

1 inspector to a senior, and then they'll move to  
2 another facility, but seven years is the maximum, and  
3 that's written in our policy.

4 CHAIRMAN CONWAY: Thank you. Dr. Hackett.

5 DR. HACKETT: Thank you, Mr. Chairman. I  
6 have a different challenge today, which is to try and  
7 help walk you through a story that's very important to  
8 us in the nuclear industry. In general, it dovetails  
9 with what Russ and Cindy had been talking about. The  
10 thing I'll add on this slide is that during the  
11 timeframe from May to October 2002, I was Assistant  
12 Team Leader for the NRC's Davis-Besse Lessons Learned  
13 Task Force. That's the role in which I'll be  
14 presenting this information to you. As you've been  
15 doing, I think I found that these work most  
16 effectively when there is back and forth exchange and  
17 dialogue. I think that would be the best way to  
18 proceed.

19 For those who don't know about this, in  
20 February 2000, we discovered a corrosion cavity, and  
21 I have some graphics here to walk you through, on the  
22 Davis-Besse reactor vessel head during inspections for  
23 vessel head penetration cracking. These are the  
24 penetrations that come through for the control rod  
25 drives. They are Inconel and the vessel head is a

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1 carbon steel.

2 The extent of the corrosive attack was  
3 unprecedented. This was from a concentrated boric  
4 acid solution, but we still don't know exactly the  
5 particulars. It was a combination of leakage through  
6 the penetration of the primary coolant system and also  
7 most likely leakage from above in terms of some of the  
8 seals on the control rod drive assemblies themselves.

9 It set up a situation on top of the head  
10 that ended up in a very aggressive attack on the head,  
11 that as you can see on the slide here, degraded over  
12 six inches of carbon steel all the way down to the  
13 internal stainless steel cladding liner, which was all  
14 that remained as the pressure boundary over the  
15 degraded area. This was absolutely a function for  
16 which the stainless steel cladding was not at all  
17 designed. I think this has been characterized in the  
18 press as a "near miss" for the industry and for us,  
19 not a place we ever want to see ourselves go back to  
20 again.

21 I like to use props, so I brought one  
22 along. I don't know if this will be too heavy to pass  
23 around. I brought along a metallurgical section here,  
24 too, the Midland reactor vessel that shows some of the  
25 features that I'm talking about. I can hold it for

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1 the camera here too and I'll pass this around. I've  
2 marked the six-inch point on here to show exactly how  
3 much steel you are talking about degrading.

4 Also this shows some details of the  
5 through-wall weld and also the stainless steel  
6 cladding. You can pass that around. It is a bit on  
7 the heavy side. That was discomforting, on the order  
8 of a nine-inch wall. When we talk about conservatism,  
9 there's definitely some there.

10 In reaction to this, the NRC chartered a  
11 Lessons Learned Task Force, as I mentioned, in May  
12 2002, and it was really aimed at answering the  
13 questions of: "Why was this event not prevented? How  
14 could this have happened?"

15 I'll talk you through some of the  
16 specifics. This came out a little bit scrunched up  
17 into PowerPoint here, but a typical pressurized water  
18 reactor. In the case that they specified, we are  
19 looking at the B&W [Babcock & Wilcox] design that  
20 illustrates some of the features I was mentioning  
21 earlier. On the top there, of course, you have the  
22 control rod drive assemblies and the penetrations that  
23 go into the top of the reactor vessel head are in this  
24 area here. That's where I'll be focusing.

25 This shows it to you a little bit better.

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1 This area right [here] is where the degradation cavity  
2 was on the Davis-Besse head. As I mentioned, pretty  
3 much along with the laser pointer here from the top  
4 right here all the way down to this inside piece was  
5 degraded over the area about the size of a football.  
6 It's been characterized as that most often in the  
7 media. Again, that was a combination of leakage  
8 through this penetration here, which was nozzle number  
9 three, which was due to stress corrosion cracking in  
10 the Inconel penetration and also leakage from the  
11 seals, above which had accumulated a crust of boric  
12 acid underneath this insulation.

13 Some other features I can mention, it's  
14 obviously a difficult area to inspect. There is a  
15 very high radiation area. Also, this has an access  
16 structure on it which has access holes in it. But to  
17 get in there and do a thorough inspection of this  
18 region on a B&W design is difficult. It's far more  
19 difficult on some of the other designs, unfortunately.  
20 B&W is actually one of the easier ones.

21 This is some detail of the penetration.  
22 The leakage that I'm talking about came through [the]  
23 wall on this material here, which is the Inconel. The  
24 cracks go through - in some cases there's both - what  
25 we call the "J-groove welds" down here, which are an

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1 austenitic weld metal that joins the Inconel to the  
2 carbon steel. They also go through the actual wall of  
3 the Inconel housing itself. Then what you set up  
4 apparently - we'll never know this for sure given the  
5 way things played out - a condition in this area here  
6 that was very conducive to accelerated attack of the  
7 carbon steel that was further complicated by a crust  
8 of boric acid and corrosion product that remained on  
9 top of the head.

10 DR. MANSFIELD: So you were indicating  
11 that the leaks and initial corrosion could have been  
12 from inside out.

13 DR. HACKETT: That's correct. What you'll  
14 see and what I'll talk to you about is that the state  
15 of the head up here over a fairly long period from  
16 probably about 1996 to 2002 was in a pretty bad state  
17 of maintenance. That is something that not only the  
18 licensee missed, was not focused on, nor was the NRC.

19 CHAIRMAN CONWAY: Wouldn't that have shown  
20 up in a refueling during that period of time?

21 DR. HACKETT: Absolutely. There were two  
22 refuels during that period of time during which the  
23 head was "inspected." Obviously those inspections  
24 were completely inadequate to have detected this  
25 phenomenon. That's part of what I'll go into.

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1           The last piece, this shows the schematic.  
2           Then we'll see the actual photo. This shows the  
3           cavity. You can see from this penetration here,  
4           number three, the entire piece of the head through  
5           this region is gone all the way down to the cladding.

6           Actually something quite spectacular to me  
7           was when I figured this out at the time that the  
8           cladding was able to serve the function of the  
9           pressure coolant boundary as well as it did. It is  
10          not at all designed for that. It's about three-tenths  
11          of an inch of stainless steel weld.

12          Our research analysis actually showed that  
13          it would have held more than double the pressure of  
14          the reactor coolant boundary over that area.  
15          Obviously that would not have lasted forever. The  
16          debate rages as to how much longer you would have had,  
17          but it was probably on the order of months to a year  
18          before it would progress to the point that you might  
19          have lost that interface.

20                 DR. MANSFIELD: So the span would grow.

21                 DR. HACKETT: Right, exactly. The problem  
22                 is trying to get into a debate with corrosion experts  
23                 around the world of exactly how fast that would have  
24                 progressed.

25                 DR. MANSFIELD: But there wasn't any

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1 degradation of the properties of the stainless.

2 DR. HACKETT: No.

3 DR. MANSFIELD: So a properly designed  
4 discontinuous support of a thin stainless steel vessel  
5 might be able to serve as a pressure vessel.

6 DR. HACKETT: That's correct.

7 CHAIRMAN CONWAY: You said there are  
8 differences, disagreement, among the so-called  
9 experts, but you bounded it presumably so the most  
10 conservative if you will --

11 DR. HACKETT: Exactly. That's what we  
12 tried to do in our bounding. We always are nervous  
13 when we use the word "bounding," because as soon as we  
14 issue that from your mouth it's challenged or it's  
15 proven to be wrong. We thought the bounding estimate  
16 would be on the order of six months that the attack  
17 could progress that fast and spread out over a wide  
18 enough area that you might actually cause a breach.  
19 So again, as I said at the opening, far closer than we  
20 ever wanted to be.

21 This is actually what it looked like.  
22 Probably not the best picture, but here, this is the  
23 top of the reactor vessel head around the side of the  
24 cavity. This dimension from here down to there is the  
25 six inches or actually I think it's about six and a

1 half inches. Then what you're looking at right there  
2 is the stainless steel cladding, looking down from the  
3 top of the reactor vessel head end. Again far worse.

4 DR. MANSFIELD: How was the cladding  
5 fastened? Was it fastened to the inside?

6 DR. HACKETT: It's metallurgically bonded  
7 to the inside of the reactor vessel head through  
8 welding. It's a strip clad process that's put down.  
9 So that's the particulars. This is showing some  
10 pretty significant evidence here. These are the  
11 access holes that I was talking about, and you can see  
12 that in this case the refuel outage in 2000, which was  
13 two years before this was discovered, showed  
14 significant evidence of boric acid and corrosion  
15 deposit streaming down through these access holes.  
16 The unfortunate situation is that the head was left in  
17 this state for a significant period of time. Our best  
18 guess is four to six years.

19 DR. MANSFIELD: Would the access that is  
20 possible allow you to have used something like a  
21 borescope or some sort of remote television thing?

22 DR. HACKETT: Absolutely. Again, this is  
23 very similar. I read at least excerpts or parts of  
24 the Columbia Accident Board Report. There are a lot  
25 of similarities here. We had two major causes,



1 technical and organizational. The technical one, I'd  
2 like to talk about. It's the easy part.

3 I don't want to underplay that, but I am  
4 a metallurgist by training, and we can fix things like  
5 that. We think we know how to fix stress corrosion  
6 cracking occasionally. We've been working on that at  
7 least most of my career. But those are the easier  
8 parts. The organizational elements, I think, are the  
9 greater challenge.

10 But in terms of the technical piece here,  
11 the parts that we had some difficulties with - or let  
12 me back up and say that this piece here, the technical  
13 piece, for those of you who are familiar with the  
14 Columbia Accident Investigation Board Report, this  
15 would be our foam strikes. This was going on.

16 Our engineers were even in some cases  
17 aware of it and were numb to it because of my second  
18 bullet here, a mindset that boric acid on the reactor  
19 vessel head, was not considered to be highly  
20 corrosive. The heads are hot and dry. "You don't  
21 have a corrosion cell set up there," was the mindset.  
22 You're just not going to get this phenomenon.

23 So there was an awareness of it, but there  
24 was also this mindset that it's not going to be this  
25 type of problem. Even if it ever got to this level,

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1 our inspection effort would catch it. You would have  
2 to have egregious leakage to result in this kind of  
3 attack, and our inspection effort would catch that  
4 type of thing. When, in fact, this happened with a  
5 very low leakage over a very long period of time, and  
6 we missed it.

7 The previous NRC assessments in this area  
8 were axial cracking in reactor vessel heads  
9 penetrations, Inconel penetrations. They were not  
10 considered to be an immediate safety concern, circa  
11 the mid-1990s. The French had a very opposite  
12 reaction to this in their program when they saw this.  
13 They were the first ones to see this stress corrosion  
14 cracking phenomenon in the Inconel. They reacted very  
15 much more aggressively than the NRC did almost 13  
16 years ago now with an event that happened with their  
17 Buget plant.

18 The other thing that happened for us is we  
19 didn't make this linkage. Because of this -- I also  
20 have a fracture mechanics background. We're very  
21 concerned with cracks and the extent of cracks and the  
22 severity. That would have considered leak-before-  
23 break.

24 The Inconel is a forgiving material. You  
25 had axial cracks. It's not terribly safety

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1 significant from a fracture mechanics standpoint. I  
2 think it's fair to say the linkage was not made  
3 between the cracking in the vessel head penetrations  
4 and the boric acid attack even though there was ample  
5 evidence available to contradict that which was out  
6 there in the literature when the team looked through  
7 this.

8 CHAIRMAN CONWAY: Go ahead.

9 MR. FORTENBERRY: Dr. Hackett, quickly.  
10 These are all listed under technical. I would argue  
11 with you on that because of a couple of things I want  
12 to ask about.

13 DR. HACKETT: Good point.

14 MR. FORTENBERRY: One of them is something  
15 that we heard from the NR folks which is interesting,  
16 and that is waivers to requirements are essentially  
17 anathema in the organization, and you describe a  
18 situation where you had some cracking that clearly  
19 wasn't within the specifications of that component.

20 DR. HACKETT: Right.

21 MR. FORTENBERRY: You'd say limits can  
22 take just so much. You essentially accepted the  
23 condition as opposed to saying, "Unacceptable, it  
24 doesn't meet the requirements." You basically  
25 entertained a waiver that allowed the cracking and the

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1 bit of leaking, and here's where you come to based on  
2 something. I know in the Lessons Learned from your  
3 task force there was some discussion. I was a little  
4 bit confused or foggy about what they were saying, but  
5 they seemed to imply that this mindset was based on  
6 some risk-informed approach that said, "What is the  
7 probability - I guess is the right way to say it - of  
8 this amount of leakage leading to an unacceptable  
9 event?" Again, a decision was reached that said,  
10 "This is not one of those paramount high significance  
11 issues. We can afford to not focus on it."

12 Of course, the utility followed logic.  
13 You saw the streaming. You showed boric acid coming  
14 out, but again that's not the focus of, let's say, the  
15 regulatory [agency] imposing itself. That's why I  
16 argued that these are in fact the organizational part,  
17 which is not the focus of our session today, and  
18 trying to understand how you avoid things like this  
19 and, again, not trying to blame, to criticize.

20 But it is interesting to compare what I  
21 heard this morning, which would have said, "We don't  
22 know what the effect of these cracks would be really,  
23 and some people could argue that it's okay, and some  
24 people might say that it's not. We can do a  
25 probabilistic assessment to say it's so much, but

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1 we're better off staying with doing it right, for  
2 example, and not allowing any cracks." Of course,  
3 that would have eliminated all the stuff.

4 DR. HACKETT: These are good comments. I  
5 did say technical here but I think there are all  
6 organizational and cultural aspects mixed in here.  
7 You hit on a very key point. In all honesty, the  
8 boric acid inspections in the plants by this point in  
9 time would not have been considered terribly risk-  
10 significant. Obviously that's the wrong answer.

11 But if you were looking at this on a risk  
12 cut, you are probably not going to get there with the  
13 NRC-mandated boric acid inspections. In fact, one of  
14 the findings of the team was that the boric acid  
15 inspection procedure was eliminated in the year 2000  
16 based on exactly that. It wasn't making the cut.

17 DR. MANSFIELD: So this isn't a way of  
18 dealing with the problem by defining it as not  
19 important. I'm struck with something our Naval  
20 Reactor colleagues told me, "If anything happens  
21 that's not submarine-sound, you never ignore it."  
22 Does that accurately put what you told me one time?  
23 You don't define it out of existence. If anything  
24 looks like a non-reactor look, then [don't] ignore it.  
25 Is that the lesson I should take?

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1 DR. HACKETT: I agree. That's very fair.  
2 The next piece tried to focus in more on the  
3 organizational pieces. Our team concluded that the  
4 event was preventable. There are three major  
5 contributing elements. The first one goes to failure  
6 to review, assess, and follow up on relevant operating  
7 experience. There's a wealth of experience in this  
8 area as it turns out.

9 It's sad to look back at that kind of  
10 thing, just like with Columbia, and find out that  
11 there was actually a history of boric acid attack  
12 events, none even approaching the severity, but that  
13 showed the potential for this type of thing to happen.  
14 There were numerous NRC communications. We  
15 communicate with our licensees through our generic  
16 communication process. We had issued numerous generic  
17 communications on the issues of stress corrosion  
18 cracking and boric acid. What we were failing to do  
19 was to integrate that all properly.

20 Then there was the very much stark  
21 contrast with the French experience, where they did  
22 operate as the Technical Director mentioned. They  
23 took a position very early on. They were not going to  
24 tolerate any cracking in these penetrations. They  
25 proceeded down a path that ultimately led to

1 replacement of the majority of the heads on the French  
2 commercial fleet, which is coincidentally now where a  
3 lot of the U.S. fleet is going, but much earlier in  
4 the process.

5 CHAIRMAN CONWAY: The second bullet there  
6 with the, "NRC, the licensee, and industry failed to  
7 adequately review...": was this pretty well known out  
8 among the industry, among the other pressurized water  
9 reactor operators? Was INPO cut in on this do you  
10 think?

11 DR. HACKETT: They were, in fact, and I  
12 think they've done their own critique of their  
13 situation. I'm not familiar with the particulars.  
14 The information was all there. When we go into well  
15 known, I guess that goes to obviously it wasn't well  
16 known enough by the right people, but the information  
17 was all there, unfortunately.

18 The second piece goes to the licensee's  
19 performance. They, in our opinion, failed to assure  
20 that their plant safety issues would receive the  
21 appropriate attention. As Cindy mentioned in her  
22 presentation, that for the NRC is the first line.  
23 We're assuming that the licensees are doing their job.  
24 Their performance and safety focus is their primary  
25 function. Our inspection program and our regulatory

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1 program is a check on what they are doing. They  
2 obviously, FENOC [FirstEnergy Nuclear Operating  
3 Company] in this case, the licensee, has owned up in  
4 their own self-critique that they had what they called  
5 the "production" rather than the safety focus. They  
6 were trying to keep the plant running. They were not  
7 focused on safety.

8 The last piece is what I'll spend the most  
9 time talking about today regarding the NRC. We really  
10 failed to integrate a lot of information that was  
11 available if you looked in the right places into  
12 appropriate assessments of their safety performance.  
13 This is probably over at least a five or six year  
14 period that this was occurring.

15 DR. MANSFIELD: I'm guessing now that you  
16 would not have failed if your inspectors were  
17 instructed to take note of anything that looked  
18 different in appearance, which means they have to know  
19 what different means.

20 DR. HACKETT: Right.

21 DR. MANSFIELD: So they would have to have  
22 a fleet-wide picture of what reactor vessel heads  
23 should look like.

24 DR. HACKETT: Another good point. Yes,  
25 that's true. One of the findings we also made -- and

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1 I think it was referenced previously to -- a  
2 questioning attitude. One of the findings on the team  
3 was that we did not see as much of a questioning  
4 attitude on the part of our own inspectors, certainly  
5 not on the part of the licensee in running these types  
6 of things down. It does go that there are some very  
7 specialized expertise obviously that would be required  
8 here, but there were some pretty egregious signs of  
9 things going wrong inside this containment, including  
10 multiple failures of the containment air coolers that  
11 were fouled with corrosion product that was ferric  
12 oxide or ferrous oxide.

13 It was obvious that it was some carbon  
14 steel corroding to a fairly large degree in the  
15 containment, but the questioning attitude went  
16 towards, "They weren't pursuing that." Instead, they  
17 were changing out the containment air cooler filter  
18 elements more frequently.

19 CHAIRMAN CONWAY: Does this utility have  
20 a safety committee that was outside of the production  
21 part of the operation?

22 DR. HACKETT: They do, in fact, as do many  
23 of the licensees. They also did not pick up this.

24 CHAIRMAN CONWAY: That's what I was going  
25 to ask. Did this question ever come up in their

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1 committee meetings?

2 DR. HACKETT: Not that I'm aware of,  
3 certainly not in advance.

4 MS. CARPENTER: We also recognize that the  
5 inspectors were aware that they were changing out the  
6 filters. They were doing maintenance, maintenance  
7 that was usually every couple of years; they were  
8 doing it routinely, and I guess they got into a  
9 groupthink and that happens. You asked about the  
10 rotation of the inspectors.

11 CHAIRMAN CONWAY: Yes.

12 MS. CARPENTER: That's one of the reasons  
13 that our inspectors do rotate out. It's one of the  
14 reasons we have region-based inspectors go out to the  
15 site, which is to maintain that questioning attitude  
16 of, "This just doesn't look right" rather than just  
17 taking on face value if the licensee says, "This is  
18 what it is." Suddenly, we were all going in that  
19 direction.

20 It's continued to emphasize in ROP. You  
21 have to question all the time: "This just doesn't make  
22 sense." It was more of an unusual maintenance  
23 situation and now it was being done routinely. Why  
24 did it change? That is one of the valuable lessons  
25 for us.

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1 DR. MANSFIELD: And my previous comment  
2 about the value you would have had if you had a  
3 questioning attitude toward the visual appearance of  
4 it extends, of course, to anything that's out of its  
5 envelope, like the filter and things like that, which  
6 is operating in a way that wasn't designed into it.  
7 I'm kind of surprised that the owner wouldn't dig into  
8 that right away the way you would if your car starts  
9 doing something outside of its envelope.

10 DR. HACKETT: Exactly. That's a good  
11 analogy. The last piece I was going to mention here  
12 goes towards the resources and staffing. If there  
13 were more time, I could touch on a lot more things.  
14 Part of the discussion previously went towards  
15 continuity. Unfortunately on our part, we had nine  
16 program managers for Davis-Besse over a ten year  
17 period. It's unacceptable.

18 We should have more continuity than that  
19 in our project management effort. We had significant  
20 changeovers as Cindy mentioned in the inspectors who  
21 were onsite. So we had a definite lack of continuity.  
22 We had a NRC Region III which oversees the plants in  
23 that vicinity very challenged during that time with a  
24 number of former watch list plants. Davis-Besse was,  
25 actually ironic to look back now, considered the top

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1 performer in the region before this event. So there  
2 definitely were some resources and staffing and  
3 continuity issues going on.

4 DR. MATTHEWS: This may be a good time to  
5 ask a question I had, and it refers back to your talk.  
6 The question is: how are you going to change your  
7 inspection and oversight program? I'm sure you're  
8 going to look at boric acid corrosion. That part's  
9 easy. But it's the cultural issues, the  
10 organizational issues, the safety culture issues, the  
11 human factors issues which are a lot more difficult to  
12 measure and predict the next type of problem. I was  
13 curious. Are you going to change anything in that  
14 area as a result of this, and what would they be?

15 MS. CARPENTER: Yes, sir. We are. Part  
16 of that is a constant reminder of "Lessons Past,  
17 Lessons Learned" to our inspectors. We have new staff  
18 come in, and with the new staff, the corporate memory  
19 disappears. It's a matter of trying to remind the  
20 staff continuously that their job is that questioning  
21 attitude. That's why they're out there.

22 The other thing is, Ed talked about  
23 operating experience. We were receiving that  
24 information. It was within the agency, but it was in  
25 various parts of the agency. No one took that piece

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1 of that and put it into the inspection program. So  
2 part of it also is building into the inspection  
3 program some of these lessons learned, going back and  
4 looking at some of these safety issues that were out  
5 there, some of the generic communications that we've  
6 issued. It's to put them into a database so that the  
7 inspectors can see that.

8 When an inspector picks up an inspection  
9 procedure and is going to go out and look at boric  
10 acid control, some of that operating experience that  
11 was out there is there for them to look at. It's to  
12 remind them that this was an event that happened a  
13 long time ago. Here's what's been happening out  
14 there. So part of it is better training of our  
15 inspectors, building it into the inspection program,  
16 and keeping our technical staffs.

17 I think Ed will touch on this. We have a  
18 task force looking at: how do we do a better job of  
19 integrating operating experience, and how do we make  
20 sure that our licensees are doing the same thing? How  
21 do we make sure that they are asking those questions  
22 and that they are following up?

23 We're changing our corrective action  
24 procedures to say, "Is the licensee making  
25 modifications? Are they deferring modifications so

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1 that they can come back on line faster? Look at those  
2 deferred modifications. Pick those out. Pick up some  
3 of those old operating experiences. What are they  
4 doing with those?" So these are different pieces that  
5 we are incorporating into it. There were a lot of  
6 great lessons learned out of this, and we're building  
7 it into the programs.

8 DR. HACKETT: On the next slide, I think  
9 in the interest of time I would go towards the bottom  
10 actually. In case anyone wants a more detailed  
11 treatment of this, the Lessons Learned Task Force  
12 Report addresses the area shown on the slide. It was  
13 completed almost a year ago now, and it is available  
14 on our website. I don't know what the download would  
15 take. It probably would be a little while. It's 96  
16 pages I believe. There's a lot of detail in there,  
17 some of which I'll touch on in the next slides here.

18 Broadly speaking, these are some of the  
19 areas we've been talking about. To jump way ahead,  
20 here is where we made recommendation, not  
21 surprisingly, in the area of inspection guidance from  
22 things as simple as Dr. Matthews mentioned and  
23 straightforward, as boric acid inspections and fixing  
24 that. Those inspections were dropped from the ROP.  
25 They are now back in obviously.

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1           But more specifically, it goes towards the  
2 pieces Cindy was touching on: the lack of the  
3 questioning attitude, and reinforcing that through  
4 training and sessions like this with the NRC staff,  
5 which we've done many of; including this team had  
6 training sessions basically with the entire NRC  
7 Headquarters staff in all four regions with the idea  
8 of trying to tell the story and internalize and  
9 institutionalize these lessons learned as part of a  
10 good learning organization.

11           MS. CARPENTER: Part of that is also each  
12 of these were being put into the licensee's corrective  
13 action program. We're going to ask our inspectors to  
14 review corrective action reports and look for trends  
15 now. "Do you see that the same corrective action, the  
16 same problem, is coming up and the licensee is not  
17 fixing it?" That's the trend piece of it that we're  
18 going to build into the corrective action procedure to  
19 have them think more about that, to pull some of those  
20 out when they do the corrective action inspections  
21 every year, pull a sample of those out and take a look  
22 at those and see why aren't they fixing them, or is  
23 there something more that we see here.

24           DR. MATTHEWS: Let me ask, not to put too  
25 fine a point on this, but, okay, your inspector is out

1 there, and he sees boric acid. You know what to do.  
2 The action is straightforward. Now he goes out there  
3 and he sees a lack of questioning attitude. What do  
4 you do with that?

5 DR. HACKETT: What we get to in the  
6 discussions is sort of back to when Mr. Reagan was  
7 President, the "Trust but verify." There is one I can  
8 share with you on this. It is our inspectors did  
9 question the maintenance of the head during this  
10 period, but where they didn't go as far as maybe we'd  
11 like to see them go, they would ask a question about  
12 the head, for instance.

13 As a specific example, "Was the inspection  
14 completed in 1998?" They would get the response of  
15 "Yes, the head was inspected." "What were your  
16 findings?" "Well, there was some boric acid there,  
17 but nothing that we haven't seen before. Not a big  
18 deal." That's as far as we pulled the thread.

19 Instead, maybe what we should have had  
20 was, "Where's the bore scope video from that  
21 inspection? I'd like to get a look at that and just  
22 let me conclude for myself what kind of state the head  
23 was in." Frankly, had they done that, already by  
24 1998, that head was in a horrible state of corrosion  
25 and corrosion product, and we didn't do that. It



1 wasn't offered up by the licensee either, but we  
2 didn't pull the thread. So that's the kind of  
3 example.

4 Cindy mentioned operating experiences as  
5 a big part of this effort. We spawned yet another  
6 task force that's looking at operating experience. A  
7 couple of items on that: we used to have an office at  
8 the NRC that was called the Office for Analysis and  
9 Evaluation of Operational Data. That office was  
10 disbanded in 1999, and it was our sort of centralized  
11 clearinghouse for assessment of operating experience.

12 Certainly what we found is that the NRC  
13 assessment of operating experience is a lesser  
14 function today than it was back then. That didn't  
15 help. It's not a cause and effect thing, but it  
16 certainly didn't operate in the right direction.

17 We mentioned consensus standards earlier.  
18 The ASME code in this case, which had inspection  
19 requirements for observation of the head that were --  
20 we find in hindsight now -- completely inadequate.  
21 They call for what ASME calls a VT-3, which is a  
22 visual observation of the area basically so that you  
23 could just say that you laid eyes on it, and you saw  
24 it. It does not require removal of the insulation.

25 When you look at the B&W design or some of

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1 the Westinghouse designs, there would be no way to see  
2 this corrosion given that kind of inspection  
3 procedure. ASME is correcting that now. We've  
4 corrected it through generic communications, but at  
5 the time, that was a serious inadequacy.

6 DR. MANSFIELD: This question just shows  
7 my ignorance of the ASME code. Is there no provision  
8 in the ASME code for inspections when direct visual  
9 inspections are impossible because of insulation or  
10 coverings or things like that? Aren't there  
11 prescribed equivalent methods?

12 DR. HACKETT: There are. In fact, in this  
13 particular area, given the mindset that prevailed, it  
14 was not subject to those inspections, unfortunately.  
15 It was relegated to what they call VT-3. Obviously  
16 it's not anymore, but that was a serious shortcoming  
17 for the ASME Code.

18 Leakage monitoring requirements and  
19 methods on our part and the licensee were: we have a  
20 lot of the recommendations of the report. Go to this  
21 area because there was a very small amount of leakage  
22 over a long period of time, and it was very difficult  
23 to discriminate where that leakage was coming from,  
24 whether it was actually reactor coolant pressure  
25 boundary, which it ultimately was found to be, versus

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1 it was just seal leakage from above. So there was a  
2 tolerance on our part and on the licensee's part for  
3 what we thought to be seal leakage that was not  
4 considered terribly safety significant. So we are  
5 looking very hard at those.

6 I'll jump to the bottom one. Our  
7 executive director asked us to take also just a quick  
8 look as far as our team went on previous lessons  
9 learned reviews. We've done these before. Are we  
10 learning lessons? Are there similar themes that we're  
11 seeing here with Davis-Besse that came up with our  
12 previous one, Indian Point, when they had their tube  
13 rupture in the year 2000?

14 We found that there were some things that  
15 were common elements among all lessons learned. We  
16 hadn't brought all that together, all of which went  
17 towards follow-up on some of these activities that the  
18 NRC, I think, would characterize itself as an  
19 organization that reacts very well to these things.  
20 I think we did a very good job to reacting to this  
21 event, but we were not proactive, and we also had  
22 found that there were cases where we just didn't  
23 follow up adequately, which was one of the team's  
24 findings, particularly with regard to long-standing  
25 hardware-type problems.

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1           It just turns out that there are 51  
2 recommendations in the report. I just brought along  
3 a few here to share with you. I think the first one  
4 goes towards one of the pieces Cindy was referring to.  
5 We issue generic communications a lot in reaction to  
6 things that we find through inspection efforts or  
7 sometimes proactively if we anticipate that there  
8 might be a problem.

9           What we find is those generic  
10 communications generally achieve what we're wanting to  
11 do at the time. One of the things we're finding is  
12 that we do not do a good enough job in following up on  
13 a generic communication that is say in this case, 13  
14 years old. We had a boric acid communication that  
15 went out in 1988, and there were some initial follow-  
16 up inspections and a lot of intense activity, but two,  
17 five, ten years later, you are probably going to be  
18 dealing with an NRC staff that's not even very  
19 familiar with that generic communication. We have not  
20 followed up on it.

21           DR. MANSFIELD: Was that warning specific  
22 to rapid corrosion?

23           DR. HACKETT: That was not specific  
24 necessarily to the rapid corrosion, but it did go to  
25 boric acid inspections and requiring those for the

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1 plants. We did not pay enough attention to that over  
2 time.

3 MS. CARPENTER: That's one place where the  
4 ROP needs to incorporate the lessons learned to  
5 occasionally go back and look at some of these issues  
6 that the staff has done a generic communication on and  
7 say, "Again, pull that generic communication out.  
8 What is the licensee [doing]? What did they say they  
9 were going to do? Are they still doing that? What  
10 are they doing today?" That is an area that the  
11 inspection program is following up on.

12 MR. FORTENBERRY: Is there an element of  
13 technical competency here in terms of understanding  
14 the interaction with the boric acid leakage and doing  
15 or performing the required or, looking back, the  
16 desired R&D [research and development] type activity  
17 to understand this, which would have then, of course,  
18 fed into some of these other actions? I don't see  
19 anything that speaks to that.

20 DR. HACKETT: There are. I apologize for  
21 that. To have gone through all these would have taken  
22 too long, but yes, absolutely. We have pieces that go  
23 to that.

24 MR. FORTENBERRY: Clearly, this wasn't an  
25 obvious issue. We are still debating about the

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1           specifics of it.

2                   CHAIRMAN CONWAY: Kent, you'd better talk  
3 more into the mike if you want people to hear what you  
4 are saying.

5                   MR. FORTENBERRY: I'm sorry. Clearly,  
6 this wasn't that straightforward. But going back to  
7 a topic that we've talked about a few times now, and  
8 that's the simple technical authority that the NR  
9 folks talked about and whatnot: can you parallel that  
10 in terms of how this problem was dealt with? I'm  
11 talking about back a long time ago when the issue  
12 first came up, and the issue was dealt with in terms  
13 of what do we need to do about it, and do we need to  
14 rip off all the insulation and go look at it? Was it  
15 a central authority that made that decision?

16                  DR. HACKETT: At least part of my answer,  
17 I guess, is fact. Part of it would be opinion. We do  
18 not have that same type of structure. I think that's  
19 obvious that the NRC is a much more diverse and  
20 frankly bureaucratic structure than I'm sure Naval  
21 Reactors is. There are challenges inherent to that  
22 that we deal with.

23                   In answer to your question, I'll back up  
24 to the technical competence. I think my answer, my  
25 opinion, is no. I don't think there were technical

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1 competence problems on the part of the NRC staff or,  
2 frankly, on the part of the licensee. Our team's  
3 findings were that there were people in place who were  
4 technically competent enough to have been aware of  
5 this and to have pursued it.

6 What we failed to do, in a single word  
7 that always comes back to me, is "integrate" the  
8 information. In looking back in time, I was in a  
9 different job at that time. I was one of the  
10 metallurgists that was involved in reviewing this  
11 situation.

12 To give you a good example, we were  
13 somewhat compartmentalized. I was in the assessment  
14 area that did the structural integrity review. So I  
15 was presented with, "You have some cracks in these  
16 Inconel housings and they are not through wall. There  
17 is some partial depth, and you're the fracture  
18 mechanics people. What does that mean to the safety  
19 of this structure?" The answer was that it doesn't  
20 really mean a whole lot to the safety of that  
21 structure. It's in pretty good shape even if you  
22 leave the cracks there. You watch them. You monitor  
23 them with some advanced inspection techniques, but  
24 it's okay to leave them there.

25 That was decoupled in our organization

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1 from the folks who were looking at the potential for  
2 boric acid attack. So that linkage was never made.  
3 That's a weakness that we're trying to address through  
4 some of the action plans that are in process right  
5 now. The proof will be in how well the NRC deals with  
6 this again, or better yet, in the Naval Reactors slide  
7 that showed obviously the better part, which is to  
8 sweat the details and focus on the small problems so  
9 you never get to something like this. That's where we  
10 want to be. I don't think we are there yet. I think  
11 we have some work to do, and that's part of what we're  
12 dealing with here.

13 MR. FORTENBERRY: Thanks.

14 DR. HACKETT: I'll just focus on the last  
15 one on here because this was a particularly tricky  
16 item for us. The reactor vessel was assumed in our  
17 probabilistic assessments not to fail. It's inviolate  
18 or sacrosanct. So we found ourselves really lacking  
19 in this area of analysis methods to assess the risks  
20 associated with passive component degradation. This  
21 was not something that we were focused on.

22 Cindy and Russ talked about the  
23 Significance Determination Process. It made that  
24 significance, the determination of that which is  
25 obviously, in a layman's sense, that this was a very

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1 significant thing. It was very difficult to deal with  
2 analytically because we did not have models that  
3 addressed this type of thing before.

4 DR. MANSFIELD: So you could get a PDF  
5 [probability density function], say, of probability of  
6 release as a function of volume and time for boric  
7 acid, but you didn't have a mechanism for turning that  
8 into probability of failure for the pressure vessel.

9 DR. HACKETT: That's correct. In this  
10 case, that was unanticipated. I guess I'll just move  
11 towards summing up here. We heard this throughout the  
12 presentations this morning. I had occasion as part of  
13 this analysis to review some books by a professor,  
14 Henry Petroski. I think he's at NC State. He's  
15 written a book on preventing structural failures.

16 What you see are these common elements, a  
17 lot of common elements between our effort and the  
18 Columbia Accident Investigation Board, for instance.  
19 A lot of it goes to communications and organization.  
20 These were some failings for us in terms of  
21 communicating up the chain what was going on at the  
22 site, at the plant, and through our inspections and  
23 the inspection effort itself, as I mentioned earlier,  
24 without a questioning attitude.

25 Also, the engineering design, in this

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1 case: What saved the day? Well, my hat's off to the  
2 designers, because you had six and a half inches of  
3 steel and it took six and a half inches of steel and  
4 the stainless steel liner still held. Not a place you  
5 want to be, but engineering design plays a key role in  
6 this. I think the nuclear industry is very fortunate  
7 to have that kind of backstop to this.

8 Then it goes to the operating experience  
9 piece. The last part is the timely dissemination of  
10 data and information. We did not do a good enough job  
11 of that in our effort internally at the NRC. The last  
12 slide.

13 DR. MANSFIELD: Excuse me. Could I ask a  
14 Naval Reactor's representative if those four points  
15 sound familiar, and would they add anything to that  
16 list?

17 MR. KAUFFMAN: Yes, they are familiar. I  
18 already talked about the importance of communicating  
19 problems to all the involved individuals and then  
20 taking timely action to resolve them. Conservatism in  
21 design, I talked about, "You get what you inspect, not  
22 what you expect." Those are key elements. There are  
23 a lot of other things that you could add, but this is  
24 a pretty good overview. I think if you are going to  
25 take away four top level things to keep in mind, this

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1 is a good list.

2 DR. MANSFIELD: Because we eventually want  
3 to consider a list like this for the Department of  
4 Energy sites as well.

5 DR. HACKETT: My very last slide just goes  
6 towards a couple of pieces that are somewhat unique,  
7 at least to the NRC, and some are not. The fact that  
8 the technical elements as I mentioned earlier are  
9 really only part of the story. Not to underplay it,  
10 but they are the parts that are easier to fix.

11 In our case, we had some real challenges  
12 in our regulatory framework in issues and then some  
13 policy issues. A good example of one to share with  
14 the Board here is we do not regulate safety culture.  
15 The NRC Commission has taken up that debate. In the  
16 past, they have decided that we don't have the  
17 appropriate wherewithal to measure safety culture. I  
18 think it's fair to say the Commission is now  
19 reevaluating that approach.

20 Also, we're going to be seeing a new  
21 composition of our Commission. It's ever a dynamic  
22 situation, but everywhere we did what we would call in  
23 this case the "Lessons Learned Task Force," a deep  
24 vertical slice on a particular issue. Everywhere we  
25 touched we saw safety cultural issues at this licensee

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1 that were disturbing. We do not regulate that. I  
2 think there's an overlap there with NASA's situation  
3 and the Columbia Board.

4 We have obviously the nature of the public  
5 interface for us. It's probably also very different  
6 from Naval Reactors. It's critical for us. We ever  
7 operate in a fishbowl, and we are accountable to the  
8 public in a very telling way. I think we think that's  
9 the way it should be. We report to the public. We're  
10 chartered to protect the public health and safety, but  
11 it makes the job very difficult to communicate this  
12 type of thing effectively the elements that Cindy  
13 mentioned as our strategic goals. Communication, we  
14 already talked about.

15 Even the study for me after this team was  
16 the importance of risk and communicating risk. I said  
17 actual and perceived. Perceived becomes actual. If  
18 we're talking to people, and we did, who live in the  
19 vicinity of this plant out in Ohio, their perceived  
20 risk is the risk. We have to be able to articulate  
21 that. It's a real challenge for us to do that in the  
22 most open and scrutable way. These are just some  
23 other elements and additional lessons for us as an  
24 organization that we're working our way through, too.  
25 That concludes my remarks.

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1 CHAIRMAN CONWAY: Thank you. A.J.

2 VICE CHAIRMAN EGGENBERGER: I have no  
3 questions.

4 DR. MANSFIELD: This was very valuable.  
5 Thank you.

6 CHAIRMAN CONWAY: It was very helpful to  
7 us. I appreciate the time you've given us this  
8 morning. Thank you very much.

9 MS. CARPENTER: Thank you.

10 CHAIRMAN CONWAY: Now, as we indicated in  
11 our previous announcements, we always invite members  
12 of the public and representatives of the public to  
13 testify. I've been informed that Mr. Richard Miller,  
14 Government Accountability Project [GAP], would like to  
15 speak this morning. Is he present? Mr. Miller,  
16 welcome.

17 MR. MILLER: Good morning, Mr. Chairman  
18 and members of the Board. My name is Richard Miller  
19 and I thank you for carving me into your schedule  
20 today. I hope I can emulate the crispness of the  
21 briefing that you've received from your previous  
22 speakers. It's often the case that you come to speak  
23 to advise people on your views and you learn more from  
24 coming to the meetings than you ever think you could  
25 possibly convey.

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