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480th Meeting

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TRO 4

1 UNITED STATES OF AMERICA  
2 NUCLEAR REGULATORY COMMISSION

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4 480TH MEETING

5 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

6 (ACRS)

7 + + + + +

8 FRIDAY

9 MARCH 2, 20001

10 + + + + +

11 ROCKVILLE, MARYLAND

12 + + + + +

13 The Advisory Committee met at the Nuclear  
14 Regulatory Commission, Two White Flint North, Room  
15 T2B3, 11545 Rockville Pike, at 8:30 a.m., Dr. George  
16 Apostolakis, Chairman, presiding.

17  
18 COMMITTEE MEMBERS:

19	GEORGE APOSTOLAKIS	Chairman
20	MARIO V. BONACA	Vice Chairman
21	THOMAS S. KRESS	Member
22	GRAHAM LEITCH	Member
23	DANA A. POWERS	Member
24	ROBERT J. SEALE	Member
25	WILLIAM J. SHACK	Member

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## 1 COMMITTEE MEMBERS: (cont.)

2 JOHN D. SIEBER Member

3 ROBERT E. UHRIG Member

4 GRAHAM B. WALLIS Member

5 F. PETER FORD Invited Guest

6

## 7 ALSO PRESENT:

8 KAREN COTTON

9 GENE CARPENTER

10 STEVE DOCTOR

11 BILL BATEMAN

12 DEBBIE JENSEN

13 BILLY CROWLEY

14 LARRY MATTHEWS

15 VAUGHN WAGONER

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

(10:01 a.m.)

CHAIRMAN APOSTOLAKIS: The next item is a briefing event at V.C. Summer Nuclear Station. Dr. Shack is the lead member on this.

MEMBER SHACK: I'm sure of the members are aware that they found a crack in the weld material of the reactor coolant hot leg piping system at V.C. Summer.

The crack occurred in alloy 182 weld metal, which is a high nickel weld metal that they typically use essentially as kind of a buttering when you're joining a Ferritic component, in this case a pressure vessel nozzle, to the stainless steel piping and essentially it minimizes the mismatch in thermal expansion and reduces thermal stresses.

We know in the past that PWR primary coolant piping systems have been very reliable and we've found very little evidence of cracking in those systems. They've been approved for leak-before-break, largely because of that reliable experience, and so there's some interest here in the general nature of whether this experience can be generalized to other systems. And, again we wanted to understand just how well, for example, inspections can be done in other

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1 plants.

2                   Joining us on the phone today, in addition  
3 to the staff at the front of the table is a  
4 contractor, Dr. Steve Doctor from Pacific Northwest  
5 Laboratory, who's an ultrasonic UT for Dr. Wallis,  
6 expert on crack detection. And I guess Gene, you're  
7 going to start off, Gene Carpenter.

8                   MR. CARPENTER: Karen Cotton will be  
9 discussing this.

10                  MEMBER SHACK: Okay. Ms. Cotton then, you  
11 can start the discussion.

12                  MS. CARPENTER: Okay. First, I'd like to  
13 say good morning. I'm Karen Cotton and I'm a  
14 mechanical engineer and the project manager for V.C.  
15 Summer. Gene Carpenter, from the division of  
16 engineering will talk about the technical review and  
17 future activities regarding the Summer crack.

18                  Larry Matthews of Southern Nuclear, he'll  
19 talk about the MRP. I would like to acknowledge Billy  
20 Crowley sitting here, he's the team leader for the  
21 special inspection team and, as you heard before, we  
22 have Steve Doctor on the phone listening in.

23                  I'm going to discuss the history of the  
24 event and I'll discuss it in three parts. I'll talk  
25 to you about the actual event, I will talk to you

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1 about what the licensee did in response to the event  
2 and I'll also talk about NRC's actions. Then I'll  
3 give a brief synopsis of what was the function of the  
4 special inspection team.

5 During refueling outage 12, during a  
6 routine walk through, boron deposits were discovered  
7 near the "A" hot leg reactor nozzle. The licensee,  
8 what they did was they continued with their routine  
9 outage activities but they began to investigate where  
10 the boron was coming from. They did a PT inspection  
11 and they discovered a four-inch crack. In the four-  
12 inch crack, they soon found that this was only a  
13 surface indication.

14 They continued and they did UT and they  
15 did eddy current testing and they found a two-and-a-  
16 half inch crack, and this exited through a weep hole.

17 Summer designated a team of industry  
18 experts to look at the situation, and the industry  
19 experts they looked at the repair and they looked at  
20 evaluation of the repair. Their focus was to come up  
21 with a root cause analysis and to come up with a  
22 repair method.

23 MEMBER WALLIS: It surprises me that the  
24 first thing that was mentioned was boron deposits. I  
25 would think there would be all sorts of other

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1 indications of leaks before that.

2 MS. COTTON: What happened was --

3 MEMBER WALLIS: A new activity or just  
4 loss of fluid.

5 MS. COTTON: There were no other  
6 indications of leaking. This leak was very small and  
7 it wasn't detected through our normal leak detection.

8 MEMBER WALLIS: Doesn't it take a lot of  
9 water to make much boron deposit?

10 MR. CARPENTER: That is correct, sir.  
11 This is Gene Carpenter. Typically, you have very  
12 small amounts of boron in the reactor system fluid,  
13 and obviously there was literally hundreds of pounds  
14 of water that had to escape before this was detected.

15 However, as Karen said, it was a very  
16 tight crack and the leak rate was much below 0.1 GPO,  
17 so they never did trigger the tech spec required 1.0  
18 in any unidentified leakage.

19 MEMBER SHACK: What was the unidentified  
20 leakage sort of in the period leading up to the  
21 incident?

22 MS. COTTON: It was like 0.6.

23 MEMBER SHACK: Three-tenths.

24 MR. CARPENTER: Yes, 0.3 GPO was about the  
25 average over the operating cycle.

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1 MS. COTTON: The team's primary goal was  
2 to ensure that the plant would safely start up. They  
3 looked at all the welds, they looked at the code  
4 requirements, they had to address all the failure  
5 scenarios, even the worst possible case. And they  
6 looked at all the indications and made sure that all  
7 these indications in the other welds were evaluated.

8 The licensee also developed a  
9 communications plan and this plan ensured good  
10 communications, thorough communications with NRC, with  
11 the other members of the nuclear industry, and also  
12 with the community surrounding the plant.

13 They also took a further step and they  
14 committed to enhance their leak detection procedures.  
15 They decided that they would examine the B and C welds  
16 during refueling outage 13, and they also committed to  
17 examining all the welds during refueling outage 14.

18 MEMBER SHACK: When had this weld been  
19 last inspected, or had it even been inspected?

20 MR. CARPENTER: Yes, it had been last  
21 inspected in 1993 during their ten year ISI.

22 MS. COTTON: The licensee's activity  
23 included we chartered a special inspection team, we  
24 chartered and formed a communications plan. As part  
25 of the communications plan we did a communications

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1 team, which met on a weekly basis, bi-weekly, we met  
2 twice a week on a weekly basis to handle all issues  
3 dealing with the Summer crack.

4 We developed a web site that was specific  
5 to just this Summer event. We issued three information  
6 notices, the last one was February 28, was issued  
7 February 28. We received a WCAP from Westinghouse  
8 regarding the integrity of the B and C welds. We did  
9 a safety evaluation regarding this and we completed  
10 and issued the safety evaluation on the 20th of  
11 February.

12 We also had five public meetings, the last  
13 public meeting was February 15 and that was a public  
14 exit meeting. We chose to have a public exit because  
15 all the meetings were public and we got very good  
16 comments from the public regarding our openness and  
17 our willingness to involve them in this event.

18 The licensee's root cause analysis was  
19 primary water stress corrosion, and this basically was  
20 due to the susceptible material of alloy 182, coupled  
21 with the repeated welds, or the repeated rewelding and  
22 rework done during construction of the weld.

23 MEMBER WALLIS: How was the grinding  
24 related to residual stresses? Was it that the  
25 grinding was too gross and rough, or was it something

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1 to do with heat generation, or what was the coupling  
2 between grinding and residual stresses?

3 MR. CARPENTER: When the weld was  
4 originally installed they had multiple weld repairs.  
5 It took, I believe, something like 40 days to do the  
6 complete weld repair of the Alpha hot leg nozzle weld.  
7 In that time they basically took out the entire weld  
8 and rewelded it in at least once.

9 MEMBER WALLIS: So grinding wasn't  
10 necessarily a cause of stress at all?

11 MR. CARPENTER: Well, they did do a lot of  
12 grinding out of welds, of flaws, and then rewelding.

13 MEMBER WALLIS: But the grinding itself  
14 didn't cause the stresses?

15 MR. CARPENTER: It added to it, sir.

16 MEMBER WALLIS: It did?

17 MS. COTTON: Steve, do you want to talk  
18 about the V-shaped? I have a slide I could put up for  
19 you? Steve? Do you want to talk about the V welds?  
20 I have a slide I could put up for you as for our  
21 discussion about the root cause analysis?

22 DR. DOCTOR: I think the key point is the  
23 fact that when they put in this bridge path, what this  
24 forced them to do was basically form a double V type  
25 of weld. And the work that EPRI had funded had shown

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1 that the stresses on the inside were much higher with  
2 that type of a weld design as compared a single V type  
3 of weld design.

4 And so the fact that you've got a grinding  
5 was due to remove the old material, but they used this  
6 bridge path and it forced the design into this double  
7 V type of design.

8 (Slide change)

9 MS. COTTON: This basically sums up the  
10 history portion of what actually happened. Now we'll  
11 talk about the special inspection team.

12 As stated in the history, a special  
13 inspection team was chartered. The focus of the team  
14 was to ensure that the licensee's corrective actions  
15 were appropriate. They looked at and reviewed the  
16 root cause determinations, and they looked at all  
17 corrective actions activities.

18 The team's activities included, as I said  
19 before, corrective action review, review of the  
20 licensee's records, they observed the welding  
21 processes, NDE activities. They also did on site  
22 metallurgical analyses that reviewed this, of the  
23 spool piece at Westinghouse hot cell labs. So the  
24 team was pretty active and they were on site for  
25 several weeks during this whole incident.

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1           The team's findings were that the root  
2           cause analysis was appropriate and acceptable and that  
3           there were no deviations from weld requirements. From  
4           code requirements.

5           MEMBER SHACK: Just on this inspection,  
6           doing the weld techniques, do you have to go through  
7           the piping to inspect the weld? Or is this something  
8           that is really done just through the weld metal?

9           DR. DOCTOR: This is Steve Doctor. When  
10          you perform the inspection according to the Section 11  
11          requirement of ASME code, you're required to inspect  
12          the inner third of the weld plus some adjacent  
13          material on both the pipe side and the nozzle side.  
14          Generally, this is approximately this a half-inch.

15          So the inspection includes both base  
16          material, structural weld and buttering.

17          MEMBER SHACK: Steve, I guess I was  
18          interested in whether, for example, if you were in a  
19          plant that had centrifugally cast piping, in order to  
20          inspect this weld you would have to look through the  
21          cast piping.

22          DR. DOCTOR: That's correct. As a matter  
23          of fact, if you look at the cold legs those are a  
24          nozzle weld with buttering structural weld going to a  
25          cast elbow. And they perform those inspections in a

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1 similar vein. The fortunate thing is that these  
2 inspections are conducted from the inside, so the  
3 amount of cast materials, the very coarse grain cast  
4 materials that you have to penetrate, is relatively  
5 small.

6 If you perform the inspection from the  
7 outside surface you have extremely long paths through  
8 the coarse grain material, which would then make the  
9 inspection extremely difficult.

10 MEMBER SHACK: Okay. Thank you.

11 MS. COTTON: The purpose of my talk was  
12 just to provide a snapshot of the history of what  
13 happened with the event. The actual event history,  
14 the response of the licensee, NRC's actions, and to  
15 give you some detail of what happened with the special  
16 inspection team.

17 Both the special inspection team and the  
18 staff feel that this event is beyond Summer, and that  
19 there are further generic activities, we should look  
20 into this further. And this will be discussed by Gene  
21 Carpenter. Gene.

22 MR. CARPENTER: Thank you, Karen. First,  
23 I'm going to go over the technical review that the  
24 staff did of the B and C hot legs, and then I'll be  
25 discussing some of the generic activities that the

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1 staff is following.

2 The staff performed an independent  
3 evaluation of the licensee's assessment of the B and  
4 C nozzle legs. Now since they had physically removed  
5 the A hot leg nozzle weld and replaced it, there  
6 really wasn't a need to evaluate the cracks in that.

7 This was done by the licensees submittal,  
8 which was the WCAP-15615 Rev 1, which is a proprietary  
9 document and the non-proprietary version 16616 Rev 0  
10 which is available on the web site for public  
11 inspection.

12 The WCAP provided the results of the  
13 Westinghouse UT and the eddy current examinations of  
14 the nozzle-to-pipe welds for loops A, B and C. In  
15 those loops, they found in five of the six nozzles,  
16 that there were crack indications -- or I should say  
17 eddy current indications. The C cold leg was the only  
18 one that did not have any indications found.

19 These indications were evaluated based on  
20 the destructive examination that was done on the A hot  
21 leg nozzle that was removed and was destructively  
22 examined at the Westinghouse hot cell facilities.  
23 And, based on those determinations, the licensee  
24 determined that Summer could be safely operated for  
25 approximately two further cycles before they needed to

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1 do any inspections or possible repairs to the existing  
2 indications in the B and C hot legs.

3 MEMBER SHACK: Is eddy current an accepted  
4 inspection technique for this kind of consideration?

5 MR. CARPENTER: No, it is not. They went  
6 beyond that. The UT could not find these eddy current  
7 indications, so basically we are going beyond the code  
8 on this.

9 MEMBER SHACK: Well, how are they  
10 estimating sizing then for these flaws?

11 MR. CARPENTER: The eddy current can  
12 determine the lengths. We're doing a 2:1 aspect  
13 ratio, so basically for a one-quarter inch long crack  
14 indication, we're assuming that a depth of one-eighth  
15 inch.

16 MEMBER POWERS: How did they possibly make  
17 a prediction that they can operate for so long of a  
18 period of time without fixing these things?

19 MR. CARPENTER: The determination was made  
20 on the basis of the susceptible material. It was made  
21 on the basis of the crack growth rate.

22 MEMBER POWERS: What is the crack growth  
23 rate in a nozzle in Summer?

24 MR. CARPENTER: The crack growth rate that  
25 was assumed.

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1 MEMBER POWERS: I'm not interested in  
2 assumptions. I want to know how they knew what the  
3 correct growth rate was.

4 MR. CARPENTER: When they did the  
5 examination, the destructive examination of the A hot  
6 leg, they went in and basically -- if I could flip to  
7 that slide.

8 (Slide change)

9 MR. CARPENTER: This is a representation  
10 of the Alpha hot leg and this is the crack that grew  
11 through wall. The assumption -- basically  
12 Westinghouse went through and evaluated the crack,  
13 found that there were multiple initiation sites and  
14 they grew together. And from that they made a  
15 determination using a fairly extensive formula which,  
16 if you'll pardon me for just one second --  $1.4 \times 10$   
17 the minus 11, K minus 9 to the 1.1 -

18 MEMBER POWERS: Show me the experimental  
19 data, applicable to Summer, that validates that  
20 formula.

21 MR. CARPENTER: I don't have that with me,  
22 sir.

23 MEMBER POWERS: I mean there can't  
24 possibly be any data that's directly applicable to  
25 this to validate that formula -- unless there have

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1       been a lot of cracks in Summer. I mean how do you  
2       justify an analysis like this that says oh, we can  
3       operate for two more cycles based on this magic  
4       formula, that is based on data for some other  
5       situation?

6               MR. CARPENTER: I will grant you that  
7       there is not a lot of data, and that was one of the  
8       problems that the staff had. And that is one of the  
9       reasons that we did not agree with a crack growth rate  
10      that would allow for two cycles before they did any  
11      further examination.

12             We looked at the crack growth rate in this  
13      extremely, and bear in mind that this crack growth  
14      rate is assumed, is bounding the limited amount of  
15      data that we do have. So what the staff did was we  
16      took what they licensee and Westinghouse provided to  
17      us.

18             MEMBER POWERS: Now, when you say you  
19      bounded the data you have, I mean how do you go about  
20      bounding this data? Presumably the crack can't go any  
21      faster than the speed of sound in the metal. I mean  
22      I -- accept that as a bound. What other bound can you  
23      possibly come up with?

24             MR. CARPENTER: When you take a look at  
25      all the data that is provided and look at the scatter

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1 growth, the licensee had a best fit to that data. The  
2 staff disagreed with that and we increased our  
3 bounding crack growth rate so that it incorporated all  
4 the data.

5 MEMBER POWERS: How do you know that's  
6 enough? If I took two more data points maybe they  
7 fell outside your bound.

8 MR. CARPENTER: We don't have two more  
9 data points, sir.

10 MEMBER POWERS: Yes, but if I had taken --  
11 why do I know that bound?

12 MR. CARPENTER: I cannot sit here and  
13 guarantee that this is the absolute bounding crack  
14 growth rate. It is much faster than what we have  
15 assumed in the past. And it is the reason that we  
16 were only comfortable with wide - operation,  
17 approximately 18 months.

18 MEMBER POWERS: I'm trying to understand  
19 why you were comfortable with five minutes.

20 DR. FORD: Gene, can I try and help you?

21 MR. CARPENTER: Please.

22 DR. FORD: Is that formula that you just  
23 gave the Peter Scott formula?

24 MR. CARPENTER: Yes, sir.

25 DR. FORD: That's based on secondary side

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1 cracks in tubes, I think. Therefore, the argument I  
2 think that's being made here, Dana, is that that could  
3 be a worse case material environment situation. The  
4 follow up question to that, however, Gene, would be if  
5 you used presumed residual stress profile through that  
6 182 crack, would you have predicted what happened on  
7 Leg A, using that formulation? I think that would  
8 answer your question, Dana, or go towards it.

9 MR. CARPENTER: Perhaps, yes.

10 MEMBER SHACK: Well probably not because  
11 the residual stresses that were used for the Summer  
12 analysis were the standard sort of piping stresses, or  
13 the standard circumferential weld residual stress  
14 distribution which probably would have arrested the  
15 crack.

16 MR. BATEMAN: This is Bill Bateman from  
17 NRR. We're into an area here when Gene does not have  
18 the technical expertise. We do have a technical  
19 expertise, however, the individual is not here today,  
20 the one who wrote the safety evaluation and was  
21 involved in asking all these questions.

22 We can follow up at a later time, if need  
23 be, to answer the questions when we have the  
24 appropriate technical expertise available.

25 VICE CHAIR BONACA: I just have a

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1 clarification, and I apologize for it. Maybe I missed  
2 something during the presentation. I thought that  
3 there was a claim that the crack that we found in the  
4 A leg was due to the unique welding process used in  
5 the location.

6 MR. CARPENTER: That is the claim that the  
7 licensee made, yes sir.

8 VICE CHAIR BONACA: Okay. But now you're  
9 telling me that the inspection showed that the other  
10 nozzles also have cracks?

11 MR. CARPENTER: Five of the six.

12 VICE CHAIR BONACA: Okay. So these  
13 nozzles, were they subjected to the same welding  
14 processes as the --

15 MR. CARPENTER: No.

16 VICE CHAIR BONACA: No, they were not.  
17 Okay.

18 MEMBER SHACK: But they do apparently have  
19 smaller cracks. At least you can't see them in the  
20 UT.

21 MR. CARPENTER: Correct. Okay, going  
22 onward. As I was saying, the staff's review basically  
23 disagreed with the licensee's premise that they could  
24 operate for two cycles, and we said that they could  
25 operate for one cycle before they needed to inspect

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1 again.

2 Again, we decided to bound the crack  
3 growth rate that they had provided to us, and that's  
4 because there is a limited amount of crack growth  
5 data.

6 MEMBER WALLIS: Can you tell me how much  
7 does happen in this one cycle? How much crack growth  
8 do you anticipate in this one cycle's okay and two are  
9 not. How much crack growth is happening in the one  
10 cycle which makes it impossible to operate any longer?

11 MR. CARPENTER: Assuming that there is a  
12 crack indication that is one quarter inch in length,  
13 with an aspect ratio of 1:2, with this crack growth  
14 rate it will not grow three quarters of a way through  
15 wall in one cycle of operation.

16 MEMBER WALLIS: But how much will it grow?  
17 Halfway through the wall?

18 MR. CARPENTER: Roughly, sir.

19 MEMBER WALLIS: So it's growing a lot?

20 MR. CARPENTER: Yes, sir.

21 MEMBER WALLIS: So you'd better be careful  
22 about up the bounding so much.

23 MEMBER POWERS: If the plant has some  
24 misadventure and they shut down, something like that.  
25 Does it change the crack growth rate?

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1 MR. CARPENTER: Define "misadventure,"  
2 sir.

3 MEMBER POWERS: An unplanned shut down  
4 SCRAM. Something, anything. Does that change the  
5 crack growth?

6 MEMBER SHACK: It would take an enormous  
7 upset event, you know, to cause mechanical crack  
8 growth rate here so this is really a, you know, a sort  
9 of stress corrosion crack growth rate.

10 MR. CARPENTER: Albeit rather fast.

11 MEMBER SHACK: Yes. I mean the 182 crack  
12 growth rates are really as high as you find in any  
13 material that you know we know in stress corrosion  
14 cracking. And, as Peter mentioned, there's a fair  
15 amount of data on alloy 600 in the cold worked state,  
16 there's less data on the 182. When you combine the  
17 two data sets, you have a fair amount of data so that  
18 you have a reasonable confidence when you bound the  
19 whole combined set of data because 182 is something  
20 like cold worked alloy 600. You can argue that  
21 there's an analogy there and the existing data points  
22 to the 182 are basically bound by the data that you  
23 see for the cold worked alloy 600.

24 So if you combine the whole total data set  
25 there's relatively little for 182 in this PWR

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1 environment. I think you can have a reasonable amount  
2 of confidence that the crack growth rate the staff has  
3 used is bounding.

4 MEMBER POWERS: I guess I just don't know  
5 where you derive your confidence here. You've got a  
6 stress corrosion cracking phenomenon, it depends on  
7 how much stress you have. That must be unique to this  
8 situation.

9 MEMBER SHACK: Oh, the crack growth rate  
10 that you have is a function of the stress. That is you  
11 have a bounding curve that it depends on the stress  
12 intensity at that location. So that becomes a  
13 variable that you have to account for in a specific  
14 analysis for a specific circumstance.

15 MEMBER POWERS: It also depends on having  
16 an aggressive corrosion chemistry. That must surely  
17 be unique to this situation?

18 MEMBER SHACK: No. That's the one good  
19 thing about dealing with primary water stress  
20 corrosion cracking is that you probably do understand  
21 the chemistry environment, that is the environment  
22 that you've studied the crack growth in is a PWR  
23 primary water environment which is carefully  
24 controlled.

25 MEMBER POWERS: Would this alloy, this



1 particular weld material and all of its associated  
2 impurities have been exactly reproduced in this test  
3 stage?

4 MEMBER SHACK: Of course not.

5 MEMBER POWERS: Well, and then you've got  
6 to convince me that you've bounded it.

7 MEMBER SHACK: But that's why you have  
8 data on multiple heats of material and, again you  
9 know, when can I say I bounded the data. You know, as  
10 Gene said, I don't think you can say you have an  
11 absolute bound but what you have is an amount of data  
12 on a reasonable number of heats of material under  
13 chemistry conditions that are representative of what  
14 you have here. It doesn't exactly represent it but  
15 you think the population is quite representative and  
16 you have to make the judgment that when you bound that  
17 it's reasonably close to them.

18 MEMBER POWERS: No, I think all they've  
19 done is they've parted the data points and run a  
20 curve that goes over the top of it. And I don't think  
21 they've done any of this, okay, does the chemistry  
22 span the range of chemistries that I'm likely to  
23 encounter or not.

24 MEMBER SHACK: Well, the other good thing  
25 of course is that under ASME code conditions, the

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1 range of the material chemistries is not all that  
2 broad. It's a fairly tightly controlled situation,  
3 especially for stainless steels. Again, for ferritic  
4 steels, impurity levels are a good deal higher.  
5 Welds, one of the bad things about welds is the fact  
6 that impurity levels are higher but, again, without an  
7 extensive study I'm not sure that you could say you've  
8 bounded the range but you certainly have a reasonable  
9 population.

10 MEMBER WALLIS: When this crack gets  
11 bigger you said it could grow as much as halfway  
12 through, does its growth rate slow down or increase as  
13 it gets to such a big crack?

14 MR. CARPENTER: As the crack grows it will  
15 reduce, it expends the energy so it will tend to slow  
16 down a bit.

17 MEMBER WALLIS: It will slow down. And  
18 when will be the next inspection? And I guess you're  
19 giving them permission to run for another cycle?

20 MR. CARPENTER: For 18 months, yes sir.

21 MEMBER WALLIS: Eighteen months. So  
22 what's going to happen in-between in the 18 months?  
23 No inspection?

24 MR. CARPENTER: I should alter that just  
25 slightly. We said that they could operate for up to

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1 18 months. They have told us that they're going to be  
2 operating for a short cycle so they will be shutting  
3 down before next summer to inspect.

4 MEMBER WALLIS: And no one will be looking  
5 for boron stalactites till next summer?

6 MR. CARPENTER: They will be looking for  
7 evidence of leakage. But it's very difficult to get  
8 into this area during operation.

9 MEMBER WALLIS: And you're satisfied that  
10 there's a good way of detecting these very small  
11 leaks? They weren't detected before.

12 MR. CARPENTER: That is correct. And that  
13 is one of the things that I will be talking about in  
14 a moment regarding leakage. Okay.

15 MEMBER SHACK: But, again, these cracks  
16 will still be relatively short in terms of structural  
17 integrity of the pipe. You know, they'll be a long  
18 way from any kind of large failure, the margin to a  
19 small leak is admittedly much, much smaller than it is  
20 to a large --

21 MEMBER WALLIS: Well it may be fine, it'll  
22 just be sort of embarrassing if you go in there next  
23 summer and find there's a huge boron stalactite  
24 somewhere.

25 MR. CARPENTER: But also bear in mind,

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1       sir, that virtually all of these cracks were axial in  
2       nature. As Dr. Shack said, it takes a considerable  
3       amount before you have a concern beyond that.

4               Some of the ongoing activities that the  
5       staff is engaged in at this time is that we're  
6       reviewing similar cracking in foreign reactors. We  
7       haven't seen anything similar to what happened at  
8       Summer here in the U.S., but the root causes of both  
9       the Summer and the Ringhals cracking in Sweden is  
10      PWSCC. So we are talking with the Swedes about that.  
11      We're also investigating --

12             MEMBER WALLIS: When you talk about PWSCC,  
13      is it stress corrosion cracking?

14             MR. CARPENTER: Primary water stress  
15      corrosion cracking. And we're also investigating  
16      reports of other foreign cracking. We haven't yet  
17      been able to verify that there are others that are  
18      identical, or at least similar to what has happened  
19      here at Summer, but we are looking at that.

20             MEMBER POWERS: When you say identical, I  
21      get the sense that we don't have to be very identical  
22      to be about the same. At least as far as our data  
23      base. So I mean how do you -- I'm trying to  
24      understand the links and bounds of identity in  
25      this sense.

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1 MR. CARPENTER: Well, I'm not trying to  
2 say that it has to be one for one matching every  
3 point. We're looking at similar welds, we're looking  
4 at similar locations. Trying to find something that  
5 we can lump together.

6 Some of the other ongoing activities that  
7 the staff is engaged in at this time is, again, we're  
8 looking at the generic implications of the Summer  
9 cracking and the industry activities.

10 Mr. Matthews of the MRP will be discussing  
11 in a few minutes what the PWR owners groups materials  
12 for a liability program is presently engaged in and I  
13 will leave that to his capable hands.

14 We're also looking at the implications on  
15 the leak-before-break analyses that have been done for  
16 virtually all the PWRs at this time. We're also  
17 looking at ISI programs, both deterministic and risk-  
18 based, seeing if we need to make any alterations to  
19 those programs.

20 MEMBER SIEBER: Since you're discussing  
21 ISI, is there any movement to augment with another  
22 technique the UT examination?

23 MR. CARPENTER: Right now the UT  
24 examination is required by code, and if the code needs  
25 to be altered then --

1 MEMBER SIEBER: Somebody has to put in a  
2 code case?

3 MR. CARPENTER: Correct.

4 MEMBER SIEBER: On the other hand, you can  
5 do the UT exam and satisfy the requirements of the  
6 code, but you could require an additional augmented  
7 inspection using other techniques. Seems to me that  
8 when I look at the pictures, the weld prep for the  
9 examination wasn't very good and it seems also that  
10 probes have a pretty good footprint and maybe this is  
11 a very difficult weld to examine just because of  
12 geometry, notwithstanding the fact that you're  
13 shooting through a pretty thick cross section of  
14 material of varying grain structure and composition.

15 I take it that since these kinds of cracks  
16 are not reliably always found by UT, that nobody is  
17 making a move to do something better.

18 MR. CARPENTER: Well, I'm not saying that  
19 yet, sir, and you're leading me by about three slides.  
20 So I'll discuss that in just a moment if I could  
21 defer, okay.

22 MEMBER SIEBER: All right.

23 MR. CARPENTER: Again, as we were just  
24 mentioning, the ability of the code required NDE to  
25 detect and size small ID stress corrosion cracks, this

1 is one of the things that we definitely need to get a  
2 handle on. And the appropriateness of the ASME code  
3 standards allowing flaws approximately 10 percent of  
4 wall thickness that, in the case of Summer, could grow  
5 with such an apparent high crack growth rate.

6 And Dr. Wallis mentioned a few moments ago  
7 about the effectiveness of the leak detection systems.  
8 These are all things that we are very much following  
9 and trying to get a handle on.

10 MEMBER WALLIS: Are you thinking of  
11 putting in some supplementary leak detection system in  
12 the places where you might detect something such as  
13 just by the well?

14 MR. CARPENTER: We have discussed that  
15 with the industry and I believe that -- will you be  
16 discussing that, Larry?

17 MR. MATTHEWS: We're going to be looking  
18 at it.

19 MR. CARPENTER: Yes. So this is part of  
20 what we're talking about.

21 MEMBER WALLIS: If you're going to look at  
22 it, are you going to have anything in place during the  
23 next cycle?

24 MR. CARPENTER: No, sir.

25 MEMBER WALLIS: You seem that you want to

1 put something in there now.

2 MR. CARPENTER: The lead time for  
3 developing supplemental inspections or supplemental  
4 leakage evaluation --

5 MEMBER WALLIS: Well it seems to me there  
6 was, I'm trying to remember the pictures I saw, but  
7 the boron stalactites were pretty obvious, right. So  
8 even just a camera would see them, and that's not a  
9 remarkable piece of technology.

10 MEMBER SIEBER: Well, the boron that was  
11 visible was not directly at the crack in the pipe, it  
12 was underneath the boot and, you know, and that's  
13 where the air flow ventilation for that section of  
14 piping comes from. So it had to appear where the boot  
15 was not tight.

16 MR. CARPENTER: When you're talking about  
17 all this, you know, it came out through here so it is  
18 not readily accessible during power operations.

19 MEMBER SIEBER: And it might not come out  
20 there.

21 MR. CARPENTER: Correct.

22 MEMBER WALLIS: But it's too rough an  
23 environment for some sort of video surveillance?

24 MR. CARPENTER: I don't know the answer to  
25 that, sir.



1 MEMBER SIEBER: It could be done.

2 MR. CARPENTER: Some of the further  
3 activities that the staff is working on right now is  
4 that we're proposing confirmatory research into the  
5 primary water stress corrosion cracking issue, and  
6 that will include some of the NDE and the ISI issues  
7 that we've discussed so far.

8 MEMBER WALLIS: What are you trying to  
9 confirm?

10 MR. CARPENTER: Confirmatory research  
11 meaning is our capability of other inspection toolings  
12 to go in and find and size these indications. For  
13 instance --

14 MEMBER WALLIS: This is a kind of, I know  
15 it's a misnomer, but research is to figure out  
16 something new not confirm something.

17 MEMBER SIEBER: But they're not  
18 anticipating a problem. They have the problem.

19 MR. CARPENTER: Determination of a  
20 bounding crack growth rate and just how the residual  
21 stresses play into that. Development of  
22 susceptibility model, and because we know that the  
23 welds that were, for instance, the welds at Summer  
24 were field fabricated, you also have some that were  
25 shop fabricated at other PWRs. You have different

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1 materials being used at different PWRs. So the  
2 susceptibility model is going to have to take a look  
3 at multiple factors.

4 The assessment of possible repair and  
5 mitigation methods that the industry may come up with  
6 and overall following of industry activities.

7 MEMBER SIEBER: Now, in all Westinghouse  
8 plants with stainless steel piping do they use the 182  
9 weld model?

10 MR. CARPENTER: No, and all of the  
11 Westinghouse plants from my understanding is that they  
12 have something like virtually every weld was slightly  
13 different. So it's going to add considerably to the  
14 complexity here of all this.

15 DR. FORD: Gene, could I make a comment?  
16 You mentioned at the beginning of this is the generic  
17 activities. When you're looking at the industry  
18 experience, are you confining yourself to pressurized  
19 water reactors? I'm thinking specifically of the vast  
20 amount of boiling water reactors which are into  
21 hydrogen water chemistry with a lot of 182 welds.

22 MR. CARPENTER: Yes. Yes, sir I have been.  
23 At this time we are looking specifically at Ps, we may  
24 expand into Bs. But this appears to be a PWSCC  
25 concern right at this moment. If we need to, we will

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1 expand the scope beyond that.

2 MEMBER SIEBER: I mean he is running at  
3 hot leg temperatures that are a good deal higher than  
4 your BWR.

5 DR. FORD: Yes I recognize that but we  
6 know what the activation enthalpies are for the  
7 cracking in these systems, so you can make some sort  
8 of comparison.

9 VICE CHAIR BONACA: I had a question  
10 regarding all previous inspections, including the year  
11 2000. They found no indications. Now, what kind of  
12 inspections were they? They were not using eddy  
13 current, of course.

14 MR. CARPENTER: If you don't mind I'll  
15 defer to Steve Doctor on that one. Steve?

16 DR. DOCTOR: Yes, I couldn't hear the  
17 complete question. Would it be possible to have you  
18 repeat it, please?

19 VICE CHAIR BONACA: Yes. My question is  
20 all previous inspections of these nozzles showed no  
21 indications, including the 2000 inspection. And I was  
22 wondering what type of inspection that was, I mean  
23 what kind of technique do you use?

24 DR. DOCTOR: They basically employ the  
25 same techniques that they employed back in 1993. The

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1 biggest improvement on the ultrasonic side was that  
2 they employed an improved transducer sled that allowed  
3 each transducer to independently gimble to do a better  
4 job of tracking the surface and thereby providing  
5 better coupling.

6 This was a significant improvement. It  
7 didn't accommodate all the conditions that in fact are  
8 associated with the ID conditions of these particular  
9 wells. The size of the footprint of the transducer  
10 and the housing that the transducer goes in is quite  
11 large and, as a consequence, it has some difficulty  
12 accommodating the root, the counterboard, and there is  
13 a difference in the diameter between the nozzle and  
14 the pipe.

15 And, as a consequence, it did create some  
16 problems. I believe that obviously one of the things  
17 that industry is going to be looking at in the future  
18 on how to ensure a better ability to track the surface  
19 and thereby improve the quality of the UT inspections.

20 And for this particular inspection, the  
21 staff at Summers and Weston, you know, agreed to use  
22 the eddy current. An eddy current inspection is  
23 primarily a surface inspection type of technique. It  
24 has not generally been used for this kind of  
25 application.

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1                   However, it is very sensitive to any kind  
2 of surface breaking flaws and, as you saw from I think  
3 the result from the Alpha leg hot outlet nozzle  
4 dissimilar amount of weld, the eddy current was very  
5 effective at detecting a number of cracks that were  
6 verified through the destructive testing. And it  
7 should be noted that there are indications in four of  
8 the five other dissimilar amount of welds that we have  
9 found with the eddy current, they have similar  
10 characteristics to the cracks that were in the Alpha  
11 leg, but at this point there are still indications.  
12 They have not been, you know, verified by any other  
13 means.

14                   There's a possibility that some of those  
15 in fact may not be cracked because some of the  
16 indications that were found in the Alpha hot leg were  
17 not verified through destructive testing. So there is  
18 some uncertainty there and in the analysis they've  
19 taken the approach to assume that, in fact, all of the  
20 indications are assumed to be cracks, although that's  
21 not proven at this point.

22                   VICE CHAIR BONACA:     So the previous  
23 inspection used the ultrasonic testing. And some  
24 forms of eddy current, if I understand it.

25                   MR. CARPENTER:   No.

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1 VICE CHAIR BONACA: No. No eddy current.  
2 Okay so it was ultrasonic testing. And that is the  
3 standard testing that is being done by the industry,  
4 right?

5 MR. CARPENTER: Correct. Code required.

6 VICE CHAIR BONACA: Thank you.

7 MR. CARPENTER: Okay. That brings us to  
8 where the industry is right at this time. The PWRs  
9 have proposed an industry initiative to respond to the  
10 cracking issue that was found at Summer. And, as we  
11 have discussed with the ACRS before, the staff has an  
12 industry initiative process that we can utilize for  
13 this, in which case an issue occurs, the industry and  
14 the staff meets on this. The industry proposes to  
15 follow this as an industry initiative, and the staff  
16 either forgoes any generic communications or generic  
17 letter per se, to tell them what needs to be done in  
18 lieu of the industry coming in and actually telling us  
19 what they're going to do following this.

20 Now at this time we have met with the  
21 materials reliability program on this twice now. And  
22 they have proposed to respond to the issue and, again,  
23 Mr. Matthews will be discussing this in a couple of  
24 moments.

25 VICE CHAIR BONACA: I just want to get

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1 back to it. It seems to me that there has to be some  
2 past experience of V&V on the ultrasonic testing that  
3 is adequate or is not adequate. We were left here  
4 with a statement that says that we have eddy current  
5 indications of cracks in the other nozzles which were  
6 not identified by UT. We're not sure yet that they're  
7 cracks, they may be something else. So we're trying  
8 to understand, in fact to validate these observations  
9 here.

10 And so my question, again, is do we have  
11 V&V of ultrasonic testing identifying these kind of  
12 cracks?

13 MR. CARPENTER: The Alpha hot leg had both  
14 eddy current testing done on it and ultrasonic  
15 examination. It was then cut out, the weld was cut  
16 out, and was destructively examined. As Steve Doctor  
17 mentioned before, some of the indications that were  
18 found by eddy current were not found in the  
19 destructive examination. Some of the indications that  
20 were found by destructive examination were not found  
21 by UT. So we're still struggling with that, sir.

22 VICE CHAIR BONACA: Okay.

23 MEMBER SHACK: Let me ask it in a  
24 different way. The inspectors that do the  
25 inspections, do they go through a performance

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1 demonstration on stress corrosion cracks?

2 MR. CARPENTER: The PDI program --  
3 Performance Demonstration Initiative -- as I  
4 understand it, I'm not the expert on this. Steve, did  
5 you want to respond to this?

6 DR. DOCTOR: Yes. Right now this is a PWR  
7 issue and all the people that are really trained for  
8 stress corrosion cracking do inspections on BWRs.  
9 There is a requirement for a supplement independent --  
10 regarding dissimilar amount of welds. That has not  
11 been implemented as of yet. It's in the process of  
12 being developed with regard to the PDI program and  
13 it's something like I think about 18 months off until  
14 that will be fully implemented, and then all  
15 inspectors will have to go through that.

16 And, of course, the timeliness of the V.C.  
17 Summer event is that now we've identified failure  
18 mechanism and so the type of flaws that have to be  
19 included in that demonstration are PWSCC.

20 MEMBER SHACK: Thank you.

21 MR. CARPENTER: Okay. Going back to where  
22 we are with the MRP. Again, the staff has met with  
23 the industry on this at least twice now. We've had  
24 multiple telephone calls with them following up,  
25 discussing the agenda items that have been in these

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1 public meetings. We will have another public meeting  
2 with the MRP in three weeks time to discuss the  
3 assessments that they are going to be providing to the  
4 staff. We have also gone down to one of the vendor  
5 sites, Framatone specifically, to take a look at the  
6 mock up that they have been making use of to look at  
7 the welds for four plants that we'll be inspecting  
8 this spring outage. And further technical and  
9 management meetings are planned to discuss what is  
10 going on.

11 And now we get to the slide that Dr.  
12 Sieber was leading me to.

13 (Slide change)

14 MR. CARPENTER: Some of the staff  
15 expectations of the generic activities. What we are  
16 hoping to come out of this with. The MRP assessment  
17 of the generic susceptibilities; they have promised  
18 this to us by the end of March and that is what we  
19 will be discussing in three weeks time.

20 The NDE methodologies and the toolings  
21 that the industry is going to be using to do their  
22 examinations. The staff has told the industry that  
23 they should be making use of the best practices and  
24 capabilities to address potential weaknesses that seem  
25 to have come out of this examinations at Summer.

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1           If potential code cases are necessary to  
2 address some of the things that we have discussed  
3 already, the staff will be looking at those in an  
4 expedited manner.

5           We also need to get a better handle on the  
6 implications for the ISI programs and also for leak-  
7 before-break. And long term assessment of the alloy  
8 82/182 applications, we're going to be discussing with  
9 the industry to take a look at that.

10          And we'll also be looking at the review of  
11 their repair and mitigation methods that they will be  
12 proposing to us.

13          And that concludes my discussion for this  
14 morning.

15          MEMBER WALLIS: I'm just wondering, the  
16 expectations, are results expected or activities?

17          MR. CARPENTER: We're hoping that there  
18 will be activities that will lead to results, yes.

19          MEMBER WALLIS: Well that's the thing, I  
20 see a lot of activity and I just wonder about the  
21 results.

22          MR. CARPENTER: We are at the very  
23 beginning of this, sir, and it's too early to --

24          MEMBER WALLIS: That's what concerns me a  
25 bit, yes. You may discuss with industry for a long

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1 time without achieving anything.

2 MR. CARPENTER: We have made our  
3 expectations very clear that this is something that  
4 needs to be expedited. It's not going to be a five or  
5 ten year practice before something occurs. That we  
6 need to have something sooner. And, again, under the  
7 industry initiative process, if the staff determines  
8 that the industry is not being as proactive as we  
9 would like, we always have the option of going out  
10 with generic communications of some sort.

11 MEMBER WALLIS: Well at least by next  
12 summer you'll have some data points?

13 MR. CARPENTER: We certainly hope so, sir.

14 MEMBER LEITCH: The licensee seems to make  
15 quite a bit out of the uniqueness of this weld in its  
16 original instruction. But I guess from hearing your  
17 presentation, it sounds as though you are not  
18 accepting that idea, that you feel there's something  
19 more generic going on here. Is that a correct  
20 assumption?

21 MR. CARPENTER: Well, initially, sir, we  
22 were in agreement that there were, as the licensee  
23 correctly points out, extensive repairs done on this,  
24 especially as opposed to the other five welds. That  
25 there were mitigations there that could have caused

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1 this one to be of concern but not the other five  
2 welds. And then there were indications found in four  
3 of the other five. And also there was indications  
4 found at Ringhals in Sweden, which is a similar plant.

5 MEMBER LEITCH: Indications but not  
6 cracks, right?

7 MR. CARPENTER: Not through wall cracks,  
8 no, sir.

9 MEMBER SHACK: No, but Ringhals is  
10 confirmed to be a crack.

11 MR. CARPENTER: But not through wall.

12 MEMBER: Yes, but it is a crack.

13 VICE CHAIR BONACA: Ringhals identified it  
14 through eddy current?

15 MR. CARPENTER: They did do eddy current  
16 examinations there also, yes. That leads us to be a  
17 little less accepting of the uniqueness suggestion.

18 MEMBER LEITCH: Yes, do we know if  
19 there's anything unique about which plant is at  
20 Ringhals weld?

21 MR. CARPENTER: Well, it's a double V  
22 weld. It's fairly similar to what we were discussing  
23 earlier. But, again, we really need to get a better  
24 handle on all this information.

25 MEMBER WALLIS: So the Ringhals crack is

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1 still growing is it? Or has it been fixed?

2 MR. CARPENTER: Debbie, do you remember  
3 what they said?

4 MS. JENSEN: They did some repairs.  
5 Debbie Jensen from the Office of Research. They did  
6 some repairs to the Ringhals crack, but we're going to  
7 meet with them next month and have face to face  
8 conversations and exchange of technical information  
9 with the similarities and the differences between the  
10 two plants in this particular issue with the pipe  
11 crack.

12 MEMBER WALLIS: Well did some repairs, do  
13 you mean they cut out this area and rewelded it or  
14 something?

15 MS. JENSEN: From what I understand, yes,  
16 they did some grinding and they replaced with addition  
17 weld metal and they took out some samples to do some  
18 testing.

19 MEMBER LEITCH: I have a question about  
20 the enhanced leak detection procedures that were  
21 mentioned. Are we going to get some more about that  
22 later, or is now an appropriate time to ask that  
23 question? I'd like to know specifically how these  
24 leak detection procedures were enhanced.

25 MR. CARPENTER: Well, that's one of the

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1 things that we have asked the industry to go and look  
2 into, to see what they can develop as far as enhanced  
3 leak detection capabilities. Right now we're not  
4 ready to discuss what could be used.

5 MEMBER LEITCH: Ms. Cotton in her  
6 presentation said that one of the licensing  
7 commitments was to enhance their leak detection  
8 procedures. Am I to understand that the plant will go  
9 back in service with -- that is that that enhancement  
10 is future, that the plant will go back in service with  
11 the same leak detection procedures?

12 MR. CROWLEY: What they plan to do is they  
13 plan to do noble gas sampling and analysis to provide  
14 additional verification of the RCS integrity. The  
15 other thing they plan to do is they're going to --

16 MEMBER LEITCH: You say they plan to do  
17 that, but will they be doing that when the plant gets  
18 back in service?

19 MR. CROWLEY: Yes. Yes, that'll be when  
20 the plant goes back in service. The other thing, the  
21 calculation of RCS water inventory balance, they plan  
22 to do that on a more frequent basis than they've done  
23 in the past to try to determine if they have  
24 additional leakage.

25 They're going to add a main control board

1 enunciator to alarm at 0.75 GPM such that the  
2 operators will be alerted prior to reaching tech spec  
3 limit.

4 MEMBER LEITCH: 75 GPM?

5 MR. CROWLEY: .75 GPM. And then they're  
6 going to, of course this is not what the plants  
7 operating -- the inspection they do when they come  
8 down next time, they're going to have an enhanced  
9 boric acid inspection. They've had boric acid  
10 inspections every time a plant comes down, but they're  
11 also going to enhance that program also.

12 MEMBER WALLIS: What happens when you have  
13 this crack and there's a leak? Do you get a jet of  
14 suppurated steam coming out of it or what?

15 MEMBER SHACK: Sure.

16 MEMBER WALLIS: And this has properties  
17 like momentum?

18 MR. CARPENTER: Yes.

19 VICE CHAIR BONACA: It'll cut like a  
20 knife.

21 MEMBER POWERS: You can't get away from it  
22 can you.

23 MEMBER WALLIS: But it's invisible isn't  
24 it? It's invisible. It's a jet of some --

25 MR. CARPENTER: Yes.

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1 MEMBER WALLIS: But it impacts on things  
2 and it carries boron with it. The boron is in the  
3 steam in some form, droplets or something?

4 MR. CARPENTER: Yes.

5 MEMBER POWERS: Vapor.

6 MEMBER SHACK: It's dissolved in it.

7 MEMBER WALLIS: Dissolved and then it  
8 comes out when it condenses on a cold surface  
9 somewhere.

10 MR. CROWLEY: Well the pipe is insulated,  
11 of course, so it has to -- whatever vapor that comes  
12 out has to get through the insulation.

13 MEMBER WALLIS: So what happens in the  
14 insulation? It deposits or is the insulation sort of  
15 blown off, does a hole get made in the insulation?

16 VICE CHAIR BONACA: Cut right through it.

17 MR. CROWLEY: Through the same, goes  
18 through the same.

19 MEMBER SIEBER: Well, most plants have  
20 mirror insulation and it travels all over the place.

21 MEMBER WALLIS: So this steam gets all  
22 lost in the insulation somewhere?

23 MR. CARPENTER: Yes.

24 MEMBER SIEBER: I was under the impression  
25 that most PWRs had some kind of noble gas detection as

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1 part of their containment radiation monitoring.

2 MEMBER WALLIS: Well let's go on. That  
3 insulation gets hot when you put steam through it and  
4 you get a hot patch on it when the steam comes in  
5 there, so if you had thermal couplers on the  
6 insulation they would get hotter if you had a steam  
7 leak. There seem to be so many things that could be  
8 done using pretty robust technology to detect some  
9 change that would be affected by a steam leak.

10 MR. CARPENTER: And these are things that  
11 we have asked the industry to go in and investigate  
12 and come back and talk to us about.

13 MEMBER WALLIS: But if you had to do it  
14 next week I would think that someone could actually  
15 come up with something. I just wonder why -- it  
16 seems to be a slow process, this asking and coming  
17 back with things. The agency doesn't seem able to  
18 respond quickly to the idea say let's put thermal  
19 couplers, or whatever it is, around something so we  
20 know what's going on.

21 It may take months to make a decision. By  
22 then the cycle's over anyway. Am I describing things  
23 right? It just takes forever to make -- not forever,  
24 but it takes so long to make decisions that it's  
25 unlikely that any detection system will be in place

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1 before the end of the cycle.

2 MR. CARPENTER: Well, there is detection  
3 systems in place at Summer. As to what needs to be  
4 done at other plants --

5 MEMBER WALLIS: Well what's the new --  
6 there's a new detection system in Summer?

7 MR. CARPENTER: Yes --

8 MR. CROWLEY: Just the improvements that  
9 we --

10 MEMBER WALLIS: Just the ones that you  
11 mentioned. But they are still -- gross balances for  
12 the plant. They're not focused on the area of  
13 concern. There's nothing installed around the welds  
14 or anything like that.

15 MEMBER SHACK: Local leak detection is  
16 harder than you think because, as Jack mentioned, you  
17 know, water and steam have a way of moving around a  
18 lot.

19 MEMBER WALLIS: Well it's very true in  
20 your house, you get a leak in the bathroom and it  
21 appears in the living room.

22 VICE CHAIR BONACA: I just wanted to ask  
23 you a question about, this is not the first time that  
24 PWR nozzle cracks have been identified, right? It is  
25 not the first time.

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1 MR. CARPENTER: I believe it is, sir.

2 MEMBER SHACK: Ringhals is the first,.

3 VICE CHAIR BONACA: Is it? I thought  
4 there have been some events.

5 MR. CARPENTER: But this is the first  
6 through wall crack.

7 VICE CHAIR BONACA: Oh through wall, yes  
8 I understand. But cracks which were not through wall,  
9 I thought there had been some instances.

10 MR. CARPENTER: Not that I'm aware of but  
11 I will get back to you on that.

12 VICE CHAIR BONACA: I guess I'm going after  
13 the issue of, you know, this seems to throw in full  
14 doubt the effectiveness of ultrasonic testing as an  
15 inspection means, and I thought that there had been  
16 some significant validations of the technique.

17 MR. CARPENTER: The ultrasonic  
18 examinations of dissimilar metal welds is a little bit  
19 more of a challenge, so that is something as Dr.  
20 Doctor mentioned a little bit ago, the PDI initiative  
21 is looking at that and they have approximately 18  
22 months to come up with a solution to that.

23 MEMBER SHACK: I mean non-destructive  
24 examination, you know they're sort of trained to look  
25 for certain things and at this point PWSCC wasn't

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1 really considered to be a major problem for PWR.

2 VICE CHAIR BONACA: I understand. In 2000  
3 they had no indications. Then eddy current comes and  
4 says there are indications. There are indications to  
5 the point where now we're putting restrictions on how  
6 long they can run. It begs the question of what do  
7 you do about all the other PWRs for which you have  
8 inspections using ultrasonic testing. And so that's  
9 why I'm asking those questions. I had more confidence  
10 in that testing than I'm getting out with now.

11 MR. CARPENTER: And these are questions  
12 that the staff are asking ourselves, yes.

13 If there are no further questions we'll  
14 turn this over to Mr. Matthews of MRP.

15 MR. MATTHEWS: My name is Larry Matthews,  
16 I work for Southern Nuclear Operating Company on the  
17 managing inspection and testing services group. I'm  
18 also chairman of the Alloy 600 issues task group of  
19 the materials reliability program, and I'm going to  
20 give you some information about where the industry is  
21 and where we're headed on this issue.

22 First off, a little brief history of how  
23 we got to where we are. You've heard about the crack  
24 and what's been done at the plant at V.C. Summer. The  
25 MRP Alloy 600 issues task group took the lead on this.

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1 The event occurred in October of 2000, the initial  
2 root cause was available early December and the issues  
3 implementation group, or issues and integration group,  
4 we can't ever decide what IIG stands for but it's the  
5 parent of the ITG, recommended in mid-December that  
6 the MRP take on as activity the resolution of generic  
7 issues relative to the V.C. Summer event.

8 We received executive approval from some  
9 utility execs here in early January to begin  
10 activities. We developed an organization and we  
11 worked out a fairly detailed plan and budget but it's  
12 evolving as we go and as we learn more.

13 The issues task group met in January 19,  
14 after the V.C. Summer public meeting on the 18th, to  
15 address the key focus areas and we organized into  
16 three committees: an assessment committee, inspection  
17 committee and a repair and mitigation committee and  
18 I'll be going into what the activities of those  
19 committees are.

20 We met with the staff on January 25, at  
21 which point we outlined the approach that we were  
22 planning on taking with respect to this issue, and  
23 solicited feedback from the staff at that point in  
24 time as to whether they saw things additional we  
25 needed to be doing.

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1           The feedback was basically they felt we  
2           were on the right path, saying the right kind of  
3           words. Of course, the proof is in the pudding -- can  
4           we deliver what we say.

5           On February 1, two of the committees had  
6           their initial meetings, inspection committee and  
7           assessment committees both met in Charlotte. They  
8           further refined their plans and schedules and budgets.  
9           On 2/16 there was an MRP/NRC executive management  
10          meeting. This is typically a meeting we've been  
11          having on an annual basis where MRP executives were  
12          meeting with the NRC management.

13                  MEMBER WALLIS: Has anybody done any work  
14          yet?

15                  MR. MATTHEWS: Yes.

16                  MEMBER WALLIS: No, I mean you have all  
17          these meetings in the management and budgets, has  
18          anyone done any engineering yet?

19                  MR. MATTHEWS: Yes, yes. I'm going to get  
20          to that.

21                  This issue was one of the topics that was  
22          discussed at the meeting along with all the other MRP  
23          activities, and just this week we've scheduled another  
24          technical meeting with NRC staff and I'll go into what  
25          we're going to discuss in that meeting.

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1           The industry plan includes a short term  
2           assessment in which we want to demonstrate that the  
3           continued operation of alloy 82/182 welds is  
4           acceptable. We're trying to get that to the staff by  
5           late March. The NSSS vendors are at work right now  
6           performing the analyses and working on this  
7           assessment.

8           We had a goal of getting interim  
9           inspection guidance.

10           MEMBER POWERS: You say here the continued  
11           operation with alloy 82/182 welds, that's just the  
12           weld not a flawed weld that you're dealing with?

13           MR. MATTHEWS: We want to -- well, what  
14           we're going to show is the margins that are available  
15           in there to cracking and even if it does crack, the  
16           margins that are available to a rupture of the pipe.  
17           We're going to try and prove here that it's not really  
18           a safety issue, it's a leak issue, it's an operational  
19           issue, we have to be very concerned about it, it's  
20           very expensive to have this kind of leak. But we want  
21           proof and show that it's not a safety issue.

22           MEMBER POWERS: What you want to show, I  
23           think, is that if you have a flaw in that weld, that  
24           it will not propagate rapidly to create a pipe  
25           rupture.

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1 MR. MATTHEWS: Exactly. Analyses to that  
2 effect were certainly part of the report that  
3 Westinghouse put together for V.C. Summer. And we  
4 will build on those analyses for the whole industry.

5 MEMBER POWERS: But you're not going to  
6 have any more data than they did.

7 MR. MATTHEWS: No, not at this point in  
8 time. I mean there's no more data that we can get our  
9 hands on right now. We've got to go create some or  
10 find out what else is out there.

11 MEMBER POWERS: Well when you think about  
12 data on stress corrosion cracking, you think about  
13 things like residual stresses, you think about  
14 chemistry. Do we have now data that are taken in  
15 irradiated water of the type we have in --

16 MR. MATTHEWS: I don't think we have data  
17 in irradiated water, but we do have data that was  
18 taken with several heats of alloy 182 weld metal and  
19 there was created, samples cut from it, several  
20 samples were put into a PWR environment in an  
21 autoclave and tested to crack --

22 MEMBER POWERS: When you say environment  
23 you're speaking of the pressure temperature  
24 environment not the radiation environment?

25 MR. MATTHEWS: Not the radiation but these

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1 things are very, very low radiation where these welds  
2 are. These welds are not in the belt line region,  
3 they're above the core.

4 MEMBER POWERS: Well, I mean I just can't  
5 help but ask, you have a lot of radiolysis product,  
6 water radiolysis products in these and they tend to be  
7 fairly aggressive chemicals as far as oxidation and  
8 reduction reactions. Do they not affect the chemistry  
9 in these?

10 MR. MATTHEWS: I guess I don't know the  
11 answer to that but the tests that we've done are  
12 trying to stimulate the PWR primary water as best they  
13 can, given that we're not doing it with a reactor.

14 MEMBER POWERS: Well my question is is  
15 temperature adequate or do you have to simulate the  
16 ozonides and peroxides and things like that because of  
17 water radiolysis?

18 MR. MATTHEWS: I guess I don't know the  
19 answer to that. We do run these plants with a  
20 hydrogen over pressure and it tends to scavenge those  
21 things pretty quickly I would hope.

22 MEMBER WALLIS: Even short life -- and  
23 this is a hot leg, this stuff has been irradiated and  
24 everything else a very short time before it comes to  
25 this spot.

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1 MR. MATTHEWS: Yes.

2 MEMBER WALLIS: So there could be some  
3 very transient type products which are in there.

4 MR. MATTHEWS: Yes, there could and I  
5 guess we haven't looked at that as an industry and  
6 perhaps we need to.

7 VICE CHAIR BONACA: I don't want to  
8 belabor it but it seems to me that the gentleman said  
9 they're trying to see if in fact this eddy current  
10 data is credible.

11 MR. MATTHEWS: The eddy current data?  
12 Yes.

13 VICE CHAIR BONACA: Now, assuming that you  
14 could prove that the eddy current indications were not  
15 correct, that would support your claim that this is a  
16 unique issue to do with that particular weld in that  
17 particular A leg, and all this would be gone. So why  
18 won't you focus immediately on the issue of the  
19 validity of eddy current as a means of inspecting  
20 these cracks?

21 MR. MATTHEWS: Well, we have some  
22 information, as I understand it, from the Ringhals  
23 test. They did UT and eddy current, and over there  
24 the eddy current was not the save all, in fact it  
25 missed flaws that the UT picked up.

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1 VICE CHAIR BONACA: Okay. The combination  
2 of the two seems to be an effective means you mean?

3 MR. MATTHEWS: Perhaps. But the eddy  
4 current here was --

5 VICE CHAIR BONACA: So you can't discount  
6 the eddy current indication, that's what you're saying  
7 right now.

8 MR. MATTHEWS: Yes. It's not a proven  
9 technology for going in and detecting and sizing  
10 flaws.

11 MEMBER SIEBER: And it focuses more on  
12 surface indications.

13 MR. MATTHEWS: Yes, that's right. Another  
14 thing the plan included was to get out some interim  
15 inspection guidance for the near term outage plants,  
16 those plants that are coming down this spring. That  
17 was completed yesterday I believe. The letter was  
18 signed out to the industry.

19 The plan also includes a longer term  
20 assessment of all the alloy 82 and 182 welds in the  
21 plants, in the PWR primary systems. We'll be looking,  
22 reviewing and improving inspection technology where  
23 it's appropriate. And we'll also be reviewing repair  
24 and mitigation methods, if necessary, working to  
25 develop some improvements in those.

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1                   MEMBER WALLIS:   Let me ask about UT.  
2           Isn't this a developing technology in the medical  
3           field that's highly developing, a lot more  
4           intelligence is used for it and they can see things  
5           they couldn't see before and it's improving very  
6           rapidly. Is this sort of a fossilized technology, or  
7           are improved UT methods coming out regularly?

8                   MR. MATTHEWS:   I think the industry is  
9           constantly looking to try and improve their technology  
10          for detecting --

11                   MEMBER WALLIS:   Is it happening?

12                   MR. MATTHEWS:   Yes, there's phased arrayed  
13          technologies that are coming out and have not been  
14          applied at this point to these welds, but that has  
15          been applied in the industry for turbine blade  
16          examination and things like that.   There's new  
17          technology being looked at by the EPRI and NDE center  
18          right now for much smaller --

19                   MEMBER WALLIS:   Is it difficult to get  
20          approval for new technology because of the regulatory  
21          process?

22                   MR. MATTHEWS:   I think the code process  
23          would be the more difficult thing to get it through  
24          but, at the same time, if there's a better way to do  
25          things I can think we can push it through.

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1 DR. FORD: Can I just come back to the  
2 very first bullet there, the short term assessment.  
3 What are the criteria for that? What are the criteria  
4 that your short term assessment is correct?

5 MR. MATTHEWS: I'm going to -- oh, I'm  
6 going to give a lot more detail of what we're going to  
7 do there.

8 DR. FORD: Okay. But there will be data?  
9 There will be stress corrosion data to back it up?

10 MR. MATTHEWS: There will be what data we  
11 have available will all be factored in to putting  
12 together the short term assessment.

13 DR. FORD: Okay.

14 MR. MATTHEWS: And while we've already  
15 started work on much of this, we expect there is an  
16 approval process for the -- the senior reps we  
17 anticipate them approving what we're laying out in our  
18 plan on March 9. But we've already started work with  
19 funds that were already available.

20 Basically, these are the three committees  
21 under my Alloy 600 ITG and we're part of the MRP and  
22 the MRP is looked to the NEI as the regulatory  
23 interface with the NRC. That's not to say we don't  
24 have technical discussions. We do. When there's  
25 technical issues to discuss with the staff, we'll

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1 discuss them directly.

2 MEMBER WALLIS: Excuse me. Who does the  
3 work? Do you contract with somebody?

4 MR. MATTHEWS: Most of the work would be  
5 contracted to vendors or consultants or done in house  
6 at EPRI. Most of the technical work, a lot of the  
7 guidance and overseeing of all that work is done by  
8 these committees. And these people are knowledgeable  
9 people in the industry in these areas too, on the  
10 committees.

11 These are just the chairmen of the three  
12 committees that we've set up. The chairman of the  
13 assessment committee is Vaughn Wagoner from CPNL. The  
14 chairman of the inspection committee is Tom Alley from  
15 Duke. And the chairman of the repair and mitigation  
16 committee is Gary Moffatt from the V.C. Summer plant.

17 One more detail about the committee  
18 activities. The first thing is to get this short term  
19 safety assessment done, the process that we've  
20 outlined involves identifying areas that are likely to  
21 be the most susceptible and that's primarily going to  
22 be based in this very short term on evaluating the  
23 size of the welds, the temperature and the weld  
24 materials. We felt that likely spots would be on the  
25 Westinghouse and combustion plants to hot leg pipe

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1 welds. At BNW is may indeed be the CRDM nozzle welds  
2 at the top of the head, but they also have some other  
3 pipe welds that they'll be looking at I believe.

4 Certainly not all the plants have the same  
5 welds. The difference between the vendor designs, the  
6 piping is completely different on the three plants, or  
7 plant designs, and even within the Westinghouse fleet,  
8 these welds have a wide variety of how they were  
9 constructed. Some shop welds, some field welds, some  
10 stainless steel, some inconel 182 butter with 82 weld  
11 material, so there's a wide variety of those and we  
12 have to go out and assess all of those.

13 One of the goals is to demonstrate that  
14 most of the cracks will be axial or in the case of the  
15 head penetrations they will be in the axial radio  
16 direction as was seen at the Oconee.

17 MEMBER WALLIS: Why will they be axial?

18 MR. MATTHEWS: It's primarily because of  
19 the stress field that the --

20 MEMBER WALLIS: The stress field stresses  
21 it more highly in that direction?

22 MR. MATTHEWS: Yes. Well the stress is in  
23 the circumferential making the crack --

24 MEMBER WALLIS: The flow direction has  
25 nothing to do with it?

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1 MR. MATTHEWS: No.

2 MEMBER WALLIS: Well flows have effects  
3 around bends and things. Flows have some effects on  
4 these things don't they?

5 MR. MATTHEWS: A little bit of flow  
6 momentum I would imagine but I don't -- then that  
7 would be taken into account. That's going to be  
8 second order compared to the other stresses that are  
9 driving these things.

10 MEMBER LEITCH: Are you going to -- can  
11 you go back and identify welds where there was major  
12 repair activity at the time of original construction.  
13 Is that one of the things you're going to be looking  
14 at here? It seems to me if that was not the prime  
15 cause of this failure, certainly I think we would all  
16 agree that it accelerated the failure in this  
17 particular A hot leg. So can you go back and identify  
18 those welds?

19 MR. MATTHEWS: The amount of data that's  
20 available to each plant varies depending on, you know,  
21 some of these plants are 20, 30 years old and their  
22 construction records are sometimes hard to come by.  
23 But what's available is available and will be looked  
24 at by the individual utilities to see if there's  
25 anything.

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1 MEMBER WALLIS: So chemistry comes into  
2 this propagation of the crack, chemistry is a factor.

3 MR. MATTHEWS: Water chemistry?

4 MEMBER WALLIS: Yes. And so there's a  
5 whole lot of flow mechanics and diffusion processes  
6 and things going on in these cracks. It's not just  
7 stresses, it's everything else, too. I just wonder  
8 how well that is understood. The biggest axial crack  
9 with the water whipping by with some sort of flow  
10 percolating around through the crack as well.

11 MR. MATTHEWS: These cracks are so very,  
12 very, very tight. The water in those cracks is  
13 probably --

14 MEMBER WALLIS: Well something has to go  
15 up there, there's going to be corrosion effects.

16 MR. MATTHEWS: Yes, but it's a very  
17 stagnant environment.

18 MEMBER WALLIS: So it's diffusion.

19 DR. FORD: If I -- maybe I could just help  
20 you out maybe. In boiling water reactors where you  
21 have an oxidizing environment, yes, the direction of  
22 flow could be important. But, in fact, the water does  
23 not enter into the crack very deeply and it becomes  
24 more an academic exercise.

25 MEMBER WALLIS: What's in the crack?

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1 DR. FORD: Well all this water but you're  
2 talking about a replenishment of the water, and that  
3 does not occur to any great extent in these tight  
4 cracks.

5 The question of the PWRs, you're not going  
6 to get too much flow effect, rate effects in this  
7 reducing environment, if you do have a reducing  
8 environment, and Dana's observation is an interesting  
9 one as far as I'm concerned.

10 MEMBER SIEBER: Maybe I could ask another  
11 question. It seems to me that 82/182 I think and  
12 alloy 600 are all, as far as stress corrosion  
13 cracking, are all dependent on temperature. And the  
14 need is what, 608, 609 degrees Fahrenheit where higher  
15 temperatures than that to correct growth rate  
16 accelerates. It would seem to me, and I worked in a  
17 plant at one time, where because of the finding of  
18 some cracks, they reduced the temperature at the plant  
19 by about 10 degrees which virtually stopped the growth  
20 of the crack. Has anybody considered that as an  
21 alternative to all these other things?

22 MEMBER SHACK: People do it in steam  
23 generators. That's generally a pretty drastic step.

24 MEMBER SIEBER: Yes, well you lose some  
25 megawatts that way but a pipe break is a pretty

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1       drastic thing, too. And given the choice, I would  
2       rather lose a few megawatts.

3               MR. MATTHEWS: I don't think anybody's  
4       considered at this point trying to reduce their hot  
5       leg temperatures because of this. The drop may have  
6       to be significant to get it down below that need that  
7       you're talking about I would think.

8               MEMBER SIEBER: Well, it might have to be  
9       below 600. On the other hand, for a lot of plants  
10      that's seven or eight or 10 degrees.

11              MR. MATTHEWS: And for a lot of plants  
12      it's more than that.

13              MEMBER SIEBER: Well, and so I continue to  
14      question. You know, once you're above 610 as a hot  
15      leg temperature, that means the reactor vessel head is  
16      at the same temperature, well the inconel welds up  
17      there that are also subject to the same kind of  
18      cracking.

19              MEMBER SHACK: But you know he has a much  
20      different problem than the steam generator people.  
21      You know, they have typically much larger margins to  
22      failure. A short crack in a steam generator gets you  
23      a lot closer to failure than a short crack in a large  
24      diameter pipe. It certainly could be done but it  
25      certainly seems pretty far down on his list.

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1 MR. MATTHEWS: And the temperature effects  
2 are certainly going to be taken into account in our  
3 assessment of susceptibility and crack growth. And  
4 temperature is one of the factors in the crack growth,  
5 too.

6 MEMBER POWERS: When you think about  
7 activation energies for processes like crack growth  
8 rates, you typically think about things with  
9 uncertainties in the activation industry on the order  
10 of five -- is that right?

11 MEMBER SHACK: Yes -- it is that much.

12 MEMBER POWERS: And so these temperatures  
13 that like factors two or three on the crack growth  
14 rate, so the difference is between the biggest between  
15 two cycles and one cycle is kind of the input -- the  
16 activation.

17 MEMBER SHACK: If all you were depending  
18 on was the activation energy. But it's certainly  
19 true that if you dropped the temperature 20C, you'd  
20 get a lot. But you may not want to.

21 MR. MATTHEWS: Somebody asked earlier if  
22 the crack growth curve that was used was essentially  
23 the Peters-Scott model. Well that model was I guess  
24 initially based on steam generators but it was  
25 modified for the Alloy 600 head penetrations and that

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1 crack growth model was used, the modified Peters-Scott  
2 model was used for the susceptibility modeling that  
3 we've done in the industry on the head penetrations  
4 Alloy 600.

5 When we tested, in the test data that  
6 we've seen on the Alloy 82/182 shows those crack  
7 growths were, depending on the orientation with the  
8 dendrites, five to ten times faster than the Alloy 600  
9 crack growth rate.

10 And then the curve that the NRC used  
11 bounded all of that so it was even more than that,  
12 faster than the basic modified Peters-Scott model.

13 The short term assessment will demonstrate  
14 a large tolerance for axial flaws and the  
15 circumferential flaws. The stress analyses that we've  
16 done indicate a preference for the axial cracking  
17 because of the stresses in the welds and how they're  
18 lined up. The flaw, as you saw on the plot they put  
19 up, was limited to the axial length of the pipe weld,  
20 which is just a couple of inches long. Basically,  
21 that's based on the V.C. Summer experience, it stopped  
22 when it hit the ferritic steel, it stopped when it hit  
23 the stainless steel, and it was only the inconel weld  
24 metal that actually experienced cracking.

25 The flaw in the CRDM nozzle at Oconee 1

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1 also stopped when it hit the Ferritic steel. It did  
2 propagate on into the Alloy 600 base metal of the  
3 penetration itself.

4 And also the load limit fracture mechanics  
5 analysis will show that there's a large margin to pipe  
6 rupture.

7 MEMBER WALLIS: These are intents or  
8 indications?

9 MR. MATTHEWS: We believe that this is  
10 what they're going to show.

11 MEMBER WALLIS: But is it what you want to  
12 show.

13 MR. MATTHEWS: No, we believe it will show  
14 it. I mean a lot of this analysis is done --

15 MEMBER WALLIS: So this is based on  
16 analysis having been done?

17 MR. MATTHEWS: The analysis -- a very  
18 similar type analysis has already been done for V.C.  
19 Summer and we're going to extend it to the rest of the  
20 situation.

21 Similarly, for the circumferential flaws,  
22 a large margin, but since they can go 360 they're not  
23 limited by their axial. We'll demonstrate in this  
24 case that leakage will be detected very easily from a  
25 partial flaw while there is still a large margin on

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1 the limit load.

2 MEMBER WALLIS: Are flaws necessarily  
3 axial or circumferential?

4 MR. MATTHEWS: Well I guess they could be  
5 diagonal, depending on what's driving in and what the  
6 stress --

7 MEMBER WALLIS: Do they tend to go in  
8 straight lines?

9 MR. MATTHEWS: Well, they're jagged  
10 straight lines most of the ones I saw. There was a  
11 circumferential flaw underneath at V.C. Summer that  
12 intersected the axial flaw but it was up underneath  
13 the ferritic part of the nozzle. And it grew for a  
14 small distance and even that tended to turn in the  
15 axial direction because of the stresses we believe.

16 DR. FORD: Sorry, did you say the crack  
17 went into the ferritic steel?

18 MR. MATTHEWS: No, underneath it. The  
19 ferritic steel is clad on the -- with inconel for part  
20 way and it grew to the ferritic and stopped.

21 And then finally the short term safety  
22 assessment will present arguments similar to V.C.  
23 Summer's presentation on the January 18 meeting about  
24 the pipe -- that are covered by defense and death.  
25 And piping failure has been analyzed in the SARs and

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1 there's systems in place to mitigate it. Also, visual  
2 inspections for boric acid have been an effective way  
3 of identifying leaks well before there's been any  
4 structural margins affected anywhere.

5 MEMBER WALLIS: What is it you see when  
6 you see boric acid?

7 MR. MATTHEWS: Pardon?

8 MEMBER WALLIS: What do you see when you  
9 see boric acid?

10 MR. MATTHEWS: Actually you see the  
11 powder.

12 MEMBER WALLIS: You see solid boric?

13 MR. MATTHEWS: Yes, solid boric. And  
14 finding those boron deposits on the walk downs has  
15 been an effective way, at least to date, of finding  
16 flaws before there's any structural damage, structural  
17 margin is significantly affected.

18 For the longer term, the assessment  
19 committee will complete our scope definition,  
20 identifying all the areas of concern. One of the  
21 things we want to do is evaluate the generic  
22 applicability of the hot leg cracking, one of the  
23 elements, so that we'll be looking at finite element  
24 analysis including operational and residual stresses.

25 We will assess the safety significance of



1 the issue for all of the components, and then we will  
2 prioritize the locations based on safety significance  
3 into capabilities and the actual experiences in the  
4 field.

5 The assessment committee is also going to  
6 be charged with determining if any new inspection  
7 requirements are necessary and, if they are, such as  
8 ISI frequency, perhaps the ten year frequency we have  
9 on these may need to be modified. We'll be looking at  
10 that. And they'll assess the research needs. Where  
11 are the holes? They're defined where we need more  
12 information and then define research efforts to get  
13 that information.

14 One of the areas we'll be looking at  
15 certainly is crack growth data available worldwide.  
16 We have some data, we think there's other data  
17 available in the world and we'll be gathering that  
18 data and factoring all of that into our analyses.

19 VICE CHAIR BONACA: So when you're talking  
20 about determining inspection requirements, you're  
21 talking about refining the understanding of what  
22 inspection you need to do to detect?

23 MR. MATTHEWS: I guess the way the  
24 assessment committee would do it would say what do you  
25 need to find and how frequently do you need to look

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1 for it. And the inspection committee, which would be  
2 the next one, would be defining what we've got to do  
3 to find that kind of indication.

4 VICE CHAIR: Oh so you have -- okay. Yes.

5 MR. MATTHEWS: The next committee is the  
6 inspection committee. The first thing they wanted to  
7 do was get some guidance out for those plants with  
8 spring outages. I believe that letter was signed  
9 yesterday by Jack Bailey from TVA, the VP there who is  
10 the chairman of the MRP. The goal was to develop a  
11 consistent inspection approach. After looking at it,  
12 the committee and the people that EPRI NDE center both  
13 felt that for these nozzles the ID UT was still  
14 considered the best available technique. It's  
15 considered adequate certainly for the upcoming spring  
16 outages for a couple of reasons.

17 V.C. Summer's inconel weld was a field  
18 weld that was installed and had multiple repairs on it  
19 done in the field. The ID contour on that weld was  
20 not necessarily the best.

21 MEMBER WALLIS: Tell me more about UT. I'm  
22 sorry, is this a thing where some diagnostician looks  
23 at some picture? Or is it something where a computer  
24 analyzes a picture, or a computer analyzes certain  
25 facets of an image or what?

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1 MR. MATTHEWS: At least for UT today, the  
2 way it's being done is it's a trained technician  
3 watches the instrument. These are automated  
4 instruments that are --

5 MEMBER WALLIS: So it's as prone to error  
6 as diagnostic X-rays in hospitals, where someone looks  
7 at a picture and tries to see a crack.

8 MR. MATTHEWS: Well it's not a picture  
9 though, it's a trace on an oscilloscope.

10 MEMBER WALLIS: Looks for some anomaly?

11 MR. MATTHEWS: It's looking for any kind  
12 of anomaly and the data that's taken on these is a  
13 digital form of data, with hot leg alphas anyway if  
14 they're done from ID, it's an automated exam where the  
15 data's gathered and stored and digitized and can be  
16 then reviewed.

17 MEMBER WALLIS: And can they zoom in or  
18 something? I mean if he thinks there's something  
19 there can he get a magnification of the signal and  
20 things like that?

21 MR. MATTHEWS: Well, you can go look at it  
22 closer but I mean all the data's there available for  
23 him to look in as much detail as is available.

24 MEMBER WALLIS: I'm just wondering if  
25 greater attention to detail in the inspection would

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1 buy you some better assessment.

2 MR. MATTHEWS: We think absolutely and  
3 that's one of the things that we're working, that's  
4 one of the recommendations that we're putting out is  
5 to enhance the awareness of those inspectors to the  
6 kinds of anomalies that led to missed indications at  
7 V.C. Summer.

8 MEMBER POWERS: And Indian Point and a few  
9 other places. I mean there's been pandemic missing of  
10 indications here.

11 VICE CHAIR BONACA: I mean I'm somewhat  
12 disturbed by the top bullet, the UT is still  
13 considered the best available technique.

14 MR. MATTHEWS: That's today.

15 VICE CHAIR BONACA: I understand but you  
16 know the whole experience we saw in the presentation  
17 says that eddy current was an important complementary  
18 technique to identify indications that are seen as  
19 significant enough to say you should go only one  
20 cycle.

21 Now if this is true, it has implications  
22 for the other plants too, and it's hard to take then  
23 at face value the statement that ID UT is still  
24 considered the best available technique. I may just  
25 have trouble in accepting both statements at the same

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1 meeting.

2 MEMBER POWERS: Separated in time they're  
3 okay.

4 (Laughter.)

5 MR. MATTHEWS: The inspection committee  
6 and the people that -- everybody there with the  
7 inspection had worked with the results from V.C.  
8 Summer. They were also aware of the indication, or  
9 the information out of Ringhals that those guys, the  
10 eddy current didn't even see some of those flaws that  
11 the UT did see.

12 VICE CHAIR BONACA: And that's why I used  
13 the word complementary. That together seem to really  
14 yield some information.

15 MR. MATTHEWS: The problem the industry  
16 has with UT at this point is it's never been used  
17 except at Ringhals and at V.C. Summer. We don't  
18 really know what's in the VNC loop, we haven't really  
19 got a clue in my mind what's there. There's  
20 indications there. They haven't been proven, we don't  
21 know what it is. And to jump in there with an  
22 unproven technique on a plant that's down for a  
23 regular ISI and say, okay, you find a scratch in  
24 there, now you're limited and you've got to come back  
25 and do the cold leg again next cycle.

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1                   We felt it was a little premature for the  
2 industry to jump to something like that.

3                   VICE CHAIR BONACA: But for your plant,  
4 still you have restrictions based on ET.

5                   MR. MATTHEWS: Well, it's not my plant,  
6 it's V.C. Summer. No, I'm from Southern Nuclear.

7                   VICE CHAIR BONACA: Oh I thought -- I'm  
8 sorry, all right.

9                   MR. MATTHEWS: The way the mergers are  
10 going I don't think it's my plant.

11                  VICE CHAIR BONACA: I was referring to  
12 that, jut I confused the two, all right.

13                  MR. MATTHEWS: Another thing that the  
14 inspection committee did do is there was a mock-up  
15 available that the EPRI NDE center had of this type of  
16 weld, with imbedded flaws. Now admitted they were  
17 fatigue flaws but it's the best we've got right now.  
18 Some of those flaws are very shallow and we  
19 recommended that the plants, and there's a very  
20 limited number of plants with iconel welds here on the  
21 hot leg that are going in for inspections this spring,  
22 I think there's actually only three plants with  
23 iconel.

24                  And we recommended that those plants have  
25 their vendors perform a demonstration of their

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1 techniques on the EPRI mock-up, and all those vendors  
2 have done so and, as a result of doing those  
3 demonstrations, there have actually been some  
4 modifications to the procedures that were being used.  
5 New transducers and new scanning gains on the  
6 instruments to get a more sensitive examination.

7 Also, we said that we were going to  
8 enhance the awareness of inspectors and not just be  
9 willing to say, well, I got 90 percent coverage on  
10 that weld, that meets the code. If you get a lift off  
11 do what you can to remedy that situation. And be  
12 aware of what a lift off looks like on the data and  
13 see if there's not something you can do about it.

14 MEMBER WALLIS: How long does it take to  
15 do this inspection? Have you got something which is  
16 going around and traversing on some track?

17 MR. MATTHEWS: It's a robot arm typically  
18 that hangs off the vessel. It is done simultaneously  
19 with the belt line weld exams on the vessel by the ten  
20 year ISI. And it will go in and has a sled that will  
21 --

22 MEMBER WALLIS: Is this a day long  
23 operation type thing?

24 MR. MATTHEWS: I imagine it's at least  
25 that. I'm not sure how long it takes. Not per nozzle

1 I would imagine it wouldn't take all day.

2 MEMBER SIEBER: About 12 hours including  
3 moving into position.

4 MR. MATTHEWS: Per nozzle.

5 MEMBER WALLIS: Presumably the signal --  
6 everything comes out as stored information so it's  
7 available at any time.

8 MR. MATTHEWS: For these particular  
9 nozzles and these particular welds it is. There's  
10 other inconel welds that are not done today with  
11 automated techniques where that's not true. But for  
12 these hot leg and the cold leg nozzles off the vessel,  
13 those are typically automated exams from the ID.

14 Back on the, well I guess I've mentioned  
15 the three plants that have inconel welds that are  
16 doing 10 year vessel ISIs we understand geometry is a  
17 very big issue here, the ID geometry in the contact of  
18 the sleds. Looking at it, those three plants, the  
19 inconel weld was a shop weld not a field weld and we  
20 firmly believe that the ID geometry for the inconel  
21 part of this weld will be in much better shape than  
22 the situation at Summer. I'm not sure we have ID  
23 contours but typically those shop welds are in much  
24 better shape when we ID than the field welds.

25 MEMBER SHACK: Can you try to finish up in

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1 five minutes?

2 MR. MATTHEWS: Oh, okay I'll hurry.

3 Other things that we're recommending is  
4 that we enhance the sensitivity of the boric acid walk  
5 down and enhance the awareness of the operations and  
6 chemistry people looking for small changes and  
7 unidentified leakage and possible, or notifying them  
8 where these 82/182 welds are.

9 Longer term actions of the inspection  
10 committee, they need to evaluate the need for  
11 alternative and new techniques and we'll be doing  
12 that. We'll be looking at the evolving capabilities  
13 of the vendors over the years and what new techniques,  
14 if applicable, could be applied.

15 We'll be looking internationally at what  
16 techniques are available. There may be something  
17 overseas that some of those vendors are using, and we  
18 realize we have to address in the little bit longer  
19 term the geometry concerns for the ID.

20 We'll evaluate the data we get out of the  
21 spring outages and feed that back in to the fall  
22 plants for further recommendations.

23 Also, we'll be defining what additional  
24 mock-ups are needed. We'll work with the vendors on  
25 delivery systems, such as the smaller transducer

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1 packages or better articulating tools, and coordinate  
2 the demonstration of capabilities with the PDI -- as  
3 they're developing their mock-ups for qualification of  
4 inspectors. That's a fall 2002 requirement that  
5 bimetallic or dissimilar metal welds be examined by  
6 qualified people.

7 And then through the NDE center we'll be  
8 providing training and expert help where it's needed.

9 And, finally, evaluate the impact on risk  
10 informed ISI.

11 But the industry experience is an integral  
12 part of that risk informed ISI process, so experience  
13 here will have to be factored in, and there's a  
14 required feedback loop in the risk informed ISI  
15 process that takes industry experience and phases it  
16 back in and into the program for those plants that  
17 have already implemented risk informed ISI. And  
18 they'll have to be assessing that impact on their  
19 programs.

20 Finally, the repair and mitigation  
21 committee's running a little bit behind the others.  
22 It's not quite as urgent for us to be addressing that.  
23 They'll be meeting in March and they will assess the  
24 need for improvements in the repair and mitigation  
25 processes. That will depend to some extent on what

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1 comes out of the assessment in the inspection  
2 committee.

3 What the repair group will be looking at  
4 will be prioritizing the locations based on repair  
5 mitigation inspection perspective which could be quite  
6 different than a safety perspective. They'll look at  
7 the likelihood and consequences of a failure or a  
8 leak, how difficult is it to implement a repair,  
9 trying to assess where we might need to work with  
10 vendors to come up with better ways to repair or  
11 mitigate the situation.

12 They're going to create a matrix by  
13 assessing the existing technology, look at what would  
14 be involved in the qualification and demonstration of  
15 a new technique, and where there's any kind of code or  
16 regulatory compliance or involvement, we'll be getting  
17 the NRC and the code people involved early in the  
18 development of those processes.

19 What is our schedule? We've scheduled a  
20 technical working meeting with the NRC on March 23.  
21 In that meeting we will be going over the detailed  
22 approach of the short term safety assessment and  
23 hopefully by that time we will have many if not all of  
24 the results available, possibly not in their final  
25 form. And we'll solicit their feedback on that short

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1 term safety assessment. The plan is to get that to  
2 them by the end of the month.

3 We're trying to arrange a visit to the NDE  
4 center by the staff. We'd be working with the staff  
5 and, as Gene said, the staff has already been down and  
6 audited the demonstration of the technology, or the  
7 inspection tools at FTI.

8 The short term assessment inspection to be  
9 completed in March. The inspection guidance, like I  
10 said, I believe that was issued yesterday. Longer  
11 term, the assessment inspection efforts for June time  
12 frame involve evaluation of the spring 2001 inspection  
13 results and assessment of all the 82/182 welds in the  
14 plant, in the primary system, not just the ones that  
15 we think might be the most likely.

16 And then even longer term there'll be  
17 continued assessment of all the Alloy 600 applications  
18 inspection and repair mitigation technology and  
19 whatever research efforts we and the staff have to  
20 come up with.

21 Finally, in conclusion, MRP has taken the  
22 lead for the industry in developing an industry plan  
23 here. We firmly believe this is not really a near  
24 term safety issue because of the margin available in  
25 these welds to failure of the piping. Visual

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1 inspections for boric acid have been effective and  
2 they are effective at finding leaks before there's any  
3 structural integrity threatened. Pipe welds are  
4 covered by defense and death approach has been  
5 inherent in the nuclear industry all along, and we're  
6 performing the short term assessment to demonstrate  
7 that we can continue to operate.

8 MEMBER WALLIS: I want to ask you about  
9 this effectiveness. Now at Summer, boric acid was  
10 used to find the leak, right.

11 MR. MATTHEWS: Yes.

12 MEMBER WALLIS: Suppose it had not been  
13 found for another period of time, how long can it go  
14 on before something worse happens?

15 MEMBER POWERS: One, two, or more cycles.

16 MR. MATTHEWS: The leak at V.C. Summer was  
17 through a very, very small pin hole where the crack  
18 had finally made it to the OD and it was a very, very  
19 small leak. It was 1.2 GPM. Before the crack gets  
20 anywhere near a crack size that could threaten a  
21 rupture of the pipe, you'll be leaking tens of gallons  
22 of water per minute and you'll easily pick that kind  
23 of thing up.

24 MEMBER WALLIS: Yes, but that's not really  
25 addressing the first question. I mean are you saying

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1 more visual inspections are effective, they're only  
2 going to be effective if they're caught on time, early  
3 enough. And if you inspect and you don't see boric  
4 acid and then you wait for so long, it must not grow  
5 in that period of time. How fast is it, I don't have  
6 a feel for how fast it would grow if you hadn't  
7 detected it.

8 MR. WAGONER: Cycles and cycles and  
9 cycles.

10 MEMBER WALLIS: Many cycles before there's  
11 a big leak?

12 MR. WAGONER: Yes, sir. I'm Vaughn  
13 Wagoner from Carolina Power and Light. And the point  
14 is that the, and I'm going to use some round numbers,  
15 but a half an inch a year, okay, three-quarters of an  
16 inch for an 18 month cycle. So you've got two or three  
17 inches of weld metal in axial direction and it's going  
18 to stop on both ends, theoretically you could run for  
19 ever. So you've got numbers of two, three inches  
20 that you'll be able probably to have a discernible  
21 leak and you've got even in the circumferential  
22 directions you've got tens of inches of flaw  
23 capability before you ever get there.

24 So you've got cycles and cycles and cycles  
25 of margin, even if you're in a circumferential

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1 direction, which is the only one we're really worried  
2 about it for a catastrophic failure. And those are  
3 round numbers, but I think it's the order of  
4 magnitude, I mean it's in the ballpark of what we're  
5 talking about.

6 MEMBER WALLIS: Is that something the --  
7 agrees with.

8 MR. WICKMAN: Keith Wickman, NRR.  
9 Critical crack size both axially and circumferentially  
10 are very large. Okay. So on the face of it, yes.

11 VICE CHAIR BONACA: So really boric acid  
12 will be identifying those before leakage?

13 MR. MATTHEWS: No. The boric acid comes  
14 from the leak.

15 VICE CHAIR BONACA: No, I understand that,  
16 I'm saying that you would find it through an  
17 inspection, walking down, you see boric acid and  
18 that's on inspection before you find it through  
19 unidentified leakage. What you're telling me is that  
20 --

21 MR. MATTHEWS: That's a distinct  
22 possibility. That's exactly what happened at V.C.  
23 Summer.

24 VICE CHAIR BONACA: Because the growth is  
25 so slow.

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1 MR. MATTHEWS: That's exactly what  
2 happened at V.C. Summer. And we do boric acid walk  
3 downs every outage and they're pretty thorough and  
4 we're enhancing the awareness of the people that are  
5 doing those boric acid walk downs to be sure you trace  
6 it back and don't assume it was a valve. Trace it  
7 back and make sure you know where it's coming from.  
8 That kind of thing. So if there is a leak and it's  
9 been going on for any -- or leaked out any significant  
10 amount of boric acid, we feel quite confident that  
11 we'll find those on the walk downs.

12 MEMBER SHACK: Coming back to Graham's  
13 question though a little bit, I mean circumferential  
14 cracks are a little more difficult to deal with  
15 because when you have stress corrosion cracking and  
16 you have residual stress pattern, you can at least in  
17 fusion systems where you get very large aspect ratio  
18 cracks, and he's certainly right that if you get a  
19 through wall crack of X inches it will take you a long  
20 time to grow that way.

21 If the crack is sort of growing at a very  
22 large aspect ratio when it comes through the wall,  
23 then things can get more exciting, which is why the  
24 NRC hasn't allowed leak-before-break in systems that  
25 have been susceptible to stress corrosion cracking.



1 MEMBER WALLIS: Aspect ratio I mean  
2 there's a long base to the crack, a little tip up here  
3 so --

4 MEMBER SHACK: Well, relatively shallow  
5 and a long length. The axial flaw are really much  
6 easier because they do, they butt up against the  
7 stainless steel on the one end and the ferritic vessel  
8 on the other, and they're sort of stuck there.

9 MEMBER WALLIS: Are they stopped forever  
10 there?

11 MEMBER SIEBER: Pretty much.

12 MEMBER SHACK: Forever as long as, you  
13 know, on the scale that we're interested in things,  
14 yes.

15 MR. MATTHEWS: And we'd certainly find  
16 those before they corroded away the nozzle from boric  
17 acid from the OD I think.

18 Interim inspection guides for near to term  
19 plants has been issued. We will revise that later as  
20 we get more information, as we have better handles on  
21 technology. The longer term assessment in the Alloy  
22 600 and 182 and 82 welds in the PWR primary system and  
23 including inspection repair and mitigation, we'll be  
24 looking at all these things in a little longer term  
25 and we intend to keep the NRC staff fully informed of

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1 everything we do and as we're going along.

2 Basically, any more questions. Did I do  
3 it in five?

4 MEMBER SHACK: Close enough.

5 MR. MATTHEWS: Okay.

6 MR. BATEMAN: This is Bill Bateman from  
7 the staff. If you don't mind I'd like to make a  
8 couple of comments quickly because I know it's getting  
9 close to lunch time.

10 I'm the chief of the branch that had to  
11 make the decision as to what to do as the result of  
12 can Summer restart or not. And at least from a code  
13 perspective, the affected weld was totally replaced so  
14 we got out of the code realm when they cut the whole  
15 weld out and put in a whole new weld. So from that  
16 perspective Summer was in compliance with the code.

17 Regarding the other two indications on the  
18 cold leg, those welds, even assuming a 2:1 aspect  
19 ratio did not achieve 10 percent depth in the pipe,  
20 which would have required a flaw analysis by the code.  
21 So by code requirements there is no requirement to do  
22 a flaw analysis because the assumed depth of that eddy  
23 current indication was not at a 10 percent depth.

24 However, we took the bounding crack growth  
25 rate and applied it to the one-eighth inch assumed

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1 depth to that crack to assure that that crack would  
2 not exceed the 75 percent through wall. And the time  
3 we came up with was about one cycle.

4 So those are the conservatisms that the  
5 staff used in coming to the conclusion that it would  
6 be all right for Summer to restart. I want to try and  
7 firm that up. There seems to be some skepticism I  
8 think in terms of our rationale.

9 So, again, in terms of the code, there was  
10 never an issue with code. Everything was totally in  
11 compliance with the code, we went beyond the code and  
12 basically with the bounded crack growth rate analysis  
13 to make our determination.

14 And, again, with respect to the crack  
15 growth rate analysis, there's not a lot of data, but  
16 the data we did have we reviewed with our own  
17 expertise and we went to National Lab and got their  
18 advice in terms of whether or not this was a valid  
19 crack growth rate, and whether or not our assumptions  
20 were valid. And all the feedback we got led us to use  
21 the data that we did with confidence that we would not  
22 have a problem prior to an inspection after one cycle  
23 of operation.

24 MEMBER SHACK: Any additional comments?  
25 No. Mr. Chairman.

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1 VICE CHAIR BONACA: With that I think we  
2 will take a break for lunch and we will come back at  
3 one o'clock.

4 (Whereupon, the above-entitled matter went  
5 off the record at 11:56 a.m.)  
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# **DISCUSSION OF V.C. SUMMER TECHNICAL REVIEW AND GENERIC ACTIVITIES**

ACRS MEETING  
MARCH 2, 2001

C. E. CARPENTER  
NRR:DE:EMCB

# STAFF'S REVIEW

- Staff Performed Independent Evaluation of Licensee's Assessment of "B" and "C" Nozzle Welds
  - "Integrity Evaluation for Future Operation: Virgil C. Summer Nuclear Plant Reactor Vessel Nozzle to Pipe Weld Regions," dated December 26, 2000 (WCAP-15615, Revision 1)
  - Provided Results of Westinghouse's UT & ET Examinations of Nozzle to Pipe Welds for Loops "A," "B," and "C"
  - Provided Flaw Evaluation Proposing That Summer Could Be Operated for Two Fuel Cycles Without Repair of Existing ET Indications on "B" & "C" Hot Leg Nozzle Welds

## **STAFF'S REVIEW** (con't)

- Staff's Review Found Summer Could Be Operated with ET Indications in "B" and "C" Hot Leg Welds for 1 Cycle
  - Used Bounding PWSCC Crack Growth Rate and Flow Stress for Weld Material, and Initial ET Indication Length & Inferred Depth
  - Used Bounding CGR Due to Limited Crack Growth Rate Data for Alloy 82/182 Material
  - Evaluation Issued February 20, 2001



# ONGOING ACTIVITIES

- Staff Is Reviewing Similar Cracking in Foreign Reactors
  - Root Cause of Summer and Ringhals Cracking is PWSCC
  - Investigating Reports of Other Foreign Cracking

## **ONGOING ACTIVITIES** (con't)

- **Staff Assessing:**
  - Generic Implications and Industry Activities
  - Implications on Leak-Before-Break (LBB) Analyses
  - Implications on ISI (Deterministic and Risk-Based) Programs
  - Ability of ASME Code-Required NDE to Detect and Size Small ID Stress Corrosion Cracks (Effect of Surface Condition)
  - Appropriateness of ASME Code Standards Allowing Flaws up to 10% of Wall Thickness Without Evaluations Given Apparent High CGR
  - Effectiveness of RCS Leak Detection Systems

# GENERIC ACTIVITIES

- Staff Proposing Confirmatory Research into PWSCC Cracking Issue to Include:
  - NDE / ISI Issues
  - Determination of Bounding CGR and Residual Stresses
  - Development of Susceptibility Model
  - Assessment of Possible Repair / Mitigation Methods
  - Following Industry Activities

## **GENERIC ACTIVITIES** (con't)

- PWROGs Have Proposed Industry Initiative to Respond to PWSCC Cracking Issue
  - PWR Materials Reliability Program (MRP) Alloy 600 Issue Task Group (ITG) Addressing Assessment, Inspections and Repair/Mitigation
  - Met with Staff (January 25 & February 16) to Discuss Industry Plans to Respond to Cracking Issue
  - Staff Observed Inspection Mock-up at MRP Vendor Site
  - Future Technical & Management Meetings Planned

# STAFF EXPECTATIONS

- Staff Expectations of Generic Activities
  - MRP Assessment of Generic Susceptibilities
  - NDE Methodologies / Tooling Should Make Use of Best Practices and Capabilities to Address Potential Weaknesses
  - Potential Code Cases
  - Implication for ISI & LBB
  - Long Term Assessment of Alloy 82/182 Applications
  - Review of Repair/Mitigation Methods

## **Industry Response Alloy 82/182 Weld Cracking**

**ACRS Briefing – March 2, 2001**

**Materials Reliability Program  
Alloy 600 Issue Task Group (ITG)**

**Larry Mathews, SNC, Chairman  
Al McIlree, EPRI Project Manager**

## **Industry Response to Generic Implications**

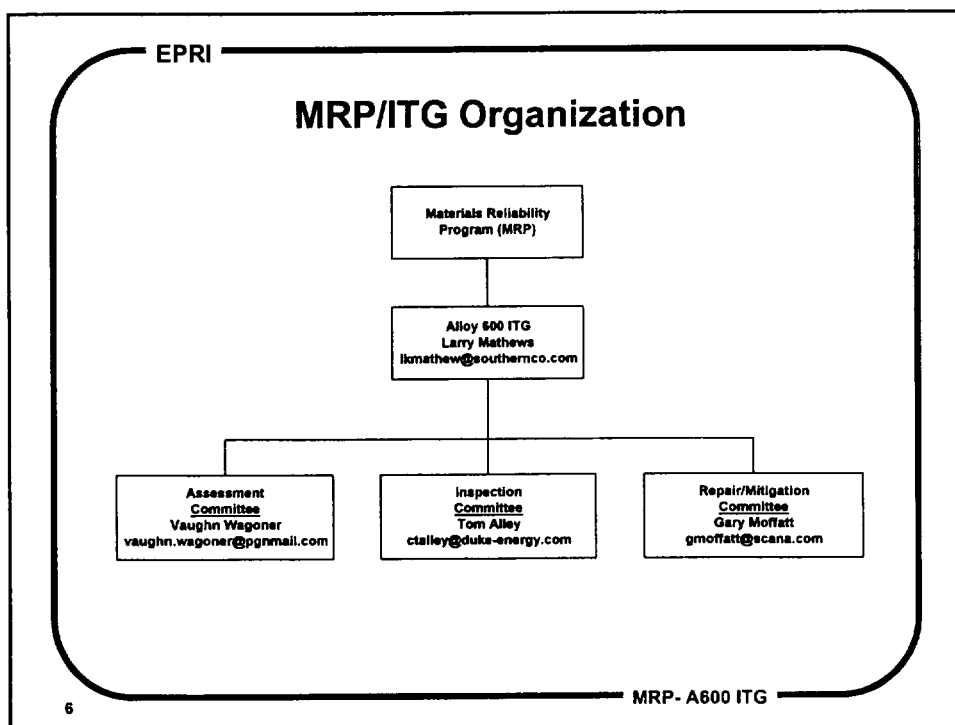
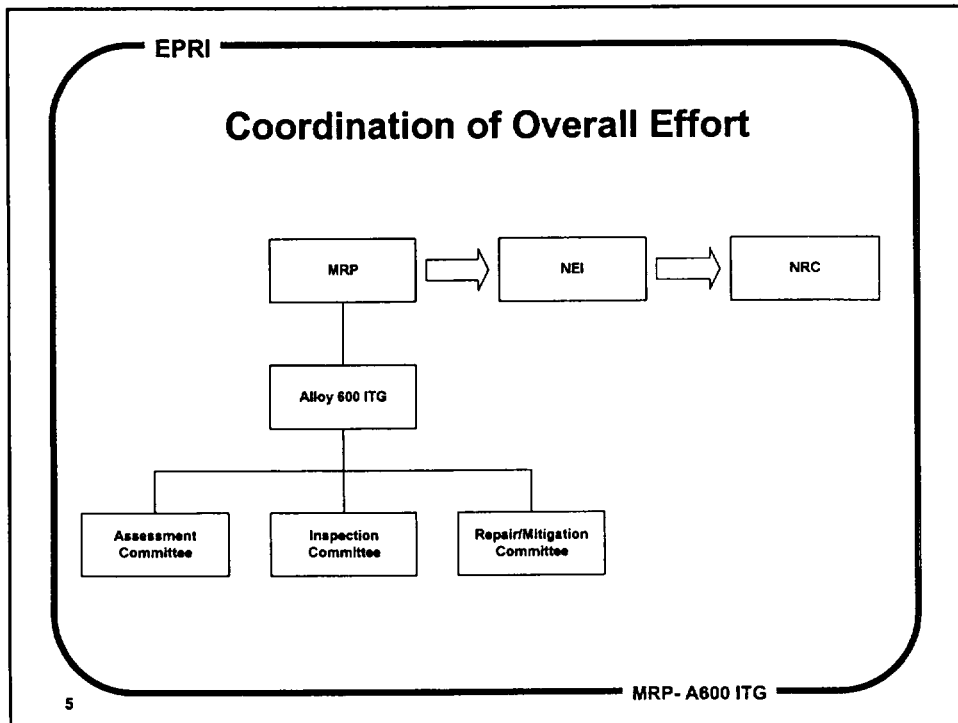
- **MRP A600 ITG has taken the lead in developing the industry plan**
  - VC Summer event Oct, 2000
  - Root Cause Information early Dec, 2000
  - IIG Recommended Industry Program mid Dec.
- **Executive approval early Jan, 2001**
  - Developed organization
  - Developed detailed plan and budget
- **ITG organized 1/19/01 to address key focus areas**
  - Assessment Committee
  - Inspection Committee
  - Repair/Mitigation Committee

## Industry Response to Generic Implications

- 1/25/01 Meeting with NRC
  - Outline approach
  - Solicit feedback
- 2/1/01 Initial meetings of Inspection and Assessment Committees
  - develop plan, schedule, and budget
- 2/16/01 MRP/NRC Executive Management Meeting
- 3/23/01 Technical meeting with NRC staff - scheduled

## MRP Status March 2, 2001

- The industry plan includes:
  - Short term assessment to demonstrate that continued operation with Alloy 82/182 welds is acceptable, by late March.
  - Interim inspection guidance for near term outage plants - Complete
  - Longer term assessment of all Alloy 82/182 applications in PWR primary systems
  - Review and improvement of inspection technology
  - Review of repair/mitigation methods and improvement if necessary
- Endorsement of plan by Senior Representatives is anticipated at their meeting on 03/09/01





## Assessment Committee Activities

- **Short Term Safety Assessment**
  - **Identify areas likely to be most susceptible**
    - » Evaluate size, temperature, and weld materials
    - » W and CE – likely to be hot leg pipe welds
    - » B&W – likely to be CRDM nozzle welds
  - **Demonstrate that most cracks will be axial, or axial-radial in case of CRDM nozzle welds**
    - » Domestic and international experience with similar welds
    - » Finite element stress analysis including welding residual and operating stresses

## Assessment Committee Activities (cont.)

- **Short term Safety Assessment (cont'd)**
  - **Demonstrate large tolerance for axial flaws**
    - » Stress analyses indicate preference for axial cracking
    - » Flaw limited to axial length of pipe weld
    - » Flaw limited to J-groove and nozzle thickness for CRDM welds
    - » Limit load and fracture mechanics analyses will show large margin
  - **Demonstrate large tolerance for circumferential flaws**
    - » Leakage will be detected from partial-arc flaws while there is still large margin on limit load

## Weld Assessment Technical Approach (cont.)

- **Short term Safety Assessment (cont'd)**
  - Pipe weld failures are covered by Defense-in-Depth (pipe failure has been analyzed in the SARs)
  - Visual inspections for boric acid have been effective in identifying leaks well before any structural margins are affected

## Weld Assessment Technical Approach (cont.)

- **Longer Term Action**
  - Complete scope definition
  - Evaluate generic applicability
    - » Finite element analyses, including operating and residual stresses
  - Assess safety significance
  - Prioritize locations based on safety significance, NDE capabilities, and actual experiences
  - Determine inspection requirements
  - Develop consistent flaw evaluation guidelines
  - Assess research needs and oversee tasks
    - » Coordination with ongoing CGR work

## Inspection Committee Activities

- **Short Term Inspection Guidance**
  - **Develop consistent inspection approach**
    - » ID UT still considered best available technique
    - » Considered adequate for upcoming spring outages
    - » Demonstrations on EPRI mockup
  - **Enhanced awareness of inspectors to signal anomalies**
  - **Review previous inspection data for geometry, signal quality, etc.**
  - **Enhanced sensitivity for boric acid walkdown**
    - » Visual inspections are effective
  - **Enhanced awareness of Operations/Chemistry personnel during operation**

## Inspection Committee Activities (cont'd)

- **Longer Term Actions**
  - **Evaluate need for alternate/new techniques**
    - » Evolving Vendor capabilities
    - » International capabilities
    - » Geometry concerns
  - **Evaluate Spring Inspection results/feedback to Fall plants**
  - **Define additional mockup needs**
  - **Work with vendors on delivery systems**
  - **Coordination of demonstrations with current App. VIII actions**
  - **Provide training/expert help to utilities**
  - **Evaluate impact on Risk Informed ISI**

## Repair/Mitigation Committee

- **Need for repair/mitigation improvements depends on Assessment and Inspection Committee findings**
- **Prioritize from repair/mitigation/inspection perspective**
  - **Likelihood/consequence of failure**
  - **Implementation difficulty**
  - **Cost and dose**
  - **Material availability**
- **Create a repair/mitigation matrix**
  - **Assess existing technology**
  - **Qualification and demonstration**
  - **Code and regulatory compliance/involvement**

## Schedule

- **Technical working meeting with NRC, March 23, 2001**
  - **Describe detailed approach**
  - **Discuss preliminary findings**
  - **Solicit feedback**
- **Arrange NRC visit to NDE Center**
- **Short term Assessment/Inspection effort completed in March**
  - **Safety Assessment of Alloy 82/182 welds**
  - **Inspection guidance for Spring 2001 outages**
- **Longer Term**
  - **Assessment/Inspection efforts for June**
    - » **Evaluation of Spring 2001 inspections**
    - » **Assessment of all Alloy 82/182 welds**
  - **Continued assessment of all Alloy 600 applications, inspection and repair/mitigation technology, research efforts**

## CONCLUSIONS

- MRP A600 ITG has taken the lead in developing the industry plan
- Not a near term safety issue
  - Visual inspections for boric acid are effective
  - Pipe weld failures are covered by Defense-in-Depth (pipe failure has been analyzed in the SARs)
  - Short term assessment to demonstrate that continued operation with Alloy 82/182 welds is acceptable, by late March
- Interim inspection guidance for near term outage plants - Complete
- Longer term assessment of all Alloy 600 and Alloy 82/182 applications in PWR primary systems, including inspection, repair, and mitigation
- Will continue to keep NRC informed

# **V. C. Summer Reactor Coolant System “A” Hot Leg Crack**

---

ACRS Meeting  
March 2, 2001

# V. C. Summer

ACRS Meeting  
March 2, 2001

- V. C. Summer Background -- Karen Cotton
- Discussion of Technical Review and future activities -- Gene Carpenter
- Materials Reliability Program -- Larry Matthews
- Billy Crowley -- Special Inspection Team Leader
- Steve Doctor, Ph.D -- Special Inspection Team Member

# History

- **October 7:** Discovery of boron deposits
- **October 13:** Liquid penetrant test revealed (PT) 4-inch indication on the “A” hot leg (later determined to be surface only)
- **November 6:** Ultrasonic testing (UT) and eddy current testing (ECT) revealed an axial crack approximately 2½” long with a “weep hole” exit point



# V. C. Summer Activities

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- Designated an evaluation and repair team
- Assembled a team of industry experts
  - ▶ Initiated Root Cause analysis
  - ▶ Researched Repair alternatives

# **V.C. Summer Activities Cont'd**

- **Established Completion Goals**
  - ▶ Plant will be safe for start up:
    - Pipe and weld(s) meet code requirements
    - Repair will bound probable failure scenarios
    - Commonalities are addressed in the other welds
      - ECT indications found in 5 of 6 nozzle welds
- **Developed a Communications Plan**
- **Licensee Commitments**
  - ▶ To enhance their leak detection procedures
  - ▶ To inspect the 'B' and 'C' hot leg welds in Refueling Outage 13
  - ▶ To inspect all nozzle-to-pipe welds in Refueling Outage 14

# **NRC Activities**

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- Special Inspection Team (SIT) chartered
- Communication Plan developed
- Communication Team formed
- Summer Event Website developed
- Issued
  - ▶ Information Notice 2000-17 -- October 18, 2000
  - ▶ Supplement 1 -- November 16, 2000
  - ▶ Supplement 2 -- February 28, 2001
- Safety Evaluation of WCAP issued 02/20/01
  - ▶ Evaluation of the 'B' and 'C' hot leg welds

# NRC Activities (Cont'd)

- Held five public meetings:
  - Atlanta - October 25, 2000
  - Washington - November 21, 2000
  - Atlanta - December 20, 2000
  - V. C. Summer Site - January 18, 2001
  - V. C. Summer Site - February 15, 2001 (public SIT Exit meeting)

# **Licensee's Root Cause Determination**

- The construction weld process of grinding out the inside of the weld with a bridge pass in place created high welding residual stresses in the material (Alloy 182/82) susceptible to primary water stress corrosion cracking (PWSCC)

# **Special Inspection Team (SIT)**

## **■ Inspection Objectives:**

- ▶ To verify that the corrective actions activities were appropriate.

## **■ Inspection Scope:**

- ▶ To review and/or observe licensee activities relative to root cause determination and corrective action.

# SIT Cont'd

## ■ Inspection Activities

- ▶ Reviewed the licensee overall corrective actions
- ▶ Reviewed original construction records, previous PSI and ISI records
- ▶ Observed current welding and NDE activities
- ▶ Two trips to Westinghouse to review metallurgical analysis of the spool piece removed from the 'A' hot leg weld

# SIT Findings

- Root Cause analysis was found acceptable
- All welding and NDE activities met Code requirements