the end of that  
17 system?

18 MR. VIJUK: On each side, yes.

19 VICE CHAIRMAN WALLIS: So it's not  
20 duplicating the flow distribution.

21 MR. VIJUK: It doesn't duplicate that  
22 aspect.

23 VICE CHAIRMAN WALLIS: But you're going to  
24 handle that in some impressive way that it's going to  
25 be all right?

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1 MR. VIJUK: I believe so, yes. Yes, I  
2 think so.

3 MEMBER RANSOM: Well, have the issues of  
4 scaling between the subscale model and the full scale  
5 been resolved in that bimodal situation?

6 MR. VIJUK: That's something we're looking  
7 at too, and we've submitted some new information to  
8 the staff on that that we plan to go through tomorrow.  
9 We have a meeting planned for tomorrow to talk through  
10 our responses to the most recent round of question son  
11 these issues.

12 And we have looked at some scaling effects  
13 as well. Yes.

14 VICE CHAIRMAN WALLIS: I think your  
15 argument is going to be that if you've got water going  
16 through the fall line, even if you don't model it very  
17 well, then it must have come from the core and  
18 therefore, there has to be water about the core,  
19 because there's a continuous flow process going on.

20 MR. VIJUK: Yes, I think what we conclude  
21 from all the -- we've run RELAP. We've run  
22 COBRA/TRAC. We've run NOTRUMP. We've run test at  
23 600. We run test at 1000. We've run test in ROSA,  
24 test is SPEDS and they all do the same thing. They  
25 spit water and steam out of the ADS4. And it gets it

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1 down to the pressure you need to inject. So I think  
2 the evidence is pretty strong that the system works.

3 So to resolve this item, I mentioned we  
4 have a meeting planned for tomorrow to work, talk  
5 through with the staff, these various issues  
6 associated with entrainment.

7 VICE CHAIRMAN WALLIS: I'm just wondering,  
8 when do we get to see the details of this? When is an  
9 appropriate time for say, the subcommittee to look at  
10 the details?

11 MR. VIJUK: A lot of the details have been  
12 sent to the staff and certainly those details --

13 VICE CHAIRMAN WALLIS: So maybe in three  
14 or four months or something?

15 MR. VIJUK: -- Can be made available. I  
16 think we'd be ready before that as far as -- to  
17 discuss. A good assessment would be after our  
18 discussion tomorrow.

19 VICE CHAIRMAN WALLIS: I'll see how you  
20 resolve things with the staff, yes.

21 MR. VIJUK: So we've submitted the  
22 additional test information. We've validated NOTRUMP  
23 against the new test. We've done the sensitivity  
24 analyses and simplified models.

25 And we believe this demonstrates that our

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1 DCD analysis is appropriate.

2 Next issue has to do with the long term  
3 proving analysis. This is after you're on to  
4 injection from the gravity systems and you're sitting  
5 there feeding the vessel on one side and steaming from  
6 the ADS4, pulling out into the long term when the  
7 containment floods off and you're feeding from the  
8 sump instead of the IRWST. So you have a lower head  
9 of water, several hours into the event.

10 And the issue that came up was relative to  
11 the sophistication of the COBRA/TRAC modeling that was  
12 done initially in our DCD submittal. We have revised  
13 that model with more noting. It's more like our large  
14 break COBRA/TRAC model now to evaluate this phase of  
15 the performance. So we've done that and completed the  
16 plan analyses. We've provided a model description and  
17 it incorporated the results into Chapter 15 of CDC.

18 The results are, I would say, on a global  
19 basis very similar to the results we had before,  
20 except now we can get a much better picture of the  
21 void profile in the core and this kind of thing during  
22 this period of time.

23 The boron issue is related to -- it's kind  
24 of the flip side of the entrainment issue.  
25 Entrainment says well, maybe this ADS4 is going to

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1 take more water out than you put in and create a core  
2 cooling problem. This is the other side that says  
3 well, maybe you can't get any water out and only steam  
4 comes out and therefore over the long term the boron  
5 concentration will build up in the reactor vessel.

6 So in dealing with this, we've run the  
7 COBRA/TRAC model, this long-term cooling model out at  
8 14 days after the power is way down, trying to get to  
9 a point where you have less steam and less chance with  
10 the steam to entrain water out. We're looking at  
11 lower power levels.

12 And this shows that you continue to get  
13 lots of water out of the system. In fact, as the  
14 power goes down, you get more and more water out of  
15 the system.

16 We've applied a first principle analysis  
17 here to look at the amount of liquid flow and compared  
18 the simple model to the COBRA/TRAC model and then used  
19 the Simple Model to calculate over a very long term  
20 what the flow is to the system and therefore have a  
21 way to calculate how the concentration and inlet  
22 temperature change as during the event.

23 VICE CHAIRMAN WALLIS: Did you find this  
24 boron steam water phased diagram which we were looking  
25 for?

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1 MR. VIJUK: No, we didn't find it.

2 VICE CHAIRMAN WALLIS: You still haven't  
3 found that?

4 MR. VIJUK: We have not been able to find  
5 --

6 VICE CHAIRMAN WALLIS: Don't you need that  
7 in order to make these calculations?

8 MR. VIJUK: I don't think so.

9 VICE CHAIRMAN WALLIS: Do you need to know  
10 how much boron goes off with the steam and how much  
11 stays behind in the water?

12 MR. SCHULZ: This is Terry Schulz from  
13 Westinghouse.

14 We found some test data where some  
15 measurements were taken of how much boron would leave  
16 in the steam, so some direct, physical test data and  
17 that's what we have used in our calculations. That's  
18 what we had been using in our calculations.

19 MEMBER ROSEN: You've qualified these ADS4  
20 valves for long-term passage of liquid at high  
21 pressure?

22 MR. VIJUK: We're going to talk about the  
23 squib valves later. Maybe that would be a good time  
24 to discuss that, but it's basically like an open pipe.  
25 But we can show you the details a bit later, if you

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1 can hold that.

2 The overall status on the thermal  
3 hydraulic items is that we've -- we responded to the  
4 items like the end of July and early August. The  
5 staff has looked at our initial response. About two  
6 weeks ago we got a set of 30 additional questions  
7 related to our responses and we've just yesterday sent  
8 in responses to 27 or maybe even a few more of the 30  
9 questions and that's basically the agenda for  
10 tomorrow's meeting is to go through those and make  
11 sure we're coming to a meeting of the minds here on  
12 these issues.

13 That's the path forward on the thermal  
14 hydraulics.

15 And looking forward to the rest of the  
16 design certification review, so we have three -- in  
17 the next week and a half we have three key meetings,  
18 if you will, on resolving items. The one tomorrow on  
19 thermal hydraulics. Another one tomorrow on leak  
20 before break issue and then the structural audit at  
21 Westinghouse next week. And we're targeting having a  
22 technical resolution and ready to talk to the full  
23 committee again, possibly as early as December.

24 I'm going to move on to the next topic now  
25 and introduce it. This is the topic on the ADS squib

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1 valves. So today, we're going to talk about --

2 MEMBER POWERS: Mr. Chairman, could I  
3 interrupt the speaker a little bit?

4 I looked ahead in the vu-graphs and found  
5 that there was some work being done by Sandia here.  
6 Trust me, I know nothing about it, but since I work  
7 for them occasionally, less and less often lately, I  
8 bring to your attention that I know nothing about this  
9 and although I'm intensely curious --

10 MEMBER ROSEN: The Chairman has granted  
11 you a waiver to participate in this discussion.

12 MEMBER POWERS: Excuse me.

13 MR. VIJUK: Okay, so we're going to talk about  
14 the design itself and we have Dan Frederick here from  
15 the valve vendor, Conax, to talk about it and we'll  
16 talk about how we use the information we've developed  
17 relative to squib valves in our PRA assessment. And  
18 part of that was getting this independent evaluation  
19 from some folks at Sandia.

20 First, why are we using squib valves for  
21 this application and this slide tries to capture our  
22 logic for choosing these relative to a more  
23 conventional type valve like an air-operated valve or  
24 a motor-operated valve and the real driving force was  
25 reliability and we believe we can engineer higher

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1 reliability into this valve than we can into an air-  
2 operated valve or a motor operated valve for this  
3 specific application.

4 And reliability to open the way the  
5 electrical circuitry can be set up, allows a more  
6 independent actuation circuit. This type of valve  
7 gives diversity from the other stages of ADS which do  
8 use motor operated valves.

9 It's essentially a closed system and only  
10 operated in an emergency. There's -- and the way you  
11 set up the circuitry, there's very little chance of  
12 inadvertent opening --

13 MEMBER FORD: May I address that one,  
14 please. This is one of the other questions I asked and  
15 which was not so far gotten an answer to.

16 The very low chance of an inadvertent  
17 opening, that's based on doing tests presumably on  
18 valves which are open to the air, etcetera.

19 They're not tests that have been done when  
20 the valve has been exposed to water and I brought up  
21 the question at last meeting that the design of the  
22 burst disk in this valve is such that you'd expect to  
23 have cracking or you could have stress corrosion  
24 cracking and therefore since it's pressurized and  
25 under normal situations, you could just get an

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1       inadvertent opening because of failure of that disk  
2       that is in the ADS4 valve.

3               I understand you have addressed this  
4       question. Is there a quick answer.

5               MR. VIJUK: The quick answer we designed  
6       this just like we designed pressure boundaries. It's  
7       ASME code Class 1 pressure boundary and that's why we  
8       don't expect it to fail.

9               But I think Dan Frederick can speak more  
10       to the specifics of the conditions for this valve.

11              MEMBER FORD: I'm sorry, does that, you  
12       mentioned a code situation. Does that take into  
13       account you could have environmental degradation  
14       occurring at that high radius curve that's on that  
15       last disk?

16              CHAIRMAN BONACA: We're having this  
17       specific presentation after this, right?

18              VICE CHAIRMAN WALLIS: We're having a  
19       presentation on the valves?

20              MEMBER ROSEN: Is he going to discuss this  
21       question?

22              So far he's just deferring our questions.  
23       That's fine.

24              MR. VIJUK: I'm not the materials expert.

25              (Laughter.)

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1 MR. VIJUK: I'm not trying to avoid the  
2 questions, but I think Dan can probably speak to it  
3 better than I can. He'll be up --

4 MEMBER FORD: Oh, he'll be up in a minute?  
5 I didn't understand.

6 MR. VIJUK: I was just trying to explain  
7 the reasons beyond choosing this type of valve as  
8 opposed to another type of valve, that's all. And  
9 another important factor was you have zero leakage  
10 during normal operation with an air operated valve or  
11 motor operated valve, you can expect some leakage.

12 The in-service testing and in-service  
13 inspection and maintenance is another aspect and I  
14 think part of this relates to your question as well as  
15 detecting cracks and so forth. That comes into the  
16 equation as well.

17 And our assessment was that after looking,  
18 we looked pretty hard at air operated valves and  
19 trying to make them perform this function and it got  
20 pretty messy from a design standpoint, from an  
21 engineering standpoint to provide the air, high  
22 pressure air and so forth needed for that. That in  
23 the end, we believe this is simpler and will be easier  
24 to implement than the more conventional type vales.  
25 And it ends up being less in size and weight and we

1 made this choice back on the AP600 and at that time we  
2 had the utility people reviewing our design and  
3 leading the design and they were strongly in support  
4 of this decision.

5 This talks about some of the circuits and  
6 the way the circuits are set up they can be made  
7 highly reliable. We have two safety protection  
8 systems divisions to each valve and one diverse  
9 actuation system actuation circuit to each valve, all  
10 independent and this way it's two-way diverse because  
11 the protection system is diverse from the diverse  
12 actuation system.

13 And these have low probability of spurious  
14 actuation and two-out-of-four logic and the controller  
15 circuit minimizes the likelihood of hot shorts and  
16 basically the required voltage to actuate the valve is  
17 not available in the controller circuits.

18 MEMBER FORD: If it minimizes the  
19 likelihood, what is the minimum achieved?

20 MR. VIJUK: I think Selim will talk about  
21 that --

22 MEMBER ROSEN: How many of these in the plant,  
23 eight?

24 MR. VIJUK: There's two on each hot leg.

25 MEMBER ROSEN: Four.

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1 MR. VIJUK: Four.

2 MEMBER ROSEN: You only have to go one go  
3 open to ruin your day, right?

4 MR. VIJUK: One. That's considered a LOCA  
5 event, yeah, and we consider it and analyze it.  
6 Inadvertent opening.

7 So that's kind of the background and I'll  
8 turn it over to Dan Frederick from Conax who has the  
9 experience behind these valves.

10 MEMBER KRESS: Welcome back again.

11 MR. FREDERICK: Thank you. Okay, I'll go  
12 ahead and get started. Can you hear okay?

13 My name is Dan Frederick. I'm Vice  
14 President of Engineering for Conax and I'm here to  
15 give an overview for the squib valve.

16 We need to flip the page.

17 (Slide change.)

18 MR. FREDERICK: Okay, first of all, to  
19 give you some of the background on the squib valve  
20 itself, it starts off approximately about 10 years  
21 ago. I was with Pyronetics at that time and General  
22 Electric was very interested in going to use a 7-inch  
23 normally closed pyro valve. And so at that point they  
24 came to us and we were one of seven valve vendors that  
25 they had contacted in regard to trying to achieve what

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1 they thought was the best approach for their program.

2 And as a result of that, the valve design  
3 that we at Pyronetics at that time had provided as far  
4 as the basic cross sectional design concept was  
5 accepted by them as the best way to proceed with what  
6 they had intended to do.

7 And I'll just give you a little history to  
8 the Pyronetics, just some of you have heard it before,  
9 but others haven't, so I just want to tie it in.  
10 Pyronetics was a company that was part of OEA that was  
11 located in Denver in the same facility.

12 MEMBER ROSEN: What's OEA?

13 MR. FREDERICK: OEA, Incorporated, it's a  
14 separate company that was located in Denver. And that  
15 company, OEA, at one point transferred all the  
16 technology of the aerospace division to Northern  
17 California and it was part of the OEA Aerospace Group.  
18 What remained in Denver was the automotive side which  
19 mainly was the initiators for the airbag.

20 And then after getting to Northern  
21 California and becoming part of OEA Aerospace, I was  
22 there for about five years in Northern California and  
23 prior to that I started with OEA in 1980. Since that  
24 time, since I left there, UPCO has bought out the OEA  
25 division and presently right now, Conax is licensed to

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1 sell product, manufacture, design and sell product  
2 that had previously been designed by OEO, "Pyronetics"  
3 during whatever stage you want to start at. So right  
4 now, we have a license to do that. And therefore,  
5 that's how Conax ties in with the Pyronetics early  
6 design phase that I'm referring to.

7 And of course, the big issue at that time  
8 is can you scale up a valve? What we had proposed was  
9 a 2-inch valve and similar here what we're talking  
10 about is scaling up a valve. That was the big issue  
11 at that time as well.

12 Then it was going from 2 to a 7 which was  
13 at that point a very huge increase in size and the  
14 present time we're talking about going from a 7 to a  
15 9. So we provided GE a list of our customers at that  
16 point. They contacted several of those. They came  
17 back and gave Pyronetics the contract.

18 We went through. We built and  
19 successfully tested the valves.

20 MEMBER ROSEN: The 7-inch valves?

21 MR. FREDERICK: The 7-inch valve, that's  
22 correct. And so, of course, the application right now  
23 for AP600, as you can see on the bottom of the chart,  
24 it was to use the same 7-inch ID valve, originally,  
25 and now for the AP1000 it requires a 9-inch.

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1                   So that's a little overview of the history  
2 of where we're at.

3                   (Pause.)

4                   Sorry about that. I haven't used this  
5 before.

6                   (Pause.)

7                   This is a cross sectional view of the 7-  
8 inch valve which was scaled up to meet the 9-inch  
9 requirement with some changes, obviously as far as  
10 interface --

11                  MEMBER ROSEN: The 7-inch is the minimum  
12 diameter?

13                  MR. FREDERICK: Yes, the 7-inch is the  
14 full passage itself.

15                  MEMBER ROSEN: That's the place where  
16 Peter, Dr. Ford, is concerned about the --

17                  MR. FREDERICK: That's correct. There's  
18 a notch right here and that gets sheared out.

19                  MEMBER ROSEN: High stress location, 9-  
20 inch diameter.

21                  MR. FREDERICK: That's correct.

22                  MEMBER ROSEN: Circumference high D,  
23 right, Dana?

24                  MR. FREDERICK: Okay, as far as the  
25 operation of the valve, first of all, it's a fairly

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1 simply operated unit. You have some initiators on the  
2 top. Generally, what you do is you have the current  
3 come in, it fires one, two or three initiators, how  
4 ever many you choose. That then, in turn, fires into  
5 a booster charge that's contained within this cavity.  
6 That then fires, creates a pressure within the top  
7 part of the valve itself. When the pressure gets to  
8 a specific level, what happens is that this tension  
9 bolt actually breaks. This piston bend is driven  
10 down. The impact force of the piston on this, what  
11 I'll call a nipple section causes this thing to come  
12 down and get sheared out of this section and this  
13 particular part right here then is driven over center  
14 and opens up for full flow through the valve.

15 MEMBER ROSEN: If I were looking down, if  
16 I was standing on top of that thing that's driven down  
17 and flops over, what's the cross section look like?

18 MR. FREDERICK: This right there?

19 MEMBER ROSEN: No, go down, go down to  
20 there to that thing. What is the cross section of the  
21 top of that look like?

22 MR. FREDERICK: Like this.

23 MEMBER ROSEN: It's a rectangle.

24 MR. FREDERICK: Yes, it's more like a  
25 rectangle.

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1           So you've got an impact force of a  
2           specific point here and then it rotates over.

3           MEMBER ROSEN: And it's hit by this piston  
4           coming down?

5           MR. FREDERICK: That's right. This piston  
6           right here, the bottom of that piston impacts right  
7           here. That generates enough force to shear that  
8           section and drive that valve down.

9           MEMBER ROSEN: All the way around 27  
10          inches?

11          MR. FREDERICK: Pardon?

12          MEMBER ROSEN: All the way around 27  
13          inches?

14          MR. FREDERICK: It's already been proven  
15          on the 7-inch. We've gone through several firing  
16          tests and every one of them were successful.

17                 And so what we're talking here is going  
18          from a 7-inch ID up to a 9 which means obviously  
19          you've got a scale of the passage here and that  
20          correspondingly changes everything here accordingly  
21          because everything is getting bigger?

22          MEMBER ROSEN: What would it take to build  
23          one and do it?

24          MR. FREDERICK: What do you mean?

25          MEMBER ROSEN: Well, build a 9-inch and do

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1 it just like you did for a 7.

2 MR. FREDERICK: Are you talking cost,  
3 schedule?

4 MEMBER ROSEN: How hard would that be?

5 (Laughter.)

6 MR. FREDERICK: The first time around when  
7 we had the contract for the 7-inch, it took about a  
8 year and 3 to 4 months from start to finish before we  
9 delivered product.

10 So we built the valves, went through our  
11 development test program. GE went through a program  
12 on all the booster charges as far as the radiation  
13 environment, etcetera, etcetera. We built the valves.  
14 We tested some in our plant in Denver. We then  
15 shipped some to Wiehle in Huntsville at which time  
16 representatives from our company and GE were there for  
17 witnessing of the actual test with the actual steam  
18 that was put into the unit to fire it.

19 MEMBER ROSEN: About a year and a half,  
20 you think?

21 MR. FREDERICK: About a year and a half.

22 MEMBER ROSEN: Would that be the same for  
23 a 9-inch?

24 MR. FREDERICK: Yes sir, right. In fact,  
25 I say that because in my mind at least I don't see the

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1 problem with scaling it up because we went through a  
2 very large exercise, working GE previously on the  
3 design analysis associated with the requirements  
4 associated with this type of valve.

5 So the design analysis work has already  
6 been completed. So what we do is we take that,  
7 implement the new requirements and we scale it up  
8 accordingly.

9 VICE CHAIRMAN WALLIS: There are no new  
10 phenomena going from 7 to 9 inches?

11 MR. FREDERICK: No sir. Things are just  
12 bigger so of course, you'd have more powder in here  
13 obviously from a booster charge standpoint because you  
14 need more pressure here in order to actually drive  
15 that thing down because your cross section is bigger.

16 MEMBER ROSEN: Now in Pittsburgh, you did  
17 say that you were planning to do these tests of a  
18 development prototype, 9-inch valve, including charge  
19 sizing, looking at things like charge sizing,  
20 inspection, hydrostatically testing, hydrostatic and  
21 leak testing vibration, actuation with over-loaded  
22 boosters and actuation with underloaded boosters just  
23 to see what kind of sensitivity I presume the device  
24 has to the over or under loading of boosters.

25 And all of that is to be done at some

1 point and the question is when?

2 MR. FREDERICK: Well, that's really up to  
3 Westinghouse. Right now, we have no contract to do  
4 that.

5 MR. CORLETTI: This is Mike Corletti from  
6 Westinghouse. That activity is part of the COL  
7 application and as part of an ITAAC verification.  
8 That testing will have to be completed as part of  
9 ITAAC.

10 MEMBER ROSEN: In the meantime, we have to  
11 take it on faith that this valve has the same failure  
12 probability as the 7-inch valve and I'm taking it on  
13 faith that when you do the testing as part of the  
14 ITAAC after you have a COL, that it will turn out to  
15 be -- have the kind of failure characteristics and  
16 thereby the likelihood of failures is that E<sup>-4</sup> numbers  
17 that you're quoting for demand -- in the meantime, we  
18 don't have any proof of that.

19 MR. CORLETTI: But the next presentation  
20 is the discussion of the reliability and I think I'll  
21 defer based on the reliability to that. But as far as  
22 on faith that we can do the type test, it's a  
23 condition of operation of the plant that these type  
24 tests are completed.

25 MEMBER ROSEN: Yes, I understand that. I

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1 understand that. That's not where I'm pushing. What  
2 I'm pushing on here is in the meantime and before we  
3 have that test, we have to take on faith reliability  
4 that you're quoting to feed into the PRA.

5 MR. CORLETTI: The next presentation will  
6 provide you why we believe we have confidence in the  
7 PRA reliability numbers that we've provided.

8 VICE CHAIRMAN WALLIS: But to come back to  
9 my concern. Even when you're doing this for GE, for  
10 the SBWR, there was no concerns at all about  
11 environmental degradation of that high radius,  
12 presumably stress concentration at the point where you  
13 -- no one was concerned about that?

14 MR. FREDERICK: Well, this particular  
15 section, we went through the design analysis report  
16 for the 7-inch valve. At that point there was  
17 established by the customer at that time, they gave us  
18 a specific corrosion rate that they had anticipated to  
19 see over the life of that unit. Therefore, that  
20 corrosion rate value was input into the design  
21 analysis and therefore the size of that section was  
22 slightly enlarged in order to account for that.

23 VICE CHAIRMAN WALLIS: General corrosion  
24 wouldn't concern me. It's more that it's use for --  
25 that's the stress components the high stress

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1 concentrator. I'm more concerned about --

2 MR. FREDERICK: Okay, well, I understand  
3 your point. The only thing I can say there is there's  
4 been an awful lot of valves built over the years where  
5 we have not had one that actually cracked from a  
6 condition we're talking.

7 Granted, we haven't had it in the  
8 conditions that we have here. I will admit that. But  
9 then on the other hand, there's been an awful lot of  
10 valves that have been delivered that had extremely  
11 high pressure requirements and have met a lot of  
12 environmental requirements on missile and satellite  
13 applications.

14 MEMBER ROSEN: What re the conditions up  
15 against the section that Peter is concerned about? Is  
16 that --

17 MEMBER KRESS: Stagnant, borated water.

18 MEMBER ROSEN: Stagnant borated water at  
19 2,000 psi?

1 MR. FREDERICK: Well, I have a comparison  
2 chart here, I think, that gives that information.

3 MEMBER RANSOM: How often would that  
4 component be replaced?

5 MR. FREDERICK: That I'll defer, somewhat,  
6 to Westinghouse, because we've had discussions with

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1 regard to when you would do a, quote, "changeout."  
2 And so I'll have to defer that to you, Terry.

3 MR. SCHULZ: This is Terry Schulz. We  
4 would do an inspection in accordance with the ASME  
5 code, which means that every ten years you would be  
6 taking this apart and looking at it on some staggered  
7 basis. It's four valves so it wouldn't all be nothing  
8 for ten years, but sometime in between ten years you'd  
9 look at it. And then based on what you would see, you  
10 could replace that rather easily if need be; it's not  
11 a hard thing to do.

12 MEMBER RANSOM: I guess I'm bringing that  
13 question up because I -- mine which also refers to  
14 your question. I bring it up because it's an easy  
15 thing to remedy. Use a different material, put a  
16 coating on it, whatever. I'm bringing it up because  
17 no one's raised this question before and I hate to see  
18 it go into service and that potential problem never  
19 have been addressed. That's why I'm bringing it up.

20 MR. FREDERICK: Well, I appreciate your  
21 concerns. I know we've had some discussions with  
22 Westinghouse with regard to what material should be  
23 utilized, and that's still undergoing and has not been  
24 totally finalized yet. So we are moving in that  
25 direction.

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1 MEMBER POWERS: May I ask you what you're  
2 using for the initiator in the charge?

3 MR. FREDERICK: I can't give you that  
4 information. It's proprietary to UPCO.

5 MEMBER POWERS: That's fine.

6 VICE CHAIRMAN WALLIS: But it can sit  
7 there for many years without doing anything, without  
8 deteriorating?

9 MR. FREDERICK: On the GE Program, the  
10 initiators and boosters were subjected to an  
11 accelerated aging test program to show that they were  
12 good in their particular case for a four-year  
13 requirement. So they did go through that program.

14 MEMBER POWERS: When you say good, you  
15 mean that they would after being aged do the function  
16 they were intended to do.

17 MR. FREDERICK: They were aged to simulate  
18 the time frame under the conditions that they would  
19 have been anticipated to be used. And after that  
20 time, we fired a bunch a hardware to substantiate that  
21 we were still getting the same performance that we had  
22 prior to that.

23 MEMBER POWERS: I guess the question that  
24 comes to my mind with squib valves that I have had the  
25 pleasure of using that the squib would work fine but

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1 the metal around it would be terribly badly corroded  
2 from products of decomposition of the squib initiator  
3 and charge itself. And that's specific to the  
4 material, and I don't know that yours is the same.  
5 Did that sort of thing get looked at?

6 MR. FREDERICK: Well, like I said, I can't  
7 give you the powder and materials used, but what it  
8 amounts to is that there was a requirement on this  
9 particular valve that had to be able to be refurbished,  
10 meaning if you fired it, you had to be able to get it  
11 back together, and it was 24-hour changeout in order  
12 to tear it down after it's fired, put in the new  
13 hardware and be ready to use it again. And that was  
14 demonstrated and proven that you could do it within a  
15 24-hour period. And so you do replace some of the  
16 components, obviously, that are involved here because  
17 I mean obviously you're sharing metal and you've got  
18 a few things happening, but the key parts associated  
19 with the body is still the same part that you have in  
20 there to start with.

21 MEMBER POWERS: Yes. But what I was  
22 asking really about the corrosion of the body over a  
23 course of time around where your charge is located.

24 MR. FREDERICK: Right in here?

25 MEMBER POWERS: Yes.

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1 MR. FREDERICK: Okay. Well, if that  
2 became an issue over a period of time and you could  
3 replace the members that you had a concern with.

4 MEMBER POWERS: It's just that those  
5 issues tend to find out when you go to use it, not  
6 because of an inspection program.

7 MR. FREDERICK: Well, I think you'd be  
8 able to see that. I think that the powder that we use  
9 in there is relatively benign to the environment  
10 itself because it is a refurbishable unit, and that  
11 was kept in mind during the design of the valve in its  
12 early stages. The one key feature about the valve  
13 itself as far as refurb, I mean you can take this  
14 whole thing apart, you know, this whole sections comes  
15 out, everything up here comes out and it's all easily  
16 removable. So anytime you chose to do a tear-down or  
17 a review or whatever you'd like to do with some period  
18 of time, we could easily do that.

19 MEMBER ROSEN: Is it welded into the pipe?  
20 I mean it's welded into the system, right?

21 MR. FREDERICK: No, no. This is metal  
22 seals, and the center faces right here.

23 MEMBER ROSEN: How is it -- here comes the  
24 pipe from your flange.

25 MR. VIJUK: A flange on one side, open on

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1 the other end.

2 MR. FREDERICK: Yes. Right here's the  
3 flange.

4 MEMBER ROSEN: Oh, okay.

5 MR. FREDERICK: And then there won't be  
6 anything over here; it will be just an open-ended.

7 MEMBER SHACK: What holds the gate in the  
8 vertical position before it fires?

9 MR. FREDERICK: Right here?

10 MEMBER SHACK: Yes.

11 MR. FREDERICK: This is all one metal, one  
12 piece of metal here.

13 MEMBER SHACK: Oh, yes. All right.

14 MEMBER ROSEN: And how thin is the minimum  
15 thickness?

16 MR. FREDERICK: I don't know the exact  
17 number offhand. I would have to look at the design  
18 analysis report. I can get that information and we  
19 can provide it later.

20 MEMBER ROSEN: Is it mils or tens of mils?

21 MR. FREDERICK: No, no. Off the top of my  
22 head I'd say at least a quarter of an inch, maybe  
23 three-eighths.

24 MEMBER RANSOM: Out of curiosity, was the  
25 breach-lock type design considered initially so that

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1 if the thin part did fail, you would get a small LOCA  
2 rather than a large LOCA or would that even be of any  
3 concern?

4 MR. FREDERICK: Well, this is the basic  
5 design that was originally proposed and no issues came  
6 up that would have caused us to go any other direction  
7 than we had proposed. Okay? Testing performed on the  
8 valve I've got listed over there. I think you can  
9 take a look at that. It went through an extensive  
10 test program.

11 VICE CHAIRMAN WALLIS: It's interesting,  
12 it snaps the bolt at the top?

13 MR. FREDERICK: Pardon?

14 VICE CHAIRMAN WALLIS: It snatches the  
15 bolt and it chops off the ring and it doesn't break  
16 the pin that across the bottom.

17 MR. FREDERICK: Right here?

18 VICE CHAIRMAN WALLIS: Right.

19 MR. FREDERICK: No, because the pin  
20 doesn't see any load. The pin is mainly there for a  
21 retainment.

22 VICE CHAIRMAN WALLIS: It gets hit by that  
23 thing coming down.

24 MR. FREDERICK: No, because you're hitting  
25 here.

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1 VICE CHAIRMAN WALLIS: Oh, it's the -- the  
2 hammer's on the bottom.

3 MR. FREDERICK: You're hitting here so you  
4 don't see any impact load on the panel. So that  
5 allows it to freely go over it without any impact  
6 loads. Okay? I just want to point out that generally  
7 with any devices that we make at Conax, generally have  
8 to have high reliability because they're used in life  
9 support programs, aerospace programs and obviously any  
10 consequence of any failure would be an absolute  
11 disaster, whether it be human life or even high  
12 millions of dollars in satellite and missile  
13 applications. So high reliability is required, and  
14 I'll get into some of the things that we do to ensure  
15 that we have that.

16 Conax procedures, first of all, control  
17 high reliability. I mean we have a very detailed  
18 approach on how we make sure that we build things, and  
19 it goes through the various departments. Everybody's  
20 interacting in order to give their input on what needs  
21 to be done, and a lot of this is based upon a lot of  
22 factors that I'll bring out here in just a minute.

23 Custom valve designs and upscaling is a  
24 standard process, so there, again, what I'm saying is  
25 I don't see a problem going from seven to nine. Going

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1 from two to seven was a much bigger task. Simple  
2 valve designs reduce problems, and I say that because  
3 I think the key thing with any squib valve is that  
4 there's not that many parts that are actually going  
5 into the valve itself. So the moving parts are very  
6 minimal, and therefore your chance or likelihood of  
7 having anything go wrong is reduced because there are  
8 a substantial amount or a fewer amount of parts that  
9 have been utilized. The development process that we  
10 go through, I've mentioned that in the previous  
11 meeting and we'll touch that a little bit here in a  
12 minute.

13 Some of the reliability numbers, I got  
14 some information from an UPCO report that I then put  
15 down here and then the Conax reliability here.

16 MEMBER ROSEN: What's UPCO stand for?

17 MR. FREDERICK: Pardon?

18 MEMBER ROSEN: What's UPCO?

19 MR. FREDERICK: UPCO is Universal  
20 Propulsion Company, and they are now owned as part of  
21 the Goodrich operation that's headquartered in  
22 Arizona.

23 MEMBER ROSEN: And they've made 64,000 of  
24 these valves?

25 MR. FREDERICK: Valves total.

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1 MEMBER ROSEN: Which are used in what  
2 service?

3 MR. FREDERICK: Mainly in missiles and  
4 satellite applications. Obviously not in commercial  
5 use like nuclear power plants.

6 MEMBER ROSEN: Missile and satellite  
7 operations. Just give me a feeling for what is it  
8 that they do in these applications.

9 MR. FREDERICK: Well, if you want to,  
10 let's say -- first of all, they're used to fire open  
11 if you want your propellant to start functioning your  
12 system. Without the valve opening, the satellite  
13 would not function, therefore it would be a loss.  
14 Okay? We have normally closed valves and normally  
15 open. We have others that when they get up there to  
16 wherever they want them they want to shut off the fuel  
17 flow. You can fire the valve, shut it off and  
18 therefore the satellite just continues its operation.

19 On other systems like missiles, for  
20 example, we have some pure gas systems that's used on  
21 some of the guidance type work that goes into some of  
22 the key missile programs. You have to fire a pyro  
23 valve to knock of the section that opens up the flow  
24 for the gas to go through, and that's used for locking  
25 on targets and doing the work. So, again, if that did

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1 not work, the missile would not work. It's also used  
2 on missile applications for, again, like satellites  
3 where things sit there for a long time, they're  
4 pressurized, they're ready to go, but until you  
5 actually fire that valve you have no fluid going  
6 through the system to drive the missile to its end  
7 state.

8 And so, generally, all the normally closed  
9 valves are used in a condition generally to take some  
10 fluid or pressure, we've got some valves that have  
11 10,000 psi operating, or we've got nitrogen tetroxides  
12 or hydrozines or monomethyl hydrozines or any  
13 combinations of those type of fluids and gases that  
14 are used up-front on that section until the time  
15 you're ready to operate that valve, and when you do  
16 then that fluid or gas does its work in the system.  
17 And that's their intent, so if the valve doesn't work,  
18 you've got a major system problem with a missile or a  
19 satellite application.

20 MEMBER ROSEN: Okay.

21 MR. FREDERICK: So there, again, that's  
22 why it's so important that the reliability is built in  
23 up front, okay?

24 VICE CHAIRMAN WALLIS: But the aging isn't  
25 -- these don't sit around for ten years before they're

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1 used.

2 MR. FREDERICK: These don't?

3 VICE CHAIRMAN WALLIS: The ones that have  
4 been tested and used didn't sit around for ten years.

5 MR. FREDERICK: Some of the satellite  
6 valves are required to stay up there a long, long  
7 period of time, some around ten years before they're  
8 ever fire.

9 VICE CHAIRMAN WALLIS: Okay.

10 MR. FREDERICK: Because that's basically  
11 the requirements for falling down, and the length of  
12 time keeps increasing as time goes on because everyone  
13 wants to extend the life or the use of something that  
14 they've already got.

15 Squib valve design summary, squib valves  
16 have high inherent reliability, and I believe that  
17 based upon the thousands of valves that have been  
18 produced and functioned very well. Reliability for  
19 smaller valves is applicable for larger valves  
20 because, obviously, you've got to start someplace to  
21 get someplace else in which case that's how you get  
22 there -- you start small and you go large. I've had  
23 cases where I've taken valves and had to miniaturize  
24 them for some of the Star Wars programs years ago in  
25 which it was a case going the other direction. I mean

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1       there are cases where you want to go down.

2               The same design standards have been  
3       established as far as how to do the engineering  
4       analysis, the proof and the leak testing of the  
5       valves. Over and under testing of boosters and  
6       initiators is a standard practice. You need to know  
7       what your margins are associated with how the unit's  
8       going to operate.

9               The design concept for shearing metal is  
10       the same. I mean, obviously, one of the key things  
11       with the squib valve you've got parent metal  
12       throughout the entire life of whatever you're trying  
13       to use until the time you're ready to open it up, so  
14       you don't have to worry about any parent metal or any  
15       connections that leak. That would be a problem if you  
16       didn't have an all metal section to prevent that. And  
17       to date there's been no failures associated with shear  
18       sections cracking under pressure or temperature  
19       conditions for the valves that we have delivered.

20              And if you have any other questions, I'll  
21       be glad to take them right now or move on. Thank you.

22              MEMBER ROSEN: There are still a few  
23       questions on the table. One is the water, the design  
24       for water, passing borated water at high pressure.

25              MR. FREDERICK: Well, that gets back into

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1 again reviewing the material combinations that's being  
2 exposed to it over time, and I've got to work those  
3 details out with Westinghouse to fine tune what the  
4 plan is as far as material applications.

5 MEMBER ROSEN: So that's later also. I  
6 mean the proof that these nine-inch squib valves will  
7 pass water at high pressure for a long period of time,  
8 I guess that's their design function in long-term --

9 MR. FREDERICK: Well, I don't see any  
10 problem with the valves passing water over long term.  
11 I guess the issue mainly is is the concern about,  
12 let's say, water in contact with the surface over a  
13 long time.

14 MEMBER ROSEN: The seed.

15 MR. FREDERICK: Yes, in contact with the  
16 seed over a long period of time. That's the issue  
17 that we're still trying to work out with Westinghouse  
18 with regard to material selection. But can we answer  
19 that right now, I would say no because that hasn't  
20 been decided yet. And, further, it would still take  
21 some kind of test program in order to do that unless  
22 perhaps Westinghouse has some data already on the  
23 liquid in contact with the materials that are planned  
24 for use.

25 MEMBER SHACK: Stainless steel has worked

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1       rather well in PWRs, and when you weld you get rather  
2       high stresses in the weld. They may not be design  
3       stresses but I haven't cracked very many welds in  
4       stainless steel in PWRs. So I think they have a high  
5       probability of success. I mean you obviously have to  
6       pay attention to the details of the design, but I  
7       think there are materials and design considerations  
8       that you can use to give you a high probability of  
9       success.

10               MR. CUMMINS:     This is Ed Cummins.  
11       Actually, if a valve opens, it's effectively a pipe,  
12       and the question is sort of equivalent to will a  
13       stainless steel pipe allow a two-phase flow, and I  
14       think that's --

15               MEMBER ROSEN: It doesn't have to reclose.

16               MR. CUMMINS: It does not have to reclose.

17               MEMBER ROSEN:    It's different in that  
18       sense from a safety relief valve.

19               MR. CUMMINS: Yes.

20               MEMBER ROSEN: Which you expect to open,  
21       pass water and then reclose.

22               MR. CUMMINS: That's right. This valve  
23       never -- you have to replace the actuating part of the  
24       valve in order to put it back in service.

25               MR. SANCAKTAR:    My name is Selim

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1       Sancaktar. I work for Westinghouse in Reliability and  
2       Risk Assessment. Earlier this year, we gave you a  
3       presentation on AP1000 PRA and during this  
4       presentation you have brought up some questions about  
5       the squib valve reliability, same questions that were  
6       already discussed today. So what we did is we went  
7       back -- since we are very much interested in the  
8       health of these valves, it's in our interest to make  
9       sure that the design will not cause problems later on.  
10      And anything that you say we wanted to make sure that  
11      we look into. So I'm going to kind of summarize what  
12      we tried to do.

13               What we did was we went to Conax, a vendor  
14      with considerable experience in this area, and you  
15      already heard Dan Frederick summarize his position on  
16      that. Whether he convinced you or not, I leave it to  
17      you, but I was impressed and I bought it. But we  
18      thought that you may need a little bit more proof than  
19      that, so we said where else and we went to Sandia. We  
20      thought that we are not on the same side of the fence  
21      with Sandia most of the time, so that should be a good  
22      check on our design and what we want to obtain.

23               So we went to Sandia and we told them what  
24      the questions were and what we are trying to do. We  
25      told them about Conax and we made sure that they

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1 contacted each other and talked with each other. And  
2 I have four slides that I want to try to very quickly  
3 summarize the Sandia report. You're right, we didn't  
4 make these slides, we just took these slides out of  
5 Sandia's presentation, and I hope that I don't butcher  
6 it. If I do any injustice to Sandia, I apologize up-  
7 front.

8 MEMBER POWERS: These guys do injustices  
9 to Sandia enough that they probably applaud.

10 MEMBER ROSEN: All the national labs are  
11 treated equally here.

12 MR. SANCAKTAR: Also it's vice versa.

13 MEMBER KRESS: I've heard that first  
14 question asked many times.

15 MR. SANCAKTAR: Why Sandia?

16 (Laughter.)

17 MEMBER POWERS: And you've seen that  
18 answer to, "Sandia has successfully."

19 MR. SANCAKTAR: No, that's their answer.  
20 My answer, Westinghouse answer is because we thought  
21 that Sandia would be --

22 CHAIRMAN BONACA: Okay. We need to move  
23 on. We have to reach our time and we there's another  
24 presentation, I understand, after this.

25 MR. SANCAKTAR: So Sandia with some basis

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1 to talk about this subject. They are not neophytes in  
2 this area. Here are the reasons for it, and they  
3 looked into this and they also provided us with their  
4 current test data, which is better done -- I'm going  
5 to show you on a slide on the next one, that they are  
6 more experienced now than they gave us data previously  
7 that we used for AP1000.

8 MEMBER KRESS: Now these are pretty small  
9 valves, right?

10 MR. SANCAKTAR: Excuse me? Yes. Yes.

11 MEMBER ROSEN: Now what is this NMLT/SLT?  
12 What are all those abbreviations?

13 MR. SANCAKTAR: I have no idea about what  
14 these acronyms stand for. The thing that I wanted to  
15 emphasize here, there was another slide we removed, is  
16 they have more experience now than they gave us in  
17 1996 when we actually used their data. See, at the  
18 time they gave us this number based on data available  
19 at that time. Now, after six years, they have more  
20 data and the trend -- that's the only thing I wanted  
21 to emphasize -- the trend is even in a better  
22 direction. But I wanted to --

23 VICE CHAIRMAN WALLIS: So two in ten to  
24 the minus four is one in 5,000? They tested -- one  
25 failed in 5,000 tests?

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1 MR. SANCAKTAR: Actually, it's zero in  
2 4,000 for this one, and this is zero in 5,000  
3 something.

4 VICE CHAIRMAN WALLIS: So it's zero  
5 really.

6 MEMBER SHACK: Well, you have to compute  
7 your confidence on that.

8 MEMBER ROSEN: It's never quite --

9 MEMBER SHACK: Zero out of 5,000 is zero.

10 MEMBER ROSEN: It's never quite zero.

11 VICE CHAIRMAN WALLIS: So there's a  
12 confidence on these numbers.

13 MR. SANCAKTAR: So their -- this is,  
14 again, Sandia conclusion. The AP1000 valve design is  
15 a basic design that has been used extensively for many  
16 smaller squib valves, so there's nothing new here.  
17 And environments -- environment was one of the  
18 questions brought up, and they're pointing out that  
19 the valves that are built so far are used in very  
20 harsh environments. The scaling, they are basically  
21 scaling is not an issue, they don't see that as an  
22 issue, and that the reliability is maintainable. The  
23 number that has been assessed at this point is  
24 maintainable. So they are basically concurring with  
25 our current position.

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1 MEMBER KRESS: And you actually paid for  
2 this? Bill Shack could have told you that for free.

3 MR. SANCAKTAR: So that's the bottom line  
4 and this is their slide.

5 MEMBER KRESS: Okay.

6 MR. SANCAKTAR: Now I'm going to just  
7 summarize things very quickly. These are just going  
8 back through numbers, we have this EPRI number, and  
9 then we have two Sandia sources which we used to  
10 calculate the AP600 and AP1000 reliability. We got  
11 new numbers now based on even more tests, and the  
12 trend is in the right direction. And what we have  
13 used is very reasonable. Just as a point, the EPRI  
14 data is really based on MOVs. They didn't have data,  
15 they just used MOV data. MOVs are considerably more  
16 complicated than these valves.

17 And we, of course, are aware of the fact  
18 that the AP1000 CDF is somewhat sensitive to the value  
19 of the squib valve. It should be. And we are aware  
20 of it, so we want to make sure that this area is  
21 covered well, and we have taken all the design  
22 operational conclusions to make sure that we are using  
23 a reasonable, maybe a little bit even conservative  
24 reliability and that we will try to maintain it  
25 throughout the operation.

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1           So the bottom line is recent information  
2           from different sources would point out that the  
3           failure probabilities are reasonable, consistent with  
4           operating experience. This can be achieved for the  
5           AP1000 specific design. Upscaling isn't a problem,  
6           operational environment is not a problem, according to  
7           people whom we've discussed the subject with, and we  
8           told you who they are, and that this really is  
9           answering your question about -- it may not be obvious  
10          from the way it's stated but it's saying that the  
11          concern is -- we don't think the concern is a major  
12          failure mode. However, we note of course your point  
13          and it should be made sure that it has been covered in  
14          the design. So that's all I have to say.

15                 MEMBER ROSEN: I guess the weakness of  
16                 this -- could you go back one slide?

17                 MR. SANCAKTAR: Certainly.

18                 MEMBER ROSEN: To me, might be -- that one  
19                 there. The first bullet, the sensitivity analysis,  
20                 you doubled the failure probability.

21                 MR. SANCAKTAR: Yes.

22                 MEMBER ROSEN: But one perhaps could argue  
23                 that doubling is a minor change in this thing. Would  
24                 you consider a tripling, a quadrupling?

25                 MR. SANCAKTAR: Certainly. If you triple

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1 it -- I mean as long as we are going in small steps  
2 like that, it would go from 15 percent to 30 some  
3 percent. I'm not sure exactly what, maybe 31 or 32.  
4 I don't know how linear it is, you know, in that  
5 range.

6 MEMBER KRESS: Increase it by a factor of  
7 ten and go to 75 percent, roughly.

8 MR. SANCAKTAR: Right. I mean if these  
9 squib valves are a factor of ten worse, and we are  
10 really off the mark, we may as well use MOVs and we  
11 don't need to go to them. The whole purpose of this  
12 design is to stay away from MOVs because MOVs are not  
13 as reliable. So we have to assure that --

14 MEMBER ROSEN: Go back another slide and  
15 let's take a look at that.

16 MR. SANCAKTAR: Okay.

17 MEMBER ROSEN: If -- back.

18 MR. SANCAKTAR: Oops. I don't know where  
19 I am. I went to --

20 MEMBER ROSEN: You're going the wrong way.

21 MR. SANCAKTAR: Oh. This slide?

22 MEMBER ROSEN: So if it's a factor of ten  
23 worse --

24 MR. SANCAKTAR: Right. We'll back to --

25 MEMBER ROSEN: -- the failure to open in

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1 demand would be 1.3 to the minus three. Take that  
2 Sandia 2002 data.

3 MR. SANCAKTAR: If you want to go from  
4 here, right, we will be going in this range.

5 MEMBER ROSEN: You're almost back to the  
6 EPRI motor-operator valve data.

7 MR. SANCAKTAR: Right. Exactly. I mean  
8 if we truly believe that we are really that far off,  
9 then we wouldn't have done this way, because already  
10 have MOVs --

11 VICE CHAIRMAN WALLIS: Well, I don't think  
12 MOVs have anything to tell you about squib valves at  
13 all. They're completely different things.

14 MEMBER POWERS: And what he's saying is he  
15 would design an MOV into the system if he wanted to be  
16 that bad.

17 MR. SANCAKTAR: We are living with them in  
18 many areas. Yes?

19 MEMBER RANSOM: All of these data are  
20 failure to open. Is anything known about the  
21 inadvertent actuation of different kinds of valves in  
22 these circuits?

23 MR. SANCAKTAR: The inadvertent actuation  
24 is a very -- will depend on the properties of the  
25 actuating design. We are not privy to how these

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1 valves are used in various applications. However, in  
2 our application, we have done -- we tried to design it  
3 out, not number it out or not try to hand write it out  
4 but design it out as much as possible. And one of the  
5 important points is we have a arm and -- separate arm  
6 and fire circuits. And if you arm it alone, the  
7 accidental, it doesn't go. If you fire it by itself,  
8 it doesn't go. You have to do both of them, and you  
9 have to do them in a certain very short amount of  
10 time, within seconds. So accidentally arming doesn't  
11 make it go, accidentally firing it doesn't go. Doing  
12 these two at two different considerably different time  
13 frames, like a minute apart or something, doesn't do  
14 it. So we tried to design it and it's very  
15 specifically designed.

16 MEMBER ROSEN: And all of that's embedded  
17 in the circuitry.

18 MR. SANCAKTAR: Yes.

19 MEMBER RANSOM: Well, can you put a number  
20 to that?

21 MR. SANCAKTAR: Yes. We did, actually.

22 MEMBER RANSOM: I mean do you know what --

23 MR. SANCAKTAR: Yes. Yes. The number to  
24 that actually is like -- that slide has disappeared  
25 due to the shortening of this -- is 5.9 minus five.

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1 It's calculated by fault tree analysis, assigning  
2 various failure combinations and common cause and this  
3 and that.

4 VICE CHAIRMAN WALLIS: Can we move on?

5 MR. SANCAKTAR: Anything else? Okay.

6 MR. CORLETTI: This is Mike Corletti from  
7 Westinghouse. I guess I'd like to ask what you'd like  
8 to see in the next presentation. This is a subset of  
9 what we presented in Pittsburgh. The question had  
10 came up what do we do for a post-LOCA aerosol  
11 deposition. We went through in Pittsburgh how we did  
12 an AP1000-specific calculation analysis, similar to  
13 what was done for AP600, and I'm leaving it up to the  
14 Committee here whether you want to see the entire  
15 presentation or --

16 MEMBER KRESS: Well, I don't think we have  
17 time for the entire presentation.

18 VICE CHAIRMAN WALLIS: The results were  
19 interesting.

20 CHAIRMAN BONACA: How long would be the  
21 NRC presentation?

22 MEMBER KRESS: That's a good question.

23 MR. COLACCINO: This is Joe Colaccino. We  
24 expect the staff presentation to be less than 15  
25 minutes.

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1 MEMBER KRESS: I'm looking at your slides  
2 to see --

3 MR. SCOBEL: Well, in a quick summary, I  
4 would say that we used the AP600 value for lambda and  
5 then later showed that AP1000 is expected to have a  
6 significantly higher lambda than AP600. So we did  
7 the analysis conservatively. That's the quick and  
8 dirty summary.

9 MEMBER KRESS: Now, lambda is a variable  
10 in time.

11 MR. SCOBEL: Yes.

12 MEMBER KRESS: I was looking at one of  
13 your slides that says you took a dominant core damage  
14 sequence from PRA?

15 MR. SCOBEL: Yes. We used a core damage  
16 sequence to generate the environments to calculate the  
17 lambda.

18 MEMBER KRESS: And you used MAAP to get  
19 the environmental conditions?

20 MR. SCOBEL: That's correct.

21 MEMBER KRESS: Which, basically, consists  
22 of the steam condensation rates and the thermal  
23 gradients --

24 MR. SCOBEL: Yes.

25 MEMBER KRESS: And the aerosol

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1 concentrations come out of MAAP also?

2 MR. SCOBEL: No. Actually, they didn't.  
3 They came from 1465.

4 MEMBER KRESS: Okay. You standardized --

5 MR. SCOBEL: We used 1465 --

6 MEMBER KRESS: You use the standardized  
7 source term.

8 MR. SCOBEL: Yes.

9 MEMBER KRESS: Timing also?

10 MR. SCOBEL: Yes. Which is based on a  
11 similar sequence from what we used for generating the  
12 environment.

13 VICE CHAIRMAN WALLIS: So the lambda is  
14 higher significantly but you're going to go back and  
15 still use AP600 lambda?

16 MR. SCOBEL: That's correct.

17 MR. CORLETTI: No. Excuse me, this is  
18 Mike Corletti. Dr. Wallis, we initially had used the  
19 AP600 lambda but I think the staff had requested us to  
20 perform a detailed AP1000 calculation. Once we had  
21 paid for that, we decided to use the value of the  
22 AP1000. So we are using the AP1000 value now.

23 MR. SCOBEL: Oh, okay. I didn't do that  
24 part of the analysis.

25 MEMBER KRESS: Yes. I noticed at one of

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1 your slides that the dominant contributor of the  
2 lambda was thermophoresis. I have a question about  
3 that. Was there any hydrogen combustion involved in  
4 this?

5 MR. SCOBEL: There was hydrogen combustion  
6 involved in the environment for the lambda  
7 calculation.

8 MEMBER KRESS: So at short periods you had  
9 high thermal gradients?

10 MR. SCOBEL: Yes.

11 MEMBER KRESS: Dana, does that raise any  
12 flags with you?

13 MEMBER POWERS: Yes.

14 MEMBER KRESS: Because it takes a while  
15 for thermal gradient lambda to be developed, and I'm  
16 not sure you have in a hydrogen combustion --

17 VICE CHAIRMAN WALLIS: Isn't it the  
18 condensation that does it?

19 MR. SCOBEL: It's a combination of the  
20 heat transfer and the condensation heat transfer, but  
21 the hydrogen combustion is occurring at ignitors so it  
22 is sustained over periods of time during the releases.

23 MEMBER KRESS: Oh, you're sustaining it  
24 over a period of time.

25 MR. SCOBEL: That's correct.

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1 MEMBER KRESS: And you feed that into a  
2 thermal gradient at the wall? Because this is  
3 thermophoresis to the walls.

4 MR. SCOBEL: Yes.

5 MEMBER KRESS: So what that does is raises  
6 the temperature of the environment?

7 MR. SCOBEL: Yes.

8 MEMBER KRESS: Okay.

9 MR. SCOBEL: If you look at the  
10 temperature plot that's in there, you can see that  
11 even on this title heat transfer rate you can see the  
12 spikes that are occurring as you have hydrogen burning  
13 at the ignitors.

14 MEMBER KRESS: Those are overall mass  
15 balance temperatures of the containment volume; is  
16 that what those are?

17 MR. SCOBEL: I'm sorry, I don't  
18 understand.

19 MEMBER KRESS: Are those average  
20 temperatures for the whole containment --

21 MR. SCOBEL: Yes, it is an average --

22 MEMBER KRESS: -- sort of a bulk average  
23 temperature.

24 MR. SCOBEL: Yes, it is an average.

25 MEMBER POWERS: Is this a one-node

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1 problem?

2 MR. SCOBEL: The aerosol calculation is a  
3 one-node problem.

4 MEMBER KRESS: So your delta T there looks  
5 like -- you don't have a wall temperature there.

6 MR. SCOBEL: I do not, but the wall is the  
7 passing containment cooling system, which would be --  
8 because it has the evaporation on the outside of the  
9 wall, it would be significantly cold.

10 MEMBER KRESS: Pretty cold. So you're  
11 looking at temperature differences of like 100 degrees  
12 C in these.

13 MR. SCOBEL: Yes, that's correct.

14 MEMBER KRESS: And that translates into  
15 what value for lambda did you actually end up with?

16 MR. SCOBEL: The average value, I believe,  
17 is 1.1 per hour.

18 MEMBER KRESS: Does that factor in the  
19 full surface area of the containment?

20 MR. SCOBEL: Yes. Yes, it does.

21 MEMBER KRESS: Dana, do you have any other  
22 questions about that lambda?

23 MEMBER POWERS: I don't know very much  
24 about this particular calculation. I'm a little  
25 surprised you say the whole containment volume. Do

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1       you really take the dome into account for this  
2       calculation?

3               MR. SCOBEL: Yes. In terms of volume?

4               MEMBER POWERS: Yes.

5               MR. SCOBEL: That's correct. Yes, we do.

6               MEMBER POWERS: That probably explains the  
7       difference between this and 600, because I don't think  
8       they did for 600; I think they left the dome out.

9               MR. SCOBEL: I think -- I don't think  
10      that's correct for AP600. We left out volumes that  
11      were inactive like the dead-ended compartments, the  
12      PXS compartment, the CVS. But the entire offered  
13      compartment was accounted for.

14              MEMBER POWERS: I mean what I know is  
15      what's written down here, and the issues that come up  
16      on this is it looks like they used a fairly small  
17      particle size but it's not very important here because  
18      thermophoresis and diffusophoresis are dominant, and  
19      in this size range there's not a whole lot of size  
20      sensitivity to that. There is a sensitivity to the  
21      shape factors that you choose to use for these  
22      particles which are not fully dense. And so the  
23      question comes up what shape factor did you use? Now,  
24      NAUASTAR tends to treat everything as though it was a  
25      sphere.

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1 MEMBER KRESS: Yes. I think they used a  
2 density factor of 0.8 of material.

3 MEMBER POWERS: So that would give you  
4 like a 1.2 shape factor, which is a pretty small shape  
5 factor. That's essentially a sphere. That's not even  
6 a very fluffy sphere. So you raise questions about  
7 that. Since AP600 was done, there's now been some  
8 measurements of shape factors under diffusophoresis,  
9 and you can get some substantial shape factor effects  
10 for what nominally look like spheres under  
11 diffusophoresis just from the double it, triple it  
12 kind of thing. And so you'd ask questions about how  
13 do you treat shape factors?

14 The devil is a lot in the details here  
15 because although the lambda they're getting out of  
16 here is not an outrageous lambda, I mean it's kind of  
17 what you'd expect, but what you've got is a  
18 substantially higher inventory. And so for the 10 CFR  
19 Part 100, you're asking what's the worst two hours  
20 here because you're leaking out, and though you've got  
21 a substantial lambda, it's not like 75 percent bigger.  
22 So you've got the worst two hours where you're very  
23 close for AP600. You've got a higher inventory, so  
24 you've got to ask what's happening in the worst two  
25 hours here, and it's not in this particular thing. A

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1 little bit surprises me that they're getting so much  
2 thermophoresis if they're not looking at internal  
3 structures. I don't know whether you are or not.

4 MR. SCOBEL: Well, the heat transfer is  
5 dominated by the passive containment cooling system,  
6 especially after an hour or so when you're expecting  
7 to get the releases of the fission products from the  
8 core. So you expect your internal heat syncs to be  
9 more or less saturated compared to the passive  
10 containment cooling system.

11 MEMBER POWERS: Sure. Sure. When you're  
12 going to the wall you've got a temperature gradient  
13 and you've got a steam flux going the same way. It's  
14 real easy to double count, so now the question is how  
15 are you adding together the two effects, and you  
16 really have to do that with Fokker-Planck equation.  
17 You can't just fumble around with it. Now, there are  
18 various ways to add and I just don't know how NAUASTAR  
19 does that.

20 MEMBER KRESS: I thought they just  
21 calculated them separately and added them linearly.

22 MEMBER POWERS: No. See now they double  
23 count because you've got a volume that's moving like  
24 this and then you're adding on to it. Well, this  
25 volume has not seen the total thermal gradient and so

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1 you're effectively depositing particles twice. It's  
2 a real problem in these combined phoretic  
3 environments. You have to do that really -- you have  
4 to go really do that. At this size, you're in the  
5 transition between the Newton regime and the continuum  
6 regime, so you've got to figure out how you're going  
7 to solve continuum mechanics and the Boltzmann  
8 equation and make them match because you can't solve  
9 them there. There's some guys that have done that in  
10 the literature mostly down in Texas, and they have  
11 some nice answers to that that they run against tests,  
12 and I just don't know how they would compare it  
13 against the straightforward addition. I'd have to  
14 look at it, but it's -- I mean it's a tough question.

15 I notice in the viewgraph that it says,  
16 gee, we neglected all these things and the experiments  
17 show that aerosols tend to form sticky material to  
18 either be retained in narrow path or fall quickly to  
19 the ground. Well, the LACE tests they pick some  
20 materials and when we look at what the fuel evolves  
21 when it degrades we don't get stuff that looks like  
22 LACE. LACE, as I recall, use cesium hydroxide and of  
23 course that's one of the great results that comes out  
24 of the Phebus Program. We don't have any cesium  
25 hydroxide. We have cesium-molybdates and things like

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1 that. And, in fact, in the tests we're doing now seem  
2 to say these reactor aerosols just are not hydroscopic  
3 and so this has neglected the hydroscopicity. That  
4 may not be a great conservatism there.

5 My point being is the devil's in the  
6 details on this, and I'm not sure how much of the  
7 detail you can go into without actually pulling apart  
8 the NAUA code and you never know where it stands right  
9 now because it's an evolving code. I mean it keeps --  
10 it reacts to the changing technical environment.

11 MEMBER KRESS: Well, I'm not sure how to  
12 proceed with this question then. Did you want to pose  
13 some specific questions you'd like answers to and  
14 they'll come back to us later on this or do you want  
15 to look into it as a Committee ourselves?

16 MEMBER POWERS: Well, I mean you're  
17 clearly going to have to look at the Part 100 analysis  
18 on this plant, and that's where this thing comes  
19 forward.

20 MEMBER KRESS: Yes.

21 MEMBER POWERS: I mean just on the face of  
22 it, I look at this lambda 1.1 and I say, well, okay,  
23 it's a larger than what they got for AP600. I don't  
24 have any reason to doubt it. I mean if they'd come in  
25 with ten, I would have said, well, they probably

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1 haven't got that right. If they'd come in with 0.1,  
2 I would have said, well, they probably haven't got  
3 that right for another reason. It's this combination  
4 of the lambda and the inventory and what the worst two  
5 hours are and do you survive the Part 100 scrutiny?  
6 And that's where we want to look at this stuff.

7 I mean you can say specific things: Okay,  
8 what did you do about the diffusophoretic shape  
9 factor, and we kind of know what that ought to be now.  
10 We've got some measurements. How do you combine the  
11 diffusophoresis term and the thermophoresis term?  
12 You've got a problem with double counting here when  
13 you do phoretics at the same time.

14 You would ask what did you do about the  
15 non-radioactive mass, because you put 1465 in. That  
16 only gives you the radioactive mass in there. So what  
17 did you do with the rest of it? Well, they probably  
18 didn't do anything with it. They probably just took  
19 the particle size. Because they're coming in a little  
20 bit small on the particle size, which, by the way, is  
21 -- it's not a huge conservatism but it's definitely  
22 not non-conservative, you know what I mean? I mean if  
23 you were dominated by gravitational sedimentation, it  
24 would be hugely conservative. But since you're  
25 dominated by phoretic processes which are very size-

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1 dependent at 0.1 microns but not very size-dependent  
2 in this range, it's kind of a wash sort of thing  
3 there.

4 To the extent that diffusophoresis is  
5 important, you really come down to what your  
6 condensation model due to the non-condensable gases in  
7 there, more of a thermohydraulic question than  
8 anything else.

9 MEMBER KRESS: That comes right out of  
10 four, I guess.

11 MEMBER POWERS: Yes. And I don't know  
12 what you're using.

13 MR. SCOBEL: Off the top of my head I  
14 don't know either.

15 MEMBER POWERS: One of them.

16 (Laughter.)

17 VICE CHAIRMAN WALLIS: So how would you  
18 reassure that they've done it reasonably? Would it  
19 require that Dr. Powers read all your stuff and review  
20 it or that Dr. Powers examines the staff about how  
21 well they have assessed all these phenomena or how  
22 would we be sort of reassured that everything is good  
23 enough? What's the means for us to get to that state?

24 MR. SCOBEL: Is that up to me?

25 (Laughter.)

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1 MEMBER ROSEN: Most assuredly, not.

2 MEMBER POWERS: Traditionally, the staff  
3 has done independent calculations in this area.

4 VICE CHAIRMAN WALLIS: So we'd go after  
5 the staff for reassurance.

6 MEMBER KRESS: I think we could ask this  
7 question of the staff. They're probably not prepared  
8 to address it today, but it's a question we could put  
9 to the staff and see how they dealt with these issues  
10 and their view and proceed from there.

11 VICE CHAIRMAN WALLIS: So the staff has  
12 got a message now, I hope.

13 MEMBER KRESS: Yes. It's strictly a  
14 question of do you meet the regulatory requirements of  
15 10 CFR 100 from the various DBAs. And they have to  
16 address those when they look at their SERs. So when  
17 we get to evaluating the SER, I guess we'll bring that  
18 question up.

19 With that, I'd like to turn it over to the  
20 staff and hear their presentation. I'm going to  
21 postpone the break until we hear from the staff.

22 MEMBER ROSEN: How long is the staff's  
23 presentation?

24 MEMBER KRESS: They said about 15 minutes.

25 VICE CHAIRMAN WALLIS: That's for their

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1 presentation; 35 minutes for questions?

2 MEMBER KRESS: Right.

3 MR. COLACCINO: This is Joe Colaccino.  
4 Each of our slides -- we each are going to present a  
5 status and we only have one slide for each of us. And  
6 so I know mine I can do in one or two minutes just on  
7 the status of the overall project.

8 VICE CHAIRMAN WALLIS: Do you have any  
9 technical content?

10 MR. COLACCINO: Yes, sir. We're going to  
11 talk thermohydraulic issues. With that, I'd like to  
12 introduce Jennifer Uhle to do that, Section Chief in  
13 the PWR Section.

14 MS. UHLE: Professor Wallis -- is this on?  
15 My slide doesn't really have any technical content per  
16 se because it was a repeat of what was said at the  
17 Subcommittee meeting. At this point, we raised some  
18 more questions to Westinghouse and they submitted  
19 about 20 -- I guess 28 of the responses to yesterday,  
20 and we're having a meeting with them too, so that's  
21 where we're really going to get down into the details.

22 At this point, what we thought the staff  
23 would do today would simply be to summarize to the  
24 full Committee what our concerns are. Now, you've  
25 already heard that because of what Westinghouse has

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1 already presented to you, so I don't know exactly what  
2 you want me to get into today. So what I had done was  
3 just put together a one-page slide that discusses the  
4 overarching issues.

5 But, first, I want to introduce the NRC  
6 Review Team. We mostly have everybody here today.  
7 We're getting some help from Research with Steve  
8 Bajorek. Gene Hsui is in NRR, he's in my section,  
9 he's in the back there. Walt Jensen, Lambros Lois,  
10 Summer Sun and Len Ward. So the independent analysis  
11 that the staff is doing is extensive. We are  
12 comparing NRC code calculations and we are doing some  
13 data comparison as well as some independent analytical  
14 modeling. I was going to put my slide up but we  
15 figured we'd be faster because I only have one slide  
16 because we have to get the projector set up, so I'm  
17 just going to speak from my slide here.

18 At this point, we have some open items  
19 that were identified in the draft SE. One that came  
20 out as part of the discussion with the SE was the  
21 identification of the limiting small-break LOCA  
22 transient that was discussed to some degree at the  
23 Subcommittee meeting, and the limiting small-break  
24 LOCA had been the DEG or the DVI. However, they're  
25 getting very similar collapse liquid levels for the

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1 ADS -- inadvertent ADS-1,2,3 as well as with the cold  
2 leg break. And so we wanted to verify that they have  
3 identified what the limiting small-break LOCA  
4 transient is because our review is focusing on that  
5 particular transient.

6 We've also noticed that with our review  
7 that containment back pressure that's been credited  
8 for the small-break LOCA transient before was 14.7 and  
9 now it's increasing to some degree, so we wanted to  
10 get a better review or do a better review of that to  
11 make sure that the back pressure that they are  
12 crediting is not, I would say, non-conservative. So  
13 we've addressed that in a question. We'll be  
14 discussing that with Westinghouse tomorrow.

15 We have an open item that was raised by  
16 the Subcommittee, and that is the NOTRUMP/RELAP5  
17 comparison. If you've compared the two calculations,  
18 we're getting somewhat different collapse liquid  
19 levels, and we're also seeing it looks like a period  
20 of time right around before the ADS4/IRWST transition  
21 where there is a bifurcation between the two codes  
22 where the NOTRUMP calculation shows an increase in  
23 collapse liquid level, the RELAP 5 shows a decrease.  
24 And after that point in time, the slopes are pretty  
25 similar, so what we're trying to do is narrow our

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1 focus to look at that period of time. At first, NRC  
2 staff was going to do that review ourselves here.  
3 Looking at staffing and the logistics of things,  
4 Westinghouse may in fact do that comparison and then  
5 NRC would independently confirm that. We're going to  
6 discuss that tomorrow as well.

7 We have, of course, the outstanding issue  
8 on the core -- the level swell during the ADS4/IRWST  
9 transition phase. And in that I should say that it's  
10 not just a level swell but it's also the entrainment,  
11 so any of the phenomena that are occurring during this  
12 period of time it gets difficult to review because  
13 there are so many phenomena that are in some way  
14 competing. The higher the level swell you have the  
15 more entrainment you would get. So to say that you're  
16 conservative in level swell you'd want to say that  
17 NOTRUMP underpredicts level swell. But then if  
18 NOTRUMP is underpredicting level swell, then that's  
19 not conservative with respect to entrainment, because  
20 you're going to be keeping more water in the core.

21 So Westinghouse has set up a variety of  
22 calculations that demonstrate that looking at each one  
23 of these phenomena individually that they have  
24 calculated conservatively the prediction of the  
25 transient, and we're going to go over that with them

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1 again tomorrow to make sure that we're in full  
2 agreement.

3 VICE CHAIRMAN WALLIS: Now, let's see now.  
4 We had a meeting in July and both you and Westinghouse  
5 knew that there were these questions. I'm a little  
6 surprised that the answer is Westinghouse submitted  
7 something yesterday.

8 MS. UHLE: Westinghouse had submitted  
9 information to us at an earlier period of time, okay?  
10 We then went out with an additional set of questions  
11 that are then questioning their answers. And what we  
12 found was that we could sit there and go back and  
13 forth --

14 VICE CHAIRMAN WALLIS: But no one was  
15 saying, "We're going to resolve this before we meet  
16 with the ACRS on October the 1st"?

17 MS. UHLE: At the time in the meeting, we  
18 thought that we would have -- that the Subcommittee  
19 meeting would be canceled and that we may have a full  
20 Committee meeting and at which point in time we would  
21 discuss what we had resolved at that point. So for us  
22 Westinghouse had submitted responses to our original  
23 questions. They thought that they had --

24 VICE CHAIRMAN WALLIS: But we're no  
25 further ahead than we were in July. You haven't told

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1 us anything new since then.

2 MS. UHLE: To the degree that we're  
3 further ahead, we're further ahead in the comparison  
4 of NOTRUMP to the --

5 VICE CHAIRMAN WALLIS: Well, maybe you are  
6 but we haven't been told.

7 MS. UHLE: Okay. I can tell you where  
8 we're further ahead.

9 VICE CHAIRMAN WALLIS: Well, you probably  
10 don't have the time to do that now. Maybe you want to  
11 tell us where you're further ahead.

12 MEMBER POWERS: Jennifer, could I ask a  
13 question. Now, you've spoken mostly about  
14 thermohydraulics and the piping system and things like  
15 that. How about this issue that was just raised, the  
16 condensation rates in the containment?

17 MS. UHLE: Yes. The containment review,  
18 that's in a different branch.

19 MEMBER POWERS: I see. And similarly --

20 MS. UHLE: That's in the Containment  
21 Section.

22 MEMBER POWERS: -- hydrogen blocking of  
23 the dome and things like that --

24 MS. UHLE: Yes. That's in a different  
25 branch, but Joelle and Joe are writing down your

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1 questions, and I believe that they would get those  
2 concerns to the appropriate group. So in reactor  
3 systems what we focus on is the --

4 MEMBER POWERS: Looking at reactor systems  
5 where you have this effluent coming out of your AD4  
6 valve --

7 MS. UHLE: Yes.

8 MEMBER POWERS: -- do you get a lot of  
9 water droplet?

10 MS. UHLE: That is an open issue that we  
11 have. Westinghouse, again, says conservatively that  
12 they would -- during the ADS4/IRWST transition time  
13 where it's conservative to assume a lot of water is  
14 going out, they have done an analysis that shows that  
15 with a homogenous situation that they're taking out a  
16 lot of liquid and that they're slowing the  
17 depressurization rate but they're still getting poor  
18 covered. And, okay, that's something that we're,  
19 again, looking at. We recognize that, but our  
20 question then turns out to be when you get into the  
21 long-term cooling analysis, you need to take liquid  
22 out, so it's now non-conservative to assume liquid is  
23 being taken out in a transition where you turn from  
24 one assumption for conservatism into another. That's  
25 our question. That's what we'll be discussing with

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1       them tomorrow.

2                   I mean based on back-of-the-envelope  
3       calculations that we have at this point, if you're  
4       talking a long-term cooling, we are concerned about  
5       the assumption that they are entraining as much liquid  
6       as they say. So on the last bullet, you'll see on  
7       boron precipitation RELAP5 or WCOBRA/TRAC sensitivity  
8       studies. We want to address that by either running a  
9       RELAP5 deck to completion into the long-term cooling  
10      stages but we have to model the sump, and there's,  
11      again, questions about the pressure drop through the  
12      lines in the sump and the configuration, and RELAP  
13      doesn't do multi-demodeling of pipes whereas  
14      WCOBRA/TRAC can where they can get a gradient and then  
15      donor the appropriate void fraction up into the ADS4  
16      lines. So we're going to work out tomorrow  
17      sensitivity studies that we would like Westinghouse to  
18      run to determine if we feel that their calculation of  
19      the entrainment during this long-term phase is  
20      conservative for the boron precipitation.

21                   MEMBER POWERS: It would be useful, if you  
22      can in the course of doing these analyses, to report  
23      the water droplet emissions into the containment in  
24      the, say, 200 to 1,000 micron range.

25                   MS. UHLE: See, we're not -- I mean we're

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1 not going to have any idea of what -- we'll have an  
2 idea of the mass coming out, but to say we know the  
3 interfacial area exactly and therefore the diameter of  
4 the droplets, there are no models in the code that  
5 have been validated to determine that. But, of  
6 course, you would think the higher the velocity of the  
7 vapor, the smaller the droplets you're going to --

8 MEMBER POWERS: That sort of information,  
9 because that may be one of the hidden conservatisms in  
10 this aerosol calculation, is those kinds of droplets  
11 are usually pretty good at sweeping out aerosol and  
12 just knowing what it is so you get some quantification  
13 would be a useful thing to do if you're trying to do  
14 a realistic source term analysis.

15 MS. UHLE: I mean we can certainly go and  
16 come with a correlation that looks at what the size of  
17 the droplets that are entrained, but it's not going to  
18 be validated in any way. And it's not given by the  
19 code; it's going to be just based on our view of --

20 MEMBER KRESS: Normally, those droplets  
21 are long gone before the source term comes out.

22 VICE CHAIRMAN WALLIS: They've all fallen  
23 out, those big ones.

24 MS. UHLE: But, Dr. Powers, you're  
25 indicating you want a lot of interfacial areas. You

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1 want very small droplets.

2 MEMBER POWERS: Well, I'm just struggling  
3 around for trying to understand all that's going on  
4 with the aerosols in this containment, and what's  
5 conservative and what's not conservative. And that's  
6 just one thing that came to mind. I mean if there  
7 isn't any, then that's fine too.

8 MEMBER KRESS: I suspect, for example,  
9 that those droplets may not be well treated in the  
10 thermal analysis of the containment.

11 MEMBER POWERS: There are droplets all  
12 over this system. What we rather suspect is the  
13 dripping off the roof if there's any condensation up  
14 there -- inconsequential. They're just too damn big.  
15 But these flows and things like that and bubbling and  
16 popping --

17 MEMBER KRESS: But those sprays they put  
18 in really sweep out the aerosol.

19 MEMBER POWERS: But now if they would just  
20 put a spray in there would be no problem at all. We  
21 could all go home and not have to agonize so much.

22 MEMBER KRESS: Sorry about that.

23 MR. CORLETTI: You want another spray  
24 system.

25 (Laughter.)

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1 MEMBER POWERS: We love spray systems  
2 around here.

3 VICE CHAIRMAN WALLIS: On the boron  
4 precipitation, did you find this mysterious phase  
5 diagram which seems to be a trivial thing to find with  
6 boron water steam?

7 MS. UHLE: We did not. That question was  
8 posed to Westinghouse. We thought we would --

9 VICE CHAIRMAN WALLIS: I think it was  
10 promised that someone would come up with one of these.  
11 Now, Westinghouse said that they're going to meet with  
12 you and then they're going to meet with us again in  
13 December, but since there seems to be no progress --

14 MS. UHLE: There is progress.

15 VICE CHAIRMAN WALLIS: Well, I mean  
16 nothing to -- no progress reported to us that's  
17 technical on any of these issues. There would have to  
18 be probably a Subcommittee meeting between now and  
19 December that's going to --

20 MS. UHLE: Right. And that's what we  
21 thought was discussed at the Subcommittee meeting,  
22 that there would be a later Subcommittee meeting when  
23 Westinghouse and the staff --

24 VICE CHAIRMAN WALLIS: Well, we can't have  
25 it until you have something to present to us which is

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1 ready.

2 MS. UHLE: Right. And it was not -- we  
3 felt or the staff's position was that it wasn't the  
4 point of today to provide progress to you. We thought  
5 that that would be at the later Subcommittee meeting.

6 VICE CHAIRMAN WALLIS: That's right. So  
7 when is that going to be? When is a reasonable time  
8 to schedule this time when you will actually show the  
9 real progress made in resolving these issues with  
10 Westinghouse?

11 MR. CUMMINS: This is Ed Cummins. I think  
12 we can answer that better after tomorrow, and I think  
13 that we could communicate with you based on the  
14 progress tomorrow.

15 VICE CHAIRMAN WALLIS: So it seems to me  
16 that your idea to come back to the full Committee in  
17 December is really rather premature because there's no  
18 --

19 MR. CUMMINS: Well, if you're  
20 Westinghouse, you think you've answered all the  
21 questions, but it's unfair to say that without the  
22 interaction with the staff that that's the case. So  
23 we feel pretty good, but I don't think you should rely  
24 just on that. I think we could communicate to you  
25 within a week when we would be ready to have a

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1 Subcommittee meeting.

2 VICE CHAIRMAN WALLIS: Well, it's a two-  
3 sided thing. The staff should be doing work too.

4 MEMBER KRESS: May I put that on your  
5 list?

6 VICE CHAIRMAN WALLIS: Maybe the staff has  
7 been doing work that concludes that your work is  
8 wrong, I have no idea.

9 MEMBER KRESS: We'll work that out. We  
10 don't need to discuss that here.

11 MEMBER POWERS: I'll just inject, I found  
12 the presentations and the information very useful  
13 since I wasn't at any of the Subcommittee meetings.  
14 Even Jennifer's zero viewgraph presentation was  
15 interesting.

16 MS. UHLE: I have a viewgraph, they just  
17 didn't put it up there. In fact, I have two. One is  
18 entitled with my name on it.

19 VICE CHAIRMAN WALLIS: Really, your  
20 viewgraph says that you're looking at the things that  
21 Westinghouse presented this morning, so that's it.

22 MS. UHLE: Yes. If you want me to go into  
23 what we have done in addition to what we had done from  
24 the Subcommittee meeting, then I can summarize that  
25 briefly for you. And that is we've been looking more

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1 at the comparison of NOTRUMP to the APEX tests. We've  
2 done more back-of-the-envelope type calculations of  
3 the level swell. We've looked at during the long-term  
4 cooling and the ADS4/IRWST injection phase. We feel  
5 that Westinghouse has, although I'm not saying for  
6 sure, appropriately compared data for the level swells  
7 in both cases. We have made -- we're starting to  
8 reduce the data from the APEX-1000 test to get a  
9 better idea of what the quality is going out the ADS4  
10 and comparing that to what is predicted by NOTRUMP  
11 during the ADS4/IWRST transition phase.

12 We've, in addition, loaded up a simplified  
13 RELAP model to do the long-term cooling. What we need  
14 from Westinghouse was the information on the L over Ds  
15 for the pressure drops and get a better idea of what  
16 the flow paths are in the system as a whole with  
17 respect to the connection to the containment. And  
18 that's when the question came up, well, why don't you  
19 just tell us what sensitivity studies to do for  
20 WCOBRA/TRAC because they already have a model put  
21 together. So that's what we're putting forth there  
22 tomorrow at the discussion.

23 And, of course, we've studied the  
24 responses that Westinghouse has provided so far and  
25 came up with the 30 additional questions, and we felt

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1 that we could go back and forth for quite a while  
2 doing questions and answers, and we thought that a  
3 workshop would be a more effective way of resolving  
4 the problems, or I should say concerns. I guess  
5 they're not problems.

6 MEMBER KRESS: Questions?

7 MS. UHLE: Questions. And also I should  
8 put we have looked at the containment back pressure  
9 determination and got our hands around exactly what  
10 type of back pressure that they've been crediting for  
11 each of the cases. We looked at the -- the  
12 containment analysis is done in another branch but  
13 looked at the assumptions that went into the  
14 calculation to determine if they were conservative for  
15 the small-break LOCA transients. But I would say the  
16 majority of our work has focused on the boron  
17 precipitation concern.

18 VICE CHAIRMAN WALLIS: And you still don't  
19 have any phase diagrams for this boron precipitation  
20 process? How can you do it?

21 MS. UHLE: Well, your phase diagram is --  
22 my feeling that your question is how much boron is  
23 taken into -- going into the steam.

24 VICE CHAIRMAN WALLIS: Right.

25 MS. UHLE: And so we're conservatively

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1 assuming none is going into the steam and it's all  
2 staying in the water. So that's conservative. And we  
3 checked to see what the inlet condition or the inlet  
4 temperature coming into the bottom of the core is and  
5 looking at the solubility as a function of time to see  
6 if there's going to be precipitation or not. And it  
7 all boils down to how much you're ripping out, and,  
8 again, we are very skeptical about the Westinghouse  
9 analysis and we're therefore meeting tomorrow to take  
10 a look at it, because when we at this point in time  
11 say is this -- are you precipitating, okay, we would  
12 probably be more concerned than Westinghouse is.

13 CHAIRMAN BONACA: Well, this will just  
14 have to come to a Subcommittee meeting and look at  
15 where we stand. It seems is if there is a lot of work  
16 that has been done.

17 VICE CHAIRMAN WALLIS: Well, we'll still  
18 be here on Friday and you've had this meeting with  
19 Westinghouse tomorrow? Perhaps we can get together on  
20 Friday?

21 MS. UHLE: Only if you pay for lunch.

22 (Laughter.)

23 VICE CHAIRMAN WALLIS: I'm not sure I'm  
24 allowed to pay for your lunch.

25 MS. UHLE: Oh, yes, you are.

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1 MEMBER POWERS: You can. She can't pay  
2 for you.

3 MS. UHLE: We're not allowed to pay for  
4 you. I'll buy you dessert to sweeten you up.

5 MEMBER POWERS: An impossible tour.

6 CHAIRMAN BONACA: Do we have another  
7 presentation?

8 MEMBER KRESS: Yes.

9 CHAIRMAN BONACA: Let's move on to that.

10 MEMBER KRESS: Let's move on. Thank you,  
11 Mr. Chairman.

12 MR. COLACCINO: Okay. I know we're  
13 pressed for time, so I will also talk from a slide on  
14 the status that's just right in front of you. Just go  
15 over real quick where we're at with the DSER, it's  
16 progress on our supplemental DSERs. What we on the  
17 project team look at are the technical issues and what  
18 our schedule is. I didn't think I said it at the  
19 outset, my name is Joe Colaccino. I'm one of the  
20 three project managers that's working the AP1000.

21 We did issue the DSER on time, on June 16,  
22 2003. We did have 174 open items. We have been -- I  
23 guess I would say we've been aggressively --  
24 Westinghouse has aggressively been engaging us and  
25 we've been responding to them on virtually all of the

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1 open items that they can have response. We are  
2 carrying some open items that really they're staff  
3 open items that we need to complete certain actions,  
4 and Westinghouse understands that.

5 As of yesterday, we had 24 of the open  
6 items that we consider resolved, we have reviewed and  
7 resolved, and we have no additional technical issues.  
8 We have 36 open items that we have gotten commitments  
9 from Westinghouse to change in a particular way, and  
10 we just have to verify those commitments and DCD  
11 changes, sorry, design control document, or in their  
12 actual response to the open item.

13 We have had some additional questions, and  
14 I think you've touched upon some of those that we have  
15 passed down to Westinghouse. We're not tracking them  
16 as open items per se, we've given them numbers. What  
17 we are really sticking with the 174 open items that we  
18 had at DSER so we don't lose track of anything.

19 We did in the DSER have five supplemental  
20 reviews that we did say in the DSER that we expected  
21 to issue supplemental draft safety evaluation reports,  
22 and I've listed the five over here. Notice in  
23 particular we have a public meeting scheduled tomorrow  
24 on leak-before-break. We have staff members here  
25 today who will be leading that discussion with

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1 Westinghouse. It is a public meeting. We're making  
2 significant progress on this issue. We don't see that  
3 -- we're moving forward on this issue. We don't right  
4 now, at this point, the progress that we've made hold  
5 this as one of our significant technical issues.  
6 There has been at least one other public meeting,  
7 several calls between the staff and Westinghouse on  
8 this.

9 The security review is not done. We did  
10 not have a security section except to say that the  
11 security review would be completed at some portion,  
12 and we would issue a supplemental DSER. We still  
13 expect to do that. That review is in progress and  
14 NSER is conducting that review.

15 The initial test program at Westinghouse  
16 has been provided a number of additional questions,  
17 and that review, that's an active review, Westinghouse  
18 has responded to those questions and we're in the  
19 progress of evaluating those. The testing and  
20 computer code evaluation, Chapter 21, we're in the  
21 documentation really. This is mostly on the staff to  
22 document the changes, how the AP600 codes are valid  
23 for AP1000. That effort is ongoing also.

24 With regard to the significant technical  
25 issues, Jennifer -- and you've heard most of this

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1 presentation -- discussed the reactor systems issues,  
2 the entrainment, long-term cooling, core swell and  
3 boron precipitation. I would hold up as the other  
4 pole in a two-tent, you know, the long poles, is the  
5 structural and seismic issues, specifically the  
6 containment design and the basemat uplift. The staff  
7 did conduct an audit and public meeting at  
8 Westinghouse in early April. The containment design  
9 was not -- the calculations associated with the  
10 containment design were not available for the staff to  
11 review then. They are available now, so next week the  
12 staff will be going and looking at that. They'll be  
13 seeing that for the first time.

14 With regard to basemat uplift, there are  
15 a number of open items that are associated with base  
16 mats that were outstanding from the April audit.  
17 Westinghouse has come back and has tried to address  
18 those questions. We've also had discussions with  
19 them, conference calls on that. So we look to next  
20 week in the structural and seismic area. We carried  
21 at the DSER phase on the order of 53 of the open  
22 items, roughly one-third of the open items in the  
23 DSER. We look at that as pretty significant activity  
24 next week, which folds into the last one, discussion  
25 of the schedule.

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1           Back in July of 2002, we set out a  
2 preliminary schedule which stated that -- which gave  
3 our DSER date of June 16, 2003, our FSAR issuance date  
4 of September of 2004. That schedule is stipulated on  
5 us having minimal open items. We still believe we can  
6 meet that schedule unless some of the other technical  
7 issues present are more trouble than we think they  
8 are. We have in that schedule, in that July 2002  
9 schedule, we had scheduled then to come back to ACRS  
10 full Committee in July of 2004.

11           Now, we are going to reassess the schedule  
12 after -- we feel that we have three important  
13 activities coming in the next couple of days, this  
14 being one of the, of course. The other one is being  
15 the workshop that's taking place tomorrow with reactor  
16 systems, and also the audit next week. So after the  
17 audit next week, we should be able to have a better  
18 idea of where we stand on our schedule, and we plan to  
19 issue some milestones, I think, as Westinghouse told  
20 you, as to how we can complete -- if September of 2004  
21 is still a good date and what our milestones that we  
22 need to meet, both NRC and Westinghouse, to meet that  
23 date. Other than that, I have nothing else. If you  
24 have any questions, I'll be glad to answer them.

25           MEMBER KRESS: Seeing none, I guess we'll

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1 turn the meeting back to you, Mr. Chair.

2 CHAIRMAN BONACA: Are there any more  
3 questions? If there are none, we'll take a recess  
4 until quarter of four.

5 MEMBER KRESS: Do you want to say  
6 something, Mike?

7 MR. CORLETTI: I think thank you very  
8 much.

9 MEMBER KRESS: Yes. Well, thank you.

10 (Whereupon, the foregoing matter went off  
11 the record at 3:29 p.m. and went back on  
12 the record at 3:48 p.m.)

13 CHAIRMAN BONACA: We're back in session,  
14 and we have interesting presentation now on this NRC  
15 research program on materials degradation. And Dr.  
16 Ford is going to walk us through this and introduce  
17 the presenters.

18 MEMBER FORD: We were originally billed to  
19 be hearing about a program that you've all heard about  
20 informally -- the material degradation program. In  
21 fact, it's going to be wider than this. Mike Mayfield  
22 is going to present a wider range of materials  
23 degradation aspects that are being covered.

24 It will be of relevance to the research  
25 report, Dana. It will also be -- give us some good

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1 background for the presentation tomorrow to the  
2 Commission.

3 MEMBER SIEBER: I've got to change it now,  
4 because I said we would be anxious to -- or eager to  
5 hear from the staff. Now --

6 MEMBER FORD: You've heard.

7 MEMBER SIEBER: -- we've heard, so now  
8 I've got to rewrite my speech.

9 MR. MAYFIELD: Well, we'll be happy to  
10 come talk to you some more.

11 (Laughter.)

12 MEMBER FORD: So, Mike, it's all yours.

13 MR. MAYFIELD: Well, thank you. Some  
14 months ago the committee had been briefed on the  
15 staff's efforts looking at the response to the Davis-  
16 Besse lessons learned passport and the program that  
17 addressed the Davis-Besse issues.

18 When I looked at the committee's letter,  
19 I said, "Well, that's interesting. I'm glad to see  
20 the support. But, oh, by the way, we have a much  
21 larger scope program than was briefed to the  
22 committee." So I had asked Dr. Larkins for some time  
23 to sit with the committee and just give you a snapshot  
24 of what we're doing and the scope of those activities.  
25 And it turns out now that with the Commission

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1 briefing, the timing, maybe we were late by a month,  
2 but at least we're a day in advance.

3 So with that, I have with me this  
4 afternoon Joe Muscara from the Materials Engineering  
5 Branch.

6 MEMBER POWERS: Is he qualified to talk to  
7 us?

8 MR. MAYFIELD: Sir?

9 MEMBER POWERS: Is he qualified to talk to  
10 us?

11 (Laughter.)

12 MR. MAYFIELD: You know, there have been  
13 doubts.

14 (Laughter.)

15 But in --

16 MEMBER POWERS: I never get an answer  
17 either.

18 MR. MAYFIELD: In this specialty, yes,  
19 sir, I contest that he is qualified.

20 What I wanted to do was to, again, talk  
21 fairly quickly about a broad range of subjects, not to  
22 do a specific technical briefing, but rather to try  
23 and illustrate the range of areas where we're working,  
24 and that we are producing some results, not just  
25 plans.

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1 Our environmentally-assisted tracking  
2 research is a long --

3 MEMBER POWERS: Mike, can I interrupt  
4 and --

5 MR. MAYFIELD: Sir?

6 MEMBER POWERS: -- tell you where I'm  
7 struggling? And it may be a little unfair to the  
8 other members, because I've looked into some of this  
9 stuff here. But I'm trying desperately to understand  
10 the bound between what's the NRC responsibility to  
11 understand about these units that -- in order to  
12 fulfill its mission of protecting the public health  
13 and safety versus what is the responsibility of the  
14 owner or operator --

15 MR. MAYFIELD: Right.

16 MEMBER POWERS: -- of the machines.

17 MR. MAYFIELD: If I can, let me address  
18 that as we go, because actually I think there is a  
19 pretty good story in this area in particular. By and  
20 large -- and part of the answer to your question goes  
21 to the second bullet. This is a long-standing  
22 program. It goes back to the early -- or, I'm sorry,  
23 mid '70s.

24 Over time, what we've been doing is  
25 responding to degradation that's been identified in

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1 service. You can look at the stress corrosion  
2 cracking in the BWR piping, and it morphed itself into  
3 irradiation-assisted stress corrosion cracking. We've  
4 been worrying about fatigue life in piping;  
5 subsequently, fatigue crack growth in pressure vessels  
6 and piping, the steam generator tube's activity --

7 MEMBER SHACK: What about embrittlement of  
8 cast stainless steel?

9 MR. MAYFIELD: Embrittlement of cast  
10 stainless steel. There is one laboratory that --

11 MEMBER POWERS: Did you guys do any work  
12 on that at all?

13 MR. MAYFIELD: There was one laboratory  
14 that did some kind of cheesy work, but we subsequently  
15 got that straightened out, and a good piece of work  
16 evolved.

17 MEMBER ROSEN: And actually, that bullet,  
18 steam generator tube degradation, really has 11-teen  
19 sub-bullets under it. But it --

20 MR. MAYFIELD: Yes, sir.

21 MEMBER ROSEN: -- starts with something  
22 called denting, if you're old enough to remember that.

23 MR. MAYFIELD: That's correct. And so the  
24 point about the steam generators is that activity was  
25 one that started out under the EAC program, and then

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1 as it blossomed became a program unto itself. And I  
2 think we've briefed the committee on that a couple of  
3 different times.

4 The primary water stress corrosion  
5 cracking is sort of the in vogue thing today, and now  
6 the boric acid corrosion. One of the things that has  
7 kept happening to us over time, as well as to the  
8 industry, is where we're responding to identified  
9 degradation, often times we're responding to the  
10 degradation being identified by water in the floor.

11 We're tired of it. The industry is tired  
12 of it. And so this has been a time where we have  
13 started putting some serious emphasis on a proactive  
14 research program looking forward, not to solve the  
15 problem, but to see what we can do to develop as  
16 research tools to do what is necessary to look  
17 forward.

18 The industry today has a major program in  
19 this area. That program materials -- I think it's  
20 just materials degradation. The chief nuclear  
21 officers, it's my understanding, have voted  
22 unanimously to form this and support the program with  
23 dollars as opposed to just moral support. They are  
24 pulling staff members online to staff the activity,  
25 and then there is research work looking proactively at

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1 what can be done. That's one major element of their  
2 program.

3 They are the ones putting, if you will,  
4 the serious money into it at this stage, and Joe will  
5 talk more about what we're doing on the proactive  
6 program as we go. But the industry are the ones that  
7 are putting the money into solving the issues. Our  
8 role is more one of confirmatory, once they've put  
9 something forward; anticipatory, in trying to get our  
10 arms around, is what the industry doing credible? Are  
11 they missing something?

12 There is no -- well, I think the one  
13 guarantee in this is that we will not guess about  
14 everything that could go wrong in a nuclear powerplant  
15 in the materials system. It's just not practical to  
16 say we would do that.

17 Hopefully, we can get further along than  
18 we are today. One of the things --

19 MEMBER POWERS: If you were king, what  
20 would we have?

21 MR. MAYFIELD: I'm sorry. Say it again?

22 MEMBER POWERS: If you were king, what  
23 would we have? If Joe were king, what would we have?

24 MR. MAYFIELD: In terms of?

25 MEMBER POWERS: The ability to predict

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1       what's going on.

2               MR. MAYFIELD: We'd have first principles  
3 models that helped us where we could understand the  
4 degradation mechanisms, identify the susceptible  
5 locations, and be able to predict quantitatively what  
6 was going on and where and when.

7               And then, we would have the inspection  
8 tools necessary to go out and confirm that, indeed,  
9 that was happening, that -- and that we could reliably  
10 detect and quantify the degradation and make sound  
11 predictions about, when do you need to react? You,  
12 the licensee, when do you need to react to -- to make  
13 the run/repair/retire decisions? I think that  
14 phrasing has fallen --

15              MEMBER POWERS: I mean, what you describe  
16 sounds like a wonderful thing for a license to have.

17              MR. MAYFIELD: Well, you said if I was  
18 king.

19              MEMBER POWERS: Yes, I know. No, I said  
20 if Joe was king.

21              MR. MAYFIELD: Ah, well. Okay.

22              MEMBER POWERS: I'm never going to make  
23 you king. I know what you'd do.

24              (Laughter.)

25              MR. MAYFIELD: I agree. And I think the

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1 NRC's role -- and, in fact, when we were here a couple  
2 of weeks ago talking about the sump blockage issue,  
3 one of the issues that came up there was the, if you  
4 will, tension between the staff's role and the  
5 industry's role. And that I think by its very nature,  
6 a confirmatory research program, brings about that  
7 tension.

8 What is our role? And when do you trade  
9 off or hand off from the staff to the industry and  
10 back? It is a difficult issue. It comes up  
11 repeatedly. I came to work for the NRC in '85. We  
12 were discussing exactly that issue for the budget that  
13 year. And we have had that discussion actively every  
14 year since, and it's -- it changes a bit with time and  
15 cycles a bit with time. And it cycles with issue.

16 MEMBER POWERS: I mean, what I can tell  
17 you is that there is an ACRS position, de facto in one  
18 of our research reports, that says, yes, it's the  
19 industry's responsibility to take care of nearly all  
20 of these problems.

21 But the problem that you run into is they  
22 can make mistakes, they can leave things out, and it's  
23 NRC's responsibility to make sure that their proposed  
24 solutions are: a) in fact, solutions; and b) do solve  
25 the problem completely. And to do that, NRC has to be

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1 an active participant in the field. I mean, that's  
2 basically what the ACRS has said in the past.

3 MR. MAYFIELD: And that's pretty much what  
4 we're doing. And I think this program area is  
5 actually an excellent example of that, and one of the  
6 things we'll talk about is some of the interaction we  
7 are having with the industry cooperatively.

8 MEMBER POWERS: Well, Joe has put another  
9 spin on that, and one that I'm enormously sympathetic  
10 with. He says if I'm an owner or operator of these  
11 things, I'm so anxious to devote all my efforts to  
12 getting rid of the problem that I really haven't got  
13 time or inclination to go into the fundamentals.

14 And if you're just looking over people's  
15 shoulder and watching, then you do have a chance to go  
16 into the -- into more fundamental perhaps than other  
17 people. And that, too, seems to be a good idea to me.  
18 I mean, I don't have any trouble with that.

19 MR. MAYFIELD: And I think that perhaps  
20 prior to the V.C. Summer and Davis-Besse events we  
21 were seeing -- and I don't want to make this sound too  
22 definitive. But generally, we would see issues or  
23 approaches to, well, let's make the problem go away  
24 and move on, rather than really understand the  
25 problem, and look for, where can something similar

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1       happen to us?

2               I think that what we're seeing now is an  
3       industry that has decided, one, it's a safety issue,  
4       so we need to do something about it. Well, they've  
5       always dealt with the safety aspects of it. But now  
6       it's getting to be a bigger and bigger economic  
7       impact, and there is plainly an economic advantage to  
8       being able to run the plant rather than having to stop  
9       and fix it.

10              So there is now both pieces coming  
11       together -- the safety interest and the economic  
12       interest. And it's --

13              MEMBER POWERS: I get --

14              MR. MAYFIELD: -- creating a situation  
15       where in this area we are I think in the kind of  
16       environment we'd like to see.

17              MEMBER POWERS: I get the sense that there  
18       is a feeling toward this like there -- like TMI.  
19       Another Davis-Besse incident impacts not just that  
20       plant but the entire industry.

21              MR. MAYFIELD: All we were trying to  
22       really illustrate with this slide is that degradation  
23       continues to evolve with time. One of the things that  
24       we have found is just about the time we think we've  
25       fixed one problem another one creeps up. And it may

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1 simply be a variant on the problem we think we've  
2 solved.

3 And that's something that we've -- some of  
4 us have wearied of. And we'd very much like to try  
5 and get our arms around it a little bit better than we  
6 have today, and to be able to deal with some of these  
7 things.

8 MEMBER SIEBER: Are there real solutions  
9 other than just changing materials? For example, your  
10 program really looks at detection in a timely fashion  
11 and adequate repair methods or replacement, you know,  
12 and --

13 MR. MAYFIELD: I think there are some good  
14 examples where there have been mitigative strategies  
15 put in place. For example, in the BWRs. The  
16 hydrogen --

17 MEMBER SIEBER: Chemistry.

18 MR. MAYFIELD: -- water chemistry I think  
19 is an excellent example. Some of the stress  
20 improvement techniques, the weld overlay repair  
21 technique -- while not really a mitigator, allowed  
22 them -- many of the plants to avoid large-scale  
23 replacements.

24 So there are things that had been put in  
25 place. The technique --

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1 MEMBER SHACK: Well, the attention we pay  
2 to water chemistry is a relative --

3 MR. MAYFIELD: The attention we pay to  
4 water chemistry today is a huge --

5 MEMBER SIEBER: On the other hand, you can  
6 develop mitigating strategies and say, "Well, this  
7 will solve this problem." In the meantime, you've  
8 created another problem. For example, steam generator  
9 chemistry in PWRs.

10 MR. MAYFIELD: Yes.

11 MEMBER SIEBER: The first inclination was  
12 to make the water as pure as it could possibly be,  
13 which happened to be the wrong thing to do.

14 MR. MAYFIELD: That wasn't all that great  
15 an idea.

16 MEMBER SIEBER: Right. And so, where do  
17 you lead yourself? By the time you're done, you've  
18 probably solved the problem. But the plant is now in  
19 really bad shape.

20 MR. MUSCARA: If I may make a comment on  
21 the water chemistry.

22 MEMBER SIEBER: Okay.

23 MR. MUSCARA: And our role and the  
24 industry's role. If you remember back in the  
25 mid '70s, a lot of work was going on, EPRI-sponsored

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1 work, on BWR pipe cracking.

2 MEMBER SIEBER: Right.

3 MR. MUSCARA: And most of that work was  
4 done with high stress and high oxygen levels. That's  
5 it.

6 MEMBER SIEBER: That's right.

7 MR. MUSCARA: We came in with our EAC work  
8 at Argonne and started doing work with the effects of  
9 impurities, and sure enough we found that impurities  
10 had a big effect, maybe even bigger than the oxygen.  
11 And this led the industry, which were developing the  
12 water chemistry guidelines.

13 MEMBER SIEBER: Okay.

14 MR. MUSCARA: So, again, there is a role  
15 for us in identifying and understanding problems, and  
16 then there's a role for the industry to respond.

17 MEMBER SIEBER: Well, there's no doubt in  
18 my mind that that's the truth. I think you bring  
19 something to the table, that it represents a little  
20 bit of a different viewpoint than the manufacturers  
21 and licensees might have. And I think it takes all  
22 three.

23 MR. MAYFIELD: I agree.

24 MEMBER SIEBER: Okay.

25 MR. MAYFIELD: The one thing that we are,

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1 have been, and continue to push is to not just deal  
2 with the problems of the day but to try and understand  
3 what's under that problem, what caused it.

4 MEMBER SIEBER: Right.

5 MR. MAYFIELD: And it has been difficult  
6 in the past to really be able to pursue that at the  
7 level we thought was appropriate. There's budget  
8 challenges, and there's all kinds of new things  
9 happening.

10 One of the things we're pushing on -- we  
11 have a commitment from Ashok Thadani to keep pushing  
12 in this area. He is very supportive of trying to get  
13 ahead of this. So this has become an element of the  
14 program that we anticipate continuing and continuing  
15 fairly aggressively.

16 MEMBER SIEBER: How much do the  
17 Commissioners, other than the Chairman, know about  
18 this?

19 MR. MAYFIELD: Probably fairly little.

20 MEMBER SIEBER: Until tomorrow.

21 MR. MAYFIELD: We have briefed the  
22 Chairman on at least the broad strategy, not on the  
23 specifics. I think the committee, far and away, has  
24 received more information, at least informally, and  
25 what we'll talk about this afternoon.

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1 MEMBER SIEBER: Okay.

2 MR. MAYFIELD: But the Chairman I think  
3 knows in sort of broad brush direction where we're  
4 going.

5 MEMBER SIEBER: Okay. So I can expect  
6 when I talk to the Commissioners tomorrow that three  
7 of them won't know very much about it.

8 MR. MAYFIELD: I think that's a fair  
9 expectation.

10 MEMBER SIEBER: Okay.

11 MR. MAYFIELD: Major activities in the  
12 materials degradation program look at environmentally-  
13 assisted cracking and lightwater reactors, corrosion  
14 of pressure boundary materials in concentrated boric  
15 acid solutions.

16 You'd think this was something we would  
17 have addressed many years ago, but it turns out there  
18 are fundamental aspects of it that even today we don't  
19 really have a good handle on. And then, finally,  
20 looking -- examination of the North Anna 2 nozzles and  
21 J-welds, and I'll talk a little bit more about what we  
22 have acquired.

23 We've got ongoing this week a vessel  
24 penetration conference, and we'll talk a little bit  
25 more about that. There's an Alloy 600 issues task

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1 group. That's an activity that's collaborative with  
2 the industry.

3 We're looking at forming an international  
4 cooperative program looking at primary water stress  
5 corrosion cracking and non-destructive examination  
6 techniques. The NDE piece we'll say a little bit more  
7 about, but you really need to have the tools that have  
8 been validated and that are highly reliable for  
9 detecting and characterizing the degradation.

10 That's going to be, I believe, essential  
11 to get ahead of this problem. And then, finally,  
12 we'll talk some more about the proactive materials  
13 degradation initiative.

14 Just to -- without going through the slide  
15 in detail, the reliability of the NDE program has been  
16 a long-standing program. It started at about the same  
17 time the environmentally-assisted cracking work did.  
18 We have a major activity looking at ISI reliability  
19 and ASME code requirements.

20 We are looking at surface roughness  
21 effects, how smooth does the surface really have to  
22 be, how does that impact the reliability of the  
23 inspection. We're looking at techniques for  
24 inspecting for stress corrosion cracking and reactor  
25 internals.

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1                   One of the big things that, frankly, Joe  
2                   had a large hand in several years ago was getting in  
3                   place in the ASME code, and then the industry moving  
4                   forward on performance demonstration programs to  
5                   demonstrate that the inspections that were being  
6                   performed really were reliable.

7                   That's an area we continue to follow and  
8                   be interested in, and looking at how sample sets are  
9                   developed, how many inspection tests have to be  
10                  performed, addition of -- additional training of the  
11                  inspectors.

12                  And, finally, we follow fairly closely  
13                  some of the parallel international research  
14                  activities.

15                  MEMBER FORD: Mike, could I ask a question  
16                  to follow up on that? At the last meeting that we  
17                  had, the subcommittee meeting on the Davis-Besse  
18                  issue, we brought up questions about probabilities of  
19                  detection, inspection techniques used for the VHP and  
20                  also the bottom head.

21                  The answers we got back from the  
22                  utilities, the MRP, were quite honesty rather woolly.  
23                  They weren't crisp and to the point.

24                  MR. MAYFIELD: Yes.

25                  MEMBER FORD: That does not -- first of

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1 all, in reality, what is the case? And do you feel as  
2 though there's a need to move forward, a need to push  
3 more?

4 MR. MAYFIELD: Well, I think that there  
5 plainly is a need to move forward and have additional  
6 mockups that deal with a broader range of issues  
7 and --

8 MEMBER FORD: I guess my more specific  
9 question was: was that just a bad communication from  
10 the speaker? Or is that --

11 MR. MAYFIELD: No. I think that the --  
12 where the industry has been, they were doing this on  
13 the fly.

14 MEMBER FORD: Right.

15 MR. MAYFIELD: It was I think to their  
16 great credit. They were taking a serious attempt at  
17 quickly putting together inspection mockups, so they  
18 would have some sense that, indeed, these inspections  
19 were being effective.

20 Doing that on the fly is always a  
21 challenge. And do you have enough sample sets? Do  
22 the range of flaws adequately capture what you would  
23 like to have? The answer to those things are no, and  
24 so there is interest and I think need for additional  
25 work in that area.

1                   Where they are today I have to admit I  
2 haven't --

3                   MEMBER FORD: Well, for example --

4                   MR. MAYFIELD: -- specific. I don't know.

5                   MEMBER FORD: -- along this same line of  
6 questioning, V.C. Summer -- I mean, they failed to  
7 identify these cracks time and time again. They were  
8 there. But then they used eddy current to identify  
9 where there were, in fact, superficial indications.  
10 And then, when they tested those with volumetric, they  
11 found the cracks.

12                   It seems as if they -- there was a  
13 discovery that a combination of eddy current and  
14 volumetric would be an improved technique to identify  
15 cracking.

16                   Now, given that it is an improved  
17 technique, are they using it now after V.C. Summer?  
18 Or is it simply something that is now being done?

19                   MR. MUSCARA: They are using it now.

20                   MEMBER FORD: They are using it now.

21                   MR. MUSCARA: Let me give you a little bit  
22 of perspective about this work that has gone on for a  
23 number of years on performance demonstration. We  
24 initiated the work at Battelle Northwest Laboratory,  
25 have come up with some recommendations, and, in fact,

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1 a draft reg. guide to require performance  
2 demonstration.

3 The reason was that the techniques are in  
4 place, cookbook procedures, didn't seem to work. And  
5 every time they changed a parameter thinking that this  
6 would solve the problem, it still wasn't working. So  
7 we decided we needed to have a performance  
8 demonstration.

9 And when we started working with the code,  
10 the initial document in fact required that any  
11 inspection that's conducted per the code should be  
12 conducted using qualified techniques, procedures, and  
13 personnel through performance demonstration.

14 Well, people realized that some of these  
15 inspections were not very effective -- for example,  
16 cast stainless steel, dissimilar metal welds. And so  
17 the words were changed a little bit. It said that you  
18 should use qualified procedures if you have a  
19 supplement.

20 So the code developed several supplements  
21 for those components and materials that were  
22 inspectable. The ones that were difficult they've  
23 left behind -- work in progress. And so what's  
24 happened is that because the problem is difficult  
25 there has been no performance administration

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1 supplement developed.

2 I've been pushing that if the problem is  
3 difficult, do some work, resolve it, get the  
4 performance administration process in place. So what  
5 has happened with some of these inspections is that  
6 there wasn't a qualified procedure. And there wasn't  
7 a qualified procedure because it was difficult.

8 But, in fact, if the code insists that any  
9 inspection that's conducted should be conducted  
10 according to a qualified procedure, then all of the  
11 inspections should be effective.

12 MEMBER POWERS: This is one of those areas  
13 that elicits some of my challenges that I'm facing  
14 here. If the code requires that there be a qualified  
15 procedure, and the licensee doesn't have one, why is  
16 it that NRC has any responsibilities other than to  
17 tell the licensee, "Go get yourself a qualified  
18 procedure."

19 Now, I can understand that that might not  
20 be a useful comment 10 years, 20 years ago. But today  
21 when we see this EPRI NDE Center, and things like  
22 that, why does NRC have any responsibilities in the  
23 NDE business at all now?

24 MR. MAYFIELD: Let me give you a case --  
25 a specific example. And Joe mentioned the cast

1 stainless steel and inspecting that material.

2 We were hearing from some of the industry  
3 folks that the material is uninspectable, the job  
4 can't be done, you just can't find flaws in it, so we  
5 should give up inspecting it.

6 We had asked Steve Doctor at PNNL to  
7 explore this. Is this true? Steve looked -- Steve,  
8 and I think with some input from Joe, looked at a low  
9 frequency SAFT system, synthetic aperture focusing  
10 technique, and took his equipment down to the NDE  
11 Center and inspected their cast stainless steel sample  
12 sets and did very well. In fact, it is inspectable,  
13 and they did a good job in characterizing the flaws  
14 that were in the sample sets.

15 So our role in this is to go back and say,  
16 "You know that story about not inspectable. Well, you  
17 may not like the speed of the technique, and  
18 economically it may be a challenge for you, but oh, by  
19 the way, the material is inspectable." Not as well as  
20 others, but it is inspectable.

21 MEMBER POWERS: And I think that's a  
22 really good example of where I think it's appropriate  
23 for the regulator to validate his contention that he  
24 thinks it's inspectable and should be inspected, and,  
25 you know, be a responsible regulator.

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1                   What I'm asking about is this -- should we  
2                   have an ongoing capability to evaluate these NDE  
3                   capabilities or not. I mean, that sort of thing.

4                   MR. MAYFIELD: Okay. When V.C. Summer was  
5                   down with their hot leg crack, we were asked to  
6                   provide some support to NRR. And we asked Steve and  
7                   Debbie Jackson from my staff to get on the airplane  
8                   and go visit with the licensee. And Steve went down  
9                   and looked at what the licensee was doing and said,  
10                  "Gee, why don't you try a different transducer," and  
11                  I don't remember the specifics, "and find cracks."

12                  And that level of expertise isn't  
13                  something that you go pluck off the shelf. Somebody  
14                  has to pay for it to keep the technique sharp, to keep  
15                  the skill set sharp. And that's a role that the  
16                  region found extraordinarily useful.

17                  I believe I can speak for Dan Archen  
18                  sitting here, I think shaking his head yes, that the  
19                  regulatory office found useful -- and ultimately I  
20                  think the licensee found useful -- but it was a role  
21                  that the Office of Research played to have that  
22                  capability and skill set --

23                  MR. VIJUK: I mean, that's --

24                  MR. MAYFIELD: -- available to support the  
25                  regulatory program.

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1 MEMBER POWERS: I mean, that is one of the  
2 criteria we have for the research program is to have  
3 that expertise. And we concede the point that to  
4 maintain that expertise you've got to get them  
5 involved in something. You just can't say be smart  
6 all the time and we'll use you when we want to.

7 And so, I mean, it's an acceptable answer  
8 to me. I just --

9 MR. VIJUK: And, Dana, I don't pretend to  
10 tell you that I've got a formula that I can tell you  
11 exactly, "Here's how much I ought to invest in these  
12 various areas." But that's the initiative. That's  
13 what we're trying to do with this.

14 MEMBER POWERS: And we will not try to  
15 tell you that either, that -- I mean, that's a  
16 judgment call that you guys in management get the big  
17 bucks -- well, in some cases the little bucks.

18 (Laughter.)

19 MR. VIJUK: Some bucks.

20 MR. MUSCARA: I think it's important to  
21 realize that you just don't get this kind of  
22 expertise. We have been supporting this work for 25  
23 years, and so we've developed people, we've developed  
24 technologies that we make use over and over.

25 MEMBER POWERS: We've already bought that.

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1 I mean --

2 MR. VIJUK: Okay.

3 MEMBER POWERS: -- you've picked one of  
4 our boxes --

5 MR. VIJUK: Okay.

6 MEMBER POWERS: -- that we bought off on,  
7 so -- and that's all I was asking for.

8 MR. VIJUK: Okay.

9 VICE CHAIRMAN WALLIS: Mike, what I'm  
10 trying to formulate here is that all of this seems to  
11 be in -- all in the context of nuclear stuff and NRC.  
12 What is NRC doing in the nuclear industry? I don't  
13 see it in the perspective of, what is the whole  
14 community -- I mean, this business of degradation of  
15 materials occurs everywhere.

16 MR. MAYFIELD: Yes.

17 VICE CHAIRMAN WALLIS: And isn't there  
18 some kind of forefront university research, which has  
19 nothing to do with nuclear, which is still relevant to  
20 you which is going on?

21 MR. MAYFIELD: Absolutely. And that's --

22 VICE CHAIRMAN WALLIS: And I don't see  
23 that perspective here at all. I really think it's  
24 within the little club of nuclear people doing this  
25 stuff.

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1 MR. MAYFIELD: Well, you see that  
2 perspective because that's the club I personally  
3 belong to. But what we are doing, and what we have,  
4 is input from many different sources. One of the  
5 programs that we belong to is actually an EPRI  
6 program, a cooperative program, cooperative  
7 international program on CIR -- I'm sorry, I've lost  
8 the name of the thing. But it's a cooperative program  
9 looking at irradiation-assisted stress corrosion  
10 cracking.

11 VICE CHAIRMAN WALLIS: That's still a  
12 closed club, though. EPRI is --

13 MR. MAYFIELD: It's a closed club, but  
14 they are reaching out to a variety of other people.  
15 One of the people Joe uses, or we use, as a consultant  
16 is Roger Staehle. And Roger's program today addresses  
17 a broad range of subjects, and it is not confined  
18 solely to the nuclear industry.

19 MEMBER POWERS: How in the world do you  
20 get Roger on the consulting fees that government will  
21 pay?

22 MR. MUSCARA: He's kind to us.

23 (Laughter.)

24 VICE CHAIRMAN WALLIS: But you need to  
25 have that perspective, and I don't quite know whether

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1       there's -- 90 percent of the understanding about this  
2       field resides in NRC and its club, or whether the --  
3       maybe you've only got 10 percent of it, and 90 percent  
4       of it is out there somewhere else. I don't have --

5               MR. MUSCARA: Just a brief comment. We do  
6       make use of people that are involved in other fields.  
7       Of course, we hear about the work they're doing for  
8       us, but they're doing work in other areas.

9               But in addition, I'd like to mention also  
10      that when we're talking about degradation and  
11      corrosion, these are mechanisms that are environment-  
12      specific. And when you look at other industries --  
13      petrochemical -- their environments are entirely  
14      different. So you wind up having to worry about,  
15      really, the nuclear core of people that notice the  
16      environment and work with these environments.

17              But their expertise goes beyond our area.  
18      Unfortunately, we cannot use much of the data that's  
19      out there, because it's for different systems,  
20      different sets of conditions.

21              MEMBER SIEBER: Well, even in the coal-  
22      fired powerplant industry, the materials are  
23      different.

24              MR. MAYFIELD: That's correct.

25              MEMBER SIEBER: As well as the

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1 environment.

2 MR. MAYFIELD: Yes.

3 MEMBER SIEBER: And if you go beyond that  
4 to aeronautics and things like that, the materials are  
5 really different. And so I think it's sort of a  
6 natural phenomenon that you end up with these clubs of  
7 specialists in certain materials under certain  
8 environments.

9 MEMBER FORD: But if I could also just  
10 address your question, if I'm allowed to. You know,  
11 the NRC is also a member of this ICGEAC, which is 72  
12 companies and national labs. And those individuals  
13 also work in other areas.

14 For instance, GE did work on chemical  
15 plants, and my ex-colleagues. So we do draw in  
16 from --

17 MR. MAYFIELD: Yes.

18 MEMBER FORD: -- other industries.

19 MR. MAYFIELD: And you mentioned that it's  
20 an international cooperative group. In its original  
21 incarnation, it was called the International Cyclic  
22 Crack Growth Rate Group, and the NRC was one of the  
23 founders of that group. It was actually an NRC  
24 initiative that got that going.

25 MEMBER SIEBER: Well, the interesting

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1        thing is that if you look for reasons why the NRC  
2        should be doing this, it's that the ASME code under  
3        which these inspections are done names the NRC as the  
4        regulating authority -- in other words, the final  
5        decisionmaker as to what's right and what's wrong.

6                And so there is a responsibility that's  
7        laid on the shoulders of the agency in order to make  
8        sure that the latest data and information and  
9        correlations and techniques are in place and in use by  
10       the users of the code.

11               MR. MAYFIELD:    That's correct.    And we  
12       also, because we endorse the code in the regulations,  
13       we pick up a responsibility to look carefully at  
14       what's in the code.

15               MEMBER SIEBER:    That's right.

16               MR. MAYFIELD:    And the best way to  
17       understand that is to have participated along the way.

18               I won't dwell on this cooperative program.  
19       We are developing this, looking to leverage both our  
20       knowledge and our funds.    We've had some informal  
21       meetings with several countries, found a fair bit of  
22       interest in pursuing this.    And we have had a bit of  
23       a kickoff meeting at the conference this week, and the  
24       feedback is positive, at least informally.

25               When you ask them to sign the check is

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1 when they get serious about their level of interest.  
2 But we think it's likely they -- that we will see  
3 participation in this program.

4 The elements of the EAC program at  
5 Argonne, we've looked at fatigue life evaluation in  
6 both PWR and BWR environments, looking at carbon and  
7 low alloy steels, as well as the stainless steels. We  
8 are looking at irradiation-assisted stress corrosion  
9 cracking for stainless steels in both BWR and PWR  
10 environments.

11 We're looking at crack growth rates in the  
12 nickel-based alloys and, finally, looking at how you  
13 reduce all of that information to practice through the  
14 code.

15 This is just to illustrate that there --  
16 we have found, at least in the laboratory, there is an  
17 effect of the environment in reducing the fatigue life  
18 for the carbon steels and the low alloy steels. I  
19 think the committee has been briefed on this work in  
20 detail by both the staff and the industry.

21 When we look at irradiation effects on  
22 stress corrosion cracking growth rates, in the normal  
23 water chemistry BWR environment, crack growth rates in  
24 the present study come out about a factor of five for  
25 the irradiated steels higher than for the unirradiated

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1 steels. And this NUREG-0313 curve is the crack growth  
2 rate curve that the staff tends to default to when  
3 they don't have other information on stress corrosion  
4 cracking growth rates.

5 And so when we irradiate these steels in  
6 the normal water chemistry environment, we find  
7 significantly higher -- and, in my world, a factor of  
8 five is significant -- higher crack growth rates.  
9 However, when we lower the oxygen, we find that the  
10 crack growth rates go down well below -- down in here  
11 -- well below the NUREG-0313 curve.

12 Just to try and summarize that -- again,  
13 crack growth rates at these kind of fluences, for the  
14 normal water chemistry we're seeing fairly high growth  
15 rates compared to what we have traditionally used for  
16 unirradiated steels. But when you drop the oxygen,  
17 the crack growth rates come back down.

18 One of the other things -- people have  
19 speculated for many years that neutron irradiation  
20 lowers the fracture toughness of stainless steels.  
21 Then comes the great debate about, well, how much?  
22 How serious an effect is it?

23 Work that's being done is showing that, in  
24 fact, the J-R curve, the crack growth, ductile crack  
25 growth resistance, has been obtained, and we find

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1       there is a substantive effect, particularly in the  
2       reduction of the crack initiation resistance -- the  
3       infamous  $J_{Ic}$  parameter. And we find that we come from  
4       fairly high values down rather sharply with  
5       irradiation. And it appears that we're going to some  
6       sort of plateau effect.

7               Continued work in this area -- we're  
8       looking at going to some higher dose levels, out to  
9       40 dpa, looking at using the BOR-60 reactor,  
10      temperatures around 300 C. We have completed the five  
11      and 10 dpa dose rate studies.

12             VICE CHAIRMAN WALLIS: The evidence for a  
13      plateau seems to be extrapolation.

14             MR. MAYFIELD: I'm telling you if it  
15      appears we don't have the data, that's why we've gone  
16      out to 40 dba, to see -- the other thing I would say  
17      is it can only go so low.

18             VICE CHAIRMAN WALLIS: Zero.

19             MR. MAYFIELD: Well, it won't -- it, by  
20      and large, won't fall apart on its own. But it's, how  
21      low does it go at the higher dose rates?

22             We're looking at effects of some of the  
23      chemical compositions. We're running a range of  
24      mechanical property kinds of tests, doing  
25      microstructural characterization of this, and we're

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1 looking to -- we talked earlier about if Joe was king,  
2 what would he do.

3 The notion here is to try and develop some  
4 modeling capability to predict this behavior, and then  
5 to make some projections for the PWR coolant  
6 environment.

7 MEMBER POWERS: And what is the  
8 counterpart industry program here?

9 MR. MAYFIELD: Very similar kinds of  
10 things coming at it from a somewhat different  
11 standpoint. They are doing test reactor irradiations.  
12 They are also getting components out of internals,  
13 getting samples from decommissioned plants. So there  
14 is a companion.

15 And, frankly, getting the samples out of  
16 the decommissioned plants is the big buck industry in  
17 the -- or initiative. Doing the BOR-60 irradiations,  
18 while not inexpensive, is certainly less costly than  
19 going and chopping chunks out of somebody's core  
20 bearing.

21 MEMBER POWERS: So, I mean, what you're  
22 seeing here I think is this point that Joe has made  
23 earlier, is that they are taking a somewhat empirical  
24 approach, and maybe you're taking a more academic or  
25 scientific approach on this?

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1 MR. MAYFIELD: We're taking perhaps a more  
2 structured approach. They are going and getting what  
3 they can get and testing it with the uncertainties  
4 that come with, well, what is the fluence that that  
5 component saw? What does the spectrum really look  
6 like? What was the temperature, the irradiation  
7 temperature?

8 So there's a fair bit of uncertainty that  
9 goes with testing things that you acquire from an  
10 operating plant as opposed to the much less uncertain  
11 situation of a test reactor irradiation.

12 One of the things that we have seen over  
13 time is that, for example, in reactor pressure vessel  
14 embrittlement you see a fair bit of scatter in the  
15 material surveillance samples, because there is a fair  
16 bit of uncertainty as to what they actually see.

17 We get much less scatter, not  
18 insignificant, but much less when we do test reactor  
19 irradiations. And it goes to being able to control  
20 the conditions.

21 MEMBER POWERS: Aren't you just saying  
22 that the industry has a bad program?

23 MR. MAYFIELD: Not at all. I'm saying  
24 they are testing the real material with all its  
25 uncertainties, and we can then use that to test

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1 modeling. At some point you have to test -- the thing  
2 that's really of interest to you is the performance of  
3 the component in service, under service-irradiated  
4 conditions, and to understand the uncertainties that  
5 go with that service operation and to correctly  
6 characterize those uncertainties.

7 MEMBER POWERS: You know, what I see one  
8 could easily forecast is they come back and say,  
9 "Okay. Well, I've taken this trojan reactor apart,  
10 and I've looked at it, and it has these properties.  
11 And that's about like my properties, and so I'm okay."

12 And you come back and say, "No, you are 10  
13 degrees colder or hotter or one way or the other. And  
14 I've run my model and it says you're not okay. And  
15 you just have catharsis here."

16 MR. MAYFIELD: One of the lessons that  
17 certainly the staff learned, and I'm pretty sure the  
18 industry learned, was from the Yankee Rowe experience,  
19 where they came in -- as you recall, they were one of  
20 the lead plants for license renewal.

21 And they came in to the staff and were  
22 doing the reactor pressure vessel assessment, and Neil  
23 Randall said, "What temperature do you run at?" Well,  
24 we run -- actually, we said, "Just a bit less than  
25 500." And he says, "But the embrittlement

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1 correlations are 525 to 575. What are you doing about  
2 a temperature correction?" And the answer was,  
3 "Nothing."

4 "Well, maybe you should." And so when we  
5 started testing what was actually going on at that  
6 plant, not plant materials but pushing at exact  
7 conditions at the plant, their license renewal story  
8 started unraveling. Economic considerations  
9 ultimately took over, but it was looking -- the test  
10 was what's really going on and how well do your plant  
11 conditions match the models that are being used.

12 And I think that acquiring samples from  
13 albeit decommissioned plants, and testing those, and  
14 understanding what the plant actually saw and how that  
15 compares to the model, and how that actually compares  
16 to regulatory criteria and uncertainty levels that we  
17 would anticipate, I think that's a valuable --

18 MEMBER POWERS: But see, without your  
19 program, the industry would never know those things.

20 MR. MAYFIELD: I'm sorry. Say again.

21 MEMBER POWERS: Without your program, the  
22 industry would never know those things.

23 MR. MAYFIELD: Well, and that's where part  
24 of the cooperative activity comes. Rather than the  
25 staff simply sitting back saying, "Gee, you ought to

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1 do all of this stuff," and then ending up trying to  
2 argue our way through it, we are, in fact, doing the  
3 more structured aspect of this, which supports some  
4 other activities that the industry has ongoing. But  
5 it gives us the independent data set to test their  
6 results and their contentions.

7 MEMBER SIEBER: Well, even if you use  
8 actual decommissioned reactor test data, you still  
9 have a problem with the dose --

10 MR. MAYFIELD: That's correct.

11 MEMBER SIEBER: -- issue, because it is  
12 quite variable as you --

13 MR. MAYFIELD: Yes.

14 MEMBER SIEBER: -- travel around the core,  
15 and you have to know exactly --

16 MR. MAYFIELD: Yes.

17 MEMBER SIEBER: You have to understand and  
18 calculate what the fluence is at the location where  
19 you take the samples.

20 MR. MAYFIELD: With all due respect to my  
21 colleagues that do those sorts of calculations, I'll  
22 trust the sampling. Thank you.

23 MEMBER SIEBER: Okay.

24 MR. MAYFIELD: One of the things that we  
25 have done in the few other instances where we've been

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1       able to acquire samples from service is to go back to  
2       some of the national laboratories, and through various  
3       counting schemes tried to back calculate what the  
4       fluence really was and test that against the transport  
5       calculations. While not all that precise, it tells  
6       you if you're grossly in error. So it has been useful  
7       from that standpoint.

8               Rather than belabor it, we do have this  
9       conference ongoing. Just to indicate the level of  
10      seriousness that the national and international  
11      communities see this problem, we've got 220 folks in  
12      a Marriott hotel up here in Gaithersburg representing  
13      11 different countries, significant industry  
14      participation to this thing.

15              We will put the proceedings out on CD as  
16      well as a NUREG conference proceedings. But this has  
17      been an extraordinarily well-attended conference  
18      covering a broad range of subjects and very active  
19      discussions.

20              VICE CHAIRMAN WALLIS: When the industry  
21      participates, do they actually present sort of  
22      significant technical work?

23              MR. MAYFIELD: Yes.

24              VICE CHAIRMAN WALLIS: Okay. Good.

25              MR. MAYFIELD: Yes.

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1 MEMBER ROSEN: Are these licensees there?

2 MR. MAYFIELD: Yes. Some are licensees,  
3 some from EPRI, but there are a fair number of  
4 licensees.

5 MEMBER FORD: To me, that was the most  
6 significant factor. At this particular conference I  
7 think there were about 20 attendees from operating  
8 reactors as opposed to two or three from EPRI that you  
9 would get at a normal technical conference. I think  
10 that's about right, wasn't it, Joe?

11 MR. MUSCARA: Well, in addition, there's  
12 also a representation from --

13 MR. MAYFIELD: Make sure you use the mike.

14 MR. MUSCARA: I said in addition there's  
15 also a representation from Bettis and KAPL, so there's  
16 wide representation. And we're getting a lot of good,  
17 relatively new information.

18 MEMBER SIEBER: Well, actually, the Navy  
19 did a lot of work in the '50s and '60s which never  
20 seemed to make it to the commercial end of the  
21 business. And I guess perhaps I don't understand all  
22 of the deal about classification, but it seems to me  
23 that the Navy data is very pertinent to what the  
24 commercial people think is --

25 MR. MAYFIELD: Some is and some isn't, and

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1       you can go a lot further than that.

2               MEMBER FORD: The change with Rickover --  
3       when Rickover went away, then the number of attendees  
4       from KAPL and Bettis increased dramatically.

5               MR. MAYFIELD: Yes. But they very often  
6       will attend, and that's -- they don't participate  
7       much, so we still fight that issue. But it -- rightly  
8       or wrongly, they have their classification rules, and  
9       so far at least I've been unsuccessful in thwarting  
10      those rules.

11              I mentioned that I think the committee has  
12      heard that we've been getting materials from some of  
13      the vessel heads. We've got nozzle 3 and then  
14      nozzles 2 and 46 from Davis-Besse, and we're doing a  
15      fair bit of characterization of those materials and  
16      looking at the cracking, how it initiates and how it  
17      propagates.

18              We have gotten samples from the North Anna  
19      Unit 2 head. Those were harvested by the industry and  
20      provided to us. Then, there is a collaborative  
21      coordinated program I guess is the phrase, looking at,  
22      what do you do beyond that?

23              One of the things that PNNL has done -- we  
24      shipped the samples to PNNL. They are characterizing  
25      them, and then the industry teams will come in and do

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1 inspections. Sort of an inspection round robin with  
2 PNNL arbitrating the program, so as sort of the  
3 independent arbiter of things.

4 One of the -- we've talked a fair bit  
5 about the inspections. We spend a lot of time  
6 worrying about how cracks initiate and grow and what  
7 they may look like. The point here with the crack  
8 tips is the way they bifurcate they create a  
9 particular challenge for the inspections and being  
10 able to correctly characterize and quantify the  
11 cracking.

12 They also can create some challenges for  
13 the fracture analysis, because you now have a  
14 bifurcated crack tip. And those don't behave quite  
15 the same way, so you -- if you treat it like it's a  
16 single sharp crack, you're going to get a conservative  
17 result.

18 So trying to find ways to characterize  
19 that historically has proven fruitless, and you treat  
20 them as a single sharp crack. You just have to  
21 recognize that there is an unquantified level of  
22 conservatism in that treatment.

23 VICE CHAIRMAN WALLIS: It's a rather  
24 strange crack there. It doesn't look like a crack.  
25 It looks like it's a chain of ponds connected by

1 little streams. It's very different from the usual  
2 crack.

3 MR. MAYFIELD: I probably have never  
4 thought to characterize it that way, but those --  
5 that's actually fairly typical of this type of crack  
6 and --

7 VICE CHAIRMAN WALLIS: It opens up that  
8 much.

9 MR. MAYFIELD: Sir?

10 VICE CHAIRMAN WALLIS: It opens up. That  
11 thing on the left, it opens up that much with a  
12 little --

13 MR. MAYFIELD: Well, the --

14 VICE CHAIRMAN WALLIS: Anyway, we don't  
15 really need to get into this. But it just looks  
16 strange. The one on the bottom there has got these  
17 very fine cracks, and then these very fat regions  
18 mixed up with it. It's strange.

19 MR. MAYFIELD: There are those of us, you  
20 know, fat people find fat regions. So --

21 VICE CHAIRMAN WALLIS: But those are  
22 ponds, isolated little ponds, too. Anyway, let's go  
23 on.

24 MR. MAYFIELD: We do have this new boric  
25 acid corrosion program going that's looking at the

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1 crack growth rates in the Alloy 600 and 182 from the  
2 Davis-Besse head. We're not all that fascinated with  
3 Davis-Besse anymore. We are, however, very keenly  
4 interested in how the Alloy 600 and the 182 materials  
5 that are still in service -- how they are behaving.

6 We're looking at a computational model and  
7 a probabilistic assessment of a number of things --  
8 crack initiation and growth. Then, finally, we're  
9 looking at measuring the electrochemical potential and  
10 wastage rates for a range of solution compositions,  
11 temperatures, and pressure boundary materials. These  
12 are fairly basic bits of data that we were surprised  
13 we couldn't put our hands on when we started trying to  
14 characterize Davis-Besse. So --

15 MEMBER POWERS: And could I understand  
16 what you do with this, for instance, the corrosion  
17 rate of low alloy steels and concentrated boric acid.  
18 I mean, isn't it adequate just to know that that's a  
19 really bad idea, to have low alloy steel and  
20 concentrated boric acid?

21 MR. MAYFIELD: It's a -- is it enough to  
22 know that if I knew exactly what I had, and that I  
23 always had really concentrated boric acid, and I knew  
24 what that meant, then I'd say, yes, that's just  
25 fundamentally a bad idea. Now you're left with, well,

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1       how bad an idea is it? And how long can I let it be  
2       a bad idea?

3               We had Sequoyah, I believe, that had a  
4       leaking valve or something up on the vessel head, and  
5       they had some minor cutting. How long had that gone  
6       on? We've had leaking seals for a very long time, and  
7       we've only had one Davis-Besse.

8               So the notion of understanding that and  
9       establishing appropriate inspection and regulatory  
10      acceptance criteria gets to be important. And to just  
11      say, gee, all boric acid is a bad idea, well,  
12      fundamentally I agree it's a bad idea. How bad an  
13      idea?

14              MEMBER POWERS: Yes. I mean, that's what  
15      I'm asking. Why do I need to know that? Isn't it the  
16      case now -- I mean, you saw drips of boric acid on the  
17      bottom of South Texas' reactor pressure vessel that  
18      were smaller than the eraser here. And that was  
19      enough to create a big brouhaha.

20              MR. MAYFIELD: Well, I think it was --

21              MEMBER POWERS: Isn't that the answer,  
22      that it demonstrates --

23              MR. MAYFIELD: No. I don't think the  
24      issue there was the potential for the boric acid to  
25      corrode away the low alloy steel. The issue there was

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1 it was an indicator that we had a leak in a place we  
2 really weren't anticipating one for other reasons.  
3 The issue here is when I've got boric acid dripping  
4 out on other things, how concerned should I be?

5 MEMBER POWERS: And so you're saying that  
6 if you go in and inspect a plant today, and it has  
7 boric acid leaking onto something, that you'll run  
8 back and do a calculation and say, "Oh, yes, you can  
9 run three more cycles and" --

10 MR. MAYFIELD: No. It's the other end.  
11 How frequently should I be looking, and with what  
12 reliability? Is it enough to simply do a plant  
13 walkdown? When I find boric acid in one place, how  
14 aggressively do I need to look in other places? Not  
15 that they were the source of the leak, but where there  
16 may be some consequential damage. And how frequently  
17 do I need to do that?

18 MEMBER POWERS: Isn't the answer always  
19 going to be if you see the boric acid, you're going to  
20 look aggressively?

21 MR. MAYFIELD: Absolutely.

22 MEMBER POWERS: And you're going to look  
23 every shutdown?

24 MR. MAYFIELD: I'm going to do some level  
25 of looking at every shutdown. Part of the issue here

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1 is predicting or getting a handle on how aggressively  
2 do I need to look at this, and how -- with what  
3 frequency. Do I need to do -- do I need to bring  
4 plants down in mid-cycle? I think that is unlikely.

5 But if the results come back and say, you  
6 know, it really doesn't take very much boric acid to  
7 create a really bad situation, which I don't think  
8 they're going to do, but if that's what they said, we  
9 may change inspection frequencies.

10 But right now we don't have the basic  
11 information to make those calls, and we think that  
12 where we are is adequate. That's the judgment. And  
13 this is a bit of confirmatory work to fill a technical  
14 hole, so that we can say that with higher confidence,  
15 or, if the judgment has been wrong, to revisit it.

16 Does that answer your question? Or --

17 MEMBER POWERS: It's an answer. I  
18 struggle with understanding it. It's a real good  
19 answer. Don't get me wrong, Mike. I really like the  
20 answer. I'm trying to figure out how I articulate it  
21 so it's limiting, because I think I could say the same  
22 thing about second quantization of iron.

23 MR. MAYFIELD: And that's where a judgment  
24 call comes in as to how far do you go. I agree. I  
25 used to have this go-round with Jim Snezak when he was

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1 the Deputy Executive Director for Operations. Why are  
2 you doing any of these radiation effects? Why don't  
3 you just call it good? Well, we learned something  
4 new. Sam Collins has regularly characterized NRC as  
5 a learning organization.

6 I don't need to learn everything that I  
7 need -- you know, out there, but I -- there are some  
8 of this that we still think important.

9 Just to give you -- do this one very  
10 quickly. NRC is looking at the North Anna 2 discarded  
11 head pieces as part of an NRC industry collaborative  
12 program. We have seven nozzles that have been removed  
13 and shipped to PNNL, and there are going to be several  
14 NDE teams that will go examine those nozzles. And  
15 then, following that we'll do destructive exams.

16 Just to give you a sense of size, these  
17 are not trivial bits of steel that we've acquired.  
18 They are contaminated to varying levels. So we've had  
19 to set up a controlled area for them to be handled and  
20 to characterize them.

21 Our part of this is --

22 MEMBER SHACK: That's a distorted picture.  
23 How much of the tube is sticking out of that sucker?

24 MR. MAYFIELD: Quite a bit. I think by  
25 the time they shipped them I think they lobbed off a

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1 fair bit of the tube. This is when they were being  
2 harvested. So, but it's more than two or three  
3 inches.

4 MEMBER POWERS: All of those samples lost.

5 (Laughter.)

6 MR. MAYFIELD: Well, the --

7 MEMBER POWERS: That would keep Bill happy  
8 for months.

9 MR. MAYFIELD: The one thing I have  
10 learned about Joe Muscara and Bill Cullen is they  
11 don't waste much. So Joe and his programs wastes  
12 virtually nothing, and Bill Cullen I think came to us  
13 with the same view in life. You don't waste valuable  
14 material.

15 The other side of that is you can only  
16 test so much Alloy 600.

17 There was a presentation to the committee  
18 years ago by one of Dr. Shack's colleagues, a  
19 gentleman by the name of Tom Kassner. And one of the  
20 committee members asked him, why does there appear to  
21 be so much data on Alloy 600 in all of these different  
22 environments?

23 And I remember Tom's answer was, oh, every  
24 graduate student loves to test Alloy 600, because  
25 everything cracks it. And we decided maybe that

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1        hadn't been the best choice of alloy.

2                Just to transition to the proactive  
3        program, when we look at how the NRC manages materials  
4        degradation, the box on the lower left goes to  
5        managing identified degradation, typically gets  
6        involved with the regulatory program, inspections,  
7        required inspections, code activities.

8                When we start looking at, where does the  
9        research program contribute and balance off against  
10       things that the industry is doing, we look at the  
11       evaluation of new materials, materials that are being  
12       proposed, Alloy 690 is a material that's being used  
13       regularly as a replacement alloy. We look at  
14       inspection procedures and techniques for testing  
15       assertions about what can and cannot be done. And  
16       then, finally, we are looking at new degradation  
17       mechanisms.

18               We talked earlier about what can be done  
19       -- mitigation strategies, looking at repair and  
20       mitigation strategies. One of the first tests is to  
21       make sure you do no harm, or at least to try and make  
22       sure you do no harm. Steam generators -- I think the  
23       varied history there is a classic example where maybe  
24       we should have looked a little harder before we moved  
25       forward.

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1                   So the research program contribution is  
2                   really looking at the center and right-hand boxes to  
3                   test this, not to develop the solutions, but to have  
4                   sufficient information and technical data to support  
5                   an assessment about whether a repair strategy really  
6                   does hold up, whether a new material really is going  
7                   to perform the way it's being touted. So that really  
8                   is our role in this.

9                   MEMBER SIEBER: Well, let me make an  
10                  observation. You can agree or disagree with it. But  
11                  I remember back in the 1950s -- and I am that old --  
12                  when Inconel 600, which is what we called it back in  
13                  those days -- was considered the next best thing to  
14                  Superman's kryptonite. And they had not observed  
15                  primary water stress corrosion cracking, and so this  
16                  was the miracle material which later on seemed to end  
17                  up cracking no matter what you did.

18                  MEMBER POWERS: Jack, it behaved just like  
19                  kryptonite does to Superman. It damn near killed him.

20                  (Laughter.)

21                  MEMBER SIEBER: On the other hand, here  
22                  comes 690, and it's being applied in a lot of  
23                  different places -- steam generators, reactor vessel  
24                  heads, and so forth. And to my knowledge, there isn't  
25                  a lot of data.

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1 MR. MAYFIELD: That's correct.

2 MEMBER SIEBER: And so where you are right  
3 now is here's kryptonite number two. And you won't  
4 know until all of a sudden these materials will start  
5 revealing sooner or later some of their imperfections.

6 MR. MAYFIELD: Left to their own devices,  
7 the materials and environments, you're exactly right.  
8 It eventually will -- if there's an operative  
9 degradation mechanism, it will self-reveal. Part of  
10 what we're trying to do, and I believe part of what  
11 the industry is trying to do, is to get ahead of that  
12 curve.

13 MEMBER SIEBER: Well, how do you do it,  
14 though, without a tremendous amount of testing before  
15 you ever apply to --

16 MR. MAYFIELD: Well, right now people had  
17 to move forward, and so there's precious little  
18 testing, and there are people making some significant  
19 financial gambles.

20 MEMBER SIEBER: That's right.

21 MR. MAYFIELD: Being followed up with  
22 additional testing, looking at what do we need to do  
23 in terms of inspection intervals, are there other  
24 mitigation strategies we need to put into place. And  
25 I think that's really where it's going.

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1 MEMBER SIEBER: So you're relying on being  
2 able to predict and define what -- when to inspect and  
3 how often to inspect and how to inspect as part of the  
4 -- a major part of the strategy for new materials?

5 MR. MAYFIELD: Well, and then develop the  
6 understanding that would support that.

7 MEMBER SIEBER: Yes, okay. But without  
8 data, how do you predict?

9 MR. MAYFIELD: Well, you have to -- that's  
10 where you have to go get the data and develop the  
11 understanding.

12 MEMBER FORD: But I don't think the  
13 situation is quite as bad as you are proposing, Jack.  
14 Yes, we've had a whole lot of problems over the last  
15 30 years. But at the same time, there has been a  
16 tremendous increase in the understanding -- the  
17 fundamental of understanding many of these cracking  
18 mechanisms for the existing materials.

19 If that understanding is any good, then  
20 you can extrapolate it from, for instance, 600 to 690  
21 and no change in microstructure, etcetera. And if  
22 your predictive models are any good, then you should  
23 know where to look.

24 MEMBER POWERS: Peter, I'm willing to bet  
25 that when the guy came in to advance Alloy 600 over

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1 stainless steel in the steam generator tubes he made  
2 the exact same speech.

3 MEMBER FORD: I can't answer your question  
4 definitively, because I wasn't around at that time,  
5 and I haven't worked on PWRs. But I know you are  
6 wrong as far as BWRs are concerned. We were way ahead  
7 of the ball, because we understood the mechanisms on  
8 IASCC in the core.

9 MEMBER POWERS: I'm stunned that you say  
10 that, because I just saw a big thing up there that  
11 said, well, we don't understand IASCC at all.

12 MR. MAYFIELD: That isn't what it said.  
13 We're continuing to improve, but it --

14 MEMBER SIEBER: I hate to introduce  
15 something that would degrade old conversation, but --  
16 and you may want to move on.

17 MR. MAYFIELD: Yes. Why don't we -- let  
18 me turn it over to Joe to talk about this proactive  
19 materials degradation initiative. Joe?

20 MR. MUSCARA: If you don't mind, maybe  
21 I'll follow up on the 690 issue just briefly.  
22 Clearly, when the plants were built, we all thought  
23 600 was a wonderful material. There was data at the  
24 time that indicated otherwise. It wasn't widely  
25 publicized, and it came out a little bit too late.

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1 But there was data early on that showed that this  
2 material could crack in primary water.

3 And with respect to the 690, we have some  
4 data, we have some understanding, particularly for the  
5 primary side. We don't really understand very much  
6 what's going to happen on the secondary side, where  
7 there's a lot of crevices and a lot of places for  
8 corrosion to take place.

9 We didn't discuss it today, because we've  
10 heard about the generator work before. But let me  
11 mention very briefly we are doing some work on  
12 evaluating the cracking susceptibility of both 600 and  
13 690. Now, the reason we're doing 600 is so that we  
14 have a lot of field experience with 600.

15 If we're able to test 600 under the  
16 appropriate environmental conditions, we're doing some  
17 additional work to define what those conditions are.  
18 We're trying to define what happens in crevices, what  
19 is the water chemistry in the crevices.

20 Given that, we'll run some tests under  
21 those chemistry conditions, both with 600 and 690, and  
22 we see how the two behave. We know how 600 has  
23 behaved in the field, and hopefully they will -- we  
24 can build a bridge to develop an understanding how 690  
25 is going to behave in the field.

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1                   And with this stage we do know that 690  
2                   cracks. We know some conditions under which the  
3                   materials cracks, and those conditions could be in  
4                   actual plants. One of the things we're trying to do  
5                   is to try and bound -- get a feeling for under what  
6                   conditions will 690 crack. And that work is planned  
7                   and will be going on.

8                   MEMBER SIEBER: Let me ask this question.  
9                   You know the conditions and perhaps the chemical and  
10                  environmental conditions where 600 cracks. So you get  
11                  a sample of 690, and you recreate in a test lab those  
12                  same conditions, and it either cracks or it doesn't  
13                  crack.

14                  If it doesn't crack, that doesn't mean  
15                  that some other mechanism or some other combination of  
16                  things that doesn't particularly disturb 600, wouldn't  
17                  cause 690 to deteriorate, crack, or whatever.

18                  MR. MUSCARA: Yes. This is why we're  
19                  trying to determine what are the realistic conditions.  
20                  And we're doing parametric studies with respect to the  
21                  environment, the stresses, the dynamic or static  
22                  stresses and strains. We're going to use samples that  
23                  are typical of what's in the generator -- is it tubing  
24                  or is it fracture mechanics specimens.

25                  So we're trying to get a better

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1 understanding of the degradation, both materials --  
2 so, again, we can make effective use of the data we  
3 have on 600.

4 MEMBER SIEBER: I guess there is nothing  
5 else you can do.

6 MR. MAYFIELD: Well, but it's -- the  
7 potential that 690 is going to crack in situations  
8 that we hadn't anticipated is exactly why you work to  
9 have an effective inspection program.

10 MEMBER SIEBER: Right.

11 MR. MAYFIELD: And the challenge there is  
12 making sure that you've got inspection procedures and  
13 techniques that will capture things that you -- rather  
14 than fine tune them for the degradation mode that  
15 you're seeing today, you need to have something that  
16 allows you to do a little more general assessment to  
17 at least detect something that's newly forming. And  
18 that's the challenge is to look for that.

19 MR. MUSCARA: The big challenge with  
20 inspection at this point is that 690 is thought to be  
21 more resistant. Therefore, industry wants us to  
22 inspect less frequently. And we don't have the data,  
23 frankly, at this point to say how often do you need to  
24 inspect.

25 MEMBER POWERS: Well, why don't you just

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1 tell industry, "Look, you want us to inspect less  
2 frequently. Good. Bring us the data to defend that  
3 position."

4 MEMBER SIEBER: To justify it.

5 MR. MAYFIELD: Well, you sort of start  
6 getting off into the regulatory policy that the agency  
7 has taken. And what's being done today is to make  
8 engineering judgments based on what limited  
9 information is available and making regulatory  
10 decisions on that basis, and then to come back and do  
11 the confirmatory research to say how good a story is  
12 this, and to either support the regulatory decision or  
13 to suggest, no, that wasn't quite right.

14 MEMBER POWERS: Let me ask another  
15 question on -- following along on Jack's line of  
16 thought there. He pointed out that 690 is the answer  
17 to a maiden's dream now, and it may not be true. Why  
18 in your program are you not looking at other alloys  
19 that are not so enthusiastically received by the U.S.  
20 industry but maybe are viewed enthusiastically by  
21 other industries? And I'm thinking of 800 right off  
22 the bat.

23 MR. MAYFIELD: I think that we have to  
24 start somewhere, and you need to make your investment.  
25 My understanding is our -- the U.S. industry has

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1 looked now at 800 and made a conscious decision to not  
2 go that direction. I think that --

3 MEMBER POWERS: They're wrong.

4 MR. MAYFIELD: Well, they may be. And  
5 that's something that as we look at some of the  
6 international experience and try and draw on -- in the  
7 steam generator world, certainly the German experience  
8 with the Alloy 800 has I think been very positive.

9 So the notion is rather than trying to do  
10 it all ourselves, let's look at where we can  
11 collaborate, where we can get information from other  
12 sources, and build on that.

13 MEMBER POWERS: I mean, here's -- you  
14 know, in the abstract, you know, that's a good answer.  
15 But I think Jack's got a point here, that you have  
16 this history that says, okay, everybody said this is  
17 great, and we're going to use it, and it turned out  
18 maybe not so great. It's not a total disaster, but  
19 it's not so great. And it's unfortunately not so  
20 great on your -- touching on your risk-dominant  
21 sequences.

22 Okay. So it's one of these things that  
23 you -- you know, you not only fence in the chickens,  
24 you guard the chicken coop as well, because it's high  
25 on your risk-dominant sequences.

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1                   Okay. Now the industry is coming in and  
2 saying, well, we've got another great thing. And you,  
3 NRC, you know, bless this, and so you're doing your  
4 research. But shouldn't you, just to protect  
5 yourself, be saying, okay, I'm going to also equally  
6 look at these other alloys that other people who are  
7 intelligent individuals and also have risk-dominant  
8 accidents if selected, and maybe I'll quit approving  
9 these 690 alloys.

10                  MR. MAYFIELD: And if I could -- yes, you  
11 were talking earlier about kingdoms. If my budget  
12 went in the right direction, I would absolutely take  
13 on that kind of program. I live in a world where  
14 there are limited fiscal resources, and we look at how  
15 to leverage those resources by reaching out to the  
16 international community, building on what they have,  
17 and addressing the problem that is most prominent on  
18 our table today.

19                  I'm not disputing that that would be a  
20 good thing to go do. Plainly, it would be. The  
21 practicality of it, given where we are today,  
22 financially is just not realistic.

23                  MEMBER SIEBER: There is the additional  
24 question as to who is the designer. You know, should  
25 the regulating agency be the one that is developing

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1 materials and saying, "This is a good one; this one  
2 isn't"? Or should they be saying, "If you use this  
3 one, you have to have this inspection protocol, use  
4 these techniques, and be able to characterize these  
5 kinds of indications"?

6 MR. MAYFIELD: And, plainly, that's where  
7 we are is more in that role. We have periodically  
8 examined other materials in different context, but we  
9 have looked at some different materials and different  
10 approaches, just to see what else is out there. But  
11 those were in the days of much larger budgets.

12 MEMBER SIEBER: Well, that's sort of a  
13 policy issue, as I see it.

14 MR. MAYFIELD: Yes.

15 CHAIRMAN BONACA: For Alloy 690, isn't  
16 there experience coming from France and every place  
17 there has -- some of the heads --

18 MR. MAYFIELD: They have.

19 CHAIRMAN BONACA: -- in the early '90s.

20 MR. MAYFIELD: And my perception is that  
21 the service data we have so far is positive. We  
22 haven't gotten any of those heads through 40 years  
23 yet, but it's positive. I don't think there's --  
24 from the information that I have seen, I don't think  
25 there's any question that 690 is a better alloy than

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1 600, and the associated weld melts.

2 And for the materials that were available  
3 today, and that the licensees in this country chose to  
4 use, I don't think there's any question that 690 is a  
5 superior choice to 600.

6 It is not impervium. It will crack given  
7 certain sets of conditions. And the test now is, how  
8 realistic are those sets of conditions, and how  
9 much --

10 CHAIRMAN BONACA: I guess what I was  
11 referring to is if there is enough experience, even a  
12 few years. I'm sure that they're reflecting the  
13 frequency of their inspections based on what they  
14 find, and that may be interesting to you --

15 MR. MAYFIELD: Absolutely.

16 CHAIRMAN BONACA: -- in setting up  
17 expectations for the frequency of inspections here and  
18 being different for the one for Alloy 600. I mean,  
19 that should --

20 MR. MAYFIELD: And we've maintained  
21 continuing dialogue with the French and others on  
22 exactly these kinds of issues, both through the  
23 regulatory program and through our research program.

24 VICE CHAIRMAN WALLIS: Everything you said  
25 is empirical. This wine is better than that wine, you

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1 know, and this year is better than that year. And  
2 there's no kind of theoretical or intellectual  
3 structure to understanding the mechanisms or following  
4 why this is better than that, getting --

5 (Laughter.)

6 I don't see any of that in here.

7 MR. MAYFIELD: Well, if you go back a few  
8 slides you'll see some hint that indeed we would like  
9 to try and develop some of that.

10 VICE CHAIRMAN WALLIS: I heard water  
11 chemistry mentioned. There must be mechanisms for  
12 what happens in these cracks.

13 MEMBER SIEBER: Well, it's not a simple  
14 problem to solve.

15 MEMBER POWERS: My favorite story in that  
16 regard with respect to stress corrosion cracking is  
17 when I joined Sandia National Laboratories I came in  
18 to a group of about 11 scientists, and I was the only  
19 one not working on stress corrosion cracking. And  
20 they hadn't figured out the mechanism.

21 MR. MAYFIELD: We've had -- Peter  
22 mentioned this international cooperative group on  
23 environmentally-assisted cracking. There were some  
24 raging debates in that community -- and these are the  
25 serious-minded technical experts -- is it anodic

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1 dissolution, or is it hydrogen embrittlement?

2 And I do believe one of the committee --  
3 at least one of the committee members, actually two of  
4 them, were active participants in those discussions,  
5 on opposing sides of the issue as I recall.

6 MEMBER POWERS: No wonder we -- I mean,  
7 and nothing has changed, by the way.

8 MEMBER FORD: Okay, guys. We've got 15  
9 minutes. We should -- this gets a lot of attention,  
10 because it is part of the Commission --

11 MR. MUSCARA: Well, I don't think I need  
12 to go into a lot of background why we look at  
13 proactive materials degradation. Clearly, the  
14 reactive approach has been inefficient and costly and,  
15 in fact --

16 VICE CHAIRMAN WALLIS: My point is that  
17 the intellectual mechanistic is the most proactive way  
18 you can do it. The list of criteria for proactive --  
19 so don't -- I'm surprised not to hear more of it  
20 mentioned.

21 MR. MUSCARA: I guess we had not discussed  
22 the steam generator program with you, because we felt  
23 we had covered it. But in that program, we are being  
24 -- it's been one of the few proactive programs we've  
25 had in recent years. And in that program we will be



1 looking at some of those issues to try and understand  
2 better the cracking. And the first place to start is  
3 to understand better the chemistry that the material  
4 experiences.

5 MR. MAYFIELD: But there are ongoing  
6 activities in some of these other cooperative programs  
7 that go to exactly the kinds of modeling and fairly  
8 basic approaches to this. And just in the interest of  
9 time, I hadn't explored those. We would be happy to  
10 come back and tell you in more detail about what's  
11 going on, if you'd like.

12 VICE CHAIRMAN WALLIS: It's significant to  
13 me that you chose not to mention that.

14 MR. MUSCARA: Well, I was going to mention  
15 it in my viewgraph.

16 MEMBER POWERS: Unfortunately, Graham, I  
17 suspect if they had come in and said, "We're focusing  
18 heavily on the mechanistic," one of the committee  
19 members would have said, "5,000 people are doing that,  
20 and they haven't made progress in the last 20 years.  
21 What makes you think you will in the next five?"

22 MEMBER FORD: Well, let's move on.

23 MR. MUSCARA: Okay. So we -- over the  
24 last few months, we've been thinking about this  
25 proactive materialistic relation, mainly because there

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1 has been a concern or a question asked from our  
2 chairman that effectively challenges us to decide or  
3 determine what is the next big problem, and are we  
4 ready? What are we going to do about it?

5 So we've been thinking about how to  
6 approach this problem. How can we be more proactive?

7 Clearly, the first step is to identify the  
8 materials and the components that are susceptible to  
9 various cracking or degradation mechanisms. So in the  
10 first step we want to identify locations where  
11 degradation could reasonably be expected in the  
12 future.

13 To do this, I was looking for a structured  
14 approach. Clearly, we need to depend on expert  
15 opinion, expert elicitation. But I wanted to have  
16 some structure to this approach, and I've looked at  
17 the PIRT process and decided that this process can be  
18 used for evaluating locations in the plant where we  
19 could expect degradation.

20 MEMBER SIEBER: Isn't that part of the  
21 Davis-Besse action plan?

22 MR. MUSCARA: No.

23 MEMBER SIEBER: No? Okay.

24 MR. MUSCARA: Now, we do need to make some  
25 changes. At least we need to adapt the PIRT process

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1 for this issue. It's somewhat different than what  
2 PIRT has been used for in the past. In the past, in  
3 fact, PIRT has been used for very focused --  
4 evaluation of a very focused problem, and here is a  
5 fairly broad problem.

6 But there are a lot of similarities. For  
7 example, when one looks at the phenomenon in the  
8 standard PIRT, and in those generally related to  
9 thermal hydraulic phenomena, a similar situation for  
10 us is the degradation mechanism themselves. So the  
11 phenomena become the degradation mechanism.

12 If we look at the scenario from the  
13 traditional approach versus what we need, in our case  
14 the scenario is really the stressors that these  
15 materials would experience. So the scenarios for us  
16 would be things like the material, the environment  
17 with respect to chemistry temperature stresses,  
18 irradiation embrittlement, and so on. So our  
19 scenarios are the stressors.

20 At any rate, we decided that this PIRT  
21 process could work. And because of its structure I  
22 think it would give us a disciplined way to go about  
23 this. And our thoughts are that we would have a  
24 panel. Within this PIRT panel, we're thinking about  
25 seven members with a PIRT technical leader.

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1           Amongst these seven members I would like  
2           to have five materials degradation experts, a systems  
3           expert, and an expert that has materials experience  
4           but also comes from the operating plant. So he has  
5           operating plant experience with knowledge and  
6           materials.

7           We foresee running about six meetings.  
8           Three meetings would be concentrating on the PWR and  
9           three meetings on the BWR. We plan on developing a  
10          lot of information before hand, background  
11          information, that the experts need to have. We don't  
12          intend on developing information degradation  
13          mechanisms, because the experts have this information.  
14          They know this.

15          But we need to develop information on what  
16          the component is, what its function is, what are the  
17          stresses that it sees, so that they can decide from  
18          those parameters whether there's a potential for  
19          degradation. So before we start the panel, we plan on  
20          pulling together a lot of information on the  
21          components, the materials, and the stressors.

22          There is information available that we can  
23          start, for example, from the GALL report. One thing  
24          that we want to do beyond GALL is -- the GALL report  
25          is based on experience of the past. We're trying to

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1 look forward, so we'll start with GALL, but we need to  
2 think about potential for cracking in the future,  
3 because initiation times may be longer -- we just  
4 haven't experienced them yet -- or maybe because of  
5 some new degradation methods that are operating.

6 So in our work we look at past experience,  
7 but are also trying to project forward and consider  
8 other potential degradation mechanisms and longer  
9 initiation times.

10 The results of this will then be reviewed  
11 by an international group of experts. Clearly, we  
12 cannot have too large of a panel, because we wouldn't  
13 get anything done. And, of course, it's quite costly.  
14 But we do want to have the results reviewed by a  
15 broader group. So we will have some independent  
16 review of the results.

17 But given that we have identified the  
18 materials and the components of interest, we then want  
19 to determine what can be done to proactively predict  
20 degradation and be able to manage it. From our side,  
21 we want to be able to develop the database or the  
22 foundation for having regulatory activities in place  
23 that would keep the degradation from becoming a safety  
24 issue.

25 From the industry side, of course, there

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1 would be interest in even avoiding the degradation.  
2 If you're now identifying the potential, there are  
3 things that can be done to avoid it. So in that  
4 context, we want to review and evaluate in-service  
5 inspection and continuous monitoring techniques for  
6 the combinations of materials in geometries where we  
7 expect the degradation.

8 If we find that the inspection techniques  
9 are not reliable, then there is a need to do new work.  
10 You know, what needs to be done to develop the  
11 appropriate inspection techniques?

12 If we find that the periodic in-service  
13 inspection techniques are not adequate to detect a  
14 particular problem that may be progressing more  
15 rapidly, then there may be a need for continuous  
16 monitoring. Those kinds of things will be determined,  
17 evaluated, and recommendations will be made.

18 We also want to review and evaluate  
19 techniques that could ameliorate the stressors to  
20 prevent the expected degradation. That is, it's quite  
21 possible for a particular component that by just  
22 changing the temperature a few degrees that you may  
23 not expect a problem. So we want to identify those  
24 kinds of things. Can we do something with the stress  
25 state, maybe the residual stresses?

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1           In addition, assuming that the degradation  
2 occurs, then one would need to consider replacement  
3 materials. And so within our work, we would plan on  
4 reviewing and evaluating potential new materials for  
5 replacement. Of course, if the industry does not  
6 intend to use new materials for replacing the  
7 component, and they use the same material, then we  
8 need to have guidance on, well, then, maybe you need  
9 to have a different in-service inspection program.

10           So given a more resistant material, maybe  
11 the inspection program does not need to be as  
12 rigorous. But with the old material, which is still  
13 susceptible to cracking, then there may be more  
14 requirements with respect to in-service inspection.

15           In addition, when one repairs a component,  
16 we find clearly from our experience that degradation  
17 often occurs in repaired areas. And that's because we  
18 wind up leaving the material in a -- with a poor  
19 microstructure and high residual stresses. So there's  
20 a need to review and evaluate fabrication techniques.

21           Will the fabrication techniques that will  
22 be used for replacing a component be adequate for the  
23 future operation of the component? I believe there  
24 will be a need to do additional work on really the  
25 welding processes, so that you control the welding to

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1 minimize stresses and to optimize microstructures.

2           These kinds of things can be done. We've  
3 done some work in the past with respect to trying to  
4 predict sensitization of stainless steel. We found  
5 that you could do this. We were really studying how  
6 different welding procedures would sensitize the  
7 material, but we found that by varying the parameters  
8 you could -- in effect, anneal inside surface, and the  
9 resolution of the material, which would have left it  
10 not susceptible.

11           So the stresses could be minimized, and  
12 the microstructures could be optimized. So that's  
13 something that needs to be looked at, review and  
14 evaluate, and then make recommendations for  
15 developments. It doesn't say that we will do those  
16 developments, but we would like to make the  
17 observations and the recommendations.

18           MEMBER POWERS: I guess, once again, I  
19 come back to saying, how far do you go in trying to  
20 teach the industry how to make good welds?

21           MR. MUSCARA: Well, again, from our point  
22 of view, if industry comes in and repairs a component,  
23 and leaves it in worse condition than it was, we need  
24 to make our own decisions. What do we require from  
25 those components? Do we require more inspection?

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1 Less inspection?

2 So we need to understand if the particular  
3 repair procedures will leave the component in a good  
4 condition or not. Now, if it's not in a good  
5 condition, then it's our responsibility to indicate  
6 that you need to do better monitoring. And if they do  
7 use a better procedure, then we know that we don't --  
8 we can accept a different inspection program.

9 So I think it's still part of our  
10 responsibility to know how well these techniques work.

11 MEMBER POWERS: But why isn't that one  
12 where you just asked --

13 MR. MUSCARA: I'm showing --

14 MEMBER POWERS: -- this repair that you've  
15 made has left the material in a better condition than  
16 it was?

17 MR. MUSCARA: Well, I think, again, if  
18 we're looking at the reactive approach, we wind up  
19 often making not necessarily the best decisions.  
20 Sometimes too conservative. But if you have a  
21 problem, and you have to replace a component, there's  
22 no time to start looking into a better or poorer  
23 repair procedure, or even making the case on how good  
24 the procedure is.

25 The fact is that the plant will be

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1 repaired and it's going to go back out. And the  
2 problem we have left is, how do we deal with this?  
3 how do we deal for its future operations?

4 MR. MAYFIELD: Well, one of the other  
5 points to not lose sight of, Dana, is that -- and it  
6 goes to Joe's last bullet about the expected  
7 interaction with the industry on this. These are  
8 things that we believe need to be dealt with. I think  
9 you have gone to -- we necessarily think we're going  
10 to deal with all of them.

11 And where we are today, at least where I  
12 am, I'm not convinced how much of this is -- really  
13 falls to the NRC to fund, and how much of it is us  
14 trying to encourage others to spend the money to chase  
15 the subject.

16 MEMBER POWERS: I'm absolutely persuaded  
17 that it's useful and worthwhile for NRC to invest  
18 something in this area. What I'm struggling with is  
19 how to make it finite.

20 MR. MAYFIELD: I'm sorry. How to what?

21 MEMBER POWERS: How to make it finite.  
22 It's very clear to me that it's more -- they're not  
23 investing enough. Quite frankly, to be blunt, the  
24 Commission right now is vulnerable to an incredible --  
25 if you have a Davis-Besse-like incident in a plant

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1       that you've given a license extension to, now I would  
2       expect the Commission would get an opportunity to  
3       explain that to the Congress in various subcommittee  
4       meetings and things like that. So it's clear they  
5       need to invest something.

6               But, you know, what's the limit on it?  
7       That's what I'm struggling with.

8               MR. MUSCARA: But, again, at this stage,  
9       as I thought I had stressed, our role right now is to  
10      review and evaluate and recommend. So, but the review  
11      and evaluation will have a feeling for --

12              MEMBER POWERS: But you see, Joe, we've  
13      conceded, we've mutually agreed that to review  
14      effectively, you have to be knowledgeable in the  
15      field. And you cannot become knowledgeable in the  
16      field simply by reading the literature.

17              MR. MUSCARA: That's correct. Yes.

18              MEMBER POWERS: And, I mean, that is an  
19      assumption that this committee has agreed -- not just  
20      with you, but throughout research. We've agreed that  
21      that is the case, and I think we understand why that's  
22      the case.

23              And so now how much do we have to do to  
24      become a knowledge reviewer of what the industry  
25      proposes?

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1 MR. MUSCARA: Well, maybe let's put that  
2 off until I'm finished, because --

3 MEMBER POWERS: Sure. That's where I'm  
4 struggling with it.

5 MR. MAYFIELD: Very quickly, we don't have  
6 the answer either.

7 MEMBER POWERS: I'm sure we don't. I  
8 mean, I'm sure we don't.

9 MR. MAYFIELD: And that where it's in the  
10 eye of the beholder, what's -- you know, when is  
11 enough enough?

12 MEMBER SIEBER: One of the issues is that  
13 where you are right now is sort of an after-the-fact  
14 deal, whereas the repair procedures in the ASME code  
15 is before the fact. And the problem with dealing with  
16 the code is that it moves at such glacial speed none  
17 of us will live long enough to see them actually shape  
18 up the code, where, you know, you draw -- circumscribe  
19 what the appropriate repair procedures are.

20 And so you're forced to do something, and  
21 I guess I come away -- first thought -- that what  
22 you're doing is probably the right thing.

23 MR. MUSCARA: Second-to-the-last bullet,  
24 review and study potential new degradation mechanisms,  
25 this effectively comes partially from the results from

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1 the PIRT. We will, I'm sure, discuss and debate  
2 different components and environment combinations  
3 where we don't know enough. We have a suspicion that  
4 cracking may occur, but we don't know enough.

5 As part of the PIRT, those areas where we  
6 have a suspicion that degradation is possible, but we  
7 don't have enough knowledge, that's an area where we  
8 think we need to develop some additional knowledge.

9 Again, as examples, we don't have  
10 experienced degradation yet in a particular component,  
11 but that may be a matter of time. Do we know enough  
12 about the crack initiation times for particular  
13 materials and environments? So it may be that we will  
14 have to address this in getting a better understanding  
15 of particular aspects of different degradation  
16 mechanisms.

17 Finally, I had a bullet here on industry  
18 and international interaction. Again, we've only been  
19 looking at this for the last three or four months.  
20 But I've had the opportunity to discuss this issue  
21 with the two main international meetings and  
22 conferences. And there clearly is a tremendous amount  
23 of interest in the willingness to support work in this  
24 area.

25 We have also discussed this with EPRI, in

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1 particular doing the first step -- identifying the  
2 materials and components that are susceptible to  
3 degradation. They are effectively telling me, yes,  
4 we're interested. Now, I'm trying to go beyond that.  
5 I'm trying to get to the next step.

6 Just in the last couple of days I've  
7 talked with Mike Robinson, who is heading the  
8 technical committee for the industry developing this  
9 new degradation -- materials degradation program. And  
10 we are going to get together within a week or two to  
11 sit across the table and discuss what we are planning  
12 on doing, what they are planning on doing, but, in  
13 addition to that, how they can cooperate and help us  
14 do this work.

15 And so, in effect, we agreed that we need  
16 to go beyond "we're interested." They need to get to  
17 the point where they can make some commitments, and  
18 we've agreed we will start doing this. So that's  
19 going to go on over the next couple of weeks.

20 But I think with respect to identifying  
21 locations, in order to be proactive we have to do  
22 this, and we have to get going on that issue.

23 There has been so much interest, and in  
24 particular we had a -- one of our international  
25 meetings in Canada on the generator program two weeks

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1 ago. I was approaching the subject at a side  
2 discussion, and there was, again, some tremendous  
3 interest there in participating, wanting to cooperate  
4 in doing work in this area.

5 So the conclusion I've come to over this  
6 last week is that originally I thought let us do the  
7 first step. Let's identify the areas of interest and  
8 then start developing the programs around us. What  
9 needs to be done with reviewing and evaluating  
10 inspection and repairs and the materials, etcetera.

11 Well, it seems to me that with the  
12 interest that is available, you already know enough of  
13 some of the areas that need to be addressed that I  
14 need to start another group concurrent with the work  
15 that's going on to identify the locations, to start  
16 planning and exploring the research program.

17 So the thought here is to get together --  
18 maybe I should mention numbers. At the first meeting  
19 I had 24 scientists and engineers and government  
20 agency people indicating that they had an interest in  
21 participating. And I've picked up additional support  
22 from the other meetings.

23 So there is a lot of interest. What I'm  
24 trying to do is pull together government agencies,  
25 international government agencies, funding agencies,

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1 and researchers to together work out a plan. What are  
2 the areas that need to be investigated? What would be  
3 the objectives of the work? How far can we take the  
4 work?

5 Develop the program and then to have a  
6 coordinated international effort to address all of the  
7 work. So each country's organization will do a small  
8 piece of the work, but together we can get all of the  
9 work done.

10 And I've approached several people with  
11 this idea. It seems to be something people want to  
12 do. So I want to explore this. So my feeling is that  
13 we should be able to identify the areas of interest.

14 We should be able to identify a broad  
15 program to address the issues -- whether it's interest  
16 from the regulator or from the NSSS vendor, from a  
17 fabricator, that the overall program would be defined  
18 and pieces of it will be done in different places, but  
19 coordinated cooperatively so everybody can take  
20 advantage of it.

21 So in my thinking at this point, this is  
22 where we're going. We do plan on starting the PIRT  
23 process hopefully this year. And we do hope to get  
24 contributions for that from the industry also.

25 MEMBER POWERS: Can I chat with you just

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1 a little bit about the PIRT process? I come at it as  
2 a person who was extremely enthusiastic about the idea  
3 of taking PIRT, which had been devised initially in  
4 the thermal hydraulics realm, and applying it to some  
5 of these phenomenological issues, like the high-burnup  
6 fuel issue.

7 And we actually saw pretty good success  
8 when it was applied in the high-burnup fuel issue as  
9 the front end of their program to decide what areas  
10 should they pursue, because there is essentially an  
11 infinite amount that you could do. And so what were  
12 the things that you ought to do based on your best  
13 understanding? And I think they did an outstanding  
14 job.

15 Since that time, I've participated in a  
16 couple of these exercises, and the most recent one of  
17 which I came away just absolutely infuriated at the  
18 way it was organized and run, because despite the name  
19 -- Phenomena Identification and Ranking Table -- it  
20 became a structure identification and ranking  
21 exercise.

22 And in trying to think about how it could  
23 be done better, I hearken back to what I think was one  
24 of the discoveries in the expert elicitation process  
25 -- if Dr. Apostalakis was here, he would say it's an

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1 expert opinion elicitation process -- that one of the  
2 things that you will find is expensive about PIRT as  
3 you get these experts together -- and it takes them a  
4 long time to focus on your problem -- is you might  
5 find it useful, because you have a technically-skilled  
6 set of staff and a technically-skilled set of  
7 contractors working for you, to create a strawdog for  
8 them to work from, rather than putting the aspiration  
9 and say invent this out of whole cloth.

10 Because I think the formalisms that have  
11 been ascribed to phenomena identification and ranking  
12 can easily take over, and you can easily lose out,  
13 especially in the phenomena aspects of it, to this  
14 formalism. Because, I mean, quite frankly, the  
15 thermal hydraulicists had a wonderful idea on doing  
16 these things, and they carried it out very nicely.  
17 Well, sometimes it's been done very well for thermal  
18 hydraulics, but you cannot take that formalism exactly  
19 and translate it into this field. And you have to  
20 make some adjustments and --

21 MR. MUSCARA: I agree. And this is why  
22 I've said it's a PIRT-like process. We really looked  
23 at -- I spent a day with Brandt, and of course we had  
24 some differences of opinion a number of times. I'm  
25 trying to use as much of that process as I can, but,

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1 in fact, you know, it's a sophisticated expert  
2 elicitation process.

3 For that reason, we're doing a lot of  
4 legwork ahead of time. We're trying to get a lot of  
5 background information. And, in fact, we are going to  
6 fill out, you know, an example, so that our at our  
7 first meeting this will be discussed with the experts  
8 and --

9 MEMBER POWERS: That's going to pay off  
10 for you big time, because what they've done on the  
11 coated-particle fuel I think is just a waste of time,  
12 because it's all formalism. And, I mean, vast areas  
13 of phenomena are just hidden in curt little structural  
14 statements, and you have to be very careful about  
15 that.

16 MR. MUSCARA: And hopefully we won't get  
17 hung up on the formalism. But I'd like to take  
18 advantage of the structure. So --

19 MEMBER POWERS: I think it's a fantastic  
20 idea, and the greater diversity you can get in your  
21 panel without having it become unwieldy -- I think in  
22 the high-burnup fuel they got tremendous diversity,  
23 and it paid off very well. But I think they paid for  
24 having a certain unwieldiness to it.

25 MR. MAYFIELD: But that's, frankly, why I

1 like Joe's approach of starting with a somewhat  
2 smaller panel, get something, and then vet that with  
3 a much larger audience.

4 MEMBER POWERS: Yes. I mean, that's  
5 probably a really good idea, because you really want  
6 diversity, but the unwieldiness will just kill you.

7 MR. MUSCARA: One of the aspects we  
8 discussed with Dr. Boyack was, you know, for PWR you  
9 want to have these other experts. For the BWR -- I  
10 said, no, for this problem, for degradation, I want  
11 the BWR guys to be there when we discuss the PWR,  
12 because it's experience that they could use.

13 So I've decided not to have two separate  
14 panels, but have the same panel, essentially with the  
15 same expertise, but taking advantage of both sides.

16 MEMBER POWERS: See, what you're seeing  
17 with Boyack is this structuralism here. You know, to  
18 find the reactor, just find the accident. And you  
19 don't have to do that, because you're working in a  
20 phenomenological area.

21 MR. MAYFIELD: And that's exactly where  
22 we've been trying to go.

23 With that, unless there are other  
24 questions, Mr. Chairman, that's all we have to say.

25 MEMBER FORD: Mike, Joe, thank you very

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1 much, indeed. I understand that there is no request  
2 from you for a letter --

3 MR. MAYFIELD: That is correct.

4 MEMBER FORD: -- on this, and the  
5 information you give to us will be useful for the  
6 research report, I think. And it will also be useful  
7 background for the talk tomorrow to the Commissioners.

8 Are there any other questions from the  
9 committee? No?

10 MEMBER POWERS: I mean, have you got all  
11 day? I'm struggling heroically here.

12 MEMBER FORD: Thank you very much, indeed.  
13 Mario, it's yours.

14 CHAIRMAN BONACA: Yes. Thank you very  
15 much.

16 Okay. I think we are going to go off the  
17 record now and take a break. We'll get back at 20 of  
18 6:00. We need to go through the presentation, the  
19 slides for tomorrow. And the other thing I would have  
20 liked to do is to read Tom's letter on security and  
21 safeguards, give him some feedback on it.

22 (Whereupon, at 5:25 p.m., the proceedings  
23 in the foregoing matter went off the  
24 record.)  
25

**CERTIFICATE**

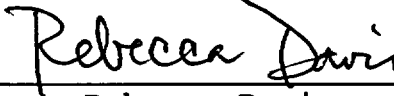
This is to certify that the attached proceedings  
before the United States Nuclear Regulatory Commission  
in the matter of:

Name of Proceeding: Advisory Committee on  
Reactor Safeguards  
506<sup>th</sup> Meeting

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the  
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**ACRS LICENSE RENEWAL FULL COMMITTEE**

**FORT CALHOUN STATION, UNIT 1  
LICENSE RENEWAL APPLICATION**

**FINAL SAFETY EVALUATION REPORT**

**OCTOBER 1, 2003**

**WILLIAM BURTON  
PROJECT MANAGER  
NRR**

## **OVERVIEW**

**APPLICATION SUBMITTED BY LETTERS DATED JANUARY 9 AND APRIL 5, 2002**

**COMBUSTION ENGINEERING PRESSURIZED WATER REACTOR**

**PLANT LOCATED IN WASHINGTON COUNTY, NEBRASKA**

**CURRENT LICENSE EXPIRES AUGUST 9, 2013. REQUESTS RENEWAL THROUGH AUGUST 9, 2033**

**SER WITH OPEN ITEMS ISSUED APRIL 21, 2003**

**ACRS LICENSE RENEWAL SUBCOMMITTEE MEETING HELD ON JUNE 11, 2003**

**FINAL SER ISSUED SEPTEMBER 5, 2003**



## **COMPARISON TO PREVIOUS LICENSE RENEWAL APPLICATIONS**

**FIRST APPLICANT TO FULLY IMPLEMENT THE GENERIC AGING LESSONS  
LEARNED (GALL) PROCESS**

**FIRST PLANT TO INCLUDE CONFIRMATION OF GALL CONSISTENCY IN  
STAFF REVIEW**

**PART OF AMR INSPECTION**

**FIRST PLANT TO UTILIZE AN SER TEMPLATE**

**TO AID IN THE PERFORMANCE AND DOCUMENTATION OF THE  
STAFF'S REVIEW**

## **STAFF CONCLUSION**

**THE APPLICANT HAS MET THE REQUIREMENTS FOR LICENSE RENEWAL, AS REQUIRED BY 10 CFR 54.29:**

- ACTIONS HAVE BEEN IDENTIFIED AND HAVE BEEN OR WILL BE TAKEN SUCH THAT THERE IS REASONABLE ASSURANCE THAT ACTIVITIES WILL CONTINUE TO BE CONDUCTED IN THE RENEWAL TERM IN ACCORDANCE WITH THE CURRENT LICENSING BASIS**
- THE APPLICABLE REQUIREMENTS OF 10 CFR PART 51 HAVE BEEN SATISFIED**
- MATTERS RAISED UNDER 10 CFR 2.758 HAVE BEEN ADDRESSED**

## **SCOPING AND SCREENING METHODOLOGY**

**METHODOLOGY USED TO IDENTIFY STRUCTURES, SYSTEMS, AND COMPONENTS (SSCs) WITHIN THE SCOPE OF LICENSE RENEWAL AND SUBJECT TO AN AGING MANAGEMENT REVIEW**

**METHODOLOGY SHOULD MEET SCOPING AND SCREENING REQUIREMENTS IN 10 CFR PART 54 AND BE CONSISTENT WITH THE LRA**

**STAFF REVIEW SUPPLEMENTED BY METHODOLOGY AUDIT**

**4 METHODOLOGY REQUESTS FOR ADDITIONAL INFORMATION (RAIs)**

**FUNCTIONAL REALIGNMENT**

**NO OPEN ITEMS**

**1 CONFIRMATORY ITEM (RESOLVED)**

## **SCOPING AND SCREENING METHODOLOGY**

### **CONCLUSION**

**METHODOLOGY IS ADEQUATELY DESCRIBED AND JUSTIFIED IN THE LRA AND SATISFIES THE REQUIREMENTS OF 10 CFR 54.21(a)(2)**

## **SCOPING AND SCREENING REVIEW RESULTS**

**STAFF REVIEW SUPPLEMENTED BY SCOPING AND SCREENING INSPECTION**

**69 RAIs ASSOCIATED WITH SCOPING AND SCREENING RESULTS**

**3 SCOPING AND SCREENING OPEN ITEMS (ALL ARE RESOLVED)**

**0 CONFIRMATORY ITEMS**

## **CREDIT FOR PRESSURIZER SPRAY NOZZLE TO MEET APPENDIX R**

**STAFF ISSUE:** SPRAY PATTERN MAY BE CRITICAL TO DEPRESSURIZING RCS TO MEET APPENDIX R. THEREFORE PRESSURIZER SPRAY HEAD SHOULD BE IN SCOPE

**RESPONSE:** SPRAY PATTERN NOT CREDITED FOR PRESSURE REDUCTION, AND PRESSURIZER SPRAY IS ONE OF SEVERAL MEANS TO COOLDOWN AND DEPRESSURIZE RCS. THEREFORE, SPRAY HEAD NOT IN SCOPE

**ACRS CONCERN:** SER IMPLIED THAT BASIS FOR STAFF FINDING WAS REDUNDANT CAPABILITY TO DEPRESSURIZE

**STAFF FIX:** STAFF REVISED SER TO CLARIFY THAT SPRAY PATTERN NOT MATERIAL TO MEETING PRESSURE REDUCTION FUNCTION. AVAILABILITY OF ADEQUATE VOLUME OF WATER IS CRITICAL, NOT THE SPRAY PATTERN (REDUCED EFFICIENCY). PRESSURIZER AND PIPING ARE CRITICAL COMPONENTS NEEDED TO ENSURE WATER IS SUPPLIED TO PRESSURIZER. THESE COMPONENTS ARE WITHIN SCOPE (SER SECTION 2.3.1.2.2)

## **SCOPING AND SCREENING REVIEW RESULTS**

### **CONCLUSION**

**THE FCS STRUCTURES, SYSTEMS, AND COMPONENTS WITHIN THE SCOPE OF LICENSE RENEWAL HAVE BEEN IDENTIFIED, AS REQUIRED BY 10 CFR 54.4(a)**

**THE FCS STRUCTURES AND COMPONENTS WITHIN THE SCOPE OF LICENSE RENEWAL AND SUBJECT TO AN AGING MANAGEMENT REVIEW HAVE BEEN IDENTIFIED, AS REQUIRED BY 10 CFR 54.21(a)(1)**

## **AGING MANAGEMENT PROGRAMS**

**STAFF REVIEW SUPPLEMENTED BY AMR INSPECTION AND AUDIT**

**24 AMPs CREDITED FOR LICENSE RENEWAL**

**14 COMMON AMPS**

**CONSISTENT WILL GALL: 5**

**CONSISTENT WITH GALL, BUT WITH SOME DEVIATION: 7**

**NON - GALL: 2**

**10 SYSTEM-SPECIFIC AMPS**

**CONSISTENT WILL GALL: 4**

**CONSISTENT WITH GALL, BUT WITH SOME DEVIATION: 6**

**NOT CONSISTENT WITH GALL: 0**

**NUMBER OF AMPs THAT ARE CONSISTENT WITH GALL - 22**

**1 AMP (NON-EQ CABLES) WAS REVISED TO BE CONSISTENT WITH GALL**

**NUMBER OF AMPs THAT ARE CONSISTENT, BUT WITH A DEVIATION FROM GALL - 13**



## **AGING MANAGEMENT PROGRAMS**

### **DEVIATIONS FROM GALL:**

**CLARIFICATIONS - 4**

**EXCEPTIONS - 6**

**ENHANCEMENTS - 10**

**NUMBER OF GALL AMPs THAT ARE REFERENCED IN THE LRA - 33**

**38 RAIs**

**NO OPEN ITEMS**

**1 CONFIRMATORY ITEM (RESOLVED)**

**STAFF ALSO REVIEWED USAR SUPPLEMENTS**

## **ONE-TIME INSPECTIONS**

**ONE-TIME INSPECTION (OTI) PROGRAM NOT YET DEVELOPED**

**STAFF CONFIRMED ITEMS TO BE ADDRESSED IN OTI AMP. ITEMS IDENTIFIED IN APPENDIX A OF SER (COMMITMENT TABLE)**

**AMR INSPECTION TEAM CONFIRMED THAT DEVELOPMENT OF OTI AMP, AND ITEMS TO BE INCLUDED IN THE OTI AMP, ARE CAPTURED IN APPLICANT'S COMMITMENT TRACKING SYSTEM**

**STAFF WILL REVIEW FULFILLMENT OF COMMITMENTS IN IP 71003 (CURRENTLY UNDER DEVELOPMENT)**

## **AGING MANAGEMENT PROGRAMS**

### **CONCLUSION**

**APPLICANT HAS DEMONSTRATED THAT AGING MANAGEMENT PROGRAMS WILL EFFECTIVELY MANAGE AGING IN STRUCTURES AND COMPONENTS SO THAT THEIR INTENDED FUNCTIONS WILL BE MAINTAINED CONSISTENT WITH THE CURRENT LICENSING BASIS FOR THE PERIOD OF EXTENDED OPERATION, AS REQUIRED BY 10 CFR 54.21(a)(3)**

**THE USAR SUPPLEMENTS PROVIDE AN ACCEPTABLE SUMMARY DESCRIPTION OF THE PROGRAMS AND ACTIVITIES FOR MANAGING THE EFFECTS OF AGING FOR THE PERIOD OF EXTENDED OPERATION, AS REQUIRED BY 10 CFR 54.21(d)**

## **AGING MANAGEMENT REVIEW**

**STAFF REVIEW SUPPLEMENTED BY AMR INSPECTION AND AUDIT**

**90 RAIs ISSUED**

**6 OPEN ITEMS (ALL ARE RESOLVED)**

**NO CONFIRMATORY ITEMS**

**OPEN ITEM 3.0-1**

### **CONCLUSION**

**APPLICANT HAS DEMONSTRATED THAT EFFECTS OF AGING WILL BE ADEQUATELY  
MANAGED SO THAT THE INTENDED FUNCTION(S) WILL BE MAINTAINED CONSISTENT  
WITH THE CURRENT LICENSING BASIS FOR THE PERIOD OF EXTENDED OPERATION,  
AS REQUIRED BY 10 CFR 54.21(a)(3)**

## **TIME-LIMITED AGING ANALYSES (TLAAs)**

**8 TLAAs IDENTIFIED IN LRA**

**13 RAIs ISSUED**

**2 CONFIRMATORY ITEMS (BOTH ARE RESOLVED)**

**2 OPEN ITEMS (BOTH ARE RESOLVED)**

**1 OPEN ITEM WAS AN ADDITIONAL TLAA THAT WAS IDENTIFIED FOLLOWING ISSUANCE OF THE SER WITH OPEN ITEMS**

**ALLOY 600 WELD REPAIR IN PRESSURIZER LOWER SHELL TEMPERATURE NOZZLE**

**APPLICANT CHOSE TO DEFER THE TLAA EVALUATION. IN ACCORDANCE WITH NEI 95-10, THE APPLICANT PROVIDED INFORMATION TO ALLOW STAFF TO CONCLUDE THAT 10 CFR 54.21(C)(1)(iii) HAS BEEN MET**

## **TLAAs**

### **REACTOR VESSEL NEUTRON EMBRITTLEMENT**

#### **UPPER SHELF ENERGY (USE)**

**STAFF PERFORMED INDEPENDENT CALCULATIONS**

**APPLICANT'S ANALYSIS OF USE PROJECTED TO END OF EXTENDED OPERATING PERIOD**

**MINIMUM LIMIT OF 50 FT-LBs**

**LOWEST PROJECTED VALUE USING METHODOLOGY IN REG. GUIDE 1.99, REVISION 2, IS 54.6 FT-LBs AT 48 EFPY**

## **TLAAs**

### **REACTOR VESSEL NEUTRON EMBRITTLEMENT**

#### **PRESSURIZED THERMAL SHOCK (PTS)**

**STAFF PERFORMED INDEPENDENT CALCULATIONS**

**APPLICANT'S ANALYSIS OF PTS PROJECTED TO END OF EXTENDED OPERATING PERIOD**

	<b>PTS SCREENING CRITERIA (Degrees Fahrenheit)</b>	<b>FCS (Degrees Fahrenheit)</b>	<b>STAFF (Degrees Fahrenheit)</b>
<b>PLATES/FORGINGS/AXIAL WELDS</b>	<b>270</b>	<b>268</b>	<b>269</b>
<b>CIRCUMFERENTIAL WELDS</b>	<b>300</b>	<b>243</b>	<b>260</b>

## **TLAAs**

### **CONCLUSION**

**THE APPLICANT HAS IDENTIFIED THE TLAAs AND HAS DEMONSTRATED OR WILL DEMONSTRATE THAT THE TLAAs:**

- 1. WILL REMAIN VALID FOR THE PERIOD OF EXTENDED OPERATION**
- 2. HAVE BEEN PROJECTED TO THE END OF THE PERIOD OF EXTENDED OPERATION,  
OR**
- 3. THE AGING EFFECTS WILL BE ADEQUATELY MANAGED FOR THE PERIOD OF  
EXTENDED OPERATION**



## **INSPECTIONS AND AUDITS**

### **SCOPING AND SCREENING METHODOLOGY AUDIT JULY 8 - 12, 2002**

**RESULTS DOCUMENTED IN SER SECTION 3.0.4**

### **SCOPING AND SCREENING INSPECTION NOVEMBER 4 - 8, 2002**

**4 INSPECTION OPEN ITEMS WERE IDENTIFIED**

**RESULTS DOCUMENTED IN INSPECTION REPORT 50-285/02-07, ISSUED ON  
DECEMBER 20, 2002**

### **AGING MANAGEMENT REVIEW INSPECTION AND CONCURRENT AUDIT JANUARY 6 - 10 AND JANUARY 20 - 23, 2003**

**INSPECTION REPORT DISCUSSES RESOLUTION OF THE 4 INSPECTION OPEN  
ITEMS IDENTIFIED DURING THE SCOPING AND SCREENING INSPECTION**

**INSPECTION RESULTS DOCUMENTED IN INSPECTION REPORT 50-285/03-07**

**AUDIT RESULTS DOCUMENTED IN LETTER DATED APRIL 9, 2003**

**REGION CONCLUDED THAT OPTIONAL FINAL INSPECTION WAS NOT NEEDED**

## **COMMITMENT TRACKING SYSTEM**

**SER APPENDIX A LISTS APPLICANT'S LICENSE RENEWAL COMMITMENTS**

**FULFILLMENT OF COMMITMENTS WILL BE CONFIRMED BY STAFF IN INSPECTION  
PROCEDURE 71003 (BEING DEVELOPED)**

**TWO ON-SITE PROCEDURES RELATED TO COMMITMENT TRACKING**

**ONGOING COMMITMENT PROGRAM**

**COMMITMENT TRACKING SYSTEM**

**COMMITMENTS ARE TRACKED USING ACTION REQUESTS (A/Rs)**

## **OPEN AND CONFIRMATORY ITEMS**

### **11 OPEN ITEMS**

**3 RELATED TO SCOPING AND SCREENING**

**6 RELATED TO AGING MANAGEMENT**

**2 RELATED TO TLAAs (1 WAS IDENTIFIED AFTER THE SER WITH OPEN ITEMS WAS ISSUED. ACRS SUBCOMMITTEE WAS BRIEFED ON THIS OPEN ITEM ON JUNE 11, 2003)**

**ALL ARE RESOLVED**

### **4 CONFIRMATORY ITEMS**

**1 RELATED TO SCOPING AND SCREENING**

**1 RELATED TO AGING MANAGEMENT**

**2 RELATED TO TLAAs**

**ALL ARE RESOLVED**

## OPEN ITEM SUMMARY

OPEN ITEM	SUBJECT	STATUS
2.2-1	SEVERAL SYSTEMS THAT MET 54.4(a)(2) SCOPING CRITERION WERE NOT IDENTIFIED AS BEING WITHIN SCOPE	<p>CLOSED:</p> <p>SYSTEMS AND ASSOCIATED AGING MANAGEMENT INFORMATION WERE BROUGHT INTO SCOPE. STAFF REVIEWED AGING MANAGEMENT INFORMATION AND FOUND IT TO BE SATISFACTORY. ALL SYSTEMS MEETING 54.4(a)(2) HAVE BEEN IDENTIFIED</p> <p>DISCUSSED DURING ACRS SUBCOMMITTEE MEETING</p>
2.2-2	DISCREPANCY BETWEEN SCOPING TABLE AND SYSTEM DESCRIPTION FOR BLOWPIPE SYSTEM	<p>CLOSED:</p> <p>DISCREPANCY RESOLVED. BLOWPIPE COMPONENTS WERE ALREADY IDENTIFIED IN LRA</p> <p>DISCUSSED DURING ACRS SUBCOMMITTEE MEETING</p>
2.3.3.15-1	CIRCULATING WATER DISCHARGE TUNNEL COULD BLOCK RAW WATER DISCHARGE	<p>CLOSED:</p> <p>TUNNEL BROUGHT INTO SCOPE AS PART OF INTAKE STRUCTURE. NO ADDITIONAL AGING MANAGEMENT INFORMATION NEEDED</p> <p>DISCUSSED DURING ACRS SUBCOMMITTEE MEETING</p>

<b>3.0-1</b>	<b>APPLICANT MADE REVISIONS TO LRA TABLES. STAFF HAD TO REVIEW THE REVISIONS</b>	<b>CLOSED:</b>  <b>STAFF FINISHED ITS REVIEW AND FOUND REVISIONS SATISFACTORY</b>  <b>THIS WAS OPEN AT THE ACRS SUBCOMMITTEE MEETING</b>
<b>3.3.2.4.1.2-1</b>	<b>IMPACT ON CVCS PERFORMANCE OF DEGRADATION OF REGENERATIVE HEAT EXCHANGER TUBES</b>	<b>CLOSED:</b>  <b>LOSS OF TUBE INTEGRITY WOULD NOT IMPACT ABILITY TO INJECT, WOULD NOT RESULT IN CONTAINMENT BYPASS, NOR WOULD RESULT IN BORON DILUTION</b>  <b>DISCUSSED DURING ACRS SUBCOMMITTEE MEETING</b>
<b>3.6.2.3.1.2-1</b>	<b>REVISE USAR SUPPLEMENT TO REFLECT CHANGE TO NON-EQ CABLE AMP</b>	<b>CLOSED:</b>  <b>USAR SUPPLEMENT WAS REVISED</b>  <b>DISCUSSED DURING ACRS SUBCOMMITTEE MEETING</b>
<b>3.6.2.4.3.2-1</b>	<b>STAFF REQUESTED APPLICANT TO PROVIDE AMP TO MANAGE BUS BAR AGING</b>	<b>CLOSED:</b>  <b>AGING MANAGEMENT WILL BE PERFORMED WITH EXISTING AMP (PERIODIC SURVEILLANCE AND PREVENTIVE MAINTENANCE). NO NEW AMP NEEDED</b>  <b>DISCUSSED DURING ACRS SUBCOMMITTEE MEETING</b>
<b>3.6.2.4.4.2-1</b>	<b>STAFF REQUESTED APPLICANT TO PROVIDE AMP TO MANAGE AGING IN HIGH-VOLTAGE CONDUCTORS OR JUSTIFY WHY AMP NOT NEEDED</b>	<b>CLOSED:</b>  <b>APPLICANT PROVIDED JUSTIFICATION (AMPLE STRENGTH MARGIN TO ENSURE CORROSION WILL NOT PREVENT TRANSMISSION CONDUCTORS FROM PERFORMING THEIR INTENDED FUNCTION DURING EXTENDED OPERATING PERIOD)</b>  <b>DISCUSSED DURING ACRS SUBCOMMITTEE MEETING</b>

3.6.2.4.5.2-1	AGING MANAGEMENT OF FUSE BLOCKS	<p><b>CLOSED:</b></p> <p><b>APPLICANT WILL MANAGE FUSE BLOCKS IN ACCORDANCE WITH ISG-05</b></p> <p><b>DISCUSSED DURING ACRS SUBCOMMITTEE MEETING</b></p>
4.7.2.2-1	LEAK-BEFORE-BREAK ANALYSIS SHOULD BE SUBMITTED FOR STAFF REVIEW	<p><b>CLOSED:</b></p> <p><b>APPLICANT WILL COMPLETE AND SUBMIT ANALYSIS PRIOR TO EXTENDED OPERATING PERIOD. APPLICANT PROVIDED SUPPORTING INFORMATION PER NEI 95-10 GUIDANCE</b></p> <p><b>DISCUSSED DURING ACRS SUBCOMMITTEE MEETING</b></p>
4.7.4-1	FLAW LEFT IN PLACE DURING ALLOY 600 WELD REPAIR ON PRESSURIZER LIQUID SPACE TEMPERATURE ELEMENT	<p><b>CLOSED:</b></p> <p><b>APPLICANT WILL COMPLETE AND SUBMIT EVALUATION PRIOR TO THE EXTENDED OPERATING PERIOD TO DEMONSTRATE THAT CRACK AND ANY POTENTIAL FUTURE GROWTH OF THE CRACK DOES NOT IMPACT STRUCTURAL INTEGRITY OF THE VESSEL FOR THE EXTENDED PERIOD. APPLICANT PROVIDED SUPPORTING INFORMATION PER NEI 95-10 GUIDANCE</b></p> <p><b>DISCUSSED DURING ACRS SUBCOMMITTEE MEETING</b></p>

## **CONFIRMATORY ITEM SUMMARY**

<b>CONFIRMATORY ITEM</b>	<b>SUBJECT</b>	<b>STATUS</b>
<b>2.1.3.1.2-1</b>	<b>SAFETY INJECTION TANK LEVEL AND PRESSURE INDICATORS SHOULD BE IN SCOPE</b>	<b>CLOSED:</b>  <b>INDICATORS BROUGHT INTO SCOPE AND SCREENED OUT AS ACTIVE COMPONENTS</b>  <b>DISCUSSED DURING ACRS SUBCOMMITTEE MEETING</b>
<b>3.0.3.12.1-1</b>	<b>SPENT FUEL POOL COOLING SYSTEM SHOULD BE BROUGHT INTO SCOPE OF THE "GENERAL CORROSION OF EXTERNAL SURFACES" AMP</b>	<b>CLOSED:</b>  <b>SYSTEM ADDED TO THE SCOPE OF THE AMP</b>  <b>DISCUSS DURING ACRS SUBCOMMITTEE MEETING</b>
<b>4.3.2-1</b>	<b>APPLICANT SHOULD SUBMIT AMP DETAILS BY LICENSE AMENDMENT IF ENVIRONMENTALLY-ASSISTED FATIGUE IN THE LIMITING PRESSURIZER SURGE LINE WELDS WILL BE MANAGED FOR AGING</b>	<b>CLOSED:</b>  <b>APPLICANT WILL PROVIDE THE REQUESTED INFORMATION BY LICENSE AMENDMENT IF THIS OPTION IS CHOSEN</b>  <b>DISCUSSED DURING ACRS SUBCOMMITTEE MEETING</b>
<b>4.3.2-2</b>	<b>SAMPLING PIPING MAY EXCEED USAS B31.1 LIMIT OF 7000 EQUIVALENT FULL-RANGE THERMAL CYCLES DURING EXTENDED PERIOD. CYCLES WILL BE TRACKED BY FATIGUE MONITORING PROGRAM (FMP). FMP WILL ALSO ANALYZE PIPING AND PERFORM STRESS CALCULATION TO DETERMINE THERMAL STRESS RANGE. APPLICANT SHOULD CONFIRM THAT RESULTS WILL MEET USAS B31.1</b>	<b>CLOSED:</b>  <b>APPLICANT CONFIRMED THAT RESULTS WILL MEET USAS B31.1</b>  <b>DISCUSSED DURING ACRS SUBCOMMITTEE MEETING</b>

## **LICENSE CONDITIONS**

### **TWO STANDARD LICENSE CONDITIONS:**

- 1. FOLLOWING ISSUANCE OF THE RENEWED LICENSE, THE APPLICANT WILL INCLUDE THE USAR SUPPLEMENT IN THE NEXT USAR UPDATE, AS REQUIRED BY 10 CFR 50.71(e)**
- 2. FUTURE INSPECTION ACTIVITIES IDENTIFIED IN THE USAR SUPPLEMENT WILL BE COMPLETED PRIOR TO THE PERIOD OF EXTENDED OPERATION**

### **NO PLANT-SPECIFIC LICENSE CONDITIONS**



## **LESSONS LEARNED**

### **LINKAGE BETWEEN SECTION 2 AND SECTION 3 OF LRA**

**INITIAL SUBMITTAL (JANUARY 9, 2002) DID NOT LINK LRA SECTIONS 2 AND 3  
(STAFF AND APPLICANT HAD AGREED TO THIS LACK OF LINKAGE DURING THE  
GALL DEMONSTRATION PROJECT)**

**WITHOUT THE LINKS BETWEEN LRA SECTIONS 2 AND 3, STAFF COULD NOT  
DETERMINE WHETHER APPLICANT HAD IDENTIFIED ALL THE AGING EFFECTS OR  
WAS PROPERLY CREDITING GALL FOR AGING MANAGEMENT OF PLANT  
STRUCTURES AND COMPONENTS**

**STAFF REQUESTED APPLICANT TO LINK LRA SECTIONS 2 AND 3**

**APPLICANT PROVIDED LINKAGE IN APRIL 5, 2002 SUBMITTAL**

**SUBSEQUENT LICENSE RENEWAL APPLICATIONS CONTAIN LINKAGE**

## **LESSONS LEARNED**

### **IDENTIFICATION OF STRUCTURES AND COMPONENTS NOT ADDRESSED IN GALL FOR WHICH APPLICANT TAKES CREDIT FOR GALL**

**THE APPLICANT CREDITED GALL WITH MANAGING AGING FOR SOME STRUCTURES AND COMPONENTS THAT WERE NOT EVALUATED IN GALL**

**STAFF FOUND THAT LRA DID NOT CLEARLY IDENTIFY THIS GROUP OF STRUCTURES AND COMPONENTS.**

**STAFF REQUESTED THAT LRA BE REVISED TO CLEARLY IDENTIFY THESE STRUCTURES AND COMPONENTS**

**APPLICANT PROVIDED REQUESTED REVISIONS IN ITS APRIL 5, 2002 SUBMITTAL (LRA TABLES 3.X-3 FOR FCS)**

**SUBSEQUENT LICENSE RENEWAL APPLICATIONS HAVE THESE STRUCTURES AND COMPONENTS CLEARLY IDENTIFIED (THOUGH NOT IDENTIFIED IN SEPARATE TABLE)**

## **LESSONS LEARNED**

### **DEFINITION OF “CONSISTENT WITH GALL”**

**APPLICANTS AND STAFF NOT IN AGREEMENT ON WHAT “CONSISTENT WITH GALL” MEANS**

**REACHED AGREEMENT ON DEFINITION**

**FARLEY WILL BE FIRST APPLICATION TO USE THE AGREED-UPON DEFINITION**

## **LESSONS LEARNED**

### **ENVIRONMENTS WERE NOT ALWAYS CLEARLY DEFINED**

**STAFF ISSUED RAI REQUESTING IDENTIFICATION OF ALL RELEVANT ENVIRONMENTS AT FCS**

**APPLICANT PROVIDED INFORMATION**

**AS A RESULT OF THESE LESSONS LEARNED, STAFF AND INDUSTRY REVISED OVERALL LRA FORMAT. NEW FORMAT BEGINS WITH THE FARLEY LRA**

## **LESSONS LEARNED**

### **VERIFICATION OF CONSISTENCY OF APPLICANT'S AGING MANAGEMENT PROGRAMS WITH GALL AGING MANAGEMENT PROGRAMS**

**AMR INSPECTION WAS EXPANDED TO INCLUDE CONFIRMATION OF APPLICANT'S  
CLAIM OF AMP CONSISTENCY WITH GALL**

**PROVED TO BE EXCESSIVE BURDEN ON THE INSPECTION TEAM**

**PROCESS HAS BEEN REVISED TO HAVE CONFIRMATION OF CONSISTENCY  
PERFORMED BY HEADQUARTERS STAFF**

**NEW PROCESS BEGAN WITH ROBINSON LRA**

## **LESSONS LEARNED**

### **USEFULNESS OF GALL**

**STAFF FOUND THAT USE OF GALL PROVIDED FOR A MORE EFFECTIVE AND EFFICIENT REVIEW**

**HOWEVER, FURTHER PROCESS IMPROVEMENTS WERE IDENTIFIED**

**IMPLEMENTATION OF THE IMPROVEMENTS BEGAN WITH ROBINSON**

**FULL IMPLEMENTATION OF THE IMPROVEMENTS WILL BEGIN WITH FARLEY**

**STAFF EXPECTS TO SEE FURTHER EFFICIENCY AND EFFECTIVENESS GAINS WITH THE FARLEY REVIEW**

## **ENVIRONMENTAL REVIEW**

**STAFF'S EVALUATION DOCUMENTED IN NUREG-1437, SUPPLEMENT 12, "GENERIC ENVIRONMENTAL IMPACT STATEMENT FOR LICENSE RENEWAL OF NUCLEAR POWER PLANTS, SUPPLEMENT 12, REGARDING FT. CALHOUN STATION, UNIT 1," PUBLISHED ON AUGUST 15, 2003**

## **CONCLUSION**

**THE ADVERSE ENVIRONMENTAL IMPACTS OF LICENSE RENEWAL FOR FORT CALHOUN STATION, UNIT 1, ARE NOT SO GREAT THAT PRESERVING THE OPTION OF LICENSE RENEWAL FOR ENERGY-PLANNING DECISION MAKERS WOULD BE UNREASONABLE.**

**CONSIDERATION OF COMMISSION RULES AND REGULATIONS IN**  
**ADJUDICATORY PROCEEDINGS**

**NO REQUEST FOR HEARING OR PETITION TO INTERVENE WAS FILED FOR THE FCS LRA REVIEW**

**CONCLUSION**

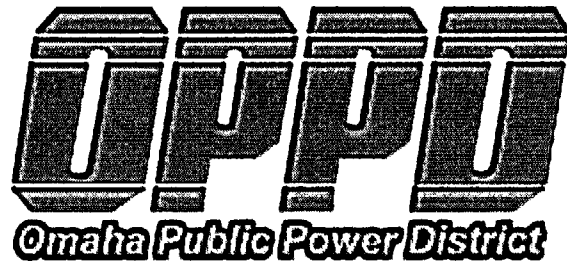
**REQUIREMENTS OF 10 CFR 2.758 HAVE BEEN MET**



## **STAFF CONCLUSION**

**THE APPLICANT HAS MET THE REQUIREMENTS FOR LICENSE RENEWAL, AS REQUIRED BY 10 CFR 54.29:**

- ACTIONS HAVE BEEN IDENTIFIED AND HAVE BEEN OR WILL BE TAKEN SUCH THAT THERE IS REASONABLE ASSURANCE THAT ACTIVITIES WILL CONTINUE TO BE CONDUCTED IN THE RENEWAL TERM IN ACCORDANCE WITH THE CURRENT LICENSING BASIS**
- THE APPLICABLE REQUIREMENTS OF 10 CFR PART 51 HAVE BEEN SATISFIED**
- MATTERS RAISED UNDER 10 CFR 2.758 HAVE BEEN ADDRESSED**



# Fort Calhoun Station Presentation to ACRS

October 1, 2003

# Presenters

Sudesh Gambhir – Division Manager,  
Nuclear Projects

Bernie Van Sant – License Renewal  
Project Manager

# Plant Operating Status

Sudesh Gambhir

10/1/03



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# Plant Operating Status

- Currently in refueling outage after breaker to breaker run (~468 days)
- All NRC Performance Indicators are Green
- NRC Problem Identification & Resolution Inspection completed May 8: no Green or higher findings
- Recognized for Industry Operating Excellence by INPO

# Strategy

**Vision: Keeping the Nuclear Energy  
Option Alive to 2033 and Beyond**

- C** - Critical self-assessments and broad and lasting corrective actions
- H** - Human performance is exemplary
- O** - Operations are event-free throughout the organization
- I** - Initiatives in high visibility areas have strong performance
- C** - Cost-effective producer of electricity
- E** - Excellence in materiel condition

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# Status of RCS Inspections and License Renewal Implementation

Bernie Van Sant

10/1/03



# Status of RCS Inspections

- Control Element Drive Mechanisms
  - No indications found in 2002 inspection
  - No indications found in 2003 inspection
- Reactor Vessel Head
  - No indications found in 2002 inspection
  - No indications found in 2003 inspection
  - More inspections planned for 2005
  - Replacement in 2006



# License Renewal Implementation

- 10 CFR 54.4 criteria met for in-scope safety related and non-safety related SSCs → Appendix B criteria applied
- Configuration control procedures being revised to meet 10 CFR 54.37 requirements for existing and new SSCs

# License Renewal Implementation

- LR Commitments
  - Listed in SER and to be in USAR
    - › New Programs
    - › Program Enhancements
    - › TLAA Evaluations
  - Identified and tracked using existing FCS regulatory commitment system
  - Implementing procedures annotated to flag commitments

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# License Renewal Implementation

- Training will be provided as part of procedure and other document revisions
- LR requirements will be ongoing and incorporated into documents, databases, and training for future plant staff

# Summary/Questions

10/1/03



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# **ADVISORY COMMITTEE ON REACTOR SAFEGUARDS**



## **NRC Research Addressing Materials Degradation**

**October 1, 2003  
Rockville, MD**

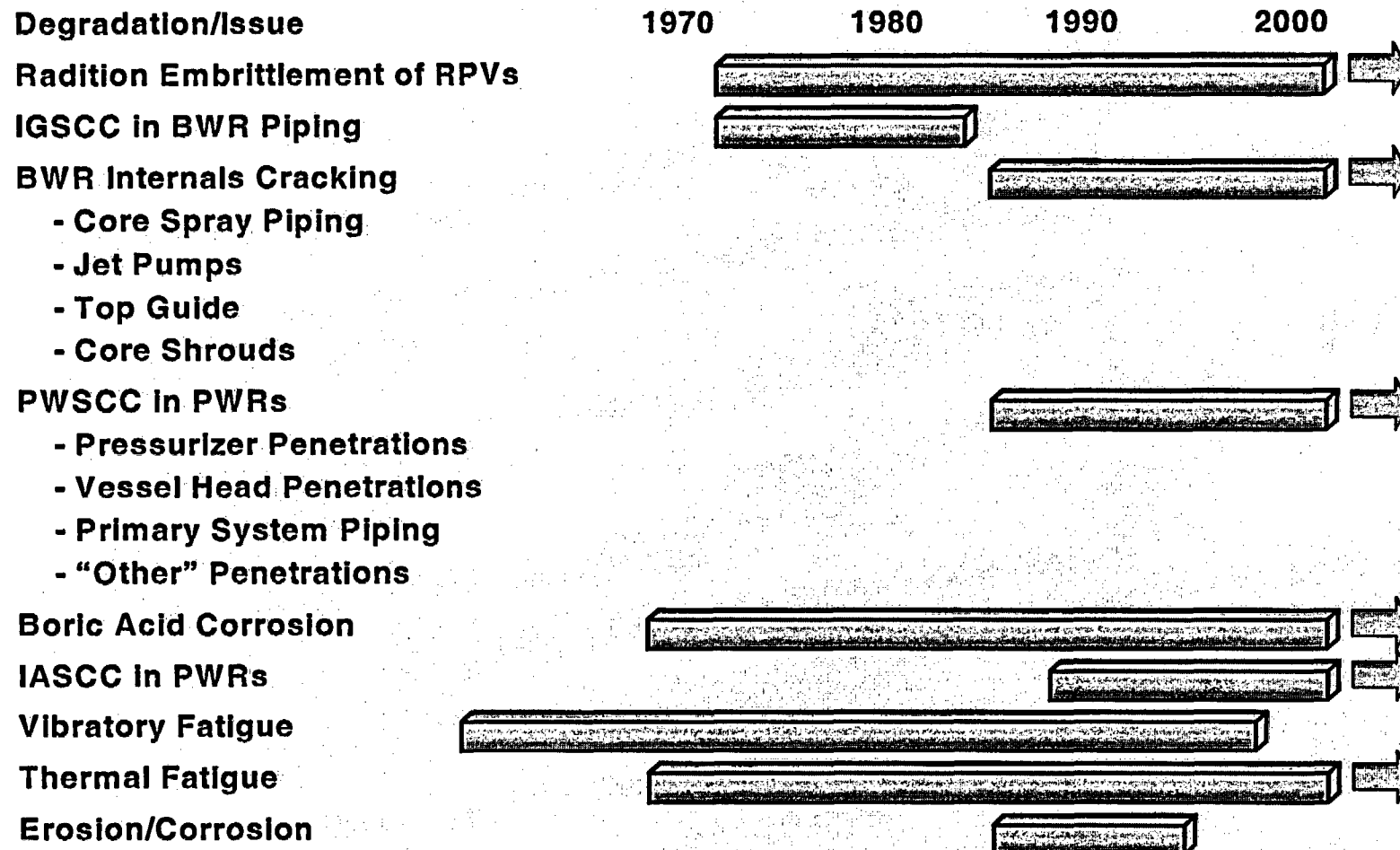
**US NRC Office of Nuclear Regulatory Research  
Division of Engineering Technology (DET)**

**M. E. Mayfield, Director, DET, (301) 415-5678  
J. Muscara, Senior Technical Advisor, (301) 415-5844  
W. H. Cullen, Jr., Senior Materials Engineer, (301) 415-7510**

## **RES' Materials Degradation Research Programs**

- **EAC research an important element of RES program since 1977**
- **Program has been adjusted over time to respond to current degradation issues**
  - **IGSCC**
  - **IASCC**
  - **Fatigue Life for Piping**
  - **Fatigue Crack Growth in RPV and Piping**
  - **Steam Generator Tube Degradation**
  - **PWSCC**
  - **Boric Acid Corrosion**
- **Recent emphasis on proactive research**

# **Sample of Significant Materials Degradation Issues In U.S. Nuclear Power Plants (Excluding Steam Generators)**



# **RES' Materials Degradation Research Programs**

## **■ Major Activities**

- **Environmentally-assisted Cracking in Light-Water Reactors**
- **Corrosion of Pressure Boundary Materials in Concentrated Boric Acid Solutions**
- **Examination of North Anna 2 Nozzles & J-Welds**

## **■ Other Tasks**

- **Vessel Penetration Conference – Sept. 29 – Oct. 2, 2003**
- **Alloy 600 Issues Task Group**
- **Formation of Int'l Coop Group on PWSCC and NDE**
- **Proactive Materials Degradation Initiative**



# **Reliability of NDE for In-Service Inspection**

- **Research on NDE Reliability was Initiated in 1977**
- **ISI Reliability and Code Requirements**
  - Evaluation of surface roughness effects
  - SCC in reactor internals
  - Evaluation of performance demonstration programs and results
  - Evaluation of parallel international research
- **Inspection of Cast SS, DMWs and Assessment of Advanced NDE Methods**
  - Determine the effectiveness and reliability of improved UT for coarse-grained material structures (cast & welded structures)
- **Continued Development of ISI Programs**
  - Assess improvements to ISI requirements and programs
  - Support ASME Code and industry activities
  - Development and assessment of NDE techniques for complex and tight cracks in stainless steels, nickel-base alloys, and dissimilar metal welds

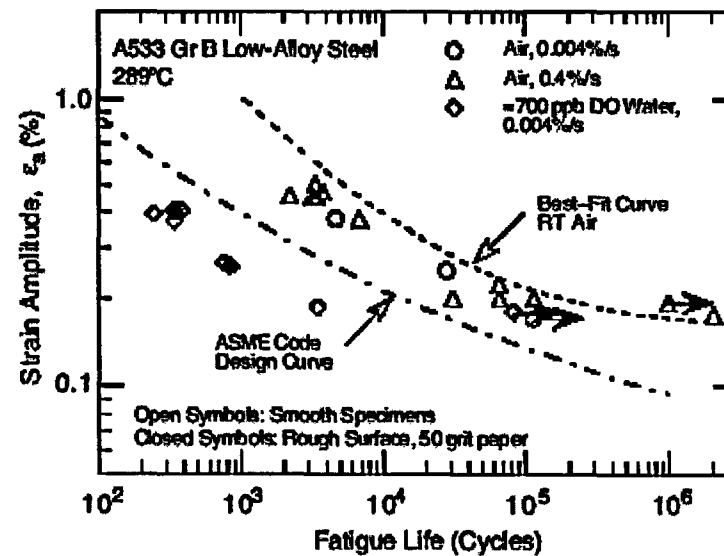
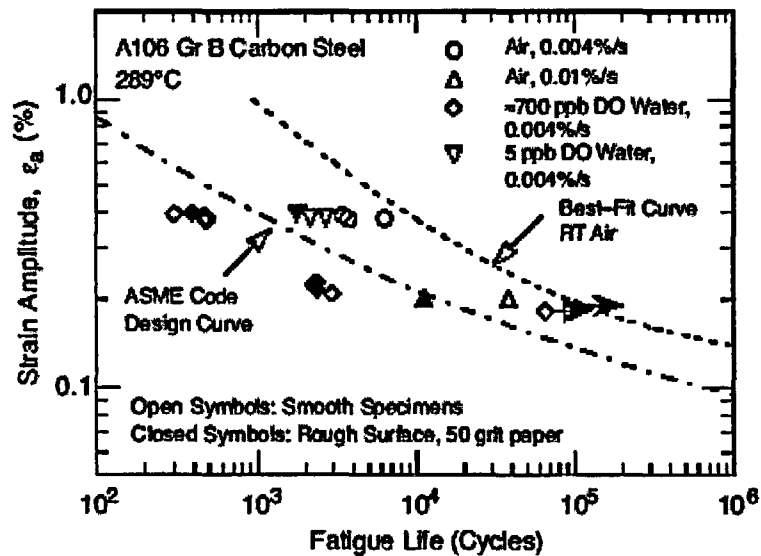
## **International Cooperative Project on PWSCC & NDE**

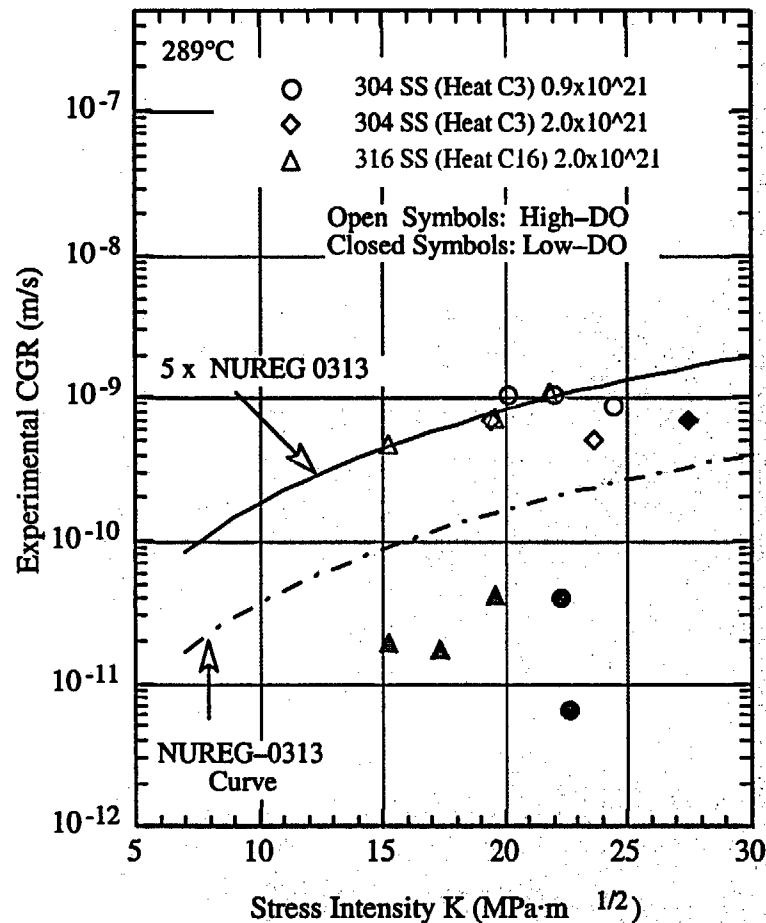
- **Cooperative project being developed**
  - **Significant international activities in this area**
  - **Opportunity to benefit from collaboration**
  - **Leverage a small budget**
- **Informal meetings held with potential participants from US, France, Sweden, Netherlands, etc.**
- **Information and kick-off meeting to be held at Vessel Head Penetration Conference, Oct. 1, 2003**

## **Elements of EAC in LWR Program at Argonne**

- **Fatigue Life Evaluation – PWR & BWR Environments**
  - Carbon and Low-Alloy Steels (NUREG/CR-6583)
  - Stainless Steels (NUREG/CR-5704, CR-6787)
- **IASCC for Stainless Steels in BWR & PWR Coolant Environments**
- **CGRs in Nickel-Base Materials**
  - Alloys 600, 182, 690, 152
    - Samples taken from former Davis-Besse Head
- **Code Committee/Rule Making Involvement**

# Degradation of Fatigue Life Due to Surface Roughness and Coolant Environment



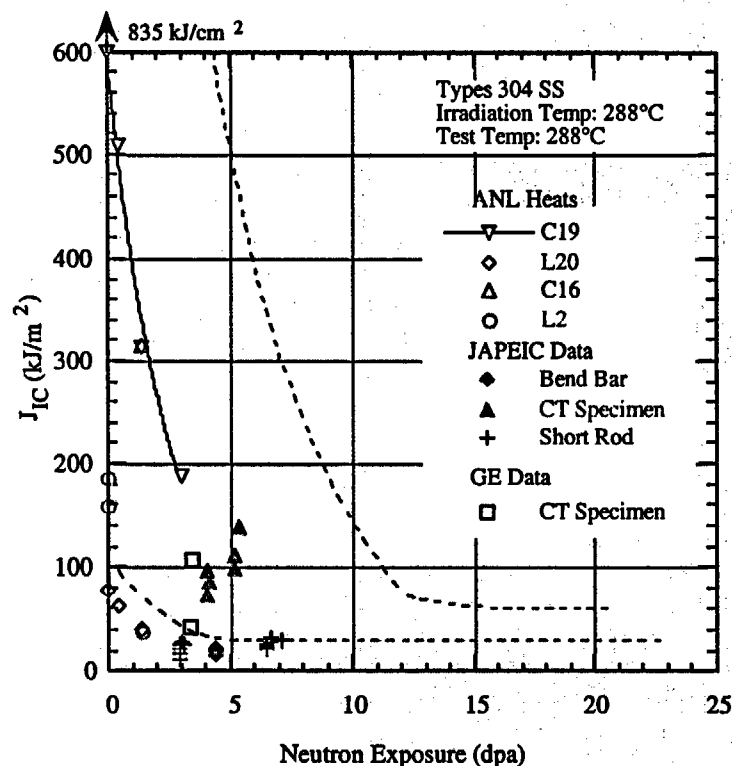


- In NWC BWR environment, CGRs from present study are a factor of  $\approx 5$  higher than NUREG 0313 curve for austenitic SSs
- CGRs decreased by more than an order of magnitude in low-DO water
- Decrease in DO appears to have no effect on CGRs of Heat C3 Irradiated to  $2.0 \times 10^{21}$  n/cm<sup>2</sup>

## **Summary of IASCC Effects for Stainless Steels (BWR Coolants)**

- **CGR data have been obtained under gentle cycling and constant load in simulated BWR environments for Type 304 & 316 SS irradiated up to  $2.0 \times 10^{21}$  n/cm<sup>2</sup> (3.0 dpa) at 288°C**
- **In NWC BWR environment, CGRs of irradiated steels are a factor of  $\approx 5$  higher than NUREG 0313 curve for non-irradiated austenitic SSs**
- **In low-DO BWR environments, CGRs of irradiated steels are decreased by more than an order of magnitude; beneficial effect of decreased DO level not observed for Type 304 SS Heat C3 irradiated to  $2.0 \times 10^{21}$  n/cm<sup>2</sup>**

# Degradation of Fracture Toughness of Stainless Steels Due to Irradiation Damage



■ Fracture toughness J–R curve data obtained on several heats of austenitic SSs irradiated to  $\approx 0.3$ , 0.9, and  $2.0 \times 10^{21}$  n/cm<sup>2</sup> (0.45, 1.35, & 3.0 dpa) at 288°C

■ Neutron irradiation at 288°C decreased the toughness of all steels

- commercial steels exhibit superior fracture toughness
- poor toughness of laboratory heats reflected in their fracture behavior

■ The results for commercial heats falls within the scatter band for data obtained from higher temp irradiations

## **Planned Research on IASCC Effects for Stainless Steels (PWR Coolants)**

- **Irradiations to 4 dose levels: 5, 10, 20 & 40 dpa**
  - **In BOR-60 reactor, at ~300°C (5 & 10 dpa doses completed)**
- **Examination of C, S & O effects in commercial and model 304, 316, 347, 348 & cast stainless steel**
- **SCC, tensile, shear-punch tests**
- **Microstructural characterization (precipitates, RIS, grain boundary chemistry)**
  - **Characterization of crack tip chemistry**
- **Development of quantitative modeling and IASCC projections for PWR coolant environments**



## **Sept. '03 Conference on CRDM and related Issues**

### **■ Five main session topics**

- **Structural Analysis and Fracture Mechanics Issues**
- **Inspection technologies, disposition & sizing of flaws, new developments**
- **Crack growth rates for relevant nickel-base alloys & welds**
- **Mitigation & Foreign Experience**
- **Continued Plant Operation**

### **■ Sept. 29 – Oct. 2 At Gaithersburg-Marriott**

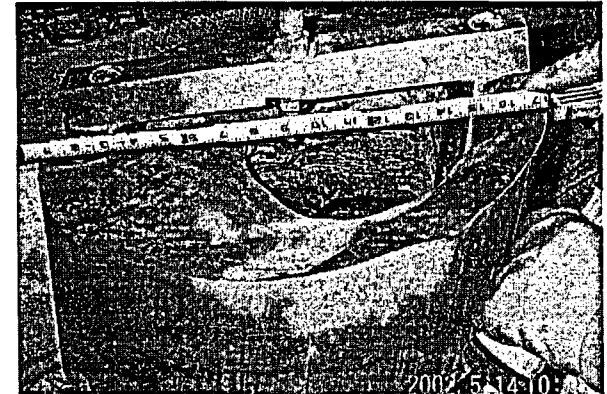
### **■ 220 attendees (11 countries) & participants**

### **■ Proceedings issued as CD and NUREG/CP**

## Harvesting of Head for Additional Research

### ■ Nozzle #3 and surrounding low-alloy steel at BWXT-Lynchburg

- Optical & SEM Microscopy of Cavity Surface
- Cladding Properties, Microstructure, etc.



### ■ Nozzles #2 and #46 - removed in June

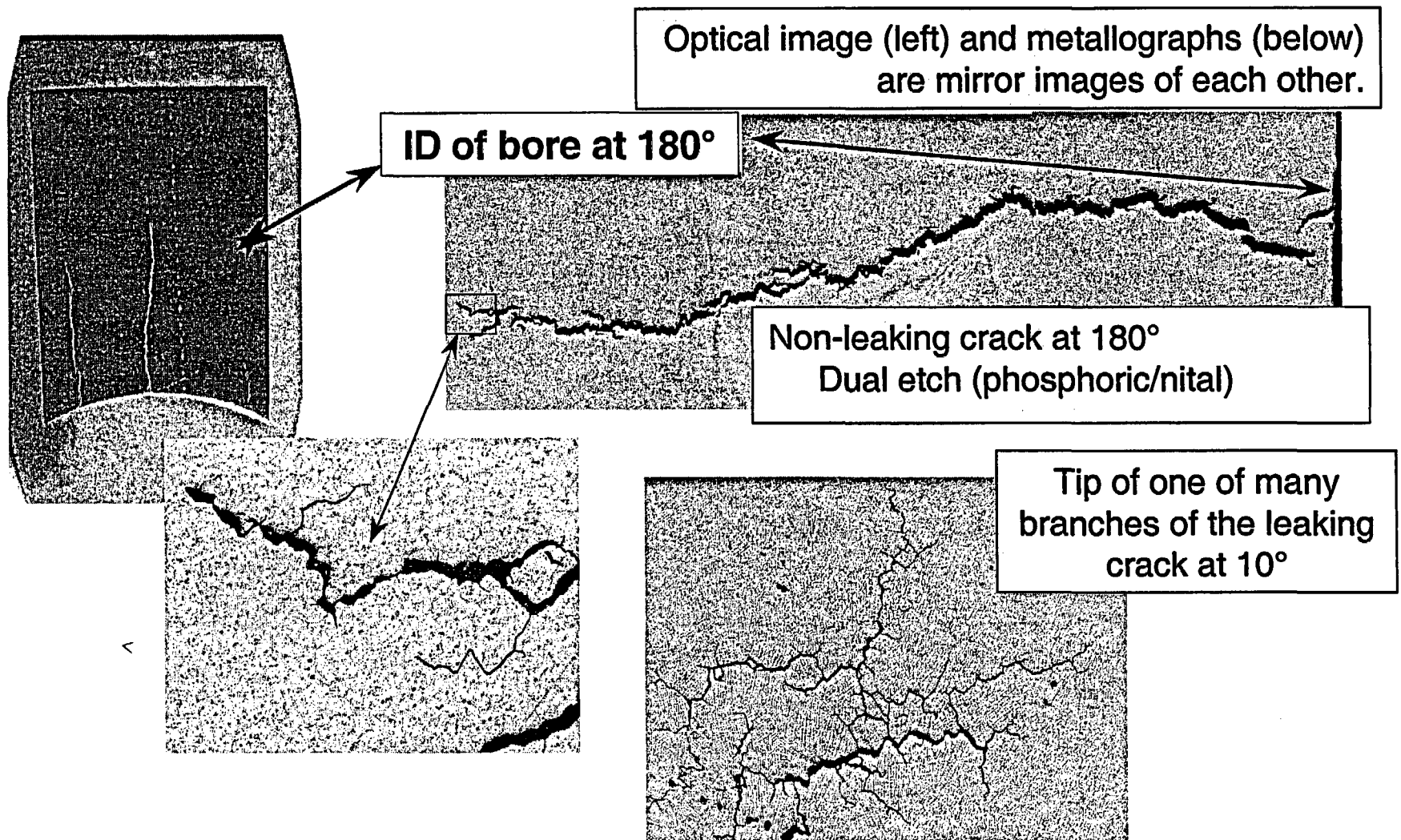
- Sent to PNNL for exam of cavity and research on “anomalous” UT indications
- Additional nozzles for crack growth rate testing

### ■ Crack Growth Rate Testing of Alloy 600 (Nozzle #3) and Alloy 182 (J-weld, from Nozzle #11) soon underway

### ■ North Anna Unit 2 Head Being Harvested by Industry

- NRC/Industry Coordination of NA2 Research
- Program combines NDE, stress analysis and SCC studies

## Character of PWSCC cracks in J-weld of Nozzle #3



## **Content of New Boric Acid Corrosion Research Program**

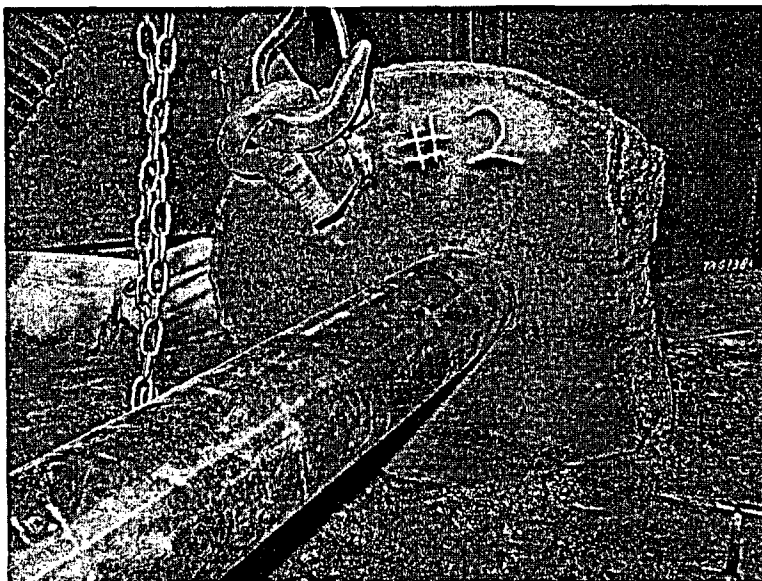
- **1. Crack Growth Rates of Alloys 600 & 182 from Davis-Besse Head**
  - **Specimens Fabricated, Supporting Tests underway, complete by 12/03**
- **2. Computational Model, Probabilistic Assessment of:**
  - **Statistics of Initiation, Probability of Detection & Accuracy of Sizing**
  - **Crack Growth Rate Variations, Stress Intensity Factor Gradients**
  - **Electrochemical Potential and Polarization Measurements of Low-Alloy Steel, Alloys 600 & 182 in Concentrated Boric Acid Solutions**
- **Measure  $E_{cp}$  and wastage rates for range of solution compositions, temperatures & pressure boundary materials**
  - **Tests at boiling point temps. nearly complete**

## **Status of North Anna 2 Discarded Head Exams**

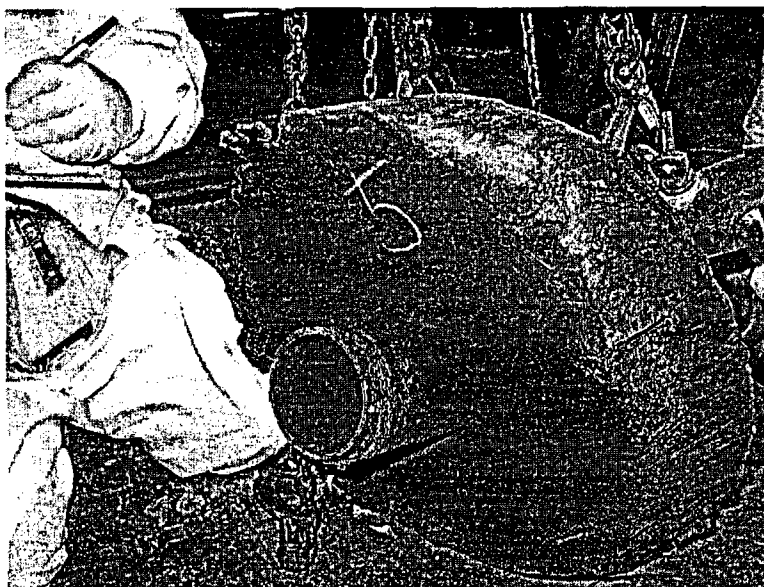
- **Part of NRC/Industry Collaboration on Alloy 600 Issues**
- **Seven nozzles removed in late June, shipped to PNL**
- **Several NDE teams will re-examine nozzles for:**
  - **Confirmation of flaw indications**
  - **Laboratory-based level of exam – compare to field results**
  - **Independent exam by NRC contractor**
- **Destructive exams to follow**
  - **Confirmation of defects, types of cracking**
    - **PWSCC, TGSCC, fatigue (?), how initiated**
    - **Leak paths (or absence thereof !)**
    - **Materials for crack growth studies, residual stress analysis**

## Salvaging of nozzles from North Anna 2's Discarded Reactor Head

**Nozzle #31**



**Nozzle #59**



# **Materials Degradation Management**

```
graph TD; A[Materials Degradation Management] --> B[Management of Identified Degradation]; A --> C[Evaluation of New Materials, Inspection Procedures and Techniques, New Degradation Mechanisms]; A --> D[Evaluation of Repair and Mitigation Strategies];
```

**Management of  
Identified  
Degradation**

**Evaluation of New Materials,  
Inspection Procedures and  
Techniques, New Degradation  
Mechanisms**

**Evaluation of Repair  
and Mitigation  
Strategies**

## **Proactive Materials Degradation Initiative**

- Identify materials and locations where degradation can reasonably be expected in the future
  - PIRT-like process
- Review and evaluate inservice inspection and continuous monitoring techniques for the detection, characterization, and evaluation of degradation
- Review and evaluate techniques that could ameliorate the stressors to mitigate or prevent the expected degradation
  - Identify where developments are needed
- Review and evaluate existing or new materials for replacement in components where degradation is expected
- Review and evaluate repair and replacement techniques for the materials and components of interest, and identify where developments are needed
- Review and study potentially new degradation mechanisms
- Industry and international interaction



# AP1000 Design Certification Status



October 1, 2003  
ACRS Briefing

**Joseph Colaccino, Senior Project Manager**  
Office of Nuclear Reactor Regulation

# NRC Current Review Status

- Issued DSER on June 16, 2003, with 174 Open Items
  - 24 Open Items Considered Resolved
  - 36 Open Items Require Verification of Westinghouse DCD and/or Open Item Response Changes to Consider Resolved
  - Additional Questions Provided to Westinghouse (Materials, Boron Concentration)
- Progress of Supplemental DSER Reviews
  - Wind and Tornado Loadings (3.3): Open Item Resolution in Progress
  - Leak-Before-Break (3.6.3.4): Public Meeting Scheduled 10/02/03
  - Security (13.3): Review in Progress
  - Initial Test Program (14.2): Questions Provided to Westinghouse
  - Testing and Computer Code Evaluation (21): Documentation In Progress
- Significant Technical Issues
  - Reactor Systems (Liquid Entrainment, LTC, Core Swell, and Boron Precipitation)
  - Structural/Seismic (Containment Design and Basemat Uplift)
- Schedule for Final Safety Analysis Report: September 2004
  - Reassess Schedule after completion of October 2, 2003, Reactor Systems Meeting and October 6-10, 2003, Structural/Seismic Audit



**AP1000 Design Certification Status Review**  
**Westinghouse Electric Company**

*Presentation to*  
**Advisory Committee on Reactor Safeguards**

October 1, 2003



## Today's Agenda

- **AP1000 Overview**
- **Design Certification Status**
- **Technical Presentations Requested by ACRS**
  - ADS-4 Squib Valve Reliability
  - AP1000 Post-LOCA Aerosol Deposition Calculation



## AP1000 Design Features - Same as AP600

AP1000

- Retain AP600 Design Detail and Design Maturity
- Retain AP600 Basis for Cost Estimate, Construction Schedule and Modularization Scheme
- Integrated Power Plant Design
- Simplified RCS Loops with Canned Motor Pumps
- Simplified Passive Safety Systems
- Microprocessor, Digital Technology Based I&C
- No Requirement for Safety Related AC Power
- Compact Control Room, Electronic Operator Interface
- Optimized Plant Arrangement
  - Construction, Operation, Maintenance, Safety, Cost
- Extensive Use of Modular Construction
- No Plant Prototype Required



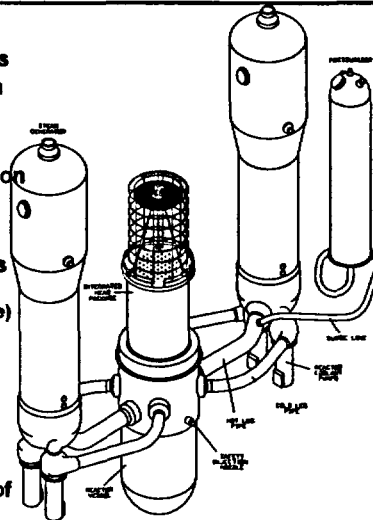
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## Proven AP1000 Reactor Coolant System

AP1000

- Proven Reactor Design/Fuel
  - Similar to Doel 4, Tihange 3, S. Texas
  - No bottom-mounted instrumentation
  - Improved materials - 60 yr. life
- Steam Generators -  $\Delta 125$ 
  - Similar to large W/CE SGs in operation
  - System 80; ANO RSG
- Reactor Coolant Pump
  - Canned motor pumps, no shaft seals
  - Naval reactors, early commercial reactors (Shippingport; Yankee Rowe)
- Simplified Main Loop
  - Reduces welds 50%
- CRDM, Reactor Vessel and Internal
  - Typical Westinghouse design
- Pressurizer
  - 50% larger than operating reactors of similar power rating



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## AP1000 Approach to Safety

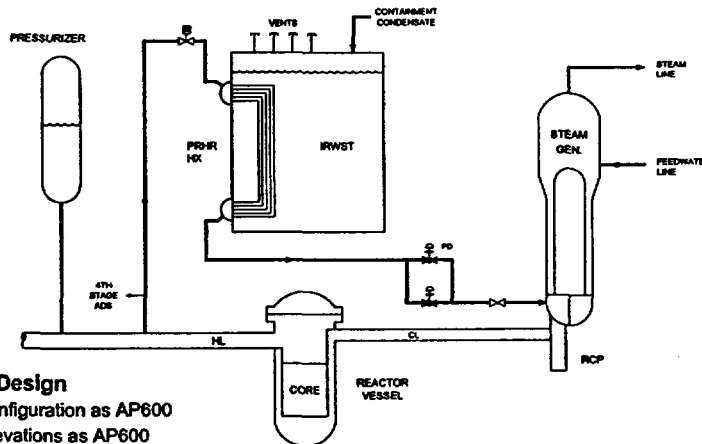
### • Passive Safety-Related Systems

- Use "passive" process only, no active pumps, diesels, ....
  - One time alignment of valves
  - No support systems required after actuation
- Reduced dependency on operator actions
- Mitigate design basis accidents without nonsafety systems
- Meet NRC safety goals without use of nonsafety systems

### • Active Nonsafety-Related Systems

- Reliably support normal operation
  - Redundant equipment powered by onsite diesels
- Minimize challenges to passive safety systems
- Not required to mitigate design basis accidents

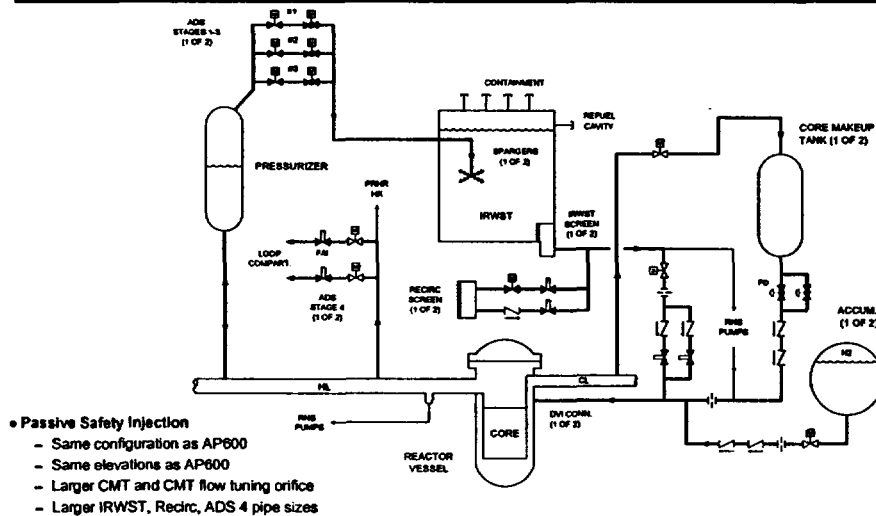
## AP1000 Retains AP600 Passive Decay Heat Removal System



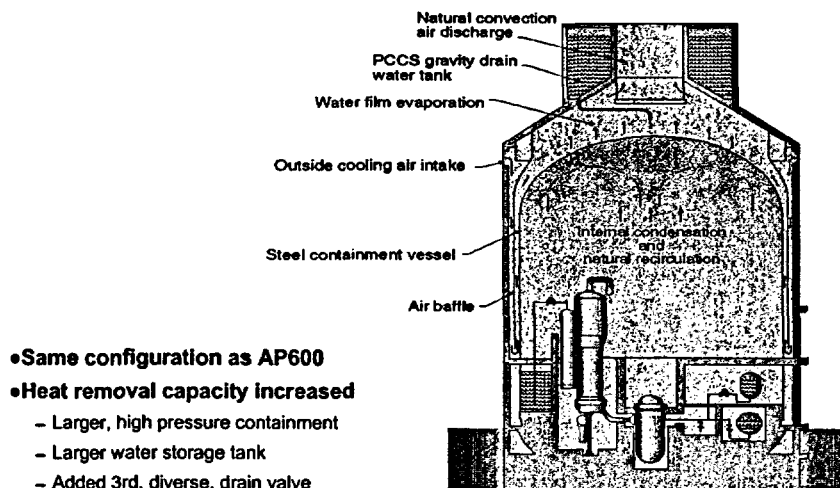
### • PRHR HX Design

- Same configuration as AP600
- Same elevations as AP600
- Larger pipe sizes (14-inch vs 10-inch)
- Increased HX surface (more / longer horizontal tubes)

## AP1000 Passive Safety Injection

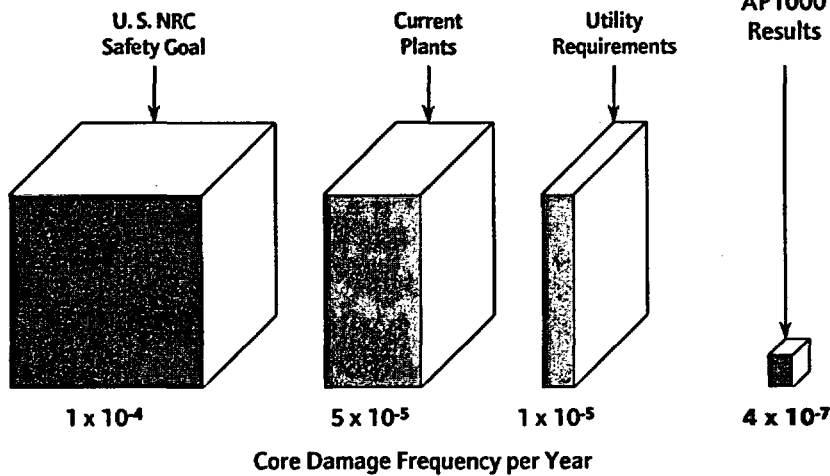


## Passive Containment Cooling System



## AP1000 Provides Safety and Investment Protection

AP1000



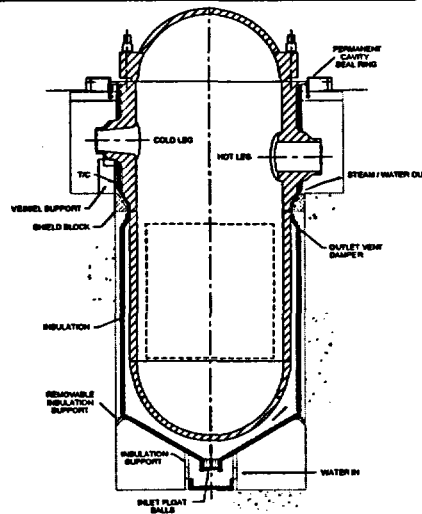
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AP1000

## Severe Accidents Addressed

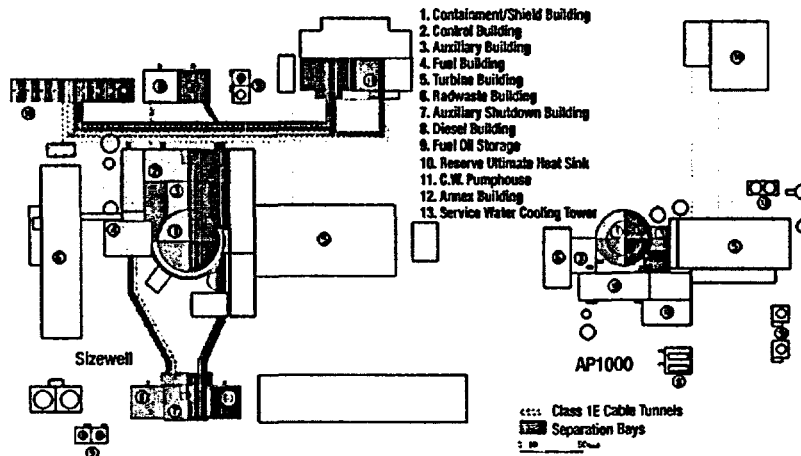
- **In-vessel Retention**
  - Ex-vessel cooling
  - Provides reliable means of cooling damaged core
  - AP600 tests and analysis of IVR reviewed by U.S. NRC - additional tests for AP1000 completed
  - Prevents core-concrete interaction
- **High Pressure Core Melt**
  - Eliminated with ADS
- **Hydrogen Detonation**
  - Prevented by igniters and passive autocatalytic recombiners
- **Steam Explosions**
  - ADS eliminates high pressure
  - IVR eliminates low pressure



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## Physical Comparison Sizewell/AP1000



## Design Certification Schedule

### Past Milestones

	Target Schedule	Status
1. AP1000 Pre-Certification Review	12/01 - 3/02	<input checked="" type="checkbox"/>
2. W Submits DCD Application (DCD / PRA)	3/28/02	<input checked="" type="checkbox"/>
2. Staff Issues All RAI	9/30/02	<input checked="" type="checkbox"/>
3. W Provide Responses to All RAI	12/2/02	<input checked="" type="checkbox"/>
4. NRC Identify Potential DSER Open Items	2/28/03	<input checked="" type="checkbox"/>
4. W Addresses Potential DSER Open Items	4/15/03	<input checked="" type="checkbox"/>
5. NRC Issues DSER	6/16/03	<input checked="" type="checkbox"/>

DSER Contains 174 Open Items - AP600 had over 1300 at DSER Stage

6. ACRS Future Plant / T&H Subcommittee Meetings	7/03	<input checked="" type="checkbox"/>
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Westinghouse / NRC have been working to resolve DSER Open Items

Approximately 60 Technically Resolved





## Draft Safety Evaluation Report

- **Key Issues Identified in DSER**

- Thermal-hydraulic issues associated with SB LOCA
- Structural design of nuclear island critical structures
- Acceptance of LBB for AP1000
- Miscellaneous PRA items
  - RTNSS uncertainty sensitivity study, squib valve reliability
- Sump performance
- Security
- Dose analysis
  - Control room X/Q, Post-LOCA aerosol deposition
- 10 CFR 50.44
- Miscellaneous ITAAC items



## SBLOCA and LTC Open Items

- **Upper Plenum and Hot Leg Entrainment during SBLOCA**
- **WCOBRA/TRAC Modeling for Long Term Cooling**
- **Boron Precipitation during Long Term Cooling**



## OSU Testing Performed to Address Entrainment Issues

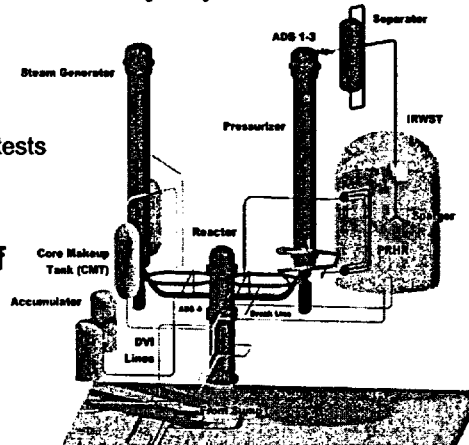
- **APEX-1000 Testing at Oregon State University**

- Facility Description Report
- Scaling Report
- Test Reports/Data for five tests
- Tests behavior same as APEX-600

- **NOTRUMP Simulation of APEX-1000 Tests**

- Simulations show good agreement
- No core uncover for DBA tests

The APEX Testing Facility



## Entrainment Open Item

- **Bounding AP1000 sensitivity studies performed**
  - NOTRUMP analysis to assess the effect of using a homogeneous flow assumption for the flow from core exit through the ADS4 lines
  - No core heatup
- **Validation of level-swell model**
  - Validation of core void fraction correlation used in NOTRUMP relative to full scale bundle test data
- **First principles analysis (Simple Model) completed**
  - Assess integrated system equilibrium condition during ADS4/IRWST transition period
    - sensitivity to distribution parameter  $C_0$  for core void equation
    - sensitivity to slip ratio for flow from core exit through ADS4



## Entrainment Open Item Resolution

- NRC Requested Additional Test Data to Support Resolution of Entrainment Issue
- APEX-1000 Tests Completed
- NOTRUMP Validated Against APEX-1000 Tests
- Sensitivity Analysis and Simplified Model Supports Predicted Safety Performance
- NOTRUMP AP1000 DCD Analysis Confirmed



## WCOBRA/TRAC LTC Model Open item

- Additional Information provided to address this item:
  - Validation of WCOBRA/TRAC level swell prediction relative to full scale bundle tests
  - More detailed WCOBRA/TRAC model for AP1000 Long Term Cooling analyses
    - Model description
    - Results with more detailed model incorporated in Chapter 15



## Boron Open Item

- **Additional Information provided to address this item:**
  - WCOBRA/TRAC LTC analysis for decay heat level at 14 days after LOCA
  - First principles analysis to assess amount of liquid flow through ADS4 in long term
    - Comparison to WCOBRA/TRAC result
  - Calculation of core boron concentration and core inlet temperature as a function of time during long term cooling

## Status of T/H Open Items

- **NRC provided 30 follow-on questions on 9/16/03 and these were discussed with Westinghouse in a telecon to reach an understanding of how each will be addressed**
- **Responses to 27 of the 30 questions have been submitted**
- **Staff/Westinghouse Meeting tomorrow to further develop basis for addressing these questions and reaching resolution**

## AP1000 Final Safety Evaluation Report

- **Westinghouse & NRC Must Resolve Remaining DSER Open Items**
  - Upcoming meetings scheduled
    - T&H meeting at NRC 10/2/03
    - LBB meeting at NRC 10/2/03
    - Structural audit at Westinghouse 10/6/03 - 10/10/03
- **NRC Completes Supplemental DSER**
- **ACRS Letter Required for FSER**

Original NRC Schedule for FSER - September 2004  
NRC to issue schedule with key milestones after upcoming meetings



## Background

- **ACRS Requested Additional Justification of ADS 4 Squib Valve Reliability Assumed in AP1000 PRA**
- **Today's Discussion**
  - Squib valve design [valve vendor, CONAX]
  - Squib valve reliability [West. PRA]
    - Independent reliability evaluation [Sandia]



## ADS 4 Valve Type Selection

### • Squib Valves Were Selected for ADS Stage 4

- Very reliable to open on demand (better than AOVs, MOVs)
- Ability to add independent actuation circuits (use 2 PMS, 1 DAS)
- Diverse from ADS stage 1/2/3 MOVs
- Very low chance of inadvertent opening
- Zero leakage during normal operation
- Simplified IST, ISI, maintenance
- Reduced capital cost
- Reduced development costs / uncertainties
- Compact size, weight
- Supported by U.S. utilities

## AP1000 Squib Valve Actuation Circuits

### • SUMMARY

- ADS 4 actuation circuits are highly-reliable to actuate
  - 3-way redundant (2 PMS divisions and DAS for each ADS 4 valve)
  - 2-way diverse (PMS/DAS)
- ADS 4 actuation circuits have low probability of spurious actuation
  - 2-out-of-4 voting for automatic actuation
  - Squib valve controller circuit minimizes likelihood of hot short causing spurious actuation
    - Energize-to-actuate
    - Two-pole, ungrounded
    - Controller has no power during normal operation
    - In containment, no adjacent cables have sufficient energy for actuation

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# SQUIB VALVE

**Dan Frederick**  
**Vice-President Engineering**

**CONAX florida**  
*A Cobham plc company*

Page 1

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## BACKGROUND

- General Electric large squib valve design for SBWR
  - Requested bids from 7 established valve vendors
  - Squib valve (Pyronetics) judged best design
    - Scale up from 2" to 7"
    - GE surveyed Pyronetics customers
    - General Electric concluded OEA Pyronetics was capable of designing, manufacturing and testing squib valves (7" ID)
  - Valves were built and successfully tested
- Westinghouse application of Pyronetics for Squib Valves
  - AP600 ADS 4 is same ID as GE valve
  - AP1000 ADS 4 requires larger ID (9" vs 7")

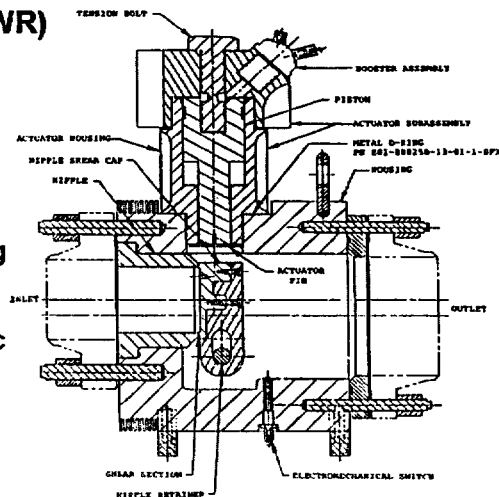
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Page 2

## ADS SQUIB VALVE DESIGN

### Testing Performed (SBWR)

- Acceptance Tests
- Closed Bomb Tests
- Lab Sample Tests
- Radiation Testing
- Accelerated Thermal Aging
- Reliability Testing
- Seismic and other dynamic loads evaluated
  - Vibration testing
  - Actuation / Flow



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## HIGH RELIABILITY REQUIRED

- Our customers require high reliability
  - Life Support programs
  - Aerospace programs
  - Consequences of failures are high
- Conax procedures control high reliability
- Custom Valve Designs / Up-Scaling is Standard Process
  - Simple valve design reduces problems
  - Development process delivers highly reliable valves
- UPCO reliability of:
  - .999568 at 90% confidence
  - .999437 at 95% confidence
  - Valves manufactured: 64,690
  - Total quantity fired: 5,324
- Conax reliability of:
  - .9998169 at 90% confidence
 Based upon:
  - Total Initiators > 25,000
  - Valves manufactured: >25,000

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## ***HIGH RELIABILITY BUILT IN***

### **Design / Analysis**

- Past experience with similar products (lessons learned)
- Design analysis of new design
- Examination and analysis of drawings
- FMEA
- Reliability analysis

### **Testing**

- Development and prototypes units
- Margin testing (over and under loaded boosters)
- Acceptance and qualification
- On propellants (powder form and in initiators and booster)

**Quality Assurance:** ISO 9001 Certification

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## ***ADS SQUIB VALVE DESIGN SUMMARY***

- Squib valves have high inherent reliability
  - Reliability for smaller valves applicable for larger valves
    - Same design standards established
      - > Engineering Analysis
      - > Proof and Leak Testing
      - > Over and under loaded boosters used during testing
      - > Design concept similar (shearing material) in all cases.
      - > No failures associated with shear section cracking under constant high pressure and temperature

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## **Reliability of Squib Valves in AP1000 Design**

**Selim Sancaktar**  
Fellow Engineer  
Reliability and Risk Assessment



## **Squib Valve Reliability Evaluation**

**Center for System Reliability**  
**Sandia National Laboratories**

**Ruby Lathon, Ph.D.**  
Senior Member of the Technical Staff



## Sandia Evaluation

- Why Sandia National Laboratories?
  - Sandia has successfully developed & tested thousands of squib valves
  - Sandia has produced numerous high reliability squib valves for use in nuclear weapons
  - Sandia has extensive experience and expertise in the design and reliability of pyrotechnically actuated valves
- AP1000 Evaluation
  - AP1000 Functional Requirements
  - CONAX proposed ADS-4 Squib Valve Design
  - Available Valve Reliability Data



## Valve Test Data (2002)

MC No.	System	Development Tests	Product D-Tests		Stockpile Evaluation	
			Lot No.	No.	NMLT/SLT	NMFT/SFT
3006	W76	143	110	554	192	126
3205	W79	354	45	318	311	83
3206	W79	194	33	210	164	88
3294	B83	97	72	162	47	85
3784			37	79	1	
3295	B83	41	45	113	47	101
3297	B83	70	14	227	47	101
3785			40	422		
3298	B83	65	38	176	48	60
All †	W84	60		604	311	80
3570	W87	59	40	87	119	54
4232			13	46		
4241	W87	0	33	59	37	14
	<b>TOTALS:</b>	1083		3057	1324	792
<b>GRAND TOTAL WITHOUT DEVELOPMENT TESTS =</b>						<b>5173</b>

No Observed Failures

Current Failure Rate Assessment : 0.00013

† Includes 4 valves: MC3425/A, MC3427/A, MC3428/A, MC3604/A



## Conclusions

- The AP1000 valve design is a basic design that has been used extensively for many smaller squib valves.
- Existing fleets of smaller valves have been successfully utilized in similar and harsher environments than that proposed for use in the AP1000.
- Evaluations by subject matter experts indicate that reliability information from smaller valves has applicability to larger valves when scaling the design.
- Given that standard mechanical engineering design practices are followed, the reliability performance of the larger valve will be consistent with that of smaller valves.



WESTINGHOUSE NON-PROPRIETARY CLASS 3

AP1000

## Summary of Reliability Data

- The following data is used either for AP1000 failure to open calculations or is obtained recently:

Source	Failure to Open on demand
EPRI	3.0E-03 *
Sandia 1	2.0E-04
Sandia 2	3.2E-04
AP600 & AP1000 PRA	5.8E-04 (calculated from above)
UPCO	4.32E-04
Conax	1.83E-04
Sandia(2002)	1.30E-04

\* - EPRI data is based on MOV failure probability from NUREG/CR-4550



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## PRA Sensitivity to Squib Valve Reliability

- If the Squib valve failure probability (FTO) is doubled, then the plant CDF for internal events at power goes from  $2.41\text{E-}07/\text{yr}$  to  $2.77\text{E-}07/\text{yr}$  - a 15% increase
- The contribution of spurious ADS opening initiating event to plant CDF is 12.3%. If the spurious opening of ADS failure probability is doubled, the plant CDF will increase by 12.3%
- The importance of ADS Squib valves in AP1000 plant risk is recognized and design and operational precautions are already built in to assure their reliability

## Conclusions

- Recent information obtained from different sources support the AP1000 PRA treatment of the ADS 4 squib valves
  - Failure probabilities used for squib valves in AP1000 PRA are reasonable
    - Are consistent with operating experience
    - Are expected to be achievable for the AP1000 squib valves
  - Up-scaling of squib valves would not negatively affect their historical high reliability
  - Operational environment is not seen as an important contributor to valve failure probability
  - The conclusions of the AP1000 PRA with respect to spurious failure of ADS 4 squib valves are valid

## AP1000 Post-LOCA Aerosol Deposition

James H. Scobel  
Containment and Radiological Analysis  
412-374-5030 scobeljh@westinghouse.com



## AP1000 and AP600 Comparison

- **AP1000 has, compared to AP600:**
  - 75% higher thermal power.
  - 20% larger containment by volume.
  - 75% more aerosol mass.
- **Expected results, compared to AP600:**
  - Higher diffusio- and thermophoresis due to higher heat transfer to containment shell.
  - Similar sedimentation due to similar concentration and well-mixed assumption (conservative).
  - As a result, higher containment lambda.





## Calculation Procedure

- **Select the AP1000 sequence**
  - high frequency in PRA
  - timing that is similar to the NRC specified RG 1.183 timing for PWR fission product release.
- **Containment thermal hydraulic conditions: MAAP4 code.**
- **Containment aerosol removal rates: Polestar QA code STARNAUA.**
- **STARNAUA**
  - documented and benchmarked against experiment,
  - applied as part of AP600 design certification,
  - recently been applied to numerous operating plant DBA alternate source term aerosol calculations



## Accident Sequence Definition

- **Dominant core damage sequence from PRA**
  - Break in a direct vessel injection line (fails 1 train of passive injection)
  - Full RCS depressurization
  - failure of gravity injection
  - successful cavity flooding and in-vessel retention of core debris
  - vessel reflooding through break
  - hydrogen igniters
- **Severe accident environment generated with MAAP4**
  - conservative conditions for lambda calculation
  - methodology used for AP600 Environment for Lambda calculation

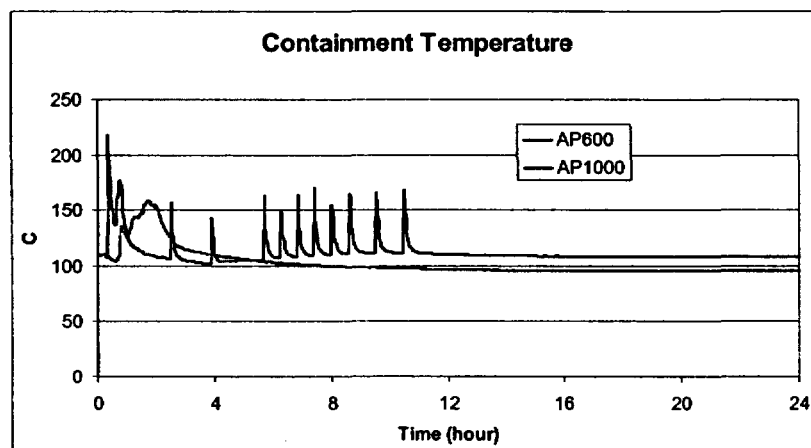


## T&H Parameters for Lambda Calculation

### • NAUA code T&H input parameters

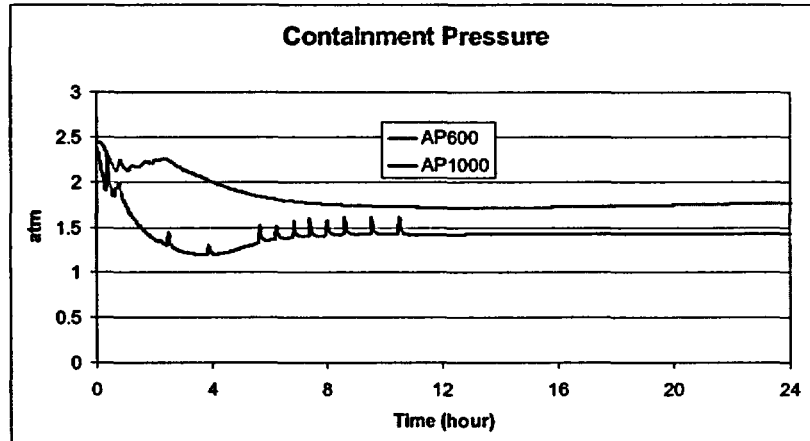
- containment pressure
- containment gas temperature
- containment steam mole fraction
- condensation rate on heat sinks
- total heat transfer to heat sinks

## T&H Parameters for Lambda Calculation

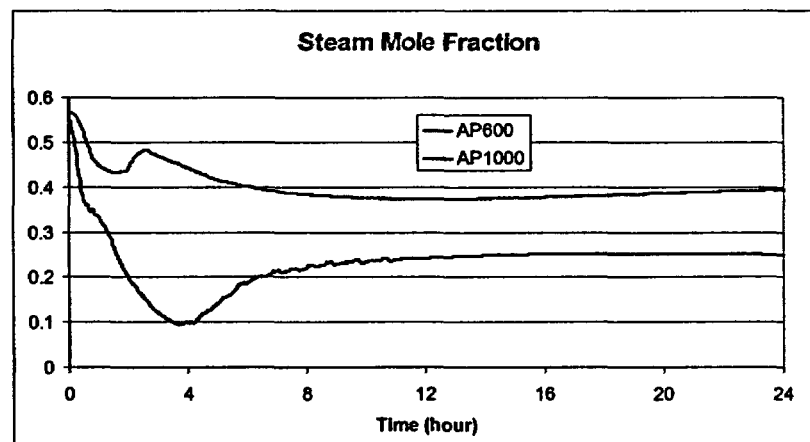




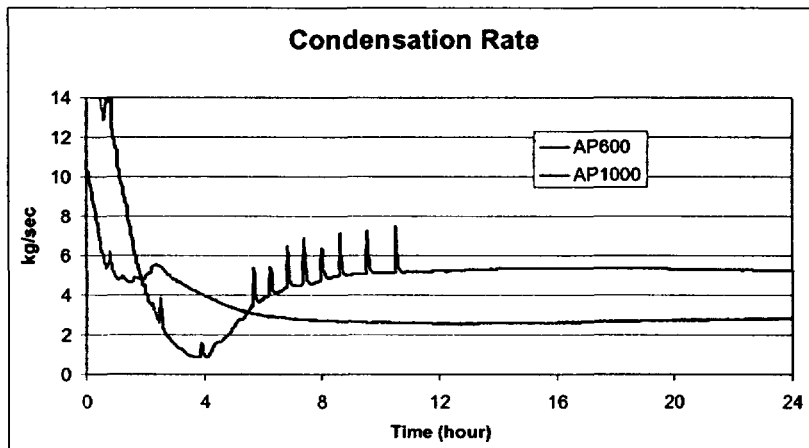
## T&H Parameters for Lambda Calculation



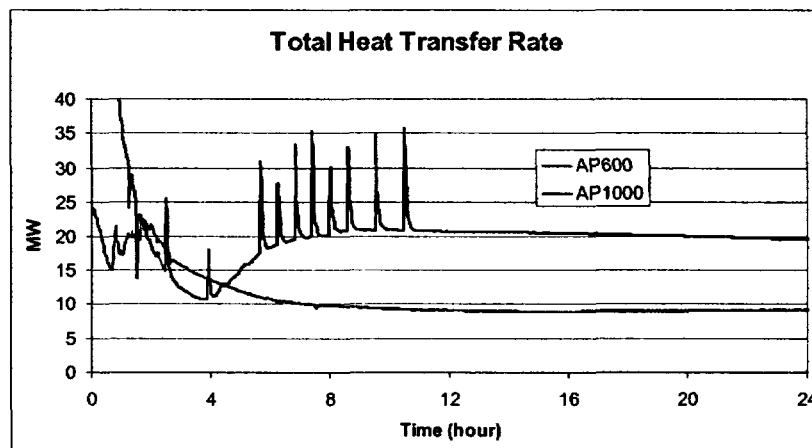
## T&H Parameters for Lambda Calculation



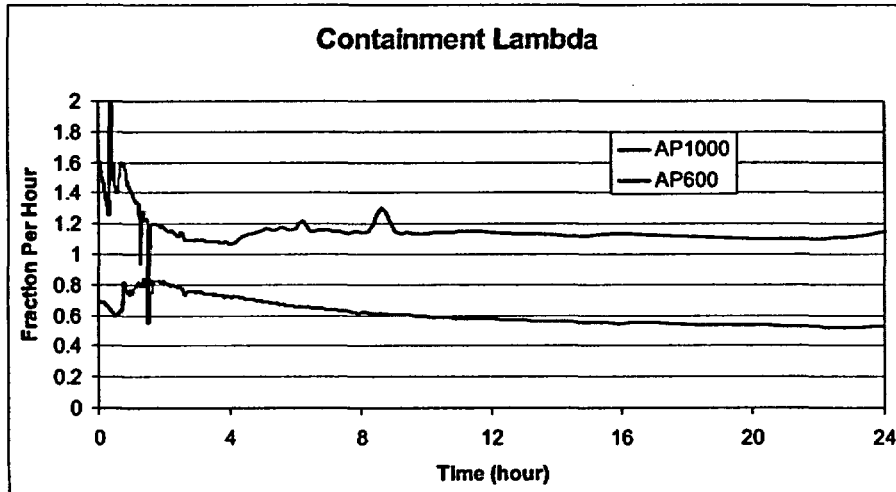
## T&H Parameters for Lambda Calculation



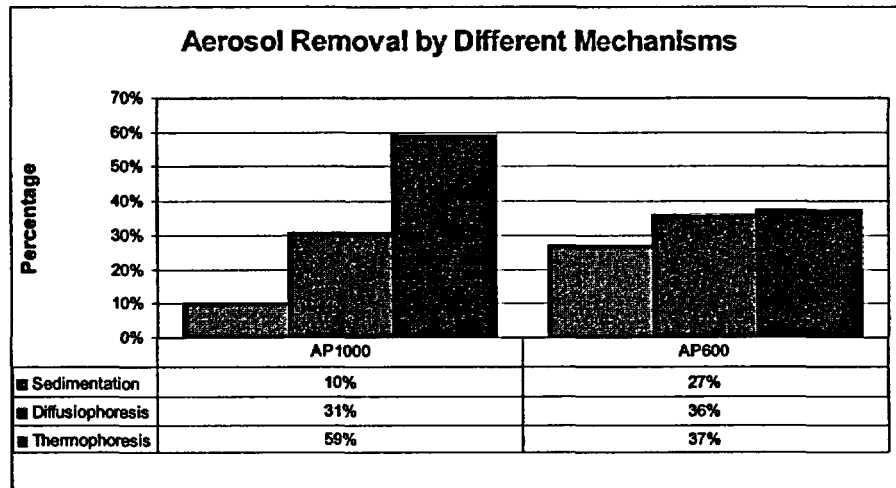
## T&H Parameters for Lambda Calculation



## STARNAUA Calculation Results



## Calculation Results (cont.)



## Discussion (cont.)

- **Conservatisms**

- Hygroscopicity neglected.
  - Hygroscopic particles grow bigger and settle faster.
- Inertial impaction on wet surface neglected.
- Retention of aerosols in leak paths neglected.
  - Experiment (e.g., LACE) shows that aerosols tend to form sticky material that either be retained in narrow path or fall quickly to the ground, if they resuspended, after leaving the path.
- Smaller than usual particle size (mmd=1.3 $\mu$ m) used.
  - Mass mean diameters used in NUREG/CR-5966 for the analysis of natural aerosol removal rates range from 1.5 to 5.5  $\mu$ m.

## Conclusions

- **Average lambda is 1.1 per hour.**
- **Result is quite robust due to combination of removal mechanisms (< $\pm 25\%$  variation on “exaggerated” sensitivities).**
- **The results are conservative.**



**United States Nuclear Regulatory Commission**

# **NRC Assessment of Thermal-Hydraulics Issues of the AP1000 Design**

**Presented to  
The Advisory Committee on Reactor Safeguards  
October 1, 2003**

**By  
Jennifer L. Uhle, Chief  
PWR Systems  
Reactor Systems Branch  
Division of Systems Safety and Analysis  
Office of Nuclear Reactor Regulation**

# Summary of NRC Review

- **NRC Review Team**
  - Steve Bajorek (RES)
  - Gene Hsui
  - Walt Jensen
  - Lambros Lois
  - Summer Sun
  - Len Ward
- **Independent Analysis**
  - NRC Code Calculations
  - Data Comparison
  - Analytical Modeling
- **Draft Safety Evaluation Report Open Items**
  - Identification of Limiting SBLOCA Transient
    - Containment Backpressure
  - NOTRUMP/RELAP5 Comparison
  - Core Level During ADS4/IRWST Transition Phase
  - APEX-1000 Test Series
    - Scaling
    - NOTRUMP Validation
  - Core Level During Long Term Cooling Phase
    - WCOBRA/TRAC Validation
  - Boron Precipitation
    - RELAP5 or WCOBRA/TRAC sensitivity study