

Official Transcript of Proceedings ACRST-3281

**NUCLEAR REGULATORY COMMISSION**

Title: Advisory Committee on Reactor Safeguards  
512th Meeting

Docket Number: (not applicable)

PROCESS USING ADAMS  
TEMPLATE: ACRS/ACNW-005

Location: Rockville, Maryland

Date: Friday, May 7, 2004

Work Order No.: NRC-1465

Pages 1-119

NEAL R. GROSS AND CO., INC.  
Court Reporters and Transcribers  
1323 Rhode Island Avenue, N.W.  
Washington, D.C. 20005  
(202) 234-4433

TR04

ORIGINAL

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION  
+ + + + +  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)  
512th FULL COMMITTEE MEETING  
+ + + + +  
FRIDAY, MAY 7, 2004  
+ + + + +  
ROCKVILLE, MARYLAND

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

COMMITTEE MEMBERS PRESENT:

MARIO V. BONACA, Chairman  
STEPHEN L. ROSEN, Member-at-Large  
GEORGE E. APOSTOLAKIS, Member  
F. PETER FORD, Member  
THOMAS S. KRESS, Member  
GRAHAM M. LEITCH, Member  
DANA A. POWERS, Member  
VICTOR H. RANSOM, Member  
WILLIAM J. SHACK, Member  
JOHN D. SIEBER, Member

1 NRC STAFF PRESENT:  
2 RAJ AULUDE  
3 BARRY ELLIOT  
4 PAUL GUNTER  
5 DON HELTON  
6 JORGE HERNANDEZ  
7 ALLEN HISER  
8 JIANG HONG  
9 WILLIAM KROTIUK  
10 SHAH MALIK  
11 TONY McMURFRAY  
12 LARRY ROSSBACH  
13 THOMAS SCARBROUGH  
14 DAVID TERAQ  
15 DOUG WEAVER  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

**NEAL R. GROSS**  
COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

I-N-D-E-X

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

AGENDA ITEM

PAGE

|                                      |     |
|--------------------------------------|-----|
| Opening Remarks by the ACRS Chairman | 4   |
| Potential Adverse Effects From Power | 9   |
| Uprates                              |     |
| Adjourn                              | 119 |

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

(8:28 a.m.)

CHAIRMAN BONACA: This meeting will now come to order.

This is the third day of the 512th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting the committee will consider the following: potential adverse effects from core power uprates, subcommittee report on fire protection issues, future ACRS activities/report of the Planning and Procedures Subcommittee, reconciliation of ACRS comments and recommendations, topic schedule for discussion during the meeting with NRC Commissioners between 1:30 and 3:30 p.m. on Wednesday, June 2, 2004, and preparation of ACRS reports.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act.

Mr. Sam Duraiswamy is the Designated Federal Official for the initial portion of the meeting.

We have received no written comments or requests for time to make oral statements from members of the public regarding today's session. A transcript of portions of the meeting is being kept, and it is

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealgross.com](http://www.nealgross.com)

1 requested that the speakers use one of the  
2 microphones, identify themselves, and speak with  
3 sufficient clarity and volume so that they can be  
4 readily heard.

5 Are there any comments from members or  
6 questions? If none, we'll proceed with the first item  
7 on the agenda, which is potential adverse effects from  
8 power uprates, and with that I turn to John Sieber.  
9 He's --

10 MEMBER SIEBER: I'm the cognizant member.

11 CHAIRMAN BONACA: Right.

12 MEMBER SIEBER: Thank you, Mr. Chairman.  
13 I'm sure the members all recall the fact that about  
14 two years ago we wrote a letter to concur in the power  
15 uprate for Quad Cities and Dresden, and, in addition,  
16 the General Electric topical report on constant  
17 pressure power uprates.

18 And in our deliberations at the time, we  
19 were concerned about the increase in flow, but mostly  
20 in the context of flood-assisted corrosion as opposed  
21 to vibration and cracking. After Quad Cities began  
22 its upgrade, and shortly thereafter, they suffered a  
23 failure which was detected by an increase in moisture  
24 carryover to the main unit turbine and indicated that  
25 some part of the moisture separator inside the reactor

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealgross.com](http://www.nealgross.com)

1 vessel had failed in one way or another.

2           You received all of the package late in  
3 April that has -- had 10 attachments to it. It came  
4 in the mail. He also -- it's also on your notebook  
5 CDs, and I got a third set as an attachment to an  
6 e-mail. But in any event, there is some important  
7 information in there that will give you some  
8 background.

9           For example, in 2002, the staff issued an  
10 information notice, which is 02-26, and then later on  
11 two supplements as information was gathered. Also in  
12 that package is a General Electric service information  
13 letter, dated August 2002, along with its supplement,  
14 and then most recently the correspondence between the  
15 NRR and the BWR Owner's Group, and presentation  
16 materials from a meeting that was held this past  
17 February.

18           So that sort of brings you up to date as  
19 to the issues involved in the potential damage caused  
20 by increased flow due to power uprates.

21           What I'd like to do now is turn to the  
22 staff. And David Terao and Tom Scarbrough are the  
23 cognizant NRR people that are responsible for this  
24 project, and we will also hear from Research later on  
25 during this period.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealgross.com](http://www.nealgross.com)

1 So why don't we just begin with --

2 CHAIRMAN BONACA: Yes. But I just need to  
3 say one thing. I would like to also bring up the  
4 issue that two or three years ago when we were  
5 reviewing the generic approach to power uprates, a  
6 number of members of the Committee raised concerns.

7 MEMBER SIEBER: Right.

8 CHAIRMAN BONACA: And that specifically  
9 was one of those -- regarding performance or  
10 components also during severe accident -- not severe  
11 accident, under accident conditions.

12 Since uprated powerplants will experience  
13 maybe higher blowdowns, or whatever, and forces  
14 solicitation of components, internals, etcetera, may  
15 be higher, we raised questions regarding margin. And  
16 we were provided the answer that there was no concern  
17 regarding this margin.

18 We also wrote a paper, I believe, myself  
19 and Dr. Wallis and Mr. -- and Dr. Cronenberg. And  
20 personally, the fact that we had these failures as a  
21 result of the power uprate in the steam dryers again  
22 brings up the question of, what about other components  
23 that are not going to be challenged during normal  
24 operation, but they're going to be challenged during  
25 accidents.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 I think at some point we would like to  
2 raise this issue. I would like to hear something  
3 about it, if Research is doing something about it.  
4 And so I would like to, you know, bring this forth.

5 MEMBER FORD: And for the record, just  
6 before we start, could I just for the record state  
7 that I'm a General Electric retiree. I don't know if  
8 that constitutes a conflict of interest, but just for  
9 the record.

10 MEMBER SIEBER: I suspect that it does,  
11 but that's for the Chairman to decide.

12 MEMBER FORD: Okay.

13 MEMBER SIEBER: I would point out that,  
14 just to amplify a little bit what Dr. Bonaca said,  
15 with constant pressure power uprate, as far as  
16 blowdown loads, and so forth, are concerned, it is the  
17 same before and after the uprate, because the pressure  
18 is the same.

19 On the other hand, there are a lot of  
20 effects, as Dr. Bonaca stated, that are due to the  
21 increase in flow -- for example, strain on the main  
22 steam stop valves when they close. You know, the  
23 increase in flow is going to give you increases in  
24 force. So these are the kinds of things that we  
25 continue to be interested in.

1                   So with all that, why don't I turn it over  
2 to the staff.

3                   MR. LARKINS: Mario, let me just clarify.  
4 We looked at a conflict of -- Peter, you don't have a  
5 conflict on this particular review, because it's more  
6 generic than specific to a GE topical or some other  
7 thing.

8                   MEMBER FORD: Okay. Good.

9                   MEMBER SIEBER: Okay.

10                  MR. TERAQ: Good morning. I'm David  
11 Terao. I'm the Section Chief in the Mechanical and  
12 Civil Engineering Branch in NRR, and, first of all,  
13 I'd like to thank the ACRS for inviting the staff to  
14 present its views today on steam dryer cracking and  
15 other EPU-related issues involved with flow-induced  
16 vibration.

17                  This is a high visibility issue that's  
18 getting a lot of attention lately. And although the  
19 staff may not have questions -- answers to all of your  
20 questions today, we are prepared to discuss and go  
21 into as much detail as you want on any particular  
22 issue.

23                  What we want to cover today are basically  
24 some of the failures that we've seen of the steam  
25 dryer at certain plant -- certain BWR plants. We want

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealgross.com](http://www.nealgross.com)

1 to discuss what corrective actions the -- what  
2 corrective action these plants have taken, what the  
3 possible causes are for these failures, as well as the  
4 industry and the staff's actions taken and/or planned  
5 to be taken to address these issues.

6 We also understand that the ACRS has  
7 invited General Electric and I believe the BWR Owner's  
8 Group to give a presentation sometime in the summer,  
9 perhaps getting into a little bit more technical  
10 detail on the loadings, the thermal hydraulics, and so  
11 we aren't prepared today to go into that level of  
12 detail.

13 With me today is Tom Scarbrough, also with  
14 the Mechanical and Civil Engineering Branch, and he  
15 will be giving the bulk of the presentation. In  
16 addition, we also have a couple staff from the Office  
17 of Nuclear Regulatory Research, who will be presenting  
18 some of their research activities related to steam  
19 dryers.

20 So with that, I will turn it over to Tom  
21 Scarbrough.

22 MR. SCARBROUGH: Good morning. What we'd  
23 like to do is just give a little bit of initial  
24 background of sort of where we are today. In the  
25 1970s, licensees began implementing power uprates to

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 increase their electric power output. And there's  
2 various categories of power uprates.

3 You know, the lowest one is what we call  
4 the measurement uncertainty recapture, and that's  
5 involving improved feedwater measurement to reduce the  
6 uncertainty, and it's about one and a half percent.  
7 Then there's a stretch power uprate, which goes up to  
8 about six percent, and that involves instrument  
9 setpoint changes, and things of that nature, just  
10 minor adjustments to attain that type of uprate.

11 And then we go up to the higher levels,  
12 which seems to be where we're seeing, you know, most  
13 of the problems, called the extended power uprates, or  
14 EPUs, and they go up to about 20 percent. And those  
15 involve major modifications -- you know, turbine  
16 changeouts or generator changeouts, or pumps, things  
17 of that nature, but major -- major modifications.

18 In terms of reactor pressure vessel  
19 internals, we have had cracking issues with those  
20 components for a long time for BWR plants, and steam  
21 dryers were no exception. There have been cracking of  
22 steam dryers. Initially, as plants start up, a lot of  
23 times that was sort of below our radar screen, and the  
24 plants just corrected them and fixed those problems  
25 and moved on.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 But recently, as we've gone to the power  
2 uprates, we've seen additional problems with both  
3 safety-related and non-safety-related equipment. And  
4 that's what's getting our attention now.

5 Specifically, with Quad Cities Units 1 and  
6 2, they've had what we've termed catastrophic failures  
7 of steam dryers. So they've had significant loose  
8 parts generated to go through.

9 Now, the steam dryers, as you know, don't  
10 perform a safety-related function themselves in the  
11 removal of the steam. However, they need to maintain  
12 their structural integrity, so you don't have a  
13 problem with either it dropping down on top of the  
14 core itself or that you have numerous loose parts that  
15 might cause problems for components in the steam lines  
16 or get down into the reactor pressure vessel itself.

17 MEMBER SIEBER: I might point out that one  
18 of our concerns is if you generate loose parts, even  
19 though the dryers are not safety-related, they do pass  
20 -- the parts pass through safety-related equipment --  
21 for example, the main steam stop valves, flow-  
22 measuring Venturis, which can be gouged and scored.  
23 They end up in the strainers of the throttle valves on  
24 the turbine, which is not safety-related, but  
25 nonetheless important.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1           The greatest concern is loose parts that  
2 you can't find. Are they in the bottom of the reactor  
3 vessel? Or in the case of the sampling nozzle, does  
4 it end up in the feed ring? Is it floating around  
5 where it can damage internal parts of the core? Did  
6 it go through the recirc pumps? And when you find all  
7 kinds of gouges in the recirc pumps, there's a clue  
8 there. And so I think every effort ought to be  
9 extended to recovering loose parts.

10           MR. SCARBROUGH: Yes, sir. We agree with  
11 that, and we've seen a lot of that in the examples  
12 we've had so far. And that's raising our concern as  
13 well.

14           MEMBER SIEBER: There are loose parts out  
15 there that people haven't found.

16           MR. SCARBROUGH: Yes, sir.

17           MEMBER SIEBER: Okay.

18           MR. SCARBROUGH: In terms of -- first of  
19 all, I talk a little bit about the scope and how the  
20 scope has expanded. First, you know, this seemed to  
21 be a steam dryer issue. But as we've had more events,  
22 the scope has expanded, and that's part of our growing  
23 concern in this area.

24           MEMBER SHACK: Tom, can you --

25           MR. SCARBROUGH: Sure.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MEMBER SHACK: -- tell me -- I mean, I see  
2 this as an engineering failure. You know, that flow-  
3 induced vibrations are not a phenomena that somebody  
4 didn't anticipate, you know.

5 MEMBER SIEBER: That's right.

6 MEMBER SHACK: They were presumably  
7 analyzed. We were told that they were analyzed, and  
8 they were okay. So there -- there was an engineering  
9 failure here. Did they -- are they getting the  
10 forcing functions wrong? Are they oversimplifying the  
11 stress analysis? Do we have assurance that when they  
12 bring in the new fix --

13 MEMBER SIEBER: That it won't fail.

14 MR. SCARBROUGH: And it's yes to sort of  
15 all those questions, because they -- they have done  
16 evaluations initially, and we'll get into a little bit  
17 of that as we get farther in. But that's where the --  
18 finding out what exactly is the forcing function is  
19 part of the problem. I mean, we've had three failures  
20 at Quad Cities 2, one failure at Quad Cities 1. And  
21 each time we think we're getting closer to what the  
22 answer is, but we don't get there.

23 And so it -- yes, sir, it is an  
24 engineering problem. We don't really -- can't get our  
25 arms around what that forcing function is and what's

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 driving these failures -- these failures in these  
2 steam dryers so catastrophically. And that's what  
3 we're working -- that's what our -- our effort is  
4 right now is to work toward that. And we'll get more  
5 into that as we get --

6 MEMBER SIEBER: Well, one of the problems  
7 is when you come up with an engineered fix, and you  
8 put it in service and it fails, that means, you know,  
9 that you don't understand the problem.

10 MR. TERAQ: Yes. If I may add, we're  
11 still -- we're still wrestling with whether or not and  
12 the extent to which this issue applies to Quad Cities,  
13 Dresden, and other BWR plants.

14 MEMBER SHACK: Yes. Every time you're  
15 analyzing flow-induced vibrations. I mean, if you  
16 don't understand the problem well enough to predict  
17 this, what gives you confidence that you're --

18 MR. TERAQ: Right. And what we're going  
19 to show you is that the catastrophic failures of the  
20 steam dryers we've seen -- and it has only happened at  
21 Quad Cities, Units 1 and 2. It really hasn't even  
22 happened at Dresden or other BWRs.

23 So at this point, we aren't sure if this  
24 is a generic BWR problem, or something specifically  
25 related to Quad Cities. And so what we're trying to

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 understand is -- as you pointed out, is the specific  
2 forcing function, the low definition that is causing  
3 the failure at Quad Cities. And that's something that  
4 we're pursuing with Exelon at this time.

5 MEMBER SIEBER: Well, let me ask a  
6 clarifying question, then. Quad Cities has had  
7 failures where things have come apart. On the other  
8 hand, you found cracks that are precursors to failure  
9 at other plants. Is that not correct? But Dresden --

10 MR. TERAQ: Yes. But I think what -- what  
11 you may see from the pictures that we're going to  
12 present is there is a big difference, at least in our  
13 mind, on a crack and a complete failure of the steam  
14 dryer, where you're generating loose parts, where the  
15 dryer looks like it has been -- it doesn't look like,  
16 it has been plastically deformed --

17 MEMBER SIEBER: Right.

18 MR. TERAQ: -- and there's a big  
19 difference between just having a crack in the dryer  
20 where it's -- it's not likely to generate a loose  
21 part. That was the assumption that we had made when  
22 we first started approving the EPUs.

23 MEMBER SIEBER: When you get to that point  
24 in your presentation, I'd appreciate it if you would  
25 expand on that.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. TERAQ: Okay. Thank you.

2 MEMBER SIEBER: Because that's an  
3 important point to me.

4 MEMBER APOSTOLAKIS: Why is it an issue of  
5 forcing function only? Couldn't you have  
6 deterioration of the material and --

7 MR. SCARBROUGH: Well, as an example, in  
8 the first Quad Cities Unit 2 failure, they had only  
9 gone up to EPU operation for 90 days. So they were  
10 only up three months.

11 MEMBER APOSTOLAKIS: Right.

12 MR. SCARBROUGH: And it catastrophically  
13 failed. So in terms of that short amount of time, we  
14 don't think it's a normal type of degradation issue.  
15 We do see stress corrosion cracking, and that's sort  
16 of normal. We see that in lots of steam dryers.

17 MEMBER APOSTOLAKIS: That assumes that the  
18 degradation would be the result of the extended  
19 uprate. Why couldn't you have some degradation before  
20 that was accelerated?

21 MR. SCARBROUGH: Well --

22 MEMBER APOSTOLAKIS: I mean, is that  
23 excluded or precluded?

24 MR. SCARBROUGH: That might have been the  
25 case. But now for Quad Cities 2, for example, they've

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 done quite a bit of inspection of the steam dryer  
2 after each failure to look for cracks and identify  
3 them.

4 MEMBER APOSTOLAKIS: Okay.

5 MR. SCARBROUGH: So, and then they have  
6 another failure, so in that short amount of time at  
7 EPU operation they have another failure. So it would  
8 have to be degradation, we feel, that occurred during  
9 that timeframe, and not something that was sort of  
10 preexisting.

11 MEMBER APOSTOLAKIS: Now, the forcing  
12 function is calculated using some GE guidance, is  
13 that --

14 MR. SCARBROUGH: Right. Well, part of the  
15 problem is in terms of how they dealt with it. There  
16 was a relatively simplified method for looking at the  
17 loads across the steam dryer, in terms of the static  
18 type of valuation. And we've been discussing the GE  
19 -- expanding that evaluation to make it more dynamic  
20 to deal with the dynamic aspects of the flow effects.  
21 And that's something that GE is working on.

22 And I think as they -- we'll give some  
23 examples of where they're sort of moving in this  
24 direction. I'm trying to gather more data to really  
25 nail down and look at that --

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MEMBER APOSTOLAKIS: But all the BWRs are  
2 using the GE guidance.

3 MR. SCARBROUGH: Yes, sir.

4 MEMBER APOSTOLAKIS: Okay.

5 MR. SCARBROUGH: So in June of 2002, after  
6 this three months of EPU operation; about 17 percent  
7 power uprate, they had a failure of the -- the steam  
8 dryer coverplate, and pieces were found down on the  
9 steam separators and farther down in the steam line.

10 And if you can show the next slide,  
11 please.

12 MEMBER SIEBER: That's BWR 3, right? With  
13 the flat --

14 MR. SCARBROUGH: Right. Yes, this is a  
15 square hood design. These are the square hood --  
16 that's -- this looks like a curved design, but it's a  
17 -- these are the square hoods. You can see the square  
18 hood design there, which causes much more -- let me  
19 see if this shows it better. You can see right now  
20 that this one -- the plate is there.

21 And so they repaired that, and we'll get  
22 into what the repair techniques were in some later  
23 slides. But just let's get -- let's go --

24 MEMBER SIEBER: How many BWR 3's are  
25 there? They're the most susceptible, right?

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. SCARBROUGH: Right. And we have  
2 Vermont Yankee, we've got the Dresden units,  
3 Monticello, and Pilgrim. And we're going to talk a  
4 little bit about those later in the presentation.

5 MEMBER APOSTOLAKIS: Why are they the more  
6 susceptible, the most susceptible?

7 MEMBER SIEBER: Well, they're the flat --

8 MR. SCARBROUGH: Right. We do have a  
9 slide for that.

10 MEMBER SIEBER: The later models had  
11 sloping sides.

12 MEMBER APOSTOLAKIS: All right. We are  
13 preempting his slides.

14 MR. SCARBROUGH: Right.

15 MEMBER APOSTOLAKIS: I'm sorry.

16 MR. SCARBROUGH: That's okay. Well, no,  
17 that's a good question. That's exactly what we've  
18 been talking about.

19 MEMBER RANSOM: Is that steam outlet lined  
20 up with that plate?

21 MR. SCARBROUGH: Yes. It -- right, right  
22 through -- right up through here, right out through  
23 there.

24 MEMBER SIEBER: Right.

25 MR. SCARBROUGH: And so that's where they

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 thought a lot of the damage was, the higher flow  
2 effects right in that area as it went into that steam  
3 line.

4 Then, about 300 days later, in June, you  
5 know, a calendar year later, Quad Cities 2 had another  
6 failure of the hood, and now it's getting -- it's more  
7 extensive. And you can see this -- right through here  
8 there was a crack right here. Well, 90 inches of  
9 crack right through this area right in here.

10 And they ended up with internal braces  
11 failing. They had about three or four of those and  
12 some tie bars failing as well. So they -- they also  
13 had some additional cracking over on the other side,  
14 not as severe, but they had some cracking on the other  
15 side, too. So these two sides, as this -- as this  
16 flow came out and whipped over this corner here, this  
17 edge, and went out that steam line, that's where they  
18 have some severe vibration effects in the --

19 MEMBER ROSEN: You know, Tom, this drawing  
20 you have on the slide isn't very good, and it's not a  
21 real engineering drawing. It's almost like a cartoon.  
22 Is there something -- do you have a better drawing of  
23 that box and the hood and -- and so we can see the  
24 details, the thickness of the materials, the  
25 construction?

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. SCARBROUGH: This is the one that they  
2 gave to us.

3 MEMBER ROSEN: That's as good as they've  
4 got?

5 MR. SCARBROUGH: Yes.

6 MEMBER SIEBER: They have better drawings.

7 MR. SCARBROUGH: Yes. Oh, they have  
8 better drawings. But in terms of what they give us,  
9 that's --

10 MEMBER SIEBER: Actually, that's in two  
11 pieces. You have to push that all together.

12 MR. SCARBROUGH: Right.

13 MEMBER SIEBER: And then, when you do  
14 that, you can't see the detail. But it is a --

15 MEMBER ROSEN: That's my first comment is  
16 we need to have a real drawing, real engineering  
17 drawings, of what these parts look like.

18 MEMBER ROSEN: Right.

19 MR. SCARBROUGH: That's not it.

20 MEMBER ROSEN: Well, that's what --

21 MEMBER APOSTOLAKIS: I mean, what happened  
22 between June 2002 and June 2003?

23 MR. SCARBROUGH: They just operated the  
24 EPUs.

25 MEMBER APOSTOLAKIS: Yes. But, I mean,

1 they had a failure.

2 MR. SCARBROUGH: Right.

3 MEMBER APOSTOLAKIS: Did they look into  
4 it, why, and so on? I mean, or was it --

5 MR. TERAQ: Well, if I could answer that  
6 question, the first failure of the coverplate was --  
7 was what we felt was an anomaly. We -- they thought  
8 it was a localized --

9 MEMBER APOSTOLAKIS: So it was considered  
10 to be aleatory.

11 MR. TERAQ: They believed it was a  
12 localized effect -- a localized effect. They looked  
13 at other components with the same type of frequency as  
14 the coverplate and found there were no other  
15 components within that area of the steam dryer that  
16 had the same frequency.

17 The failure of the coverplate in 2002 was  
18 attributed to alignment of the vortex shedding  
19 frequency together with the acoustic load frequency,  
20 which matched the frequency of the coverplate itself.  
21 So that's why they believed this was a very localized  
22 effect, and we had no evidence to contradict it or to  
23 doubt that.

24 So that's why the second failure, when we  
25 had the second failure of the same unit on their steam

1 dryer, that -- became very serious about looking into  
2 the failures of these steam dryers, because we  
3 realized that something else was going on. And that's  
4 when we sent the special inspection team out to Quad  
5 Cities to review the details of their calculations and  
6 get a better understanding of the technical analysis  
7 that was performed on these steam dryers.

8 MEMBER APOSTOLAKIS: But this could have  
9 been done also in 2002, couldn't it?

10 MR. TERAQ: Yes. But because they fixed  
11 it, they changed the -- they replaced the quarter-inch  
12 thick coverplate with a half-inch thick coverplate,  
13 they changed the frequency. At that point, we -- we  
14 believed that the issue was resolved.

15 CHAIRMAN BONACA: They did not notice  
16 anything during operation? Or simply the failure  
17 happened in June 2003, and then they shut down and  
18 went to see what happened?

19 MR. TERAQ: Yes, yes. There were some  
20 indications that something was happening in the plant,  
21 including a change in the moisture carryover levels.  
22 That was probably the biggest indication.

23 CHAIRMAN BONACA: But they -- I mean, did  
24 they run for a period of time under these conditions?  
25 Changed condition? Or they simply, when they saw this

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 difference in moisture carryover, they shut down?

2 MR. TERAO: Well, when they first --

3 CHAIRMAN BONACA: I'm trying to understand  
4 for how long they ran in this condition.

5 MR. TERAO: When they first sensed the  
6 change in moisture carryover, I mean, a change in  
7 moisture carryover could be due to other reasons  
8 besides steam dryer failures. But they did monitor  
9 it, and as the moisture carryover increased, then they  
10 decided to shut down the plant and see what was  
11 causing --

12 CHAIRMAN BONACA: Okay.

13 MR. TERAO: -- causing it. But going back  
14 to Dr. Apostolakis' question on what happened before  
15 June of 2003, before the second Quad Cities 2 steam  
16 dryer failure, they did have a spurious actuation of  
17 their safety relief valve. Or they call it PORVs at  
18 Quad 2.

19 MEMBER SIEBER: These are the target rock  
20 valves?

21 MR. TERAO: It -- these were the target  
22 rock PORVs --

23 MEMBER SIEBER: Right.

24 MR. TERAO: -- I believe, yes.

25 MEMBER ROSEN: I think they're called

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 SRVs.

2 MR. TERAQ: Well, no, these were called  
3 PORVs.

4 MEMBER SIEBER: No, they were --

5 MR. TERAQ: They were very unique.

6 MEMBER SIEBER: They were pilot-operated.

7 MR. TERAQ: Yes. And so these -- so the  
8 valve spuriously opened and did not close.

9 MEMBER SIEBER: Right.

10 MR. TERAQ: So they're attributing that  
11 some of the loadings from this relief valve discharge  
12 contributed to the steam dryer failure a few months  
13 later, in addition to the flow-induced vibration from  
14 the EPU.

15 MEMBER SIEBER: Well, I have a question  
16 about that. When I read about that, I got the feeling  
17 that it was because of the higher flows condition and  
18 vibration in the line that may have contributed to the  
19 failure of the valve. Is that -- you know, it's a  
20 chicken-and-the-egg kind of a thing, and I couldn't  
21 figure out from what I read which came first.

22 MR. SCARBROUGH: Right. And they have  
23 found significant vibration effects, and we found that  
24 in the Unit 2 failures that occurred. And so it may  
25 have been that vibration causing that -- initiation of

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 that valve. So, yes, right.

2 MEMBER SIEBER: If my memory is any good,  
3 there was a broken drain line --

4 MR. SCARBROUGH: Right.

5 MEMBER SIEBER: -- involved with that, and  
6 some support damage, and --

7 MR. SCARBROUGH: We have some -- a slide  
8 on that, too.

9 MEMBER SIEBER: Okay.

10 MR. TERAQ: Wait. Actually, we're getting  
11 two events mixed up. The broken drain line was at  
12 Quad Cities 1, which happened in November.

13 MR. SCARBROUGH: Right. And we're going  
14 to get to that.

15 MEMBER LEITCH: We had a subcommittee  
16 meeting at General Electric in San Jose in September  
17 of 2002. And so that was between the first and second  
18 failure, just a couple months after the first failure.  
19 And we asked General Electric about this issue, and at  
20 that time they told us they were going to model the  
21 steam dryer. And I was wondering: did you -- do you  
22 know if that was done?

23 In other words, were they in a position to  
24 predict or suspect that there may be a subsequent  
25 failure, which actually occurred in 2003? In other

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 words, before the 2003 failure, did they really seem  
2 to understand the problem and say, "Well, the next  
3 refueling outage you're going to have to go in there  
4 and do some additional work"? Was there some  
5 additional work planned, or do they think everything  
6 was fine, and it just failed again in 2003?

7 MR. TERA0: I think that would be better  
8 left to ask General Electric. I'm not sure what they  
9 knew at that time.

10 MEMBER LEITCH: Okay.

11 MEMBER SIEBER: Well, it seems to me that  
12 that's a very difficult geometry to model from the  
13 standpoint of vibration and force as --

14 MEMBER LEITCH: Yes. But they told us  
15 they were going to do it.

16 MEMBER SIEBER: Yes. But if they didn't  
17 get it quite right, I wouldn't be surprised. But if  
18 they didn't do it at all, or did a superficial job,  
19 then the --

20 MR. SCARBROUGH: And we've had four  
21 significant failures, so we don't think that we're  
22 quite there yet. I mean, we don't really think they  
23 nailed this thing down.

24 MEMBER SIEBER: Right. That would be a  
25 clue.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. SCARBROUGH: Yes. Yes.

2 Okay. Let me go on to Dresden, bring  
3 Dresden in here. Dresden, in October of 2003, they  
4 shut down for a refueling outage inspection after two  
5 years of running at about a 17 percent EPU, and they  
6 did find some cracks. And they were sort of in the --  
7 that sort of gusset area on the diagonal -- diagonal  
8 brace/brackets area, so they were -- they found some  
9 cracks there.

10 They weren't as severe as what we've seen  
11 before, what had occurred at Quad Cities Unit 2, but  
12 they did see some issues. And at the same time, they  
13 found some holes in their feedwater sparger. And they  
14 discovered that there was a broken sample probe that  
15 was in there, and originally they thought they had  
16 problems with this before, and it was sort of a stress  
17 corrosion cracking issue.

18 But then they had done some upgrades, but  
19 then these seemed to break off as a result of the  
20 vibration effects. And so that started us down this  
21 path, and now we have this -- now we've moved from the  
22 steam lines into the feed lines, because they also  
23 have the increased flow. So now we're bringing in  
24 that other side of the plant, so our -- our scope is  
25 expanding here.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MEMBER ROSEN: Do you know for sure that  
2 the four-inch cracks that were found in Dresden 2 were  
3 not there prior to EPU operation?

4 MR. SCARBROUGH: No, that's part of the  
5 sort of the learning curve that we've been on here.  
6 A lot of these older inspections were not done very  
7 thoroughly, and then we moved up, and then there was  
8 a discussion of using the VT-3, sort of the visual  
9 inspection. Since it's not code, they were then doing  
10 a best effort. So, and then they found that even that  
11 wasn't looking -- finding some of these cracks.

12 And so we've had this learning curve as  
13 we've gone along. Probably the best we've done is  
14 most recently that Exelon has done at Quad Cities 2 in  
15 March where they did a VT-1 everywhere to see what's  
16 going on. But that has always been a point of  
17 discussion is some of these -- were some of these  
18 cracks there before and we just didn't see them? And  
19 we're learning more as we go along, so that's part of  
20 the -- the issue here is, where do these cracks start,  
21 and how long have they been there?

22 MEMBER SHACK: But the prior inspections  
23 were VT-3's?

24 MR. SCARBROUGH: If at all. I mean, they  
25 -- yes, they were -- and some of them were -- you

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 know, were less aggressive, especially they might do  
2 VT-1 on the welds themselves but VT-3 on the services.  
3 But as you saw, some of these go right into the base  
4 metal services themselves. They might not --

5 MEMBER ROSEN: This seems to pose the  
6 question as to whether the agency should require VT-1  
7 prior to allowing extended power uprate operation.

8 MR. SCARBROUGH: The inspection is -- one  
9 of the areas we're looking at very closely is how --  
10 how much detail they look at these steam dryers, in  
11 terms of identifying preexisting problems, so they  
12 know where they may have a problem in the future.

13 But yes, sir, that's something that we're  
14 going to be having to look at, especially since  
15 Vermont Yankee is in now --

16 MEMBER ROSEN: Sure.

17 MR. SCARBROUGH: -- to see what type of  
18 inspection they do.

19 MEMBER ROSEN: And others perhaps after  
20 that.

21 MR. SCARBROUGH: Right.

22 MEMBER FORD: When we visited GE in  
23 September 2002, they indicated some surprise at the  
24 issues that we are raising, because their view was  
25 that -- because the VIP designation that this was not

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 a safety-related component.

2 They also indicated that there had been  
3 many incidences of steam dryer cracking beyond just  
4 the stress corrosion cracking we know of the drain  
5 lines. Have you taken that into account -- these  
6 "many incidences" of steam dryer cracking? And were  
7 those locations of cracking in line with the locations  
8 that we're seeing now?

9 MR. TERAQ: Yes. Well, first, we have to  
10 go back --

11 MEMBER FORD: And then this addresses the  
12 question that Mr. Rosen was asking, was this -- it was  
13 a precursor to these particular incidences, which are  
14 accelerated maybe by power uprate, but cracks were  
15 there beforehand.

16 MR. TERAQ: Yes. We have to understand,  
17 first of all -- and keep in mind always that these are  
18 not ASME Code class components.

19 MEMBER FORD: Correct.

20 MR. TERAQ: They were not constructed to  
21 ASME Code. They were constructed to standard industry  
22 practice.

23 MEMBER FORD: Yes.

24 MEMBER SIEBER: Well, they aren't pressure  
25 vessels either.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. TERAQ: They're not pressure-  
2 retaining. So there's very little controls on these  
3 components. The inspections that we spoke about  
4 earlier that -- were just visual inspections. When  
5 they removed these dryers during normal refueling  
6 outages, they would look at them. But I would not  
7 characterize them as any type of formal visual  
8 inspections.

9 And what Tom was referring to were -- was  
10 the fact that some licensees may have done more  
11 detailed inspections than other licensees. But there  
12 were no -- there was no requirement to do any visual  
13 inspection.

14 MEMBER ROSEN: Well, I think that all  
15 that's true, and I think the presumption was that  
16 these things will retain their structural integrity,  
17 and there is no -- no issue. And, therefore, they can  
18 be treated that way. And if that were true, that  
19 would be just exactly the way it was.

20 But what we found through operation and  
21 experience is that they don't retain their structural  
22 integrity under some circumstances. So now we raise  
23 the question, which is the obvious one, is: where do  
24 the parts go? And if they go to places where they  
25 could affect safety-related functions, then we have a

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 business in asking: will these things retain their  
2 structural integrity? Are they -- have they retained  
3 their structural integrity?

4 We make a presumption when we agree to  
5 extended power operation -- uprate operation that  
6 those things have structural integrity. And maybe --  
7 and that's what's being brought into question here.

8 MR. SCARBROUGH: Yes, sir, we agree with  
9 that. Let me go on to now Quad Cities Unit 1 in  
10 November. So they had been operating for about a year  
11 at EPU, about 17 percent, and they observed in late  
12 October or early November a sudden increase in the  
13 moisture carryover. And it kept increasing, and they  
14 shut down, and they found a -- if you want to flip to  
15 the next slide.

16 You can see the significant cracking in  
17 this vertical plate, and then there was a -- about a  
18 six by nine inch piece of metal that was missing, and  
19 they searched significantly for that piece of metal.  
20 I mean, they -- they had their little robotic camera  
21 go in many places looking for this.

22 Finally, they believe that it ended up in  
23 the bottom of their reactor vessel head, and that was  
24 circumstantial, because they saw some marks on the  
25 recirculation pump propeller that weren't there, from

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 their belief, during the replacement of that.

2 MEMBER SIEBER: So the pump ate the part.

3 MR. SCARBROUGH: Yes. You know, it pushed  
4 it --

5 MEMBER SIEBER: Like the dog ate my  
6 homework.

7 MR. SCARBROUGH: Yes, right. Exactly.  
8 And that's where they ended up with -- that was their  
9 best guess of where it was. And so it's there now.

10 MEMBER LEITCH: Where is the orientation  
11 of the steam line relative to that location?

12 MR. SCARBROUGH: It's right --

13 MEMBER SIEBER: Right there.

14 MEMBER LEITCH: There's four steam lines  
15 in this unit?

16 MR. SCARBROUGH: There's one over there.  
17 There's like one there --

18 MEMBER LEITCH: Not quite 90 degrees  
19 apart? I mean, they're --

20 MR. SCARBROUGH: Yes, sir, about -- yes.  
21 And so there's one about -- about right there, and  
22 that seems to be a real problem here where this flow  
23 whips out over there.

24 MEMBER LEITCH: And they inspected that  
25 steam line?

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. SCARBROUGH: Yes. Yes. They went  
2 down that steam line, way down that steam line,  
3 looking for it.

4 MEMBER RANSOM: The flow comes out through  
5 slots in the top of this?

6 MR. SCARBROUGH: Yes, it comes out the --

7 MEMBER RANSOM: And then flows over that  
8 ledge?

9 MEMBER SIEBER: Over the wall.

10 MR. SCARBROUGH: And into the steam line,  
11 yes.

12 Now, they did a lost parts -- now we're  
13 into lost parts evaluation that the licensee did, and  
14 the staff did look at that and determine that there  
15 wasn't any immediate concern from that lost part. But  
16 there was a concern that -- that there might be some  
17 fuel fretting and things of that nature. And so there  
18 was concern that -- that that would be left there long  
19 term.

20 So the licensee is, by the time the next  
21 outage rolls around, determine if they're going to  
22 remove the core and get that part out of there. So  
23 that's still under discussion now.

24 MEMBER SIEBER: Well, this is a pretty big  
25 part. It's, what, six by nine or something?

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. SCARBROUGH: It's six by nine and a  
2 half-inch thick. And the next slide --

3 MEMBER SIEBER: And so as far as fuel  
4 fretting is concerned, it's too big to get up into the  
5 fuel area.

6 MR. SCARBROUGH: Right. They're worried  
7 it might --

8 MEMBER SIEBER: But it could be rubbing  
9 down amongst control rod housings and --

10 MR. SCARBROUGH: Right. Yes, sir.

11 Now, if you wanted to put the next slide  
12 up, please.

13 MEMBER RANSOM: It might not be in one  
14 piece any more, right?

15 MR. SCARBROUGH: Yes. If it bends a  
16 little bit, it could push down through and get into  
17 the jet pumps and get down there.

18 MR. TERAQ: That's right. In fact, the  
19 lost part analysis assumed that the large piece broke  
20 down into different and various sizes, I think as  
21 small as half an inch. So it looked at the  
22 implications of the lost part from half an inch all  
23 the way up to its full size.

24 MR. SCARBROUGH: Okay. Want to hit the  
25 next slide?

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1                   Now, you can see how this piece came out.  
2                   You can -- you can see that it's -- the metal, it just  
3                   ripped right out of there. I mean, this is rolled up,  
4                   and so this is not the normal type of static, you  
5                   know, load across that. Something severe is happening  
6                   there.

7                   MEMBER ROSEN: Did they look at the  
8                   fracture surfaces?

9                   MR. SCARBROUGH: Yes. And they determined  
10                  it was fatigue of a type of failure. And I have a  
11                  slide on that which talks about how they've migrated  
12                  in terms of, you know, exactly the type of fatigue it  
13                  was. You can see it's a catastrophic failure of this  
14                  dryer.

15                 Also, now we move beyond just a steam  
16                 dryer, because as they did their walkdown they found  
17                 -- in the main steam line they found electromagnetic  
18                 relief valve -- a drain line was leaking from this  
19                 particular valve, and they took the actuator cover  
20                 off, and they said it sort of fell apart in their  
21                 hands.

22                 The plunger spring had been pushed right  
23                 up through its holder, and a microswitch just was off  
24                 -- was falling off. The ports on it were damaged, and  
25                 it was inoperable. It was basically inoperable.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 Now, they checked the other three ERVs,  
2 and they had some extent of damage, but they weren't  
3 this severe. So now we're into this severe  
4 vibrational effect into the main steam line.

5 They also had steam line supports that  
6 were damaged, and then, although we don't have a lot  
7 of detailed information about it, there was a HPSI MOV  
8 that had a limit switch problem in terms of the spring  
9 for the limit switch, the finger springs, were damaged  
10 by the vibration effects. And so this is --

11 MEMBER ROSEN: A HPSI MOV?

12 MR. SCARBROUGH: Yes. yes.

13 MEMBER ROSEN: This was located where?

14 MR. SCARBROUGH: It's into the HPSI steam  
15 line supply.

16 MEMBER ROSEN: Which is located where --

17 MR. SCARBROUGH: Right off the main steam  
18 lines.

19 MEMBER ROSEN: -- relative to the reactor  
20 vessel?

21 MR. SCARBROUGH: Right. Well, it's not  
22 near the vessel itself. It's into the -- it's into  
23 the steam line going off, and it taps off for -- the  
24 HPSI line taps off.

25 MEMBER ROSEN: I know it's in the HPSI

1 steam line. I'm just trying to figure out, was it  
2 close to the vessel or close to the HPSI turbine, the  
3 valve we're talking about here?

4 MR. SCARBROUGH: Oh, it's farther  
5 downstream. It's not --

6 MEMBER ROSEN: It's way downstream.

7 MR. SCARBROUGH: Yes. It's not near the  
8 vessel.

9 MEMBER ROSEN: So this effect is  
10 propagating way downstream.

11 MR. SCARBROUGH: Right. It's --

12 MEMBER LEITCH: Well, it's in containment,  
13 isn't it?

14 MR. SCARBROUGH: Yes. There would be one  
15 inside containment and one outside containment.

16 MEMBER LEITCH: Yes. So it's not all the  
17 way down at the HPSI. It's -- but it's not adjacent  
18 to the vessel.

19 MR. SCARBROUGH: Right. It's not the  
20 vessel itself that --

21 MEMBER ROSEN: That's what I'm trying to  
22 establish, what you just told me, Graham. It's 10  
23 feet from the vessel or more?

24 MR. SCARBROUGH: Probably something like  
25 that, yes. It's -- well, it's a ways down. It's not

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 right next to it. It's not like right there, because  
2 it has to tap off the main steam line and then tap off  
3 there farther. So it's over its isolation valves for  
4 containment. So it would be next to the containment  
5 wall and --

6 MEMBER ROSEN: Yes. It would be helpful  
7 if you had a drawing that showed this.

8 MR. SCARBROUGH: Yes. I don't think -- I  
9 have a drawing, but I don't have one on a slide.

10 MEMBER ROSEN: I find that a lot of what  
11 you've got here is very simple. I mean, there's very  
12 little detail, and you need to provide more --

13 MEMBER SIEBER: Well, we'll get to that  
14 when we get to a subcommittee meeting.

15 MR. SCARBROUGH: Right. Well, we're still  
16 learning.

17 MEMBER ROSEN: Okay.

18 MR. SCARBROUGH: I mean, this is -- we're  
19 still in the learning phase.

20 MEMBER SIEBER: Well, let me ask you a  
21 question now. In this branch line, since this power  
22 uprate was essentially a constant pressure uprate, the  
23 flows in the line are the same as they were before the  
24 upgrade took place, because the pressure drop is the  
25 same.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1                   So that tells me that the -- whatever  
2 vibration is coming is coming from the main steam  
3 line, mechanically coupled to this branch line, as  
4 opposed to something that's -- some phenomenon that's  
5 unique to the branch line. Is that the right kind of  
6 reasoning?

7                   MR. SCARBROUGH: Well, part of it is that  
8 these have such smaller diameter steam lines. The  
9 steam flow --

10                  MEMBER SIEBER: Yes, right.

11                  MR. SCARBROUGH: -- is so great, much  
12 greater than the other plants, that it's causing this  
13 -- and they think it -- you know, some type of --

14                  MEMBER SIEBER: Well, would it have failed  
15 whether the dryer was good or bad, or you didn't have  
16 a problem anyplace else?

17                  MR. SCARBROUGH: Right. And that's an  
18 issue in terms of would -- would replacing the steam  
19 dryer fix this problem? It may be that the steam  
20 flows are so great, even if you replace the steam  
21 dryer you still might have problems --

22                  MEMBER SIEBER: Well, that's --

23                  MR. SCARBROUGH: -- these other  
24 components.

25                  MEMBER SIEBER: Well, that's the other

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 issue. If you get a failure of one of these  
2 electromagnetic relief valves, the question is: did  
3 the failure -- did the damage mechanism occur before  
4 the dryer failed or after the dryer failed? You know?  
5 It could be the failure of the dryer that changed the  
6 operating condition in the line, or it could be you  
7 just have a lot of steam flow and you're wrecking  
8 supports and shaking -- shaking everything a lot.

9 MR. SCARBROUGH: Right, right.

10 MEMBER SIEBER: And so have you come to a  
11 conclusion whether there's a relationship between  
12 dryer failure and these other problems that you find,  
13 or are they independent?

14 MR. SCARBROUGH: Well, they do shut down.  
15 As the main -- the moisture carryover increases  
16 quickly, they shut down within a week or so. I mean,  
17 it's just a few days before they shut down.

18 MEMBER SIEBER: Yes, but it is days --

19 MR. SCARBROUGH: Yes.

20 MEMBER SIEBER: -- nonetheless.

21 MR. SCARBROUGH: Yes. So --

22 MEMBER SIEBER: And you can get a lot of  
23 cycles in a few days.

24 MR. SCARBROUGH: Right, yes. So I -- but  
25 that's something that some testing is going on, and

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 we'll talk to that later. Exelon has done quite a bit  
2 of vibration testing and evaluation to find out -- try  
3 to find out what's going on with this. And that's  
4 part of what they're supposed to present to us as the  
5 Owner's Group, is sort of taking responsibility for  
6 this and coordinating this.

7 MEMBER SIEBER: But they don't have a  
8 baseline, right?

9 MR. SCARBROUGH: Well, that's -- well,  
10 they are, in terms of they were gathering data --

11 MEMBER SIEBER: At the old full power?

12 MR. SCARBROUGH: No. They were -- they  
13 were doing some EPU -- going up to obtain vibration  
14 data at EPU as well.

15 MEMBER SIEBER: Okay.

16 MR. SCARBROUGH: So -- right. So they're  
17 working on it.

18 MEMBER SIEBER: All right.

19 MEMBER LEITCH: We had a problem starting  
20 up a BWR with -- where the turbine governor valves  
21 were fluctuating and causing pressure pulsations all  
22 the way back through the main steam lines. And  
23 basically, the fix was an electronic one. We had to  
24 retune the --

25 MEMBER SIEBER: Controls.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1                   MEMBER LEITCH: -- the EHC control system  
2 with some additional capacitors and stuff to dampen  
3 out that vibration in the turbine governor valves.  
4 And this only occurred at high power. And I'm just  
5 wondering if -- if there's any possible connection  
6 here. In other words, these are now operating at  
7 higher power than they were before.

8                   Might we have moved into a region of  
9 instability in the turbine governor system? And if  
10 those turbine governor valves are sitting there  
11 fluctuating, it could be reflecting fluctuations back  
12 to and up the main steam line.

13                   MR. SCARBROUGH: Right. Right. Yes, and  
14 we have seen instances where the set points all need  
15 to be adjusted under these EPU conditions and places  
16 where they had not been adjusted. So this may be  
17 something that we can raise with the licensee to see  
18 if they have gone back and adjusted those governor  
19 valves and make sure they're working properly.

20                   MEMBER LEITCH: Because they should be  
21 real stable. I mean, they can be made to be real  
22 stable. If they're tolerating some fluctuations in  
23 those valves, it can raise havoc, in fact, through the  
24 steam lines.

25                   MR. SCARBROUGH: Thank you. We'll raise

1 that.

2 MEMBER APOSTOLAKIS: Well, I'm a little  
3 bit puzzled here. The issue -- I mean, the first  
4 failure was observed in June of 2002, and you will  
5 show in your next slide that cracks have been found as  
6 late as the spring of this year.

7 MR. SCARBROUGH: Yes.

8 MEMBER APOSTOLAKIS: What is the risk  
9 significance of this? Why do we keep seeing these  
10 things and the plants keep operating and we keep  
11 finding failures? Has somebody decided that the risk  
12 significance is very low?

13 CHAIRMAN BONACA: Yes. I had the same  
14 question exactly.

15 MEMBER APOSTOLAKIS: I don't understand  
16 why --

17 CHAIRMAN BONACA: Because if you go past  
18 the --

19 MEMBER APOSTOLAKIS: I mean, every other  
20 month you have a problem.

21 CHAIRMAN BONACA: So you just identify the  
22 problem, collect the broken pieces, fix it up, and  
23 start again, and then collect the next pieces. I  
24 mean, what's going on?

25 MEMBER APOSTOLAKIS: And then in another

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 plant you find similar problems. So can you tell me  
2 what the risk significance of this is? I mean, is it  
3 really low, so we don't care?

4 MR. SCARBROUGH: Well, part of it was the  
5 -- sort of how it progressed. You started off with  
6 June 2002, you had a failure. It was determined that  
7 that was a -- you know, a once sort of in a lifetime  
8 sort of situation, and they --

9 MEMBER APOSTOLAKIS: We can forgive the  
10 first instance.

11 MR. SCARBROUGH: Right. Okay. Then we  
12 had another failure.

13 MEMBER APOSTOLAKIS: Yes.

14 MR. SCARBROUGH: And then that -- that was  
15 caused by -- maybe it was aggravated by this PORV  
16 initiating. So they beefed it up some more, and I --  
17 I have another slide which talks about how they beefed  
18 this piece of metal up more and more.

19 And then we get to -- you know, and now  
20 we're into late November, and we have these other  
21 failures. And then we start saying, "Okay. Let's get  
22 the Owner's Group involved and solve this problem."  
23 But it comes back to the steam dryer -- you know, it's  
24 non-safety-related, so there's this real --

25 MEMBER ROSEN: I wish you'd just stop

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 saying that.

2 MEMBER APOSTOLAKIS: That is, you know,  
3 the pre-PRA categorization. After that, we have now  
4 a tool that can give us some idea how important these  
5 things are.

6 CHAIRMAN BONACA: Right.

7 MEMBER APOSTOLAKIS: So how important are  
8 they?

9 CHAIRMAN BONACA: But, you see, even PRA  
10 by itself won't tell you the whole story, because, I  
11 mean, we don't -- we can't predict where these parts  
12 are going. They're going in different locations.  
13 Every time -- I mean, he'll show additional slides now  
14 that show that, you know, in following shut down for  
15 refueling, or whatever, identify additional failures,  
16 pieces located in different parts, etcetera, and --

17 MEMBER APOSTOLAKIS: But it's part of the  
18 development of scenarios.

19 CHAIRMAN BONACA: Yes, I understand that.

20 MEMBER APOSTOLAKIS: In one scenario, the  
21 part goes this way; in another, it goes that way. And  
22 you try to figure out, you know, what the risk is.  
23 Have you done any analysis?

24 MEMBER LEITCH: Pieces have been found on  
25 the turbine valves. So by definition, they have been

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 through the main steam isolation valves, which are  
2 safety-related. And these pieces could certainly  
3 impact the operation of the main steam line isolation  
4 valves.

5 MEMBER APOSTOLAKIS: So they can have an  
6 impact on the estimated core damage frequency.

7 MEMBER ROSEN: Well, you can have an  
8 impact on an enclosure -- the successful closure  
9 frequency of the MSIVs.

10 MEMBER APOSTOLAKIS: Okay.

11 MEMBER ROSEN: And figure that into the  
12 event sequences.

13 CHAIRMAN BONACA: But most of all, the  
14 point I was trying to --

15 MEMBER APOSTOLAKIS: How important is  
16 that?

17 CHAIRMAN BONACA: -- I was trying to make  
18 is that we don't know the initiators. I mean, every  
19 time it seems like we have a neutral price. Other  
20 pieces are missing that we didn't expect to see, and  
21 so you may have other -- you see what I'm trying to  
22 say is that, you know, it's not fully contained  
23 insofar as what is breaking off and what is going. I  
24 mean, we -- you know, so we can develop some  
25 scenarios, but --

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

1 MEMBER APOSTOLAKIS: Yes. But we can  
2 certainly say something about the consequences, yes,  
3 of these failures, at least the failures that have  
4 been observed. So have you done anything with this?

5 MR. SCARBROUGH: There is a research --  
6 you know, some of the research activities are  
7 involved, and some of it is looking at what the  
8 consequences are of these failures. And, you know,  
9 the staff did look at -- the Systems Division did look  
10 at this issue, and they're the -- they have the PRA  
11 group. And they determined that there wasn't a severe  
12 immediate risk to letting them go back up, and that's  
13 -- you know, that's not a lot of --

14 MEMBER APOSTOLAKIS: Maybe there wasn't --

15 MEMBER LEITCH: That's another one of our  
16 other concerns here is with our other -- one of our  
17 other missions right at the moment is we're looking at  
18 license renewal for Dresden and Quad Cities, and we're  
19 somewhat surprised to -- to find that the dryers are  
20 not in the scope of the license renewal. And they're  
21 -- there are a number of -- I mean, the reason is that  
22 they're not -- they're not safety-related.

23 One of the other things is that -- one of  
24 the criteria for being in the scope is to be safety-  
25 related, but another criteria is to be non-safety-

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 related but to impact the operation of safety-related  
2 equipment.

3 MEMBER APOSTOLAKIS: Sure.

4 MEMBER LEITCH: And it seems to me by  
5 definition these could impact the operation of the  
6 MSIVs, which are safety-related. So, you know, it  
7 seems to me that these things ought to be in the scope  
8 of license renewal considerations.

9 MR. SCARBROUGH: Right. And there has  
10 been a lot of discussion about that, where they should  
11 -- I think right now what we're doing is we're trying  
12 to solve this as a current operational issue.

13 MEMBER LEITCH: Right.

14 MR. SCARBROUGH: Not even letting it get  
15 that far into, you know --

16 MEMBER LEITCH: Yes, sure. Right.

17 MR. SCARBROUGH: -- the license renewal  
18 space. It has to be solved now, and that's why we're  
19 dealing with it now. But you're right, there's been  
20 a lot of discussion whether it should be in scope or  
21 out of scope, but we're going to solve it now. I  
22 mean, you know, that's -- that's part of the issue  
23 now.

24 Like Quad Cities is not at EPU now.  
25 They're at - they're not allowed to go up to -- I

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 mean, that's -- we have more slides on that, is that  
2 -- is that part of this last failure in March, that  
3 was it. They cannot go up into EPU unless they get  
4 NRC approval to do that. They agreed that that would  
5 be a condition, and they're not up, so they're -- you  
6 know, after four times, they're staying at dual power  
7 level until they solve this problem.

8 MEMBER APOSTOLAKIS: Now, is there a  
9 document that documents this risk assessment -- I know  
10 this is not a significant risk issue -- that we can  
11 look at?

12 MR. SCARBROUGH: I can go back and ask if  
13 there was something that was prepared on that.

14 MEMBER APOSTOLAKIS: Because, you know, I  
15 find it a little bit -- that we are a bit  
16 inconsistent. I mean, in the reactor oversight  
17 process, the inspectors go around and they find some  
18 minor violations or -- not really violations and some  
19 minor problems. And then we have this elaborate SDP  
20 -- significant determination process -- to tell us  
21 what the color is. Okay?

22 And here we have real failures, and we  
23 don't do something like that. Or maybe you will do  
24 it, but we don't have access to it. But it would be,  
25 I mean, an interesting -- like I think this probably

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 is more serious than maybe finding that one siren is  
2 not operable, and, you know, going to the SDP.

3 And here we have failures that affect the  
4 primary loop, and I would expect to see, you know,  
5 some color or some -- something that says, you know,  
6 yes, this would affect the CDF and we are taking  
7 action because of that.

8 MR. TERAQ: Actually, the ACRS will be  
9 hearing later this morning from the Office of Research  
10 on one of their activities involving the PRA or  
11 looking at the risk significance.

12 MEMBER APOSTOLAKIS: And they do this kind  
13 of thing? They do this --

14 MR. TERAQ: Yes. Well, I don't know  
15 exactly what their -- I will let the Research staff  
16 address that issue.

17 MEMBER APOSTOLAKIS: I'm not even sure  
18 it's a research issue. I mean, you can actually see  
19 the impact title. Well, there's a PRA Branch in NRR,  
20 isn't there?

21 Any comments maybe? No? Okay.

22 MR. CARUSO: Well, George -- George, I  
23 just want to make a comment. I believe something like  
24 that was done as part of the BWR VIP program. There  
25 was -- this is Ralph Caruso. I'm from ACRS staff, but

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 I used to work on this.

2 And I believe there was a report that was  
3 done by a research contractor as part of the BWR VIP  
4 program to look at the consequence of vessel internal  
5 failures and the effect of pieces coming out of  
6 components in the upper part of the vessel and their  
7 impact on various different scenarios.

8 And I don't know if there's anyone here  
9 from Research who remembers that, but I do remember  
10 that they had a contract which --

11 MEMBER APOSTOLAKIS: When was this done?  
12 When was this done?

13 MR. CARUSO: Three or four years ago.

14 MEMBER APOSTOLAKIS: But that was before  
15 the failures.

16 MR. CARUSO: Yes. Yes, it was part of --

17 MEMBER APOSTOLAKIS: So now one can take  
18 that report and say, "Okay. This actually happened.  
19 Let me see now which scenarios are possible and what  
20 frequencies they have," right? And do an event-  
21 specific evaluation.

22 MR. CARUSO: I don't know. I don't  
23 remember the details of it. I remember being involved  
24 in it a little bit.

25 MEMBER APOSTOLAKIS: Yes, I understand

1 that.

2 MR. CARUSO: So I don't remember the  
3 details. Pardon?

4 MR. TERAQ: I'm not sure that that was a  
5 Research report. There was a -- there is a report  
6 issued by the BWR VIP -- it's number 06 -- that deals  
7 with this type of failures of safety-related and non-  
8 safety-related components inside the vessel, including  
9 the steam dryer. And it looked at the impact of the  
10 loose parts and the steam dryer collapsing onto the  
11 steam separators.

12 MR. CARUSO: Right.

13 MR. TERAQ: And the staff has reviewed  
14 that report. We are still looking at it for -- to see  
15 if it needs to be reevaluated in light of the recent  
16 steam dryer failures.

17 MR. CARUSO: I remember that the industry  
18 did it, but I also thought the staff had Research look  
19 at it, and they had a contractor do a study as part of  
20 their evaluation.

21 MEMBER APOSTOLAKIS: Wouldn't that be the  
22 first thing you would do? You would go to a report  
23 like that or the PRA and insert these failures and try  
24 to figure out what happens and how significant these  
25 things are? Instead of talking about -- this is non-

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 safety-related or it may affect a safety-related  
2 component. I mean, I would expect to see something  
3 like that today and say, you know, for these reasons  
4 we decided to keep studying it.

5 I mean, it's very consistent with what the  
6 reactor oversight process does, which goes to this  
7 phased approach to the significance determination and  
8 all that. And here you have a real failure. Anyway,  
9 I think we've said enough about this.

10 MR. SCARBROUGH: Well, we're still working  
11 on resolving this. Let me go on --

12 MEMBER APOSTOLAKIS: But one of the -- of  
13 the objectives is -- of the Commission is to maintain  
14 and even enhance public confidence in the agency. In  
15 the discussion of the last 10 minutes, I'm not sure  
16 how much it contributes to that.

17 MR. SCARBROUGH: I agree.

18 MEMBER APOSTOLAKIS: It's not just the CDF  
19 that bothers me. It's this appearance as well. You  
20 know, you guys are like Caesar's wife. You know what  
21 they said about her.

22 MEMBER SIEBER: We shouldn't talk about  
23 that.

24 (Laughter.)

25 MEMBER APOSTOLAKIS: I shouldn't talk

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 about Caesar.

2 MR. SCARBROUGH: Okay. Well, let me go on  
3 and -- the other examples we have. Dresden Unit 3  
4 shut down in December, and this is where the staff  
5 actually was actively involved in convincing Exelon to  
6 shut down the unit to do an inspection. And they  
7 found a couple of four-inch throughwall cracks in the  
8 steam dryer, and they found two more sample probes  
9 that had problems.

10 And also, Dresden Unit 2 happened to shut  
11 down during that month, and they found one of their  
12 probes -- feedwater probes also missing. So that's  
13 where we were with that, with Dresden.

14 Now, this year Quad Cities Unit 2, in  
15 March, now they've had another eight months of  
16 operation, and they shut down for a refueling outage  
17 inspection, and they found numerous problems with  
18 their steam dryer. And part of it involved where they  
19 had done repairs in the past.

20 And if you can show the next slide there,  
21 you can see --

22 MEMBER LEITCH: This is eight months of  
23 operation. I'm just a little confused. Was this at  
24 the new 100 percent power level, this eight months?

25 MR. SCARBROUGH: No, this is back -- this

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 was back up to the EPU, 17 percent above the  
2 original --

3 MEMBER LEITCH: Yes. Okay.

4 MR. SCARBROUGH: So they went -- yes, they  
5 had eight more months of EPU operation.

6 MEMBER LEITCH: Yes, okay. thank you.

7 MR. SCARBROUGH: And so they found -- one  
8 of the areas they found problems was right here where  
9 they had installed these gusset plates, this piece of  
10 metal, and they had a disconnect here between the old  
11 half-inch and one-inch plates, and they had a  
12 disconnect there, and that -- and that failed.

13 They found several broken tie bars up in  
14 here. There's cracks like right in there. You can --  
15 where those were coming apart, and then they -- they  
16 had a weld where there was a plate attached, and this  
17 right through this weld popped out from the vibration.

18 So, and then down here on the tip of the  
19 gusset -- I don't know if you can see it, but you can  
20 see there's a crack right down there. But part of the  
21 problem was they -- they were finding damage where  
22 they had made repairs in the past.

23 Now, there's a series of things that  
24 happened since then, and we have some slides on that.

25 Other steam dryer inspections that we've

1 had this year -- Nine Mile Point has a curve to a  
2 design, and they did find an 18-inch crack along a  
3 weld right where the curved hood sort of comes  
4 together. And they determined that was a fatigue type  
5 of crack caused by acoustic loading.

6 But they had been operating for several  
7 years, and so that's what they saw. They did -- there  
8 was some blow by through that crack.

9 Brunswick has been operating for a couple  
10 of years at 13 percent power uprate, and it has the --  
11 sort of the slanted design, which is sort of the in  
12 between of the square and the curve. And they found  
13 some minor -- some minor cracks, fatigue cracks, in  
14 their steam dryer.

15 MEMBER LEITCH: Just as a matter of  
16 interest, Brunswick Number 1 just came out of a  
17 refueling outage where they preemptively beefed up,  
18 shall we say, the dryer, and they're now operating at  
19 the full new extended power uprate -- that is, the  
20 full approximately 120 percent of the original power  
21 rating. They've been at that rating now for about two  
22 weeks, and, you know, so far so good. But I don't --  
23 it has only been two weeks, as I said.

24 MR. SCARBROUGH: Yes. When we talked to  
25 them, they said that they were putting some of those

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 gussets -- those very long gussets in to try to  
2 strengthen that -- those plates. And so -- and they  
3 said they were going to go up to 20 percent. But they  
4 are -- they are doing some extensive vibration  
5 monitoring and walkdowns, things of that nature, to  
6 try to be prepared to see if they have any problems.

7 MEMBER FORD: But following on from what  
8 Dr. Shack said at the very beginning, aren't we just  
9 chasing this problem? If we can't -- we don't  
10 understand it, just putting in gussets is not going to  
11 stop it, right?

12 MR. SCARBROUGH: Right. Yes, sir. And  
13 that's getting to where we're going with these slides.

14 MEMBER APOSTOLAKIS: But you told me  
15 earlier that when the Quad Cities -- the first  
16 incident occurred in 2002, they only had 90 days of  
17 power uprated operation. And when I asked about  
18 degradation, you said, "Well, gee, most likely that  
19 wasn't the problem, because they're forcing function."

20 Doesn't the experience of -- with Vermont  
21 Yankee contradict that? That they found numerous  
22 cracks at the original licensed power? Do we know  
23 that there were no -- no cracks in the Quad Cities  
24 case, or it was a combination perhaps of material  
25 degradation and forcing function underestimation?

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. SCARBROUGH: Right. The first  
2 failures at Quad Cities, you never really know whether  
3 or not it was something that was there before that was  
4 aggravated.

5 MEMBER APOSTOLAKIS: Oh, okay.

6 MR. SCARBROUGH: Okay. But as they've  
7 done more and more inspections and they keep having  
8 more and more failures, you get to the point where  
9 they've inspected it sufficiently thoroughly so that  
10 they -- there weren't preexisting problems, that these  
11 really are EPU-related, and now these Vermont Yankee  
12 problems -- they didn't find them in the areas where  
13 the Quad Cities was failed. Not in those areas. They  
14 found them in other areas -- drain channels and welds,  
15 and things like that.

16 So they didn't find them in the areas that  
17 Quad Cities was failing. So we're not quite sure if  
18 those were related to this type of sort of full effect  
19 phenomenon, or was there something else happening  
20 there with those. We won't know yet on that, but  
21 we're still -- because we still don't really know what  
22 the forcing function was on these.

23 MEMBER APOSTOLAKIS: So we don't know, but  
24 we are convinced the risk is low, so we -- they can  
25 keep operating.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. SCARBROUGH: Well, for EPU, Quad  
2 Cities is not operating at EPU. I mean, they're not.  
3 That's -- you know, now Dresden is, but that's a  
4 different issue.

5 MEMBER FORD: All these minor and numerous  
6 cracks in this particular design, do we know how they  
7 occurred?

8 MR. SCARBROUGH: Some of them occurred by  
9 just stress corrosion cracking. They know that.

10 MEMBER FORD: Because the resolution to  
11 the stress corrosion cracking problem is completely  
12 different from that of fatigue.

13 MR. SCARBROUGH: Yes, sir.

14 MEMBER FORD: So if you go with what  
15 Professor Apostolakis is posing -- that many of these  
16 problems that we have which we see after power uprate  
17 are really just an acceleration of previous damage  
18 which occurred over the 20, 25 years of operation.

19 But I'm struggling to come away from the  
20 conclusion that this is not an isolated occurrence to  
21 just flat-topped BWR-3 designs. It could be over the  
22 whole BWR fleet, if they are all -- if they have all  
23 got prior damage from IGCC or whatever.

24 MR. SCARBROUGH: Yes, we haven't limited  
25 the scope just to the square hood designs yet. I

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 mean, that's where we're seeing the severe problems,  
2 which is good that it's sort of focusing on the area.  
3 But we haven't said this is only a square hood. We're  
4 making sure this is a broad look at this issue before  
5 we say, "This is the scope."

6 And that's what -- that's what our concern  
7 is, that it -- the scope is not something very neat  
8 where you can say, "Okay. This is it. If we fix  
9 this, we're done." We just seem to have more  
10 problems.

11 Now, I was going to mention briefly some  
12 of these causes that we've had, and this is -- we've  
13 talked about this as we go along.

14 But high cycle fatigue -- the first Quad  
15 Cities Unit 2 failure in 2002 -- it was high cycle  
16 fatigue, and there was a high frequency of resonance  
17 that aligned with the coverplate, natural frequency,  
18 and, you know, all these sorts of things that said  
19 this was like a once in a sort of blue moon situation.  
20 But then we -- a year later we have Quad Cities Unit 2  
21 with high cycle fatigue due to the low pressure  
22 pressuring loading -- low frequency pressure loading.

23 And then, in November, Quad Cities 1 -- we  
24 have the high cycle fatigue with a fluctuating  
25 pressure load with acoustics. And then we have the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 Dresden feedwater probes with resonant frequency  
2 vibration. So they're all vibration fatigue-related,  
3 but they haven't really nailed down what it is.

4 But let me mention -- we've talked about  
5 the dryers themselves. There are basically three --  
6 the BWRs have three dryer designs -- a square hood,  
7 the older type, and the slanted, and the curved. And  
8 GE has done an analysis of the various hood designs  
9 and has seen that the square hoods just have more  
10 stress for the same amount of flow than the slanted  
11 and the curved -- significantly different for those.

12 Quad Cities and Dresden have the  
13 disadvantage that they have smaller diameters, so  
14 their steam velocities are up around 200 feet per  
15 second compared to more the 150, 60, 70, sort of areas  
16 that we're seeing with the other plants. So they have  
17 a lot more flow, and then on top of that Quad Cities  
18 and Dresden have these higher power uprates where  
19 they're going up to 17 or so percent in the others.  
20 So they have a combination of problems.

21 Now, the other square hood designs --  
22 Monticello, they've had six percent power uprate, and  
23 they've operated for five years without really any  
24 problem. Pilgrim only had that small 1.5 percent for  
25 about a year, and they haven't seen any problems.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 Vermont Yankee now -- the other square  
2 hood design -- wants a 20 percent uprate. So  
3 that's --

4 MEMBER ROSEN: But they've already found  
5 numerous cracks -- Vermont Yankee.

6 MR. SCARBROUGH: Yes, they have found  
7 some. Right.

8 MEMBER ROSEN: So it presumes they would  
9 do something about that.

10 MR. SCARBROUGH: They will. They will.  
11 We will not grant that EPU uprate until we're  
12 satisfied that issue is soft, and we told the licensee  
13 that. And they know that, and they're here, and  
14 they're interacting with GE, and they know they have  
15 to learn --

16 MEMBER APOSTOLAKIS: The extended -- I'm  
17 sorry, go ahead.

18 MR. SCARBROUGH: They have to evaluate the  
19 lessons learned from Quad Cities before they determine  
20 that they've solved the problem for Vermont Yankee.

21 MEMBER APOSTOLAKIS: The Vermont Yankee  
22 power uprate has not been granted?

23 MR. SCARBROUGH: No, sir. They just came  
24 in just recently --

25 MEMBER APOSTOLAKIS: Okay.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. SCARBROUGH: -- with a request. And  
2 we have a series of RAI questions that have gone out  
3 to them regarding this issue and how they're going to  
4 resolve it.

5 MEMBER APOSTOLAKIS: So you will not  
6 include Vermont Yankee into this statement here --  
7 Quad Cities and Dresden and Vermont Yankee?

8 MR. SCARBROUGH: They're included, because  
9 they have -- they're requesting --

10 MEMBER APOSTOLAKIS: They are not  
11 included.

12 MR. SCARBROUGH: Well, they're included in  
13 the sense that they have -- they have requested a 20  
14 percent power uprate. Okay. They have a square hood  
15 design --

16 MEMBER APOSTOLAKIS: Yes.

17 MR. SCARBROUGH: -- and they have the  
18 smaller steam lines.

19 MEMBER APOSTOLAKIS: Right.

20 MR. SCARBROUGH: Okay. So they -- they  
21 are in the most susceptible group, despite the --

22 MEMBER APOSTOLAKIS: So, but that's what  
23 the slide says.

24 MR. SCARBROUGH: Right. And that's what  
25 I was adding on here.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MEMBER APOSTOLAKIS: So Vermont Yankee  
2 could be there.

3 MR. SCARBROUGH: Right.

4 MEMBER APOSTOLAKIS: Or would be there.

5 MR. SCARBROUGH: So if we granted it, they  
6 could be in that group.

7 MR. TERAQ: So that's why we're looking at  
8 it more closely.

9 MR. SCARBROUGH: Now --

10 MEMBER LEITCH: Can I just go back again  
11 to the experience we had with these governor valves,  
12 these turbine governor valves, and stress that it was  
13 important that the configuration and dimensions of the  
14 main steam line, because that EHC system has to be  
15 tuned to get those valves to be stable.

16 And we found that at different plants --  
17 you know, in some plants the head end of the turbine  
18 is near the reactor. In other plants, the generator  
19 is there, and it's a very long steam line, so it  
20 affects the dynamics of the situation and affects the  
21 tuning of that EHC system.

22 So I just keep -- it sounds to me like  
23 there is a distinct possibility, and you need to look  
24 into whether these governor valves are really stable  
25 or not. And it could vary quite a bit from plant to

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 plant, but depending upon the configuration and size  
2 of the main steam line, because it does affect the  
3 dynamics of that whole control loop.

4 MR. SCARBROUGH: Okay. Thank you. We'll  
5 raise that.

6 In January, GE has -- you know, has been  
7 looking at this issue, and they determined that there  
8 was a fluctuating pressure load in the acoustic range  
9 that they hadn't evaluated before, they hadn't really  
10 seen before, and they identified that to us.

11 Also, Exelon has been running vibration  
12 analyses of their steam line components, their ERVs  
13 and MOVs, HPSI MOVs, and etcetera. And they found  
14 that the vibrations were so severe they could not  
15 justify the ERVs as they were at Quad Cities for a  
16 full cycle. It was just a few months that they could  
17 only justify their operation at that vibration level.

18 So they've installed attachments to  
19 strengthen those -- those components to prevent them  
20 from having problems, at least until the next outage  
21 where they can refurbish them. So they're only on a  
22 one-cycle length of time before they have to refurbish  
23 these. So there is some severe vibration going on.

24 MEMBER ROSEN: Isn't that a bandaid fix?  
25 I mean, the real problem here is not -- is that the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 vibration -- something is causing the vibration. And  
2 what they're doing is stiffening these components to  
3 resist the vibration. The right thing to do is to  
4 eliminate the vibration.

5 MR. SCARBROUGH: Right. Yes, sir. And  
6 that's going back to what's causing this, what's  
7 causing these problems.

8 MEMBER FORD: And part of that is -- is it  
9 says GE identifies. When we were visiting GE, they  
10 indicated that they were putting vibration monitors,  
11 or they had in the past, and continuing to do  
12 presumably, put vibration monitors onto the steam  
13 dryers. Is that true?

14 MR. SCARBROUGH: Not on the dryers  
15 themselves.

16 MEMBER APOSTOLAKIS: That was the  
17 indication.

18 MR. SCARBROUGH: Not in the plants. Now  
19 maybe in their separate effects testing or something  
20 that they were doing, but not in the plants  
21 themselves. And that's been a discussion that we've  
22 had.

23 Now, in a couple of the --

24 MEMBER FORD: My question was about to go  
25 on.

1 MR. SCARBROUGH: I'm sorry.

2 MEMBER FORD: How have you qualified these  
3 analyses? That was the end of my conversation.

4 MR. SCARBROUGH: Okay. And part of this  
5 is, you know, the staff is currently reviewing the  
6 Vermont Yankee request, and part of that review is  
7 going to be a detailed look at the GE analyses. And  
8 we're setting that up now.

9 I mean, that process to go and look at  
10 those analyses in detail is in the works. We just  
11 haven't set the time for when the experts -- and  
12 that's not me -- to go out and look at these analyses  
13 into a lot of detail and evaluate them. But the staff  
14 is getting a contractor to assist on that as well.

15 In March, the licensee was saying at Quad  
16 Cities 2 there was design problems with the gusset  
17 repair. There was a discontinuity there. There were  
18 some problems with, you know, the stresses and the tie  
19 bars, how they attached them, and how they attached  
20 the stiffener plate, where they clamped it down to --  
21 and it popped out.

22 So there are some issues here. Part of it  
23 -- I mean, this is not code work, so, you know, it's  
24 not -- and it's very difficult work to do, you know,  
25 a lot of times under water and things of that nature.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 So it's a difficult repair to make, and what their  
2 explanation was is there were some design problems.  
3 But that's not -- that's not solving the problem.  
4 That's just explaining what -- why they thought it  
5 occurred.

6 In terms of the corrective actions, a  
7 whole series -- and this is what you have brought up,  
8 and it's a good point. I mean, you start in July, you  
9 go from a quarter-inch thick plate to a half-inch  
10 plate, and then you go from July of 2003 and you go  
11 from a half to a one, install some gussets.

12 And then, in October, you know, Dresden 2  
13 received a modification similar to that Quad Cities 2.  
14 And then -- and if you want to look at the next slide,  
15 we'll show you a little bit about what they're doing.  
16 And this is what -- where we showed what they  
17 installed -- they cut out this piece that broke, and  
18 they installed these gussets. But they left a little  
19 gap there where they went from a half-inch to a one-  
20 inch plate, and that discontinuity it just -- it  
21 wobbled on them, and it just broke, and --

22 MEMBER ROSEN: Now wait a minute. Wait a  
23 minute. They went in and put these gussets in. The  
24 obvious -- it seems to me one doesn't do that unless  
25 you have an analysis, an engineering design.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. SCARBROUGH: Right.

2 MEMBER ROSEN: So something -- they did  
3 draw it in the design.

4 MR. SCARBROUGH: Yes, sir. And they  
5 freely said they missed it now that they say -- they  
6 still -- now what they've done, if we flip on -- you  
7 can see the plates -- go to the next one. It gives  
8 you a little closer look.

9 You can see where -- right there, you'll  
10 see right where it --

11 MEMBER ROSEN: No. They missed -- what  
12 did they miss? They missed the forcing function, what  
13 they were designing against, what was the strain to  
14 the materials they installed. We need some detailed  
15 analysis of what this is, and to do that, of course,  
16 you need engineering drawings -- my earlier point.

17 MR. SCARBROUGH: Right.

18 MEMBER ROSEN: That these cartoons don't  
19 do it for me.

20 MR. SCARBROUGH: Right. Right. Right.  
21 I know. That's been part of our problem is getting  
22 the details.

23 MEMBER ROSEN: Why is it your problem?  
24 Why don't you just require them to deliver these --  
25 this information to you and where the analysis and

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 engineering that you can review -- you have the  
2 capability within the agency to do that.

3 MR. SCARBROUGH: Right.

4 MEMBER ROSEN: To ask them, what are the  
5 forces they're designing to resist, and what -- from  
6 what phenomena do those forces arise? And having once  
7 concluded that they've got the phenomena correct and  
8 the forces are right, then you can decide whether the  
9 structural fixes make any sense.

10 MR. SCARBROUGH: Right.

11 MEMBER ROSEN: I mean, there's a process.  
12 We all learn it in college.

13 MR. SCARBROUGH: Right. I agree. And the  
14 staff just missed this. I mean, we had a special  
15 inspection team that went out in July of 2003 to the  
16 plant and looked at what they did, and whatever we saw  
17 we agreed that it was acceptable.

18 MEMBER ROSEN: Well, now you know better.

19 MR. SCARBROUGH: And we know better.

20 MEMBER RANSOM: Well, is there any attempt  
21 to understand the flow dynamic forces that are causing  
22 this problem?

23 MR. SCARBROUGH: Oh, absolutely.

24 MEMBER RANSOM: Either by CFD-type  
25 calculations or wind tunnel-type experimentation?

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. SCARBROUGH: Right.

2 MEMBER RANSOM: Is there anything going on  
3 in that area?

4 MR. SCARBROUGH: Absolutely. The Owner's  
5 Group is looking at this. The staff is looking at  
6 this. We've asked Research to evaluate -- help us  
7 evaluate, step back. You know, we're sort of tired of  
8 being drug along here.

9 We've asked Research to help us step back,  
10 look at it from a sort of first principles, and decide  
11 what's going on with the CFD, what's going on with the  
12 model, try to, you know, do some confirmatory look at  
13 what's going on, so that when GE comes in again and  
14 says they've solved this problem we can really work  
15 from a knowledge base rather than sort of where we are  
16 now.

17 And so that's exactly what we're doing.  
18 We're trying to step back and solve this.

19 MEMBER RANSOM: Because once you  
20 understand the flow dynamic forces, it may turn out  
21 very simple things. We'll eliminate the -- stabilize  
22 the vortex shedding or --

23 MR. SCARBROUGH: Right.

24 MEMBER RANSOM: But you must understand it  
25 before you can do that.

1 MR. SCARBROUGH: Right. Yes, sir. We  
2 agree with that.

3 Let me go on to the next slide. Now,  
4 then, in March, you know, more failures. And if you  
5 want to flip to the next one, David, you'll see that  
6 now we've gone from -- now they've taken out the whole  
7 plate.

8 Now they're putting up these large gussets  
9 here, and so, you know -- and, you know, so now we  
10 have this one-inch plate, and then half-inch gussets  
11 going all the way up almost into the top and holding  
12 that in.

13 Now, we've asked some questions about the  
14 design in terms of, you know, what's going on with  
15 these edges over here. Do we have another  
16 discontinuity? We've been asking all those sorts of  
17 questions about what's going on, and they've  
18 strengthened those ERVs.

19 But that's part of what we'll talk about  
20 in a minute is what they have said to us in their  
21 letter coming in in terms of their commitments to us,  
22 to show us exactly that they've nailed down this  
23 issue.

24 MEMBER ROSEN: Now, these are like  
25 dramatic relief valves that are credited in the safety

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 analysis, correct?

2 MR. SCARBROUGH: Yes, sir.

3 MEMBER ROSEN: And they're now qualified,  
4 continue to be qualified to perform their safety-  
5 related functions with these new strengthening --

6 MR. SCARBROUGH: Yes.

7 MEMBER ROSEN: Have they tested them again  
8 or repeated the testing that they did that established  
9 their initial qualification?

10 MR. SCARBROUGH: I don't know that they've  
11 done flow-type testing. But I know they did a lot of  
12 shaker testing on these out -- that Exelon did --

13 MEMBER ROSEN: As modified.

14 MR. SCARBROUGH: -- to demonstrate, yes,  
15 that they would hold up their capability. So -- but  
16 that's only good for the next outage.

17 In this reactor, I mean --

18 MEMBER ROSEN: Well, the implication is  
19 that the forces they're worried about are forces for  
20 two years of duration. You said only good for two  
21 years.

22 MR. SCARBROUGH: Right. But --

23 MEMBER ROSEN: But what if they have an  
24 event in which the -- you know, the design basis event  
25 where these valves were expected to function. They

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 didn't test that.

2 MR. SCARBROUGH: I don't know if they went  
3 up to that high level. I don't know if -- I don't  
4 know if they did that or not.

5 MEMBER ROSEN: That was my initial  
6 question is these valves were initially qualified to  
7 perform a safety function during accidents in transit.  
8 They have been modified, right? Will they continue to  
9 perform their function during accidents in transit is  
10 the question.

11 MR. SCARBROUGH: The best of our  
12 knowledge, they will.

13 MEMBER ROSEN: Not a very satisfactory  
14 answer.

15 MR. SCARBROUGH: I know.

16 In terms of industry action, GE put out a  
17 SIL in August 2002, which talked about --

18 MEMBER APOSTOLAKIS: SIL? What's a SIL?

19 MR. SCARBROUGH: Oh. It's a services  
20 information letter. It's a voluntary --

21 MEMBER APOSTOLAKIS: I guess everybody  
22 knows that.

23 MR. SCARBROUGH: I'm sorry.

24 MEMBER APOSTOLAKIS: Except me.

25 MEMBER SIEBER: We sent you some a couple

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 weeks ago.

2 MEMBER APOSTOLAKIS: Okay. So that's why  
3 I threw it away. I didn't know what it was.

4 MR. SCARBROUGH: Okay. And it was focused  
5 on the Quad Cities Unit 2 event, the first one, so it  
6 only really dealt with square hood dryers, and it  
7 talked about monitoring moisture carryover and  
8 refueling outage inspections.

9 And then, after the next failure at Quad  
10 Cities 2, they put out a supplement which now it  
11 expanded to all of the BWRs at power uprate, but still  
12 focused on moisture carryover and refueling outage  
13 inspections, and mostly on external inspections for  
14 anything except the square hood design.

15 And then in February of this year, the  
16 Owner's Group took the lead. We had a meeting with  
17 them, and they took the lead in terms of evaluating  
18 the issue, and has a series of activities that they're  
19 doing, that they're going to be submitting a written  
20 plan. We asked for a written plan of what they're  
21 doing.

22 And then, in March, following the issues  
23 at Quad Cities Unit 2 again, Exelon did an evaluation  
24 of the Dresden plant to justify operating an EPU until  
25 their next fueling outages. And part of that was the

1 loads are much lower at Dresden than at Quad Cities in  
2 terms of the vibration effects.

3 MEMBER POWERS: Could I ask a couple of  
4 questions here?

5 MR. SCARBROUGH: Oh, sure.

6 MEMBER POWERS: When you say the loads are  
7 much lower, this is that difference between 200 and  
8 157 feet per second?

9 MR. SCARBROUGH: Right. They still have  
10 high flow rates, but their loading that they  
11 determined, it's much -- I'd have to pull out the  
12 report that -- well, the slides that they sent us. We  
13 still ask for the report. They -- in their letter  
14 they sent to us in April -- on April 2nd, they just  
15 said that their contractor had provided an analysis,  
16 and we've asked for that contractor report to find out  
17 exactly how they did that evaluation and find out what  
18 the loads were smaller.

19 MEMBER POWERS: Okay. So you really only  
20 have an assertion from them when you say that.

21 MR. SCARBROUGH: Right. Yes, sir.

22 MEMBER POWERS: Okay. Could you also  
23 explain to me what you mean when you say the BWR  
24 Owner's Group assumes the industry lead for the EPU  
25 vibration issue?

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. SCARBROUGH: Right. When we had a  
2 meeting with them in early February, we laid out what  
3 -- basically what we've told you here today, that our  
4 concerns with the scope of this issue, it kept  
5 expanding. We kept adding more metal onto these steam  
6 dryers. We kept having failures. It's into the  
7 feedwater lines, the steam lines, and there was no  
8 unified industry effort to try to solve this problem.  
9 And that's what we laid out.

10 And the Owner's Group came back at that  
11 same meeting and said they're going to take  
12 responsibility for solving this problem. They're  
13 going to coordinate with Exelon, which seems to have  
14 most of the problems, in terms of the vibration  
15 analysis. They're going to coordinate with GE as GE  
16 tries to get their arms around this issue and report  
17 back to the staff.

18 So they took the lead in terms of  
19 coordinating that. Rather than having us deal  
20 exclusively with licensees, that they would be the  
21 front people for evaluating this problem, and then  
22 they would coordinate that. And that's what I meant  
23 by they took the lead.

24 MEMBER POWERS: So if you want Mr. Rosen's  
25 drawings, you'd call BWR Owner's Group and they'll get

1           them for you?

2                       MR. SCARBROUGH: I'm sorry. I didn't hear  
3           the question.

4                       MEMBER POWERS: If you want Mr. Rosen --  
5           provide Mr. Rosen the drawings he's asking for, you'll  
6           just call the Owner's Group?

7                       MR. SCARBROUGH: That would be a way to do  
8           it, and we are -- we're trying to get more information  
9           ourselves as to these details. But the Owner's Group  
10          is taking the lead, and that would be a fair way to  
11          contact them.

12                      MEMBER ROSEN: It seems astonishing to me  
13          that you don't have them already. I mean, after all,  
14          they had to build them. They have engineering  
15          drawings to build them.

16                      MR. SCARBROUGH: Well, they have them.

17                      MEMBER ROSEN: Yes. All you have to do is  
18          ask for them.

19                      MR. SCARBROUGH: Asking for them and  
20          getting them are two different things.

21                      MEMBER ROSEN: And then they may say,  
22          "Well, they're proprietary," and then you say, "Okay.  
23          Well, provide them."

24                      MEMBER APOSTOLAKIS: I don't understand  
25          what you just said -- asking for them and getting them

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 are two different things.

2 MR. SCARBROUGH: Right. Well, you have  
3 to --

4 MEMBER APOSTOLAKIS: Why would they  
5 resist?

6 MR. SCARBROUGH: Well, I don't think  
7 they're resisting. I think they're evaluating it.  
8 And unless you send out a formal letter to evaluate it  
9 -- to ask for it, you know, it doesn't come.

10 MEMBER APOSTOLAKIS: Okay.

11 MR. SCARBROUGH: It's not satisfactory to  
12 us either. And it -- let's see, where are we? Okay.  
13 Next one.

14 Exelon. Exelon came in on April 2nd in  
15 response to all the failures at Quad Cities 2, and  
16 they said they would limit Quad Cities 1 and 2 to pre-  
17 EPU power, except for some testing that they were  
18 going to do for 72 hours. They also provided a test  
19 plan, which talked about pressure sampling, and we  
20 have some areas of concern in there.

21 They talked about strengthening these Quad  
22 Cities Unit 1 release valves.

23 MEMBER ROSEN: Excuse me. On pressure  
24 sampling, what did you mean by "pressure sampling"?

25 MR. SCARBROUGH: They were going to

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 measure pressure at various places in the steam lines  
2 and try to feed that back into a model that they were  
3 developing. Now, there's -- they are trying to  
4 develop --

5 MEMBER ROSEN: Is this pressure sampling  
6 going to give them a trace of the high frequency  
7 pressure of circumstances? Or is -- are they going to  
8 look to see if they're seeing pressure fluctuations?  
9 They've established the absolute pressure and see what  
10 the range around that absolute pressure is. Is the  
11 pressure increasing and decreasing? Is it doing so in  
12 some sinusoidal repeatable manner?

13 These are the kinds of things that force  
14 vibrations, if you find them. If you look for them,  
15 you may find them.

16 MR. SCARBROUGH: Right. And we have -- we  
17 raised some concerns with what their plan was, because  
18 we think it's -- it's so far removed from the steam  
19 dryer we're not sure that you're going to learn enough  
20 to be able to say what's happening with the steam  
21 dryer itself.

22 Now, they insisted that this would be a  
23 successful approach. Now, they have gathered data.  
24 They have gone up to EPU for a few hours with Quad  
25 Cities 2 and gathered this data, and they're supposed

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 to come in and talk to us about what they found.

2 MEMBER ROSEN: You need to know what the  
3 pressure is doing, what its absolute magnitude is, and  
4 how it is varying as a function of time to start. So  
5 that's what they should find out, and you need to know  
6 that several different places.

7 MR. SCARBROUGH: Right. And that's what  
8 they're supposed to be doing. So -- yes, so we're not  
9 convinced yet that they are going in the right  
10 direction.

11 MEMBER SIEBER: So you're making these  
12 measurements downstream of the dryer for the purpose  
13 of figuring out what's going on in the dryer?

14 MR. SCARBROUGH: Yes, sir. That was our  
15 reaction.

16 MEMBER SIEBER: Good luck.

17 MR. SCARBROUGH: And that's what they're  
18 doing. They also made some other commitments to us  
19 that they were going to send in a letter in early May,  
20 and this is sort of a laundry list of them, because we  
21 had written up some concerns with this April 2nd  
22 letter.

23 In it they have a summary of their Dresden  
24 EPU justification, which has this sort of contractor  
25 study referenced and some qualitative discussion -- a

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 summary. And so we've asked for that; we haven't  
2 gotten it yet.

3 And so these were some other areas, and I  
4 -- you know, I don't want to go through all of these  
5 with you, but basically you can see that we had some  
6 concerns regarding what they were telling us in terms  
7 of their commitments in terms of making sure that they  
8 capture this issue in a significantly detailed manner.

9 MEMBER LEITCH: Didn't they also shake off  
10 a limit switch down by the turbine stop and control  
11 valves?

12 MR. SCARBROUGH: Well, the limit switch  
13 they -- are you talking about like a valve limit  
14 switch for a valve?

15 MEMBER LEITCH: Yes.

16 MR. SCARBROUGH: Okay. The one they told  
17 us about was the HPSI steam line, what they call HPSI  
18 4 and 5, which are the containment isolation valves.  
19 And they said that a limit switch was damaged for that  
20 valve. They said --

21 MEMBER LEITCH: I see. I was under the  
22 impression that was down by the turbine stop and  
23 control valve.

24 MR. SCARBROUGH: There might be one down  
25 there, too. We're getting information through slides

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 from them. I mean --

2 MEMBER SIEBER: Inside the containment?

3 MR. SCARBROUGH: Yes. I think this was  
4 one -- they didn't give me a number. I don't know if  
5 this is inside or outside. I can't say which one it  
6 was.

7 MEMBER SIEBER: But generally they're  
8 about six feet from the penetration, which -- and the  
9 penetration is pretty solid.

10 MR. SCARBROUGH: Yes. And they -- so this  
11 is an area we've asked for information on, and we're  
12 still -- and this is all part of -- before they take  
13 Quad Cities back up to EPU, they were -- part of that  
14 provision was they were going to give us all this  
15 information for us to evaluate it.

16 So right now they're still at the pre-EPU  
17 level, and so, you know, we'll just have to see if  
18 they want to go up to --

19 MEMBER SIEBER: Okay.

20 MR. SCARBROUGH: -- say where they are.

21 Okay. Where they're going from here with  
22 the Owner's Group, they've committed to submit a plan  
23 which describes these activities. GE and Exelon are  
24 working on operational improvement recommendations  
25 from all the vibration testing analyses they've done.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 GE is working on a revision to the SIL, service  
2 information letter.

3           Once they complete the evaluation that  
4 they're doing to try to look at -- improve their  
5 structural evaluation of these, and then the BWR  
6 Vessel and Internals Project, once the -- it plans to  
7 complete their steam dryer inspection guidance, that  
8 licensee can implement in September.

9           So that's what their plan is, but we  
10 haven't seen it in writing. And they said they would  
11 submit it to us in May.

12           MEMBER FORD: If you look at it, it's  
13 September 2004, which is over two years since the  
14 first occurrence. And yet they're still talking about  
15 plans. Is there any motion or thoughts as to what the  
16 danger might be or the safety impact of just  
17 continuing to make plans and not do anything between  
18 -- over the last two years?

19           MR. SCARBROUGH: Right. Well, I think  
20 part of it is -- is, you know, right now, you know,  
21 Quad Cities 1 and 2 are at the old power level. I  
22 mean, so that's -- so they have that. But, you know,  
23 there is this -- and I've heard, and it's interesting  
24 that Dr. Rosen said it, because I've said it to  
25 licensees, too, because they would always lead off our

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 meetings with them and say, "This is a non-safety-  
2 related piece of equipment."

3 And I said the exact same thing to them.  
4 I said, "Stop telling us that. We know that."  
5 Because it has to maintain a structural integrity.  
6 And part of the concern is that -- that it's not.

7 Now what we've seen so far is that its  
8 focus on these particular plants -- Vermont Yankee is  
9 not going up yet, and the other plants are seeing  
10 relatively minor problems. So that's sort of where we  
11 are. But you're right, this is a longer schedule.

12 Now, we have indicated a long schedule,  
13 and this was a concern to us. And they emphasized to  
14 us that they're working as fast as they can to try to  
15 survey the BWR licensees to determine where they're  
16 going to go from here, and that sort of thing.

17 But you're right, this schedule is  
18 unsettling, because it's not really nailing this down.  
19 And part of it is we're fighting this issue that it's  
20 a non-safety-related piece of equipment, and you have  
21 to convince people that the loose parts -- and we have  
22 the VIP, the Vessel Internals Project that did the  
23 study, which said that all these pieces wouldn't cause  
24 a safety problem, and all of those issues.

25 But you're right, at some point you've got

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 to say this equipment has to maintain its structural  
2 integrity just from a common sense point of view.

3 MEMBER APOSTOLAKIS: And when is that  
4 point?

5 MR. SCARBROUGH: That's where we are now.  
6 I mean, that's where we are now in terms of, you know  
7 Quad Cities is staying where they are, and they're  
8 trying to solve this problem.

9 MEMBER ROSEN: Okay. So you've drawn the  
10 conclusion that it has to maintain its structural  
11 integrity. Good. Now, you've also got a --

12 MEMBER APOSTOLAKIS: What sort of  
13 conclusion is that?

14 MEMBER ROSEN: Well, let me say that it  
15 leads you to --

16 MEMBER APOSTOLAKIS: Could it be  
17 otherwise? I don't --

18 MEMBER ROSEN: Of course not, George. I'm  
19 just glad to hear that they have concluded that these  
20 things need to stay together.

21 Now, we've got a September 2004 inspection  
22 guidance. Once you've concluded structural integrity  
23 is needed, one can say one needs to inspect to set --  
24 prove that these, in fact, are -- have structural  
25 integrity, correct? And one needs to do it soon if

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 you're going to continue operation. This isn't a  
2 question about uprate. This is a question about  
3 continued operation.

4 You're going to go in and inspect those  
5 machines, those dryers now, to say, "Yes, they look  
6 okay. Yes, they've got some minor hazing cracks on  
7 the surface, but they don't threaten the structural  
8 integrity." I mean, those are conclusions one would  
9 have to draw. Or the converse, one would say, "Oh,  
10 we've got lots of cracks we didn't know about. They  
11 do threaten structural integrity at current conditions  
12 or uprate," depending upon how -- what your  
13 calculations show. I mean, you have to go through  
14 this.

15 So I would say your September 2004 thing  
16 is long overdue, and that it's not -- not just a  
17 question of having guidance in 2004, in September,  
18 it's carrying out the inspections and reporting the  
19 results. So I don't want to wait another whole cycle  
20 until -- September is a good time to do it, because  
21 that's when the plants typically refuel, in the fall.  
22 Those are the ones that are going to refuel.

23 MR. SCARBROUGH: Right, right.

24 MEMBER ROSEN: They ought to get in and do  
25 the guidance. They ought to get in and perform the

1 inspections in September.

2 MR. SCARBROUGH: Right. And that's  
3 something we've emphasized to the Owner's Group.

4 MEMBER ROSEN: Now that's a question. Now  
5 I need an answer. Are you going to have them do the  
6 inspections, or are they going to provide you a book?  
7 You know, "Here's the guidance."

8 MR. SCARBROUGH: Right.

9 MEMBER ROSEN: Well, the guidance doesn't  
10 do you any good unless you use it.

11 MR. SCARBROUGH: That's right. That's  
12 right.

13 MEMBER ROSEN: So?

14 MR. SCARBROUGH: Yes. I don't make those  
15 decisions. Now, I would like to see them do those  
16 inspections in the fall. That's part of what we told  
17 the Owner's Group, that we would like to see the  
18 guidance sooner, so it could be implemented for the  
19 fall inspection.

20 MEMBER ROSEN: Good.

21 MR. SCARBROUGH: But that's higher pay  
22 grade than me. The --

23 MEMBER SIEBER: Actually, one round of  
24 inspections doesn't tell you much, because it doesn't  
25 give you the degradation rate. So you can't -- just

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 from one inspection, the only thing you can make a  
2 statement about is that instant in time, and you can't  
3 say that it's going to stay together until the next  
4 refueling, for example.

5 CHAIRMAN BONACA: Well, but the -- I mean,  
6 you're keeping these plans to run the pre-EPU power  
7 level.

8 MEMBER SIEBER: Just --

9 MR. SCARBROUGH: Quad Cities 1 and 2. The  
10 others are --

11 CHAIRMAN BONACA: So you won't learn much  
12 by inspecting them at that point. I mean --

13 MR. SCARBROUGH: At least we'll see if  
14 there's any cracks. Like, for example, at Dresden 3,  
15 when they came down in December, you know, they had  
16 those four-inch cracks in there. Their first reaction  
17 when we talked to them was they were going to keep  
18 running before they shut down.

19 And there was some pressure put on them by  
20 the staff --

21 CHAIRMAN BONACA: Right.

22 MR. SCARBROUGH: -- and they did shut  
23 down, and they found those cracks. And the question  
24 is problematic whether or not those cracks would have  
25 grown if they kept running at EPU. They did -- they

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 did a modification to their plant, and it's actually  
2 a little better than what the other -- the Quad Cities  
3 have.

4 So, you know, there has been some action  
5 taken, but it hasn't been maybe to the level that some  
6 would like to see on this.

7 MEMBER SIEBER: Well, one of the problems  
8 that you have is if you want to tell the licensees to  
9 go and do the inspection, you have to show that  
10 they're -- it's safety-related somehow or other. And  
11 so your argument needs to be pretty solid in that  
12 area.

13 MR. SCARBROUGH: Right.

14 MEMBER SIEBER: As to what the potential  
15 consequences of failure could be.

16 MR. SCARBROUGH: Right.

17 MEMBER SIEBER: And that gets back to Dr.  
18 Apostolakis' question, you know, if there's a safety  
19 impact, you ought to study it, write it down, and  
20 decide what it is.

21 CHAIRMAN BONACA: Whatever work they  
22 develop here will have to be convincing enough for you  
23 to allow them to go back again to EPU power.

24 MEMBER SIEBER: Yes.

25 CHAIRMAN BONACA: And have you looked at

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 what you need to make the determination?

2 MR. SCARBROUGH: That's one reason why  
3 we're bringing in the consultant, and we're bringing  
4 -- asking Research to go back and step back and say,  
5 you know, what is it that's happening here? What are  
6 the fundamentals here? And that -- because, yes,  
7 we've been sort of led along on this path with just  
8 more metal being slapped onto this dryer. And, you  
9 know -- and we've accepted it.

10 And at some point we've got to step back  
11 and say, "Okay. What's really happening here? Is  
12 more metal going to solve the problem, or do we need  
13 to do something, you know, just significantly  
14 different right from the outset in terms of solving  
15 this problem?" And maybe it's something, you know --  
16 some adjustment of something needs to be made. We  
17 don't know.

18 MEMBER SIEBER: We've got to draw the line  
19 at about a three-inch plate, beyond a three-plate for  
20 --

21 MEMBER LEITCH: Yes. I really think you  
22 really need to look at these -- the steam line  
23 vibration, fluid vibration, because, I'll tell you,  
24 there is a guy who is probably 90 years old now at  
25 General Electric, and he -- you know, tell me the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 volume of your steam lines between the outlet of the  
2 reactor and the turbine stop valves and your flow, and  
3 I'll give you a capacitor for this EHC system that  
4 will make it work in those situations.

5 And what I'm saying is I think that  
6 there's a distinct possibility that that piece of  
7 experience has been lost, and maybe we're looking at  
8 the wrong end of this pipe to try to solve the  
9 problem. And, I mean, we may even be looking  
10 organizationally incorrectly, because I don't know if  
11 that hypothetical guy resides in San Jose or  
12 Schenectady. That issue --

13 MEMBER ROSEN: I think I can testify that  
14 there is -- I have had in my background a similar  
15 problem with an aux feedwater and a pressurized water  
16 reactor, aux feedwater steam line with very high  
17 resonant vibrations, which had the effect of breaking  
18 off drain lines off the auxiliary feedwater steam  
19 line, which wasn't found until the line was -- the  
20 cause of it was not found until the line was  
21 instrumented with pressure recording equipment that  
22 could find the vibrations or forcing functions and  
23 deal -- and eliminate the forcing function, not  
24 stiffen the drain lines.

25 Because the more you stiffened them, they

1 just broke off sooner. These forcing functions are  
2 very, very intense. The idea is to eliminate them  
3 instead of trying to fight them.

4 MR. TERA0: I would like to point out --

5 MEMBER LEITCH: And we had experience with  
6 this operating fine at 80 percent. But when you came  
7 up to 100 percent, you got this, and that's  
8 essentially what we -- we're talking about doing here.  
9 So, I mean, I really think we really need to get them  
10 to look into that component of the problem.

11 MR. TERA0: I did want to point out that  
12 Exelon has retained the expertise of Fred Moody. I  
13 don't know if he's 90 years old, but he has retired  
14 from General Electric. But they are looking to have  
15 him look into this issue.

16 MEMBER LEITCH: Good.

17 MEMBER POWERS: He is not famous for his  
18 -- his expertise in vibrations, is he?

19 MR. TERA0: Heat transfer I think.

20 MEMBER SIEBER: Well, we may be getting  
21 too deeply involved in trying to solve the details of  
22 this problem now for -- for an overview presentation.  
23 So maybe we could just take all of our advice, go do  
24 it, and then we'll move on here and you can finish up.

25 MR. SCARBROUGH: Good. Well, we'll take

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 all the help you can give us.

2 MEMBER RANSOM: Do you have a date or a  
3 plan when either Research or the BWR Owner's Group is  
4 going to give you some information on -- from their  
5 research on the flow dynamic forces?

6 MR. SCARBROUGH: Well, they're going to  
7 start giving us the plan in May. It's over the  
8 summer, and then June there's more information coming  
9 in. And in September they're supposed to give us the  
10 results. So it's over this sort of timeframe that  
11 they're giving us the information.

12 Now, Research -- they have a schedule.  
13 They'll show you their schedule when they come up.  
14 But, yes, it's --

15 MEMBER SIEBER: Yes. You can skip over  
16 what you already did and get to --

17 MR. SCARBROUGH: Okay.

18 MEMBER SIEBER: -- where you are now.

19 MR. SCARBROUGH: Okay. All right. Let me  
20 skip over those. That's what we've done so far in  
21 terms of when we had some meetings with Research. We  
22 did send a letter back to Exelon, you know, indicating  
23 these concerns. I'm not trying to say that we have  
24 these problems solved, or even know how to solve them.

25 But we relayed our concerns to Exelon that

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 they didn't indicate that they were going to identify  
2 these forcing functions -- this forcing function.  
3 They did reverse engineering to back out what it took  
4 to break the metal, but they didn't know what the  
5 maximum level was.

6 I mean, so they don't -- they can't do  
7 that, so they're always working from reverse  
8 engineering here.

9 The test plan talked about this pressure  
10 pulse sampling, which we weren't clear was going to  
11 even get into the steam dryer or the potential fluid  
12 structure interactions that might be involved here.  
13 We made this -- high steam flows were into that range,  
14 so those concerns.

15 In terms of the Dresden EPU, we were  
16 concerned about -- there wasn't really a quantitative  
17 assessment of the loadings and stresses. They were  
18 referenced in this contractor study, and they didn't  
19 discuss any components except the steam dryer.

20 And so we relayed these concerns back to  
21 them in a letter on April 20th, and, you know, we'll  
22 see where that comes from.

23 MEMBER ROSEN: Well, that's much better.  
24 Now you're getting into the heart of the document.

25 MR. SCARBROUGH: Okay. Now, where we go

1 from here, we have -- still have to continue to review  
2 the Exelon information. That's going to be coming in,  
3 you know, on Quad Cities and Dresden, you know, to  
4 resolve this EPU operation for Dresden.

5 Now, regulatory communications -- we have  
6 a regulatory issue summary that we've been drafting to  
7 try to see if we want to try to inform licensees of  
8 all these activities that are ongoing, because it's a  
9 long, involved process that's hard to explain just in  
10 a short amount of time.

11 We've also been discussing a generic  
12 regulatory action, like a 50.54F letter, which might  
13 ask the other BWRs what they're doing to address this  
14 issue. That's something that's being discussed.

15 Vermont Yankee, in terms of the -- we're  
16 looking at these recent inspection findings from the  
17 steam dryer to see how they affect the power uprate  
18 request and what the similarities are between Dresden,  
19 Quad Cities, and Vermont Yankee. And that has to be  
20 dealt with before they get to power uprate.

21 And then we to go back and decide where we  
22 went wrong with our power uprate review standard and  
23 revise it to decide what -- how to avoid these future  
24 problems that we might have. That's where we are,  
25 and, you know, as you can tell we're just sort of

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 getting -- trying to get our arms around this issue,  
2 just like GE is, I mean, and so any assistance that  
3 ACRS can provide, we are certainly happy to take it to  
4 help resolve this.

5 MEMBER ROSEN: Well, I think these last  
6 few slides make me feel a little better that -- Tom,  
7 that you're now beginning to head in the right  
8 direction. I would comment, though, that this is not  
9 just about power uprate, because these forces and  
10 functions are there at full power as initially  
11 licensed. So let's not -- let's not put our blinders  
12 on about that.

13 MR. SCARBROUGH: Okay. Good. Thank you.

14 CHAIRMAN BONACA: Another comment I would  
15 like to make is I -- the one I started at the  
16 beginning. To me, this failure has put a cloud over  
17 the whole EPU. I think it's necessary that you look  
18 at it, because the increased flow rate has caused the  
19 failure. And I can't understand why increased  
20 blowdowns or whatever may happen as a result of  
21 accidents in -- in a powerplant which has been uprated  
22 may not come with surprises there.

23 MR. SCARBROUGH: Yes, sir.

24 CHAIRMAN BONACA: Challenging certain  
25 components. I mean, clearly here it may very well be

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 that these dryers already had cracks in them, and the  
2 failure has been accelerated by these vibrations, that  
3 they've been identified here.

4 And the questions raised two or three  
5 years ago was: are these components as good as new?  
6 Those which are inside the vessel, for example,  
7 internals, that will have to sustain certain forces  
8 during accidents? Comparisons were made. Assumption  
9 was made that the criteria to compare against were the  
10 original criteria, which is essentially component says  
11 no.

12 And so I think you have to review also  
13 that issue. That's just my thought.

14 MR. SCARBROUGH: Thank you.

15 MEMBER SIEBER: Now, according to your  
16 schedule here, you have Research involved in some of  
17 your activities.

18 MR. SCARBROUGH: Yes.

19 MEMBER SIEBER: Just what are they doing?  
20 Are they here to tell us?

21 MR. SCARBROUGH: Yes, they're going to  
22 give you a brief summary of --

23 MEMBER SIEBER: Okay. We have 15 minutes  
24 left, so maybe you can tell us in 15 minutes.

25 Thank you very much. Hope we weren't too

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 hard on you. On the other hand, it pays to be a  
2 little hard to keep you enthusiastic about pursuing  
3 this to a good endpoint.

4 MR. MALIK: Good morning. My name is Shah  
5 Malik. I'm in the Division of Engineering Technology,  
6 Office of Research. On my left side is Don Helton.  
7 He's in the Systems Analysis Division in the Office of  
8 Research, and we'll -- today we'd like to provide you  
9 a draft research plan, which at present we are  
10 discussing among Research at NRR to finalize it. So  
11 at the moment it is still a draft plan.

12 The object of the research are to try to  
13 identify and determine significance of basic phenomena  
14 that can cause adverse flow effects in a steam dryer  
15 and other components of steam and feedwater flow  
16 lines, and, again, apply those phenomena to  
17 characterize failure observed or potential failure  
18 that could happen in various components in the BWR  
19 plant under power uprate condition. And the  
20 discussion will also cover the existing power  
21 condition as well.

22 And determine, based on those experiences,  
23 try to determine potential implications that can be  
24 drawn from those results which we obtain, and assess  
25 -- finally, the assess the feasibility of a screening

1 tool that can be developed from this research and that  
2 can be used by NRR in reviewing those submittals.

3 And we'll continue to support NRR in any  
4 BWR submittal. And as a matter of fact, we've been in  
5 contact with the licensee as well to get more and more  
6 information to strengthen our product.

7 MEMBER APOSTOLAKIS: So in which bullet  
8 will you evaluate the risk significance of this  
9 number?

10 MR. MALIK: Risk significance is currently  
11 not a part of this project. It is being developed or  
12 being worked on in another project called Safety  
13 Module Project under the same division. I'm not sure  
14 or -- if there is some time we can look briefly on  
15 that as well.

16 MEMBER APOSTOLAKIS: But how can you  
17 determine relative significance and generic  
18 implications if we don't have PRA context? And why is  
19 that an issue of research? I mean, can't you just  
20 take a PRA and put -- like the accident sequence  
21 precursor program. Is that still in existence, by the  
22 way? ASP?

23 MR. LANIK: Yes.

24 MEMBER APOSTOLAKIS: So did they evaluate  
25 this?

1 MR. LANIK: I think they have it in a  
2 preliminary stage. I'm not part of that program, but  
3 in my discussions with them I think they actually got  
4 it entered as a preliminary but not -- they haven't  
5 done an analysis yet.

6 MEMBER APOSTOLAKIS: I mean, it shouldn't  
7 be that hard to do. I'm not saying it's a matter of  
8 an hour, but -- so the ASP will tell us soon.

9 MEMBER SIEBER: No. ASP is never soon.

10 MR. FLACK: I can't speak for the ASP  
11 analysis, but I would imagine that the risk is coming  
12 in in an indirect way through loose parts and things  
13 that could be generated and thrown through the core  
14 causing other events to happen.

15 But at this point, I don't know where they  
16 stand on the ASP analysis itself for just the failures  
17 of the dryers. It's going to be involving the  
18 implications and propogations -- it's going to be a  
19 difficult thing I think to quantify in the input.

20 MEMBER APOSTOLAKIS: Okay. Let's leave  
21 the ASP out. But, I mean, this research program  
22 should be able to do a quick calculation, especially  
23 if you are going to draw any generic implications.  
24 Don't you need to look at the accident sequence? You  
25 don't need a separate research program for that.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MEMBER SIEBER: I think you need that just  
2 to either grant or deny an EPU or to require a  
3 licensee to stay at the power level that he's at. You  
4 need to know what the risk is.

5 MEMBER APOSTOLAKIS: You need to know  
6 that.

7 MEMBER SIEBER: And if you don't know what  
8 it is, you don't have a basis to do it.

9 MEMBER APOSTOLAKIS: Okay.

10 MR. FLACK: And I think we agree that the  
11 risk is an important part of the equation.

12 MEMBER APOSTOLAKIS: Yes.

13 MR. MALIK: Okay. Next slide. This slide  
14 is the present subdivided into two phases. Phase 1 is  
15 essentially collecting data with the help of NRR from  
16 the licensee, as much data, plan data, and using those  
17 data to support our analysis. And the second major  
18 effort in this phase will be to procure a technical  
19 consultant in flow-induced vibration area, in  
20 particular in the CFD and flow fraction and  
21 computational structure, where we can combine all  
22 three effects.

23 MEMBER APOSTOLAKIS: Do you have in-house  
24 experts in these areas?

25 MR. MALIK: We have a CFD -- in the CFD

1 area we have, but not other two. Some expertise we  
2 have, but we'd like somebody who has more broad  
3 expertise, so we can combine them together.

4 MEMBER APOSTOLAKIS: Okay.

5 MEMBER RANSOM: Under your first bullet  
6 you have scale model test data. Does somebody have a  
7 scale model developed?

8 MEMBER SIEBER: Well, scale model is -- GE  
9 has some data we are trying to get. These are the  
10 kind of information we'd like to get from the licensee  
11 and their vendors.

12 MEMBER FORD: The presumption here is that  
13 the whole degradation process is flow-induced  
14 vibration. There's nothing here that presumes that in  
15 fact --

16 MR. MALIK: That is -- when we start  
17 looking at phenomena, we are looking to that -- the  
18 next phase of --

19 MEMBER FORD: Looking to what?

20 MR. MALIK: Yes.

21 MEMBER FORD: Into what? You said you --  
22 in the next phase you're going to look into?

23 MR. MALIK: That the flow is what could  
24 cause this kind of phenomena.

25 MEMBER FORD: Well, it's not so much the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 -- I think flow-induced vibration is probably the  
2 predominant one, but I'm thinking of the initiating  
3 event, which could be stress corrosion cracking.

4 MR. MALIK: Yes.

5 MEMBER FORD: Which has been occurring for  
6 20-odd years.

7 MEMBER SIEBER: The way you expand your  
8 horizon, though, is if you fail at this approach,  
9 right? If you can show that it's flow-induced  
10 vibration, and that you can analyze it, then, for  
11 example, arguments like Mr. Leitch's would not be  
12 pursued, except by a licensee trying to tune up a  
13 plant.

14 MR. MALIK: Okay.

15 MEMBER SIEBER: I don't know whether  
16 that's right or -- the right way or the wrong way to  
17 attack the problem. I'd probably do it that way, but  
18 others would do it a different way.

19 Go ahead.

20 MR. MALIK: Okay. The phase 2, which is  
21 the -- where we are doing that, once we have a  
22 consultant or consultants on board. We're going to  
23 start looking at things that are of concern, such as  
24 thermal hydraulic models, and things such as stress  
25 corrosion cracking. And we'll use those in trying to

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 predict what kind of flow-induced vibration or other  
2 loading conditions can exist using thermal hydraulic  
3 models.

4 Also, in the process we will try to  
5 determine what is the significance of flow interaction  
6 with high flow velocity interacting with the  
7 components that are --

8 MEMBER APOSTOLAKIS: So this overlaps what  
9 degree with what the industry is doing?

10 MR. MALIK: It will be our introductory  
11 program, and it will go on a longer term basis, unless  
12 they come up within the six months to a nine month to  
13 a year timeframe of -- we are going to be doing it in  
14 a much more comprehensive way. Yes, there will be  
15 some overlap in that.

16 MEMBER APOSTOLAKIS: So you will have the  
17 benefit, then, of their work.

18 MR. MALIK: Yes. And we'll be interacting  
19 to get more and more data, and they'll benefit from us  
20 as well.

21 MEMBER APOSTOLAKIS: Fine. Fine.

22 MR. MALIK: Okay. Once we have determined  
23 flow-induced vibration and conditions, we'll apply  
24 those to current -- the model to perform analysis to  
25 find the stressors that are --

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MEMBER SIEBER: Now --

2 MR. MALIK: -- things like that.

3 MEMBER SIEBER: Sir, you'll have to talk  
4 into the microphone.

5 MR. MALIK: Sorry.

6 MEMBER SIEBER: So the recorder can pick  
7 you up.

8 MR. MALIK: Thank you.

9 And based on those analyses, we'll try to  
10 predict component failure as well as operating  
11 condition and potential concern that may come up from  
12 those analyses results.

13 Okay. Then, the next step will be the  
14 task -- the next task will be for generic implication.  
15 As you can see, this plan is essentially on a  
16 deterministic basis, and we may have to modify it to  
17 bring the probabilistic aspects out of --

18 MEMBER APOSTOLAKIS: I noticed that. I  
19 agree with you.

20 MR. MALIK: Yes.

21 MEMBER APOSTOLAKIS: So you agree with me,  
22 too?

23 MR. MALIK: Yes.

24 MEMBER APOSTOLAKIS: Oh, that was quick.

25 (Laughter.)

1                   The usual answer is, "We'll think about  
2                   it."

3                   MR. MALIK: No.

4                   MEMBER APOSTOLAKIS: John?

5                   MEMBER ROSEN: John, here you are  
6                   presenting what looks to me like a -- you know, a  
7                   cohesive plan to build -- to get the agency up to  
8                   speed on something that's established technology. I  
9                   mean, flow-induced vibration that -- these kinds of  
10                  things, is not unknown. It's not a research subject.

11                  MR. FLACK: Well, I would say it's applied  
12                  research. We never learn enough about things as they  
13                  age, so I wouldn't say necessarily it's -- it's not  
14                  part of research.

15                  MEMBER ROSEN: It's just the way we do  
16                  business in the agency. We call this research, but  
17                  people have been doing -- have known about flow-  
18                  induced vibration for a long time. They've known  
19                  about resonance and what resonances can do to  
20                  powerplants, piping, aircraft wings, all kinds of  
21                  things.

22                  MEMBER APOSTOLAKIS: Yes. But this is  
23                  regulatory research.

24                  MEMBER SIEBER: Yes. This is --

25                  MEMBER APOSTOLAKIS: Regulatory.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MEMBER SIEBER: -- probably rather new to  
2 the agency, because they ordinarily don't get involved  
3 in these kinds of work -- this kind of work.

4 MEMBER SHACK: Somebody has clearly been  
5 having a problem with the interfering of this problem.

6 MEMBER SIEBER: Everybody so far.

7 MEMBER APOSTOLAKIS: Well, presumably, you  
8 will review the literature and talk to other people's  
9 experience and build on it, right?

10 MR. MALIK: Yes.

11 MEMBER APOSTOLAKIS: Okay.

12 MEMBER SIEBER: Okay. Go ahead.

13 MR. MALIK: Okay. The final task under  
14 this phase would be development of a potential  
15 screening tool that NRR can use in reviewing those  
16 submittals.

17 Let me go on the next page. We will try  
18 to give a draft schedule for these activities.

19 MEMBER APOSTOLAKIS: So let me -- I can't  
20 -- fiscal year '06, develop potential screening tool.  
21 So you will be denying power uprate requests until  
22 then?

23 MR. MALIK: No. That's why we have put on  
24 the last bullet, "Continue providing additional  
25 guidance to NRR based on the information we collect up

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 to that point." So --

2 MEMBER APOSTOLAKIS: So it's conceivable,  
3 then, we'll approve an EPU in the next two months?  
4 Even though this research is going on? Yes, it is  
5 conceivable.

6 MR. MALIK: In the supplies for NRR, you  
7 know, how much they give --

8 MEMBER ROSEN: Perhaps if they come to us  
9 with a request for that kind of thing, am I to expect  
10 some questions in this area?

11 MEMBER APOSTOLAKIS: Do you think there  
12 will be some questions?

13 MEMBER ROSEN: I suspect it, yes.

14 MEMBER APOSTOLAKIS: I'm sorry. But it's  
15 a natural reaction.

16 MR. MALIK: Yes. I understand that. One  
17 other thing that's driving this schedule is that  
18 procuring -- if we can get within the DOE lab area,  
19 that will be a shorter period. Otherwise, it's  
20 showing up like for a six-month time from May 2004 to  
21 September 2004. Commercial contracts take that long  
22 to go through the process.

23 MEMBER APOSTOLAKIS: Of course, Dr.  
24 Paperiello told us yesterday that he would like to see  
25 most of the work in the Office of Research done in-

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 house.

2 MR. MALIK: Yes.

3 MEMBER APOSTOLAKIS: So I don't know how  
4 consistent that is with that.

5 MR. MALIK: Well, there will be a --

6 MEMBER APOSTOLAKIS: I'm sorry. Go ahead.

7 MR. HELTON: Some of this work is going to  
8 be done in-house. For instance, the CFD work that's  
9 on there is planned for in-house, and some of the  
10 finite element work is also planned for in-house. But  
11 there is some of it that will have to be contracted  
12 out.

13 MEMBER APOSTOLAKIS: Okay.

14 MR. MALIK: All right. Okay.

15 MEMBER POWERS: I think that's an  
16 important point. We have -- this flow-induced  
17 vibration is known technology. It is by no means  
18 trivial technology. And it's a highly specialized  
19 field.

20 MEMBER SIEBER: Right. Yes, it is.

21 MEMBER POWERS: You're not going to find  
22 people with expertise. And these gentlemen face a  
23 particular difficult problem, whereas you can do flow-  
24 induced vibration on a wall, or a structure, they have  
25 to look at the whole piping system as an integral

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 whole. And I --

2 MEMBER KRESS: It won't be an easy task.  
3 We are not going to --

4 MEMBER POWERS: Not by CFD it's not going  
5 to be an easy task.

6 MEMBER KRESS: It's not going to be easy  
7 to find the resonant frequency of the components.

8 MEMBER POWERS: Yes. Without some good --

9 MEMBER SIEBER: Not with that kind of  
10 geometry.

11 MEMBER POWERS: Without some good  
12 experimental data on the actual system of interest,  
13 they're going to get nowhere with this study.

14 MEMBER ROSEN: It seems to me that you've  
15 got your finger right on it. You need to do some  
16 measurements.

17 MEMBER KRESS: And that won't be easy.

18 MEMBER POWERS: I mean, they can -- they  
19 can learn their computer codes 'til the cows come  
20 home. They're not going to get anything out of this.

21 MEMBER SIEBER: Okay. Why don't we go on.

22 MR. MALIK: Okay. We say that the 2004 --  
23 in early 2005 we'll be doing some of the initial  
24 scoping studies. And once we have the consultants on  
25 board, we are going to be trying to come up with

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 determining various mechanisms that could cause  
2 failure of flow-induced vibration.

3 And, again, in 2005, try to predict flow-  
4 induced vibration loading via thermal hydraulic  
5 analysis. And, similarly, fluid extraction as well as  
6 circulations will be done during FY05. And using all  
7 that information, during FY06, we will try to build up  
8 some generic implication as well as potential  
9 screening tools.

10 MEMBER APOSTOLAKIS: Very good.

11 MEMBER SIEBER: So the initial event  
12 occurred in 2002, and you're going to get the result  
13 in 2006?

14 MEMBER APOSTOLAKIS: That doesn't sound  
15 good. Doesn't sound good.

16 MEMBER SIEBER: Well, that's when you're  
17 going to decide --

18 MEMBER POWERS: It sounds vastly overly  
19 optimistic as a matter of fact.

20 MEMBER SIEBER: Yes. Which one you're  
21 going to decide whether you're giving more EPU's. But  
22 by then everybody will have one, right?

23 MEMBER POWERS: We presumably have the  
24 sump as a standard.

25 MEMBER SIEBER: Well, anyway --

1 MEMBER APOSTOLAKIS: I'm just curious,  
2 though.

3 MEMBER SIEBER: -- it's not swift.

4 MEMBER APOSTOLAKIS: When we do  
5 inspections and we find things, we have an action  
6 matrix.

7 CHAIRMAN BONACA: It is important.

8 MEMBER APOSTOLAKIS: When failures occur,  
9 do we have an action matrix? No. Should we? I don't  
10 understand --

11 MEMBER SHACK: It gets increased  
12 regulatory attention, George, even without an action  
13 matrix.

14 MEMBER APOSTOLAKIS: If this is increased  
15 regulatory attention, I would like to see what  
16 decreased attention is.

17 MEMBER SIEBER: Without the risk analysis,  
18 I'm not sure how you --

19 MEMBER APOSTOLAKIS: That's right.

20 MEMBER SIEBER: -- how you make  
21 increased --

22 MEMBER APOSTOLAKIS: You would need the --

23 MEMBER SIEBER: -- happen.

24 MEMBER APOSTOLAKIS: You would need the  
25 equivalent of a significance determination process.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MEMBER SIEBER: You would think.

2 MEMBER APOSTOLAKIS: That's it. Well --

3 MEMBER SIEBER: But this is pretty complex  
4 to put through that, particularly when you don't know  
5 what the consequences of all of these --

6 MEMBER ROSEN: Well, wait a minute, Jack.  
7 It's much simpler than that. You're making this --

8 MEMBER APOSTOLAKIS: It's much simpler  
9 than that, yes.

10 MEMBER ROSEN: You know the consequences,  
11 potential failure of the main steam isolation valves.  
12 That's one. Just take that. One can go into existing  
13 PRAs and conclude the importance of that.

14 MEMBER SIEBER: Well, yes, that's --

15 MEMBER APOSTOLAKIS: And then you may come  
16 to --

17 MEMBER SIEBER: That's a pretty gross way  
18 to do it, but there's all kinds of --

19 MEMBER APOSTOLAKIS: This should give it  
20 some --

21 MEMBER SIEBER: -- by design they fail  
22 different ways.

23 MEMBER ROSEN: Well, failure to close is  
24 what I'm talking about.

25 MEMBER SIEBER: Well, we're wasting time

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 on that. You guys knows how to do it.

2 MEMBER APOSTOLAKIS: This is not their job  
3 to do that.

4 MEMBER SIEBER: Right.

5 MEMBER APOSTOLAKIS: So we are not --

6 MEMBER SIEBER: Okay. Would you like to  
7 conclude?

8 MR. MALIK: Yes. We hope to continue  
9 getting more information from the industry, as much as  
10 possible, and that's the push we are trying to do to  
11 begin this program.

12 MEMBER SIEBER: Okay. Does anybody have  
13 any questions they'd like to ask the staff before we  
14 wrap this up?

15 Well, I'd like to thank the staff for  
16 making the presentation. This is important to us.  
17 It's a matter of concern. I think we ought to be  
18 thinking about a subcommittee meeting or maybe even  
19 the full committee prior to one of our regular  
20 meetings, so we can spend some more time to understand  
21 the details of the problem. And I think that the  
22 staff is getting their arms around it, but I think the  
23 problem is far from solved at this point.

24 So with that, Mr. Chairman, I would turn  
25 it back to you. And we're almost on schedule.

1 CHAIRMAN BONACA: Yes, thank you. Thank  
2 you to the presenters.

3 And at this point we will take a break of  
4 15 minutes, and get back at 10 of 11:00.

5 (Whereupon, the proceedings in the  
6 foregoing matter went off the record at  
7 10:34 a.m.)

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

CERTIFICATE

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

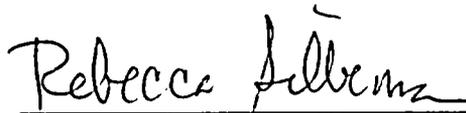
Name of Proceeding: Advisory Committee on  
Reactor Safeguards

512<sup>th</sup> Committee Meeting

Docket Number: n/a

Location: Rockville, MD

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



Rebecca Silberman  
Official Reporter  
Neal R. Gross & Co., Inc.

# **POTENTIAL ADVERSE FLOW EFFECTS FROM POWER UPDATES**

---

David Terao  
Thomas G. Scarbrough

Mechanical and Civil Engineering Branch  
Division of Engineering  
NRC Office of Nuclear Reactor Regulation

May 7, 2004

# INTRODUCTION/BACKGROUND

---

- Since 1970s, licensees have been implementing power uprates to increase NPP electric output.
- Power uprates categorized as
  - ▶ Measurement Uncertainty Recapture (about 1.5%)
  - ▶ Stretch (about 6%)
  - ▶ Extended Power Uprate (up to about 20%).
- Cracking of RPV internals is long-standing issue in BWR plants without power uprates.
- Some NPPs experiencing additional problems with safety-related and non-safety related equipment during power uprate operation.
- Quad Cities Units 1 and 2 experienced catastrophic failures of steam dryers during EPU operation.

# SCOPE OF ADVERSE FLOW EFFECTS FROM POWER UPRATE OPERATION

---

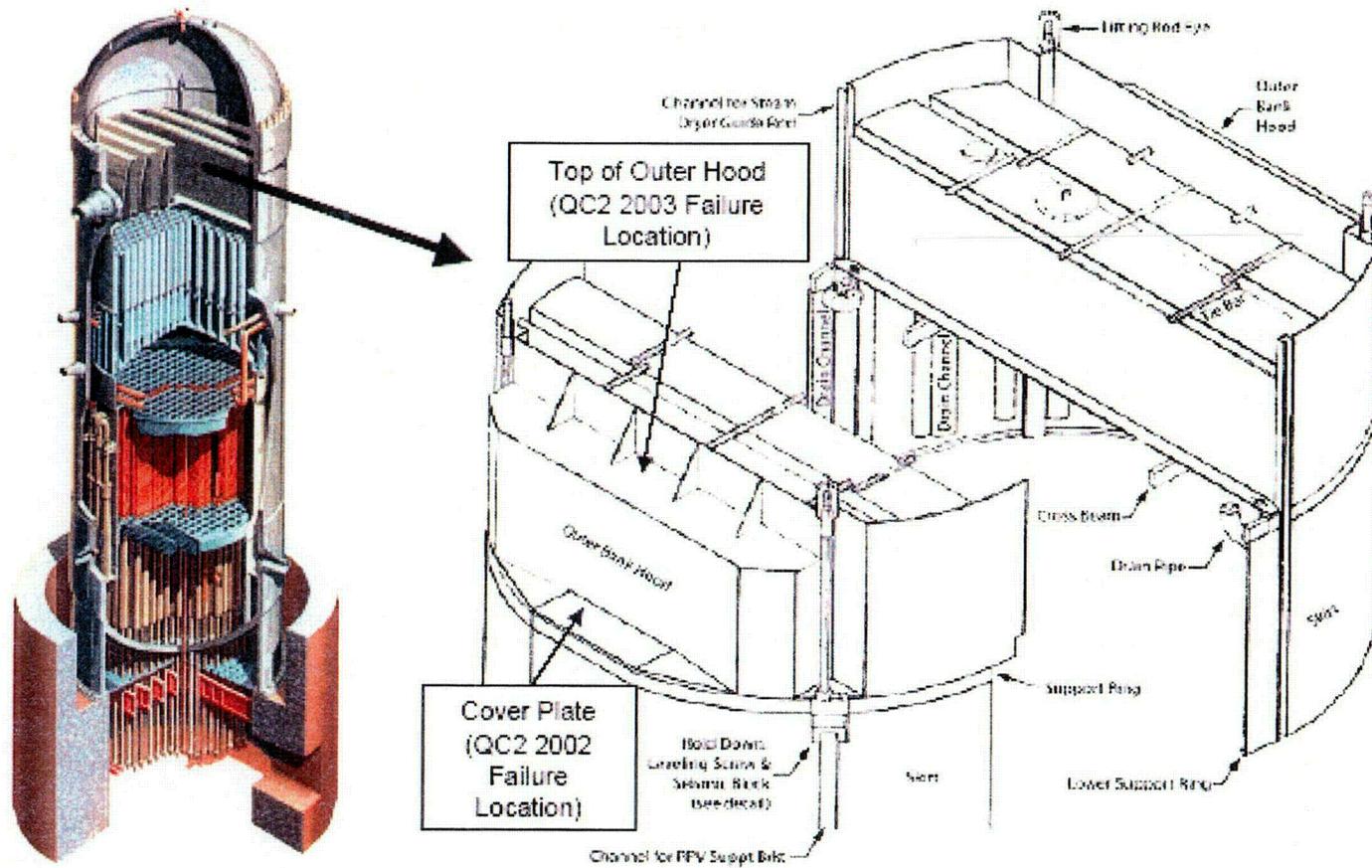
- Quad Cities Unit 2 - June 2002:

After 90 days of EPU operation, steam dryer cover plate fails with pieces found on steam separators and in main steamline.

- Quad Cities Unit 2 - June 2003:

After additional 300 days of EPU operation, steam dryer experiences failure of hood, internal braces, and tie bars.

# QC2 Steam Dryer Failures 2002 and 2003



# SCOPE OF ADVERSE FLOW EFFECTS FROM POWER UPRATE OPERATION (continued)

---

- Dresden Unit 2 - October 2003:

During RFO inspection after two years of EPU operation, 4-inch cracks identified in steam dryer hood panels.

Holes found in feedwater sparger from broken sampling probe.

# SCOPE OF ADVERSE FLOW EFFECTS FROM POWER UPRATE OPERATION (continued)

---

- Quad Cities Unit 1 - November 2003:

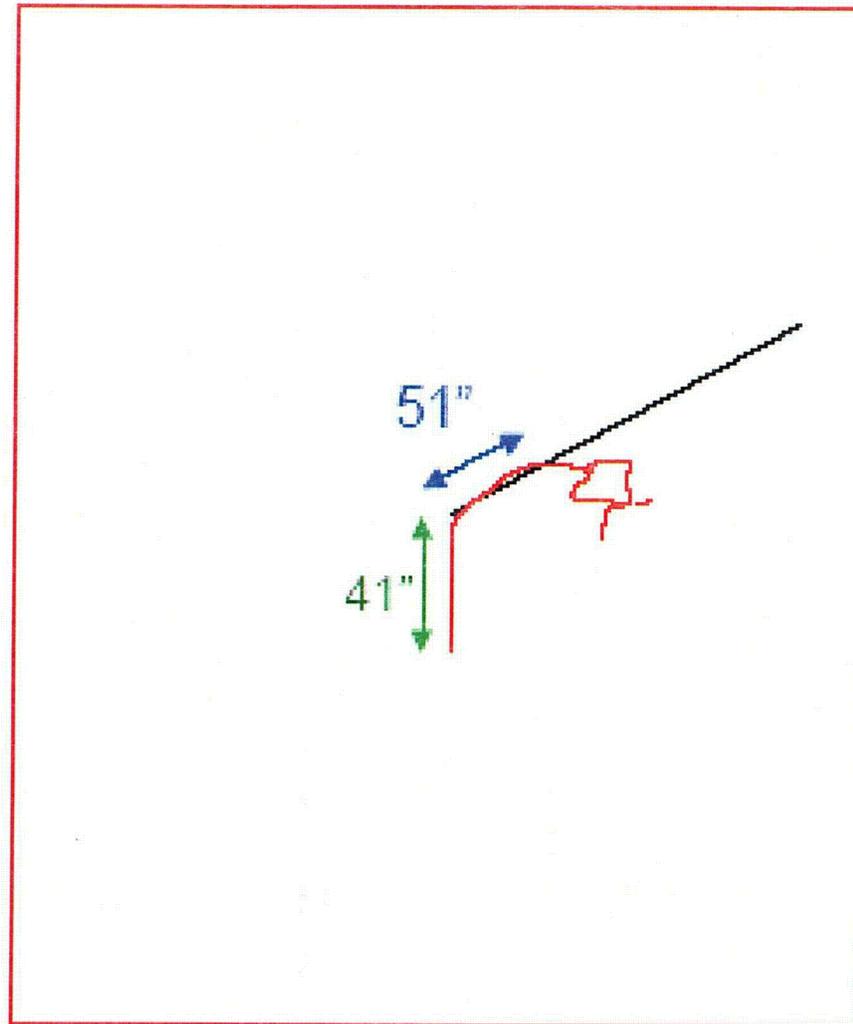
After about one year of EPU operation, steam dryer hood experiences significant cracking with 6x9 inch piece of outer bank vertical plate missing.

Damage also found to

main steam electromatic relief valve (ERV),  
steamline supports, and  
HPCI steam supply motor-operated valve.

# QC1 Steam Dryer Failure November 2003

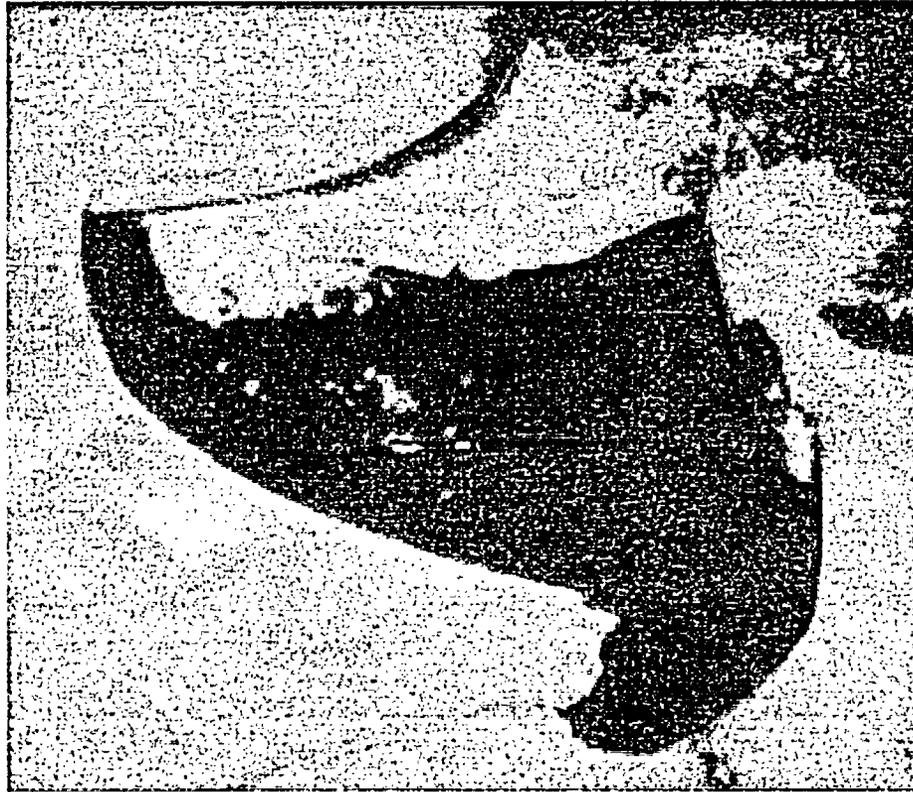
---



270° Side

# QC1 Steam Dryer Failure November 2003

(close-up)



Missing portion of outer bank vertical plate, approx. 6 in. x 9 in.

# SCOPE OF ADVERSE FLOW EFFECTS FROM POWER UPRATE OPERATION (continued)

---

- Dresden Unit 3 - Dec 2003:

During shutdown inspection after about 10 months of EPU operation, two 4-inch through-wall cracks identified in steam dryer hood, and two FW sampling probes found in sparger.

Licensee determines FW sampling probe missing from installed location.

# SCOPE OF ADVERSE FLOW EFFECTS FROM POWER UPRATE OPERATION (continued)

---

- Quad Cities Unit 2 - March 2004:

After about 8 months of EPU operation, numerous steam dryer indications identified during refueling outage inspection including

cracking near gussets installed in 2003,

broken tie bar welds, and

damaged stiffener plate weld.

# QC2 Steam Dryer Failure March 2004

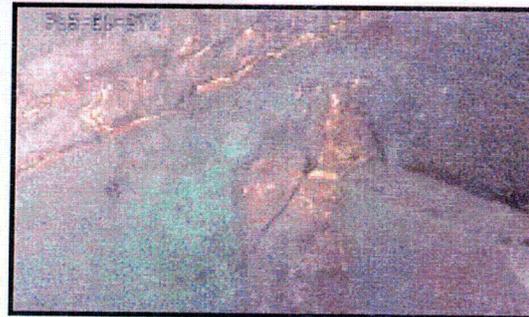
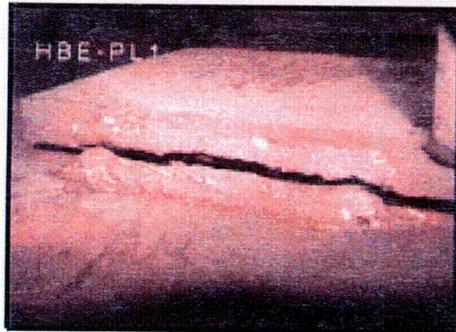
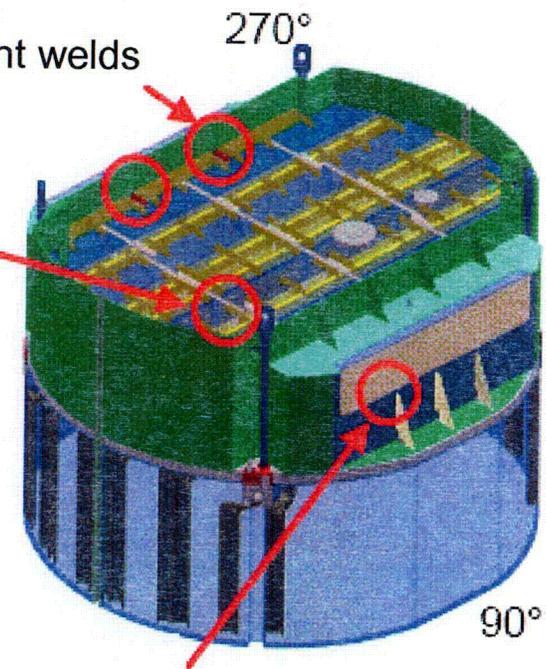


Plate attachment  
stitch weld

Tie bar to  
attachment welds

Tip of gusset plate



# SCOPE OF ADVERSE FLOW EFFECTS FROM POWER UPRATE OPERATION (continued)

---

- Other BWR steam dryer inspections in Spring 2004:
  - ▶ Nine Mile Point Unit 2 (curved hood steam dryer) finds a thin 18-inch crack along a weld after several years of operation at 4.3% power uprate.
  - ▶ Brunswick Unit 1 (slanted hood steam dryer) finds only minor cracks after 2 years of operation at 13% power uprate.
  - ▶ Vermont Yankee (square hood steam dryer) finds minor but numerous cracks after operation at original licensed power.

# POTENTIAL CAUSES OF ADVERSE FLOW EFFECTS

---

- July 2002 QC 2 steam dryer cover plate:

high cycle fatigue due to high frequency resonance (180 Hz) as a result of alignment of cover plate natural frequency, standing acoustic wave frequency, and vortex shedding frequency.

- July 2003 QC 2 steam dryer hood:

high cycle fatigue due to low frequency pressure loading (0 - 50 Hz).

- November 2003 QC 1 steam dryer:

high cycle fatigue from fluctuating pressure loading with acoustics.

- 2003 Dresden FW probes: resonance frequency vibration.

# POTENTIAL CAUSES OF ADVERSE FLOW EFFECTS (continued)

---

- Quad Cities and Dresden more susceptible to adverse flow effects:

Steam dryer with square hood experiences greater stress than slanted or curve hood design.

Main steam lines with smaller diameter have higher steam velocity.

EPU power uprate involves more significant changes from original power level.

# POTENTIAL CAUSES OF ADVERSE FLOW EFFECTS (continued)

---

- January 2004:

GE identifies fluctuating pressure load in acoustic range as potential failure cause of QC steam dryers.

Exelon study of vibration effects determines QC ERVs unable to withstand EPU vibration for full cycle.

- March 2004 QC 2 steam dryer:

inadequate design of previous gusset repair, movement of high stress point during tie bar repair, and poor installation practice for stiffener plate.

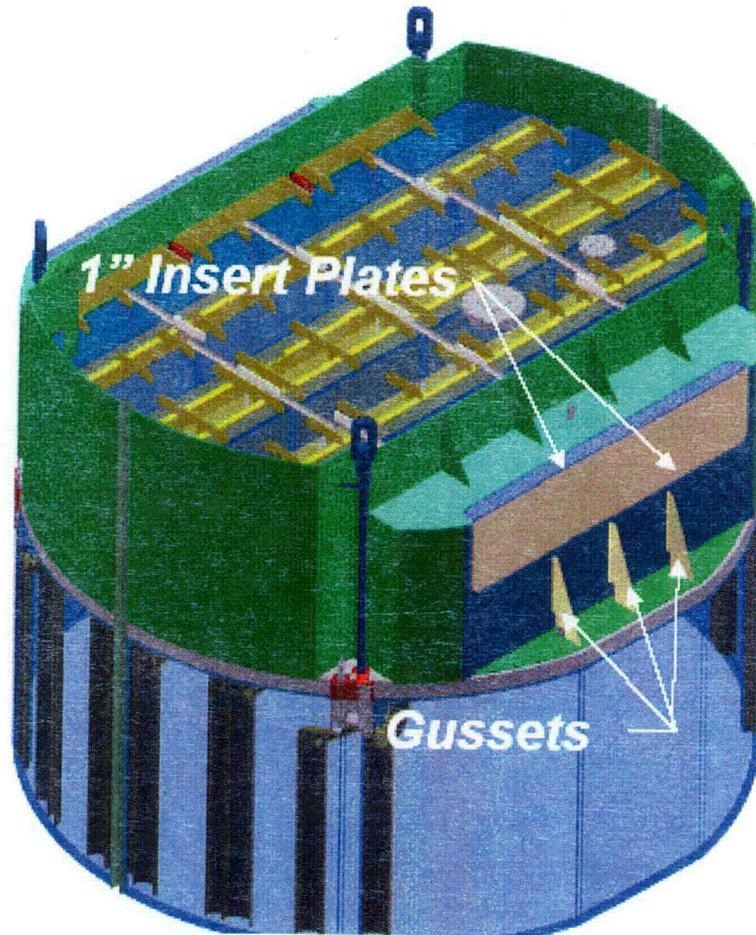
# PLANT-SPECIFIC CORRECTIVE ACTIONS

---

- July 2002: QC 2 steam dryer cover plate increased from 0.25 to 0.5 inch.
- July 2003: QC 2 steam dryer outer hood plates increased from 0.5 to 1 inch with gussets installed and braces removed.
- Oct 2003: Dresden 2 steam dryer modified similar to QC 2 (July 2003).
- Nov 2003: QC 1 steam dryer modified similar to QC 2 (July 2003).
- Dec 2003: Dresden 3 steam dryer repair improved over QC 1 and 2.

# QC1 Steam Dryer Repairs November 2003

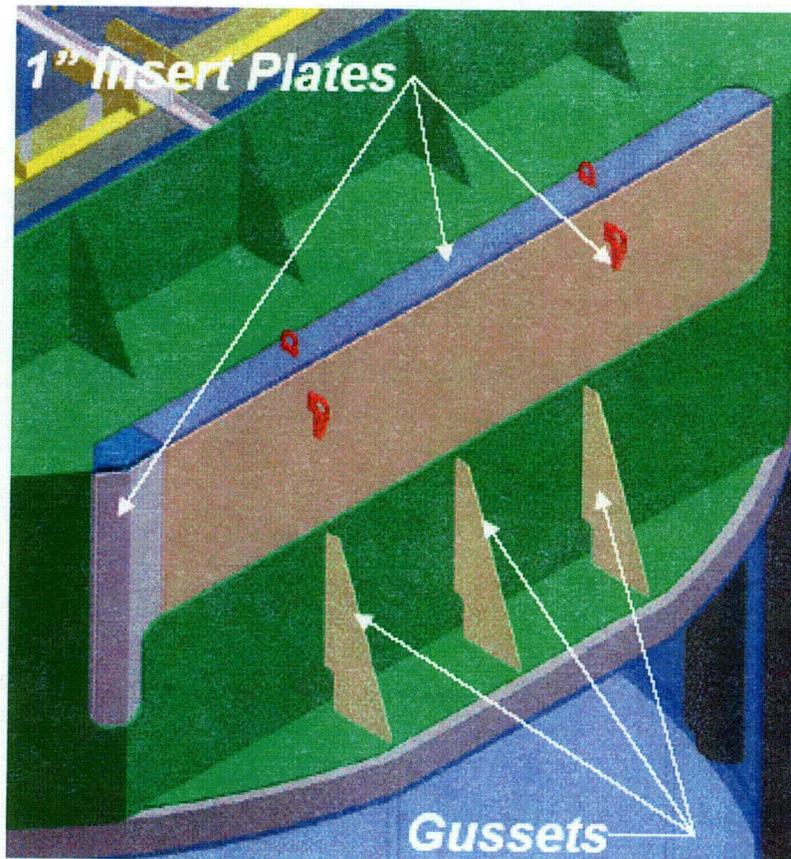
---



Similar to:  
QC2 - June 2003  
D2 - Oct 2003

# QC1 Steam Dryer Repairs November 2003

(close-up)



# PLANT-SPECIFIC CORRECTIVE ACTIONS (continued)

---

- Quad Cities Unit 2 - March 2004:

Replacement of entire vertical plate of steam dryer hood.

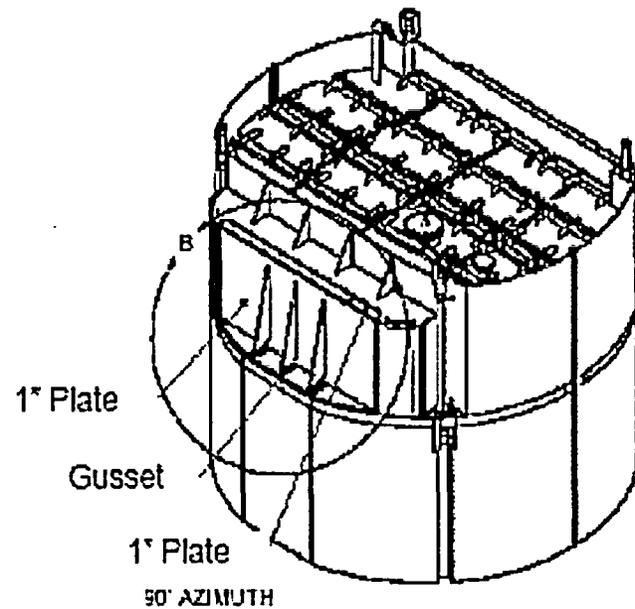
Installation of full-length gussets on vertical plate.

ERVs strengthened to support 2-year operation.

# QC2 Steam Dryer Repairs

## March 2004

---



# INDUSTRY ACTION

---

- Aug 2002: GE SIL 644 for square-hood steam dryers to monitor moisture carryover and RFO inspections.
- Sept 2003: Supplement 1 to SIL 644 to all BWRs with power uprates to monitor moisture carryover and RFO inspections.
- Feb 2004: BWROG assumes industry lead for EPU vibration issue.
- Mar 2004: Exelon evaluated Dresden EPU operation with RFOs for Unit 2 in Nov 2005 and Unit 3 in Nov 2004.

# INDUSTRY ACTION (continued)

---

- Exelon Commitments - April 2, 2004:

Limit QC 1 and 2 to pre-EPU power except for 72-hour testing.

Modify QC 1 electromatic relief valves before long-term EPU operation.

Provide specific commitments on

- obtaining NRC acceptance of QC 1 and 2 EPU operation;
- monitoring steam dryers and other components;
- criteria for prompt corrective action if needed;
- description of steam dryer loads;
- evaluation of QC 2 steam dryer repairs;
- independent review;
- reevaluation of flow-induced vibration assessments;
- EPU vulnerability team effort; and
- future steam dryer inspection plans.

# PLANNED INDUSTRY ACTION

---

- May 2004: BWROG to submit plan and GE/Exelon to complete operational improvement recommendations.
- June 2004: GE to complete review of steam dryer and steam/feedwater components.
- Sept 2004: BWR Vessel and Internals Project to complete steam dryer inspection guidance.

## NRC STAFF ACTION

---

- Sept 2002: Information Notice 2002-26 on QC 2 steam dryer cover plate failure.
- July 2003: NRC Special Inspection Team and Supplement 1 to IN 2002-26 in response to QC 2 steam dryer hood failure.
- Sept 2003: NRC letter (9/26) to BWROG with comments on SIL 644 (Supplement 1).
- Nov 2003: Public meeting (11/5) with BWROG.
- Nov 2003: NRC discussions with Exelon on QC 1 steam dryer repair and lost parts.

# NRC STAFF ACTION (continued)

---

- Jan 2004: Supplement 2 to IN 2002-26 on QC 1 steam dryer and additional component failures.
- Feb/Mar: Public meetings (2/3 and 3/4) with BWROG.
- Mar: IN 2004-06 on loss of FW sampling probes at Dresden 2 and 3.
- Mar/Apr: NRR/RES meetings to discuss research support on adverse flow effects from power uprates.

# NRC STAFF ACTION (continued)

---

- April: Acknowledgement letter (4/20) to Exelon:

No problem with proceeding as described in April 2 letter.

Concerns with plans to justify long-term EPU operation at Quad Cities and Dresden. Examples include:

Licensee did not indicate that loads (forcing function) causing steam dryer damage will be identified.

Quad Cities test plan not clear that sufficient data will be collected to assess dynamic loading on steam dryer and other components.

Dresden EPU basis did not provide quantitative technical assessment of loadings and stresses that could fail steam dryer or other components.

# FUTURE PLANS

---

- Review of Exelon information supporting Quad Cities and Dresden EPU operation.
- Regulatory communications being considered:
  - ▶ Regulatory Issue Summary on potential adverse flow effects from power uprates.
  - ▶ Generic regulatory action for other BWRs with power uprates.
- Review of Vermont Yankee power uprate request.
- Revision to power uprate review standard.



# **Draft Research Plan to Assess Potential Adverse Flow Effects During BWR Power Upgrades**

**Shah Malik, MEB/DET/RES**

**Don Helton, SMSAB/DSARE/RES**

**ACRS Briefing**

**May 7, 2004**

**US NRC**

# Research Program Objectives

---

- Due to recent events at Quad Cities 1 & 2 and Dresden 2 & 3 plants, a research program is being planned in RES to address adverse flow effects due to power uprates in BWRs
- **Objectives of Research Program:**
  - Identify and determine relative significance of phenomena that cause adverse flow effects in steam dryers and other components in steam and feedwater flow paths leading to degradation and potential failures due to flow induced vibration (FIV) and high cycle fatigue
  - Apply these phenomena to characterize failures observed in BWR plants under power uprate conditions
  - Determine if there are any generic implications that can be drawn on the extent of the adverse flow effects
  - Assess feasibility of developing a screening tool that NRR can use to review submittals on BWR power uprates
  - Support NRR in evaluating BWR power uprate submittals

# Research Plan (Draft)

---

- **2-Phase approach to understand and evaluate the adverse flow effects**
- **Phase 1:**
  - **With the assistance of NRR, acquire detailed plant data**
    - Affected components drawings and vibration monitoring data
    - Scaled-model test data, in-plant test data
    - Analytical modeling information (fluid and structural evaluations)
    - Licensee inspection information
  - **Procure tech. consultants in flow induced vibration (FIV)**
    - Computational fluid dynamics (CFD),
    - Fluid-structure interaction (FSI),
    - FIV computational structural dynamics analyses (FEA)
  - **Perform CFD feasibility studies to predict vortex shedding**
  - **Perform FEA structural dynamics studies (natural frequencies, mode shapes, ...)**

# Research Plan (Contd.)

---

- **Phase 2:**
  - Determine what FIV mechanisms are of concern
    - Turbulent loading
    - Vortex shedding
    - Acoustic excitation
    - Any other mechanism
  - Predict FIV loadings via thermal-hydraulic models
  - Determine significance of fluid-structure interaction (FSI)
  - Apply FIV loadings on finite element structural dynamic models and perform analyses
  - Predict components' failure modes
  - Infer generic implications
  - Develop potential screening tools for NRR's use in review of submittals on power uprates

# Research Plan Schedule (Draft)

---

- **Phase 1:**
  - Acquire detailed plant & analysis data: 05/2004 - 06/2004
  - Procure FIV technical consultants: 05/2004 - 09/2004
  - CFD feasibility study: 07/2004 - 02/2005
  - FEA structural dynamics studies: 07/2004 - 03/2005
- **Phase 2: (Tentative)**
  - FIV mechanisms determination: 10/2004 - 12/2004
  - Predict FIV loadings: FY05
  - Determine significance of fluid-structure interaction (FSI): FY05
  - Develop FEA structural dynamics models and perform analyses: FY05
  - Predict operating conditions and potential issues: FY05-FY06
  - Infer generic implications: FY06
  - Develop potential screening tools for assessing power uprate submittals: FY06
- **Continue providing additional guidance to NRR in reviewing submittals as soon as research information becomes available**