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ORIGINAL

Title: Advisory Committee on Reactor Safeguards  
Thermal Hydraulic Phenomena Subcommittee

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

January 26, 2005

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, taken on January 26, 2005, as reported herein, is a record of the discussions recorded at the meeting held on the above date.

This transcript has not been reviewed, corrected and edited and it may contain inaccuracies.

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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

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MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
(ACRS)

SUBCOMMITTEE ON THERMAL-HYDRAULIC PHENOMENA  
+ + + + +

WEDNESDAY,  
JANUARY 26, 2005

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ROCKVILLE, MARYLAND  
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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Dr. Graham Wallis, Chairman, presiding.

COMMITTEE MEMBERS:

- GRAHAM B. WALLIS, Chairman
- F. PETER FORD, Member
- THOMAS S. KRESS, Member
- VICTOR H. RANSOM, Member
- STEPHEN L. ROSEN, Member
- JOHN D. SIEBER, Member

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ACRS STAFF PRESENT:

RALPH CARUSO

NRC STAFF PRESENT:

HERBERT BERKOW

ROBERT DAVIS

MICHELLE HART

STEVE JONES

N. (KALY) KALYANAM

RICHARD LOBEL

LOUISE LUND

KAMAL MANOLY

L.B. (TAD) MARSH

JAMES MEDOFF

SAM MIRANDA

KRIS PARCZIEWSKI

PAUL PRESCOTT

WILLIAM H. RULAND

ANGELO STUBBS

MARTIN A. STUTZKE

JAMES TATUM

JOHN TSAO

LEN W. WARD

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ALSO PRESENT:

ROB ALEKSICK, CSI Technologies

JEFF BROWN, Westinghouse

PRASANTA R. CHOWDHURY, Entergy

JOSEPH CLEARY, Westinghouse

DAVID CONSTANCE, Entergy

STEVEN CYBERT, Westinghouse

THOMAS FLEISCHER, Entergy

JAMIE GOBELL, Entergy

MARIA ROSA GUTIERREZ, Entergy

ALAN HARRIS, Entergy

JERRY HOLMAN, Entergy

THEODORE LEONARD, Entergy

G. SINGH MATHARU, Entergy

JOSEPH REESE, Entergy

RALPH K. SCHWARTZBECK, Enercon

PAUL SICARD, Entergy

DON SISKKA, Westinghouse

DAVID VIENER, Entergy

ARTHUR (GENE) WEMETT, Entergy

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1                   Okay. I also review the section on leak  
2 before break. And the operating conditions under the  
3 uprated conditions will not alter the conclusions of  
4 the previous leak before break analysis for Waterford  
5 3. It's still valid.

6                   Are there any additional questions?

7                   I'll turn it over to John Tsao.

8                   MR. TSAO: I'm John Tsao from the  
9 Materials and Chemical Engineer Branch. I reviewed  
10 five sections; coding system, flow accelerated  
11 corrosion programs, steam generator tube inspections,  
12 steam generator blowdown systems and chemical and  
13 volume control systems.

14                   I will be talking about only two systems  
15 here; flow accelerated programs and steam generator  
16 tube inspections because they are more significant in  
17 terms of power uprate.

18                   For the flow accelerated corrosion  
19 programs, this morning there was some issue as to how  
20 much you increase. I have this backup slide.

21                   The FAC program measure the wear rates in  
22 terms of mils per year. And these are the changes  
23 that would be due to power uprate conditions.

24                   Also, I want to show you another slide  
25 that gives the effectiveness of the FAC program. This

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1 is provided by the licensee. And as licensee said, it  
2 is more in the -- they used CHECWORKS. It's a  
3 computer program that considers hydrodynamics, heat  
4 balance, temperature in particular.

5 As you can see the predictive method is  
6 conservative considered to actual measurement.

7 DR. FORD: I'm sorry. Could you explain  
8 that?

9 MR. TSAO: Okay.

10 DR. FORD: It looks as though it's equally  
11 scattered around the one to one line. So why are you  
12 saying it's conservative?

13 MR. TSAO: Well, for example, you can see  
14 -- let's see.

15 You can see just for example, this point  
16 here the measurement is about 300 mils. The predict  
17 value, let's say, from here to here is about 240 mils.  
18 So what it says is that the methodology will predict  
19 that the tube wall thinner than measured, therefore it  
20 also indicated that the licensee may need to do some  
21 monitoring or replacement of that pipe.

22 DR. FORD: But equally there are points on  
23 the other side which are not, what you call it --

24 MR. TSAO: Well, that's true. Yes, that's  
25 correct. But as you know this is only a prediction.

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1 Predictions, hopefully -- well, from the data point  
2 you can see they are scattered toward the conservative  
3 side. And also the FAC program according to EPRI is  
4 that it's a process. In other words, the licensees  
5 would go out, make an inspection, UT or ultrasonic  
6 measurements or the pipe thickness and then they will  
7 come back and they input that data into the computer  
8 code so that to make sure there is a certain accuracy  
9 in their predictions.

10 Also predict that the -- in the prediction  
11 method they include some safety factors.

12 DR. FORD: It seems to me as though  
13 there's a huge amount of scatter around that one-to-  
14 one line. And so the question immediately arises as  
15 to what is the impact of that in terms of could you  
16 get a through wall erosion event taking place when you  
17 had predicted it would not have done so?

18 MR. TSAO: It could.

19 DR. FORD: Did you go through that sort of  
20 "what if" argument? I mean if you look at that data  
21 base, you don't really have too much confidence in  
22 CHECWORKS.

23 MR. TSAO: Well, I wouldn't say they would  
24 be relying on CHECWORKS per se. The licensees, not  
25 only Waterford but other licensees, you know they

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1 include other factors. For example, other industry  
2 experience. You know if some plants have some problem  
3 with FAC water lines, then they will consider --

4 DR. FORD: I recognize that.

5 MR. TSAO: Right.

6 DR. FORD: But this particular EPU is  
7 putting a lot of basis on CHECWORKS to manage this  
8 problem. And if this a general observation as to how  
9 good CHECWORKS is, my confidence is a little bit  
10 shattered.

11 MR. TSAO: I should point out that  
12 Waterford is not unique. I did the review for license  
13 renewal, and I also asked questions. And this is type  
14 of plot that, you know, other licensee has shown me.

15 DR. FORD: Yes, I know.

16 MR. TSAO: In other words, I don't think  
17 that licensee is depending solely on what prediction  
18 is. They also, you know, include other experiences and  
19 inspections. Not only the inspections for the fact,  
20 but there are other SME code inspections they have to  
21 perform.

22 DR. FORD: I'll ask again. Did you go  
23 through the "what if" scenario?

24 MR. TSAO: I have Kris Parcziewski from my  
25 branch to elaborate on this.

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1 DR. FORD: With that amount of uncertainty  
2 in your modeling capability and therefore your  
3 management capability, do you not feel uncomfortable?

4 MR. TSAO: No.

5 DR. FORD: No?

6 MR. PARCZIEWSKI: Kris Parczewski from  
7 the Chemical Engineering Branch.

8 To answer your question, those points are  
9 predicted. CHECWORKS predicts but in addition there  
10 is a correction factor for each individual line which  
11 is here at the top right hand side, line correction  
12 factor which indicates that it is corrected for each  
13 individual line all the points predicted in the line  
14 are corrected by this line correction factor. And the  
15 line is defined as a portion of the system which has  
16 the same chemistry but not necessarily the same  
17 temperature. If I answer your question.

18 So all those points are already corrected.  
19 Ideally, if they were ideal, they would lie in the 45  
20 degree line, the middle line. However, obviously,  
21 there is some scatter.

22 DR. FORD: I understand the physics --

23 MR. PARCZIEWSKI: Yes.

24 DR. FORD: -- of the erosion process.  
25 It's highly dependent on ph. High dependent on

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1 temperature. Highly dependent on corrosion potential  
2 and all of those things are interacting. So that if  
3 you're a little bit off on your definition of one of  
4 those parameters, then you're going to get a big  
5 change. So I can understand why there is a scatter  
6 there because you're not able to define your system  
7 adequately enough, and therefore that's the physical  
8 origin of your LCF. But I still feel uncomfortable  
9 about that huge scatter and how you use it in  
10 management from their point of view and in terms of  
11 regulation from your point of view.

12 MR. TSAO: Okay. For regulation,  
13 basically there's no regulation on FAC program.

14 DR. FORD: That's what worries me.

15 MR. TSAO: The FAC program is instituted  
16 because of the bulletin. Back in the '80s it was  
17 result of Bulletin 87-01 where Surry had a --

18 DR. FORD: Yes, sure.

19 MR. TSAO: -- a rupture. And Generic  
20 Letter 89-08 that required the licensees to institute  
21 some type of program, FAC program. And then the  
22 industry, you know, with EPRI guidance come up with  
23 this program. And so --

24 DR. FORD: I understand all that. I'm  
25 just looking at what the history has been since then.

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1 And, you know, a few months ago we had fatalities in  
2 Japan because of this phenomenon, which was not  
3 managed well. And you know if this is supposed to be  
4 the state-of-the-art of prediction of management and  
5 therefore regulation, I just don't feel comfortable.

6 MR. TSAO: Okay. Speaking of the  
7 Japanese, again from my understanding is that Japanese  
8 did not inspect, you know, the last 20, 30 years.

9 DR. FORD: Correct.

10 MR. TSAO: Where here under FAC program  
11 the licensees will have to inspect at least they say  
12 50 to 100 inspection points for their large bore  
13 piping and small bore piping they probably sometime  
14 inspect 100 percent. And so there's a constant  
15 inspections going on to make sure that the --

16 DR. FORD: I understand that.

17 MR. TSAO: Right.

18 DR. FORD: All I'm pointing out is  
19 everyone bows to CHECWORKS and says yes, yes that's  
20 the best thing that's around. And I'm just  
21 questioning it. Is it adequate?

22 MR. HOWE: This is Allen Howe.

23 And I'd just like to add in at this point  
24 that we understand the question and we will be happy  
25 to get back with you with a response on that.

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1 DR. FORD: Thank you.

2 MR. TSAO: Okay. Next slide.

3 Next slide I will be talking about is the  
4 related to steam generator tube inspections.

5 This morning you also raised about the  
6 question that -- sorry.

7 Next slide. The power operator will effect  
8 the anti-vibration tubes for locations. What it does  
9 at the increase of feedwater flow will cause the tube  
10 to vibrate a little bit more. And the possible  
11 degradation is where the anti-vibration bar, they call  
12 the bat wings on top of that square shape, hitting the  
13 supports.

14 Now, we have the requirement in tech spec  
15 that we have the leakage requirement, which the  
16 licensee has reduced to 75 gallons per day of a steam  
17 generator. This is pretty significant in that the  
18 normal primary to secondary leakage limit is 150  
19 gallons per day. And Waterford is willing to go down  
20 to 75 gallons per day. And that it is very good  
21 limits to detect any potential leakage. Because 75 for  
22 tech spec translate into administrative limit.  
23 Control probably would be at even lower. Therefore,  
24 if there's any leak, you know they would probably go  
25 into a special administrative control actions

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1 by the ASME 3 code or anything like that. Similarly  
2 it's just stress code in cracking that's been  
3 accelerated.

4 MR. SIEBER: But wear phenomenon is  
5 covered by the ASME code.

6 DR. FORD: Yes.

7 MR. KARWOSKI: Through the plugging limits  
8 and what not and through the plant technical  
9 specifications.

10 DR. FORD: Right.

11 CHECWORKS?

12 MR. KARWOSKI: I think Louise Lund was  
13 going to talk about CHECWORKS.

14 DR. FORD: Maybe if I could just state  
15 what my problem was, Louise, and that would make it  
16 more efficient for you to answer it.

17 MS. LUND: Should I introduce myself first  
18 for the record?

19 DR. FORD: Yes.

20 MS. LUND: I'm Louise Lund. I'm the  
21 Section Chief for the Steam Generator and Integrity  
22 and Chemical Engineering Section, NRR. And, anyway,  
23 I was asked to come over and discuss the FAC program.

24 DR. FORD: My concern was that the way  
25 that they're using CHECWORKS right now, it is

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1 primarily a prioritization tool as to where you're  
2 going to look in the carbon steel piping. From the  
3 measures that were shown this morning, it's apparent  
4 that CHECWORKS is not good on one-to-one correlation.  
5 Therefore, it's quite possible that you may use  
6 CHECWORKS to say that I should not look at that pipe  
7 because of the particular operating conditions of that  
8 pipe, but I should look at this pipe. But in fact that  
9 pipe there might well be eroding at quite a large  
10 rate, but you wouldn't look at it for one, two, three  
11 cycles. In that time you could go through wall. So  
12 that was essentially my worry that you're using a  
13 model which is not precise to make prioritization  
14 decisions.

15 MS. LUND: Right. And I just want to say  
16 off the top, you know we have a very active interest  
17 in the FAC programs. Specifically we've had generic  
18 letters or generic correspondence that has asked  
19 industry to put together these type of programs which  
20 manage FACs and also have these predictive  
21 methodologies. However, it's not a case of just using  
22 the predictive methodologies blindly and looking at  
23 information on one line or another; there's a number  
24 of things that inform the decision as far as what's  
25 inspected and how it's inspected. Because it is a

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1 tool, but it's not a blind tool in that particular  
2 way. And, in fact, this gentleman I believe is from  
3 Waterford and he was mentioning, we had a kind of  
4 offline discussion about it and that's why I asked him  
5 to come up here and help discuss this, and  
6 specifically for Waterford.

7 I also wanted to say that for these FAC  
8 programs, I think that we have an interest in looking  
9 at them through power uprate and license renewal in  
10 that we ask that the licensee provide information on  
11 their most susceptible lines with their measures  
12 versus their predicted and whether it gave them  
13 information such that they could replace the lines,  
14 you know, in a timely manner. Because that's really  
15 what we want to know is, is it giving you the  
16 information at the time that you need it in order to  
17 make the decisions you need to make good decisions  
18 about running your plant.

19 So that's the kind of questions we ask. We  
20 do not do a re-review of their CHECWORKS data. We do  
21 not take all their raw data and subsequently do an  
22 audit of it. Okay. So I just wanted to kind of  
23 clarify what it is that we do, you know, in our review  
24 process. Usually through a request for additional  
25 information we usually will ask them for the most

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1 susceptible lines.

2 MR. ROSEN: We call that a performance-  
3 based regime?

4 MS. LUND: Right. Right. And when we put  
5 out that generic letter where we asked the licensees  
6 to put together a FAC program and also have these  
7 predictive methodologies, we did inspections of those  
8 programs at that time. Okay. In fact, to make sure  
9 that these programs were in place and in fact doing  
10 what we thought that they were doing. Okay.

11 Now, I now in license renewal, true  
12 license renewal we've been asked to come and give a  
13 presentation to the ACRS on FAC and FAC programs. And  
14 we've actually been in contact with CHECWORKS user  
15 script to ask them to come in and help present this  
16 information such that you can look industry-wide at  
17 how well these FAC programs are working, specifically  
18 with the CHECWORKS program and give you a lot of sense  
19 -- instead of looking at just one graph, kind of get  
20 a sense for generically how this is working and where  
21 it may be challenged in certain ways or another,  
22 because they think that they have a very good story to  
23 tell.

24 Now maybe if you could introduce yourself,  
25 and then also explain how programmatically it's a much

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1 lighter look at how you choose the lines and --  
2 because there's a surrogate aspect to it where, you  
3 know, if you see something you look at other things  
4 that are like that. There are a lot of things that go  
5 into the program that don't rely on just this  
6 measurement.

7 So, anyway --

8 MR. ALEKSICK: Good afternoon. My name is  
9 Rob Aleksick. I'm with CSI Technologies representing  
10 Entergy today.

11 Real quick about my background. I've had  
12 the opportunity to be involved with flow accelerated  
13 corrosion since 1989 and in particular have modeled or  
14 otherwise addressed approximately 20 EPU efforts in  
15 the last two years.

16 Dr. Ford made a very good point earlier  
17 when he said that the graph that we looked at did not  
18 display a very good correlation between the measured  
19 results and the predicted results out of CHECWORKS.  
20 Programmatically -- well, let me back up a second.  
21 That is certainly true in the example that we looked  
22 at. That is not always the case.

23 CHECWORKS models are on a per line or per  
24 run basis. The run --

25 CHAIRMAN WALLIS: Could we go back to that

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1 graph that we saw? The graph was a plot of thickness  
2 versus predicted thickness.

3 MR. ALEKSICK: That's correct.

4 CHAIRMAN WALLIS: Because if you looked at  
5 amount removed versus predicted amount removed, it  
6 seems to me the comparison will be even worse.

7 MR. ALEKSICK: That's correct. In fact --

8 CHAIRMAN WALLIS: That's what you're  
9 really trying to predict is how much is removed.

10 MR. ALEKSICK: Yes, that is true. And my  
11 point is that in some subsets of the model, the one  
12 that we looked at here which was high pressure  
13 extraction steam, the correlation between measured and  
14 predicted is not so good. And in some subsets of the  
15 model, the correlation is much better.

16 CHAIRMAN WALLIS: It looks to me that in  
17 some cases it's predicting no removal whereas in fact  
18 there's a lot of removal. So the error is percentage  
19 wise enormous?

20 MR. ALEKSICK: Yes, exactly. Exactly.  
21 Some runs results are imprecise and some more precise.  
22 And we look at both accuracy and precision.  
23 Programmatically we account for that, that reality, by  
24 treating those runs that have what we call well  
25 calibrated results, i.e., precise and accurate results

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1 coming out of the model that are substantiated by  
2 observations, we treat those piping segments  
3 differently programmatically than we do areas where  
4 the model is less good. If the model results do not  
5 correlate well with reality, different actions are  
6 taken primarily increased inspection coverage to  
7 increase our level of confidence that those systems  
8 can continue to operate safely.

9 In addition to the CHECWORKS results many  
10 other factors are considered to assure that the piping  
11 retains its integrity, chief among these are industry  
12 experience as exchanged through the EPRI sponsored  
13 CHUG group. Plant experience local to Waterford in  
14 this case. And the FAC program owner maintains an  
15 awareness of the operational status of the plant so  
16 that, for example, modifications or operational  
17 changes that occur are taken into account in the  
18 inspection of the secondary site FAC susceptible  
19 piping.

20 DR. FORD: And my final question on this  
21 particular subject was given the uncertainties in the  
22 model, changed by this performance based aspect that  
23 you just talked about, is there any way that you can  
24 come up with a quantification of the risk associated  
25 with a failure of a specific pipe?

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1 MR. ALEKSICK: There's currently no  
2 accepted methodology to quantify that risk, no.  
3 However, it is accounted for primarily on a judgment  
4 basis through industry experience and information  
5 exchange through the EPRI CHUG group.

6 DR. FORD: Okay.

7 MR. MITCHELL: Yes, this is Tim Mitchell.

8 Just to give you a feel for how we're  
9 addressing for this upcoming refueling outage, we have  
10 increased our scope for a couple of reasons. One to  
11 get additional data and we always do more than just  
12 exactly what CHECWORKS supports. So you're always out  
13 validating and getting more data to be able to help  
14 predict where do you need to be looking. But in  
15 addition, we're taking some additional points to make  
16 sure we have good baseline data for the next cycle to  
17 ensure that those points give us a good indication  
18 going forward after the EPU.

19 The analysis for flow accelerated  
20 corrosion shows very minimal changes as a result of  
21 power uprate. But we are taking seriously our  
22 inspection program and expanding it for this upcoming  
23 outage to ensure that we know what's happening not  
24 just what we're predicting.

25 MR. ROSEN: Let me roll that back now,

1 Tim. Can you tell me like for the last three or four  
2 outages have you done some actual replacement of  
3 piping based on predictions of FAC from the CHECWORKS  
4 code or have you never replaced anything? What are  
5 you seeing at Waterford?

6 MR. MITCHELL: I can give you non-  
7 Waterford data better than I can give Waterford to  
8 ponder.

9 MR. CHOWDHURY: My name is Prasanta  
10 Chowdhury and I'm working with Entergy design for last  
11 20 years.

12 I was involved with FAC also for several  
13 years in the past.

14 It's not the CHECWORKS model that  
15 determines what replacement is to be done. We base it  
16 on actual measurement we take during the refuel  
17 outage. So we also project based on actual measurement  
18 that what will be our future projected thickness in  
19 next refueling outage. So you can survive until next  
20 cycle. And then we do some evaluation based on our  
21 criteria that makes the stress criteria -- or based on  
22 the code requirement. Like make all the equation.

23 Now code allows to go thinning in local  
24 area but the FAC is a local thinning. So we do some  
25 local thinning evaluation to make sure that it goes to

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1 the next cycle.

2 Does that answer your question?

3 MR. ROSEN: No.

4 MR. MITCHELL: Did we replace any piping  
5 in the last three outages?

6 MR. CHOWDHURY: I don't recall. I don't  
7 recall. But we did extensive modification on  
8 extraction steamline in the past. But it changed to  
9 crack piping or stainless steel piping or chrome moly,  
10 which is more corrosion resistance piping. I don't  
11 answer your question --

12 MR. ROSEN: You say you have made  
13 extensive modifications --

14 MR. CHOWDHURY: In the past.

15 MR. ROSEN: -- you changed to chrome moly?

16 MR. CHOWDHURY: Several years back, yes.

17 MR. ROSEN: Okay.

18 MR. CHOWDHURY: So whatever we did, see  
19 the corrosion of thinning, we took it out and made  
20 modifications.

21 MR. ROSEN: Yes, well, that's typically  
22 the plant's response. If you find substantial  
23 thinning, then you just don't go back and put in  
24 carbon steel back in the same place.

25 MR. CHOWDHURY: Right.

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1 MR. ROSEN: Because what happened before  
2 will happen again.

3 MR. CHOWDHURY: I mean we have also made  
4 a procedural entry into this FAC that anytime we do a  
5 replacement, we use a better corrosion resistant  
6 material or EPRI guidelines.

7 MR. ROSEN: Okay. So you're saying you  
8 have made those kinds of modifications.

9 MR. CHOWDHURY: Yes. But still we are  
10 ongoing and doing things. If we see something we need  
11 to change, we change it.

12 Does that answer your question, sir?

13 MR. ROSEN: It's a little better. Not a  
14 100 percent.

15 MR. CHOWDHURY: Okay.

16 MR. ROSEN: I would prefer something, and  
17 maybe for next meeting you can come back with some  
18 real data that there are 11 locations that you changed  
19 in the last five years or something.

20 MR. CHOWDHURY: Yes, we can do that.  
21 Because I don't have the data with me. I can get in  
22 touch with the FAC program engineer and get those  
23 information. Thank you.

24 CHAIRMAN WALLIS: That would be excellent.

25 DR. FORD: Thanks very much indeed. I

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1 appreciate it.

2 MR. KALYANAM: Next we have the  
3 Containment Systems group Richard Lobel.

4 MR. LOBEL: Good afternoon. My name is  
5 Richard Lobel. I'm with the Probabilistic Safety  
6 Assessment Branch but in the Containment System area.

7 Next slide, please.

8 I wanted to talk about the review of the  
9 analysis that were done for the containment accident  
10 analysis. This slide lists the areas that were looked  
11 at. Basically the analysis of containment response to  
12 a LOCA both the mass release and the containment  
13 response and the containment response to a main  
14 steamline break, both mass and energy into the  
15 containment and the containment response and  
16 subcompartment analysis also, which is a type of LOCA.

17 Next slide.

18 CHAIRMAN WALLIS: You mean that PSA Branch  
19 actually does this sort of thermal-hydraulic analysis?

20 MR. LOBEL: We're the orphan section. We  
21 go to the branch meetings but don't understand what  
22 they're talking about, because it's all acronyms  
23 dealing with risk and we just sit there and listen.  
24 But that's where they put us.

25 The mass and energy for the LOCA was

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