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UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

June 14, 2006

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, taken on June 14, 2006, 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.

1 UNITED STATES OF AMERICA

2 NUCLEAR REGULATORY COMMISSION

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4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

5 (ACRS)

6 SUBCOMMITTEE ON THERMAL HYDRAULICS PHENOMENA

7 + + + + +

8 RESEARCH ACTIVITIES RELATED TO RESOLUTION OF GSI-191

9 + + + + +

10 WEDNESDAY,

11 June 14, 2006

12 + + + + +

13 The Subcommittee meeting convened at the

14 Nuclear Regulatory Commission, Two White Flint

15 North, Room T-2B3, 11545 Rockville Pike, at 8:30

16 a.m., Graham B. Wallis, Chair, presiding.

17 SUBCOMMITTEE MEMBERS PRESENT:

18	GRAHAM B. WALLIS	Chair
19	MARIO BONACA	ACRS Member
20	RICHARD B. DENNING	ACRS Member
21	THOMAS S. KRESS	ACRS Member
22	OTTO L. MAYNARD	ACRS Member
23	WILLIAM J. SHACK	ACRS Member
24	JOHN D. SIEBER	ACRS Member

25

1 ACRS STAFF PRESENT:

2 RALPH CARUSO

3 NRR STAFF PRESENT:

4 RALPH ARCHITZL

5 DAVE CULLISON

6 THOMAS HAFERA

7 WALT JENSEN

8 PAUL KLEIN

9 WILLIAM KROTIUK

10 SHANLAI LU

11 TOM MARTIN

12 MIKE SCOTT

13 STEVE UNIKEWICZ

14 LEON WHITNEY

15 MATT YODER

16 ALSO PRESENT:

17 ANN LANE Westinghouse

18

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21

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

2 8:32 a.m.

3 CHAIRMAN WALLIS: Good morning. The
4 meeting will now come to order. This is the second
5 day of the meeting of the Subcommittee on Thermal
6 Hydraulic Phenomena of the Advisory Committee on
7 Reactor Safeguards. We are going to continue the
8 subject we discussed yesterday PWR sump performance.
9 Yesterday we heard from research and today we are
10 going to hear from NRR. I invite Mike Scott to get us
11 going.

12 MR. SCOTT: Thank you, Dr. Wallis. I
13 would like to say that we are pleased to come before
14 you and brief you again on this subject. We have made
15 some progress since we last talked to the Subcommittee
16 in February and the full Committee in March. We've
17 got a long way to go as we'll communicate with you.

18 I'm going to start off with a short
19 discussion, sort of a summary of where we've been and
20 an outlook of where we're going and then we'll get
21 into the individual technical subject areas that I
22 know you are primarily interested in hearing about
23 today.

24 Since we last talked to you, actually
25 right about the same time as we talked to you, we sent

1 requests for additional information to all the PWR
2 licensees to address gaps in the Generic Letter
3 responses. We subsequently agreed to an industry
4 request to defer those responses for several reasons.
5 No. 1 is we agreed that the industry should keep its
6 focus on the design and installation of larger sump
7 strainers.
8 As we discussed with you the last time we
9 were here, we see that as the most important thing
10 that we can do in the near-term, especially given the
11 various technical issues and uncertainties regarding
12 GSI-191. We strongly believe that installation of
13 larger strainers will enhance safety.
14 Also, as we discussed yesterday, there is
15 ongoing work. For example, the alternate buffer
16 testing that the industry is currently doing that may
17 in the end change the solution to GSI-191 for one or
18 more plants. We believe that it is appropriate at
19 this point to not require additional information
20 responses because the answers simply aren't available
21 for those plants. The work is ongoing.
22 We sent the industry a letter in March
23 that said that we would agree to the following that
24 you see in the second two sub-bullets under the second
25 bullet which is for plants that install their new

1 strainers, or their enhanced strainer sump
2 installations in 2006, we have requested and they have
3 agreed to provide responses to our RAIs and/or
4 supplemental responses to the Generic Letter by the
5 end of December of 2006. I'll show you in a few
6 slides how many plants that involves.
7 For plants that install strainers after
8 2006 we are expecting the responses within 90 days
9 after the outage that installs those strainers or at
10 the latest by December of 2007. Those submittals are
11 expected to fully address the Generic Letter 2004-02
12 items including providing basis for the adequacy of
13 the sump designs.
14 We also submitted a SECY paper to the
15 Commission which provided a status on GSI-191,
16 discussed our plans for path forward, and also
17 provided criteria that the staff plans to use for
18 review of any requests from any licensees for
19 extension beyond the December 2007 deadline for
20 completing actions to address Generic Letter 2004-02.
21 Since that time we have received -- I
22 guess this is slightly behind the times now. We have
23 six extension requests in. One of them we are still
24 considering. We approved four and rejected one. We
25 approved the four consistent with the second criteria

1 which involved showing a substantial improvement in
2 the sump design, typically a much larger strainer.
3 Some of the plants came in with requests
4 that said, "We are going to put our new larger
5 strainers in in fall 2006 but we have additional
6 modifications that we want to make."
7 For example, to downstream valves that are
8 going to necessitate waiting until the next outage for
9 all the plants that have made these requests those
10 outages would be in spring 2008. We are going to have
11 a much better design but we have some details to take
12 care of that we are asking for those to be taken care
13 of in the 2008 spring outage.
14 CHAIRMAN WALLIS: Mike, you are going to
15 have responses from how many different utilities?
16 MR. SCOTT: Are you speaking of the
17 previous slide?
18 CHAIRMAN WALLIS: Well, both of these
19 together. There were 69 reactors or something like
20 that?
21 MR. SCOTT: There are 69 and so if you --
22 CHAIRMAN WALLIS: Are they going to have
23 an RAI for each one of those, RAI responses?
24 MR. SCOTT: What they have the option to
25 do is either respond to the RAIs item by item or to

1 provide a supplemental Generic Letter 2004-02 response
2 that addresses all those RAIs.
3 CHAIRMAN WALLIS: Have to describe the
4 basis for the sump design and operations and
5 everything.
6 MR. SCOTT: That's correct.
7 CHAIRMAN WALLIS: Someone has to review
8 all these?
9 MR. SCOTT: Yes. The staff.
10 CHAIRMAN WALLIS: This is a full-time job
11 for how many people?
12 MR. SCOTT: Well, right now there are
13 eight staff members working on GSI-191. Of course, we
14 have some folks who are working on it part-time, too.
15 As I'll show you in a couple of slides here, because
16 we are asking for some of the responses to be in by
17 the end of 2006 and other to be in throughout 2007, we
18 don't anticipate getting all of these responses in in
19 the last quarter of December '07 but there will be a
20 substantial number of them.
21 CHAIRMAN WALLIS: It is conceivable that
22 some of these sump designs will prove to be inadequate
23 when examined by your staff?
24 MR. SCOTT: Yes, that is conceivable in
25 which case additional actions may be needed.

1 CHAIRMAN WALLIS: Is there some way --
2 would we have any involvement in this process at all,
3 the ACRS?
4 MR. SCOTT: We will continue to brief you
5 on the audits and we will brief you at the time we get
6 the Generic Letter responses on what we are finding.
7 CHAIRMAN WALLIS: Okay. And there will in
8 the public record these responses?
9 MR. SCOTT: They will.
10 CHAIRMAN WALLIS: And the sump designs
11 will be in the public record?
12 MR. SCOTT: To the extent the information
13 is not proprietary.
14 CHAIRMAN WALLIS: But they have to include
15 in their responses what you call the basis for
16 adequacy of sumps.
17 MR. SCOTT: Correct.
18 CHAIRMAN WALLIS: So there must be quite
19 a bit of technical basis which is in the public
20 record.
21 MR. SCOTT: That would be my assumption,
22 yes.
23 CHAIRMAN WALLIS: Okay. So if we wish to,
24 or if someone else wished to, they could examine these
25 and see how believable they were and hopefully they

1 would all be believable.

2 MR. SCOTT: Right. As you know, and as I

3 mentioned to you all yesterday, because we don't have

4 these responses yet, we don't know at this point the

5 approaches that the industry -- we don't know in

6 detail the approaches that the industry are going to

7 take plant by plant to address the issue. Once we

8 start getting those responses in, we are going to get

9 a lot more informed.

10 CHAIRMAN WALLIS: So let's say a master

11 student at a university could take as his thesis

12 examination of these sump designs and efficacy or

13 efficacy or however you want to pronounce it.

14 MR. SCOTT: Sure.

15 CHAIRMAN WALLIS: Okay. That might be

16 interesting to do. Thank you.

17 MEMBER DENNING: It might give a feeling

18 to the experimental work that is going to go on with

19 models of their screens. How does the timing of that

20 relate to when the installation will occur? Do you

21 have a feeling? I mean, will some of that testing

22 occur after installation has actually occurred?

23 MR. SCOTT: Okay. The testing I assume

24 you are referring to is the vendor testing?

25 MEMBER DENNING: The vendor testing.

1 MR. SCOTT: Most of the vendor testing
2 that was scheduled has been done. As a matter of
3 fact, we are leaving today to watch some of the last
4 of it after we are done briefing you.
5 MEMBER DENNING: Most vendor testing has
6 been done?
7 MR. SCOTT: Right. There is a fair chance
8 that because they did most of that testing before
9 chemical affects issues have been resolved, there may
10 be additional testing needed. We'll have to see how
11 that plays out.
12 MEMBER DENNING: And when will you -- you
13 say you are going to observe the results or something?
14 MR. SCOTT: We'll talk to you. Shanlai Lu
15 will talk to you in some detail about each of the --
16 well, not much detail but he'll mention the vendor
17 designs and talk about the fact that we are going to
18 see, or have been to see all of the vendor designs.
19 Some of the testing is actually going to happen this
20 summer so there is some of it yet to come but a lot of
21 it is already completed.
22 MEMBER DENNING: So you haven't actually
23 seen their experimental design yet as to what their
24 plans really were and what the spectrum of conditions
25 are that they are running with. You'll see that after

1 you go talk with them now?

2 MR. SCOTT: We have seen some vendor

3 testing of some plants. Remember, each vendor will

4 have half a dozen or more licensees. Each licensee

5 will have a plant specific situation so the testing is

6 not identical one to one. We are not attempting to

7 watch the testing for every licensee. We are watching

8 representative testing so we have seen some of that

9 and we have some more to do.

10 CHAIRMAN WALLIS: There will be testing

11 for each plant based on the particular conditions at

12 that plant do you think?

13 MR. SCOTT: That is correct.

14 CHAIRMAN WALLIS: And there will be some

15 module which is tested and then there will be many

16 modules installed in a plant so there has to be some

17 way of designing for the many-module situation.

18 MR. SCOTT: As we have mentioned to them,

19 and I think we noted for you all a couple of months

20 ago, we expect them to show that the vendor testing

21 can be scaled to actual plant conditions.

22 MR. WHITNEY: This is Leon Whitney of NRR.

23 Just for the record, we expect approximately 40

24 responses for the 69 plants. Some plants are tested

25 identical.

1 MEMBER BONACA: So there will be
2 groupings?
3 CHAIRMAN WALLIS: It looks to me as if
4 everything is going along so fast that most decisions,
5 not all, will be made before ACRS has any chance to
6 comment on any of this.
7 MR. SCOTT: Well, I don't see it playing
8 out fast. Now, what is going on expeditiously is the
9 installation of the strainers that we have talked
10 about and I'll show you a slide in a minute that will
11 give you a time line for that. The resolution of the
12 generic letter is going to be an ongoing process over
13 the next 24 months. I guess I don't see how that is
14 going to happen rapidly.
15 CHAIRMAN WALLIS: I just wonder if we have
16 any influence at all and it would not be good for us
17 to come in after it's all being done with some
18 criticism of what has been done. That is not the way
19 we like to operate. We like to operate by influencing
20 what is going to be done in the proper way.
21 MR. SCOTT: Right. We can come in and
22 brief you in the responses. When responses start
23 coming in, which we anticipate is the end of this
24 year, we can come in and talk to you about that.
25 CHAIRMAN WALLIS: I think it is very much

1 up to you to design it so that we are going to have
2 some effect that can be useful and not be in anyway
3 upsetting at the end. We don't want to have to look
4 at something at the end after it's all been done and
5 then have to wait a letter if we find there are some
6 holes in what has been done. If there is any place
7 where we can influence events in a way which is
8 positive, we would like to do it early.
9 MR. SCOTT: I agree, but the issue,
10 though, is until we start getting the responses in it
11 will be limited. The staff is going to talk to you
12 today about some review guidance that we are
13 developing. We believe that review guidance is going
14 to tend to be iterative based on what we see when
15 responses come in. There are going to be several
16 opportunities along the way here for you all to be
17 involved, as you said.
18 CHAIRMAN WALLIS: Thank you.
19 MEMBER SIEBER: I think the greatest
20 difficulty that I see in this whole thing is the
21 licensees are being asked to design and install
22 strainers before the research is completed that will
23 tell the NRC staff to review it and what the design
24 parameters ought to be. To me that is sort of a
25 perplexing situation.

1 One outcome of that would be that the
2 strainers the licensees design won't be adequate to
3 meet the conditions that we eventually determine are
4 going to be in the plant. I think there will be
5 modifications that will come later as a result of the
6 review. The strainer goes in before the letter is
7 written.
8 MR. SCOTT: Let me make a point on that if
9 I might. Having looked at the designs that the
10 utilities are coming up with, they are installing very
11 large strainers. At least in order of magnitude
12 greater than the size that is in there now. It may
13 well be that at the end of the day if the analysis
14 shows that those very large strainers are not enough
15 in some plants, then those plants will have to
16 consider modifications that aren't likely to include
17 larger strainers.
18 They could include and we have encouraged
19 the industry to remove problem materials when they
20 can. If a very large strainer won't handle it, then
21 there is probably a problem materials issue that the
22 plant needs to address.
23 MEMBER SIEBER: That's what I would do
24 first if I were a licensee now.
25 MR. SCOTT: Some of them are actually

1 doing those things in parallel. They are removing
2 insulation that is a problem at the same time they are
3 enlarging their strainers.
4 CHAIRMAN WALLIS: We know very little
5 about downstream effects so far.
6 MR. SCOTT: We are going to talk to you
7 some about that today.
8 CHAIRMAN WALLIS: This could change what
9 is a good strainer, what is a bad strainer.
10 MR. SCOTT: I suggest we hold that in
11 abeyance.
12 CHAIRMAN WALLIS: Okay. We'll hear about
13 it later today.
14 MR. SCOTT: Okay. Moving on here we have
15 conducted an audit of Watts Bar implementation of
16 actions to address Generic Letter 2004-02. This is
17 our first audit and we are not completely done with it
18 yet. We are done with the looking part and we are in
19 the writing the report part and waiting on the RAI
20 responses from the licensee. We'll talk to you all
21 about this audit also today.
22 We met with the PWR Owners Group,
23 previously known as the Westinghouse Owners Group to
24 discuss concerns and industry plans regarding in-
25 vessel downstream effects. We accepted a topical

1 report on chemical effects review that you'll hear a
2 little bit more about today.
3 CHAIRMAN WALLIS: This is a Westinghouse
4 report?
5 MR. SCOTT: Yes. A WOG, PWR Owners Group
6 Report. Paul Klein will talk to you all about that
7 today.
8 CHAIRMAN WALLIS: It's a WCAP report of
9 some sort?
10 MR. SCOTT: Yes, it is a WCAP.
11 CHAIRMAN WALLIS: I think we have that,
12 don't we? This is the one which tells you how to make
13 your surrogates.
14 MR. SCOTT: Yes.
15 CHAIRMAN WALLIS: Okay.
16 MR. SCOTT: We have also received a
17 revised topical report on downstream effects. A
18 little bit of background on this. The staff had made
19 some informal comments on the downstream effects
20 topical report late last year and Westinghouse
21 addressed those comments and submitted a topical
22 report formally for staff review. We just got it, I
23 believe, last week. That is, by the way, downstream
24 effects mostly X vessel.
25 CHAIRMAN WALLIS: That's a WCAP?

1 MR. SCOTT: It is, yes.

2 CHAIRMAN WALLIS: Is there anything on in-

3 vessel effects?

4 MR. SCOTT: I'll talk about that in just

5 a second.

6 CHAIRMAN WALLIS: Okay.

7 MR. SCOTT: We developed a plan to perform

8 confirmatory analysis of the potential for in-vessel

9 flow blockage and we are going to talk to you about

10 some of the results of that today.

11 CHAIRMAN WALLIS: That means research when

12 you say confirmatory analysis?

13 MR. SCOTT: It means NRR and research

14 working together. We'll talk to you about that.

15 We are conducting multiple observations of

16 strainer testing as I mentioned earlier and

17 documenting the results of that. What we are doing in

18 the way of documentation is making the trip reports

19 that show our comments on the various vendor testing

20 practices available to the licensees that are using

21 the services of that vendor by putting them on Adams

22 and informing the licensee of the availability of the

23 document in the public library.

24 We also discussed a planned topical report

25 on in-vessel downstream effects with the Owners Group

1 and the Owners Group plans to begin development of the
2 WCAP to address that subject. They were to get
3 approval from their management to start that report
4 this month so obviously since they haven't started
5 writing that one yet, that is a few months down the
6 line before we are actually going to see it.
7 We developed action plans for the major
8 GSI-190.
9 CHAIRMAN WALLIS: Go back to this. You
10 are going to have this report written. Is there
11 enough knowledge available to write this report?
12 MR. SCOTT: Which report are you referring
13 to?
14 CHAIRMAN WALLIS: The in-vessel downstream
15 report.
16 MR. SCOTT: The knowledge will be
17 developed. Again, we are going to talk to you about
18 that.
19 CHAIRMAN WALLIS: I remember from the
20 other report I read, I think it was WCAP, it seemed to
21 say these are the things you need to calculate but it
22 didn't indicate if it was known how to do it.
23 MR. SCOTT: Clearly the purpose of the
24 report is to provide that guidance.
25 CHAIRMAN WALLIS: So you are confident

1 that it is known how to predict these downstream
2 effects?
3 MR. SCOTT: I'll just wait and see what
4 they come up with when they write their report.
5 CHAIRMAN WALLIS: Because we don't know.
6 Maybe you don't know either.
7 MR. SCOTT: I don't know. However, I do
8 have staff who are more knowledgeable than I am who
9 will talk to you more a little later today and maybe
10 they will be able to provide you more perspective.
11 As I said, we developed action plans for
12 the major technical sub-issues. For any of you who
13 were at the May meeting, then you are aware that we
14 discussed those chemical effects, coatings, downstream
15 effects, and head loss testing plans with NEI and the
16 industry in May. We communicated the plans and the
17 related expectations.
18 The purpose of those meetings, actually we
19 met with NEI and we also met separately one at a time
20 with each strainer vendor, was to focus the industry
21 and the NRC on the additional work needed to resolve
22 the GSI. Also another point that we came up with was
23 to include plans for review guidance which you all
24 recommended to us in your last letter.
25 As the staff reviews the topical reports,

1 two are in and one more to come, NRC sponsored
2 research reports, as you heard yesterday, research is
3 busy writing their NUREGs and getting them approved.
4 We'll be looking at them over the next several months
5 and determining how best to use those research
6 results.
7 We'll also have the generic letter and the
8 REI response submittals that will start to come in
9 towards the end of this year. Those results will
10 provide us the information we need to determine
11 whether changes to our plans are needed.
12 As I mentioned to you yesterday, we can't
13 say with security that the information the licensees
14 is going to provide us is going to fully address GSI-
15 101. Once we have the information you see on the
16 slide available, we will better be able to determine
17 if a course change is needed.
18 Enhanced sump installation, as we have
19 said several times, that remains the top near-term NRC
20 priority. We are confident that will substantially
21 reduce the risk posed by this issue. Changes
22 generally involve much larger strainers also in
23 concert with other things that you see here. There is
24 discussion among the industry regarding changes in
25 containment, pH buffers based on the research results

1 that have been appearing and that you all were briefed
2 on yesterday, as well as the ongoing work that the
3 Owners Group is doing to address alternate buffers.
4 CHAIRMAN WALLIS: You say will
5 substantially reduce risk of sump clogging. Do you
6 have a measure of that risk and how much it has to be
7 reduced by?
8 MR. SCOTT: We do not have a quantitative
9 analysis of the risk. When you take a strainer that
10 previously had 40 square foot of surface area and you
11 raise that 2,400 square feet, then we have an
12 expectation that risk is reduced.
13 CHAIRMAN WALLIS: Well, yeah, but is it
14 reduced enough or what? How do you know it's good
15 enough?
16 MR. SCOTT: We don't. Again, when we get
17 the information, we will then have that information in
18 hand to make a determination as to whether enough has
19 been done and if enough has not been done, then we
20 will determine how best to proceed.
21 CHAIRMAN WALLIS: You better we sure that
22 it doesn't enhance the risk of some downstream
23 effects.
24 MR. SCOTT: We believe that is not the
25 case and, again, we will talk to you about that today.

1 This just shows you --

2 CHAIRMAN WALLIS: The main risk is, of

3 course, to the core and it's not really sump clogging.

4 It's what is the effect of all of this on the

5 effectiveness of long-term core cooling and all the

6 effects that this will have on that.

7 MR. SCOTT: That is correct.

8 CHAIRMAN WALLIS: Thank you.

9 MR. SCOTT: This slide shows the time line

10 for installation of larger sump strainers. As you can

11 see, some plants -- a few of them, actually, had

12 already done it, Davis-Besse, for example, and Diablo

13 Canyon. Several are doing it this spring. Many are

14 doing it this fall and then the remainder -- most of

15 the remainder over spring and fall of 2007. The

16 spring 2008 plants are associated with the extensions

17 that I talked to you about a few minutes ago. As you

18 can see, the industry is proceeding on this and moving

19 forward.

20 CHAIRMAN WALLIS: So that means that 33 we

21 finished this year and they will give their responses

22 to the letter by December?

23 MR. SCOTT: That is correct, 33.

24 CHAIRMAN WALLIS: About half of them will

25 be done this year.

1 MR. SCOTT: Close to half, yes. As I
2 said, industry is moving forward to reduce the risk of
3 sump clogging and to develop their licensing bases for
4 the new configurations they are going to install. The
5 path forward to issue resolution is consistent with
6 the NRC developed action plans that we are going to
7 talk to you all about today.
8 The NRC approach remains that the issues
9 have been identified to the industry and the industry
10 needs to show resolution in accordance with the
11 schedule that we've established. As I mentioned to
12 you earlier, as the issue proceeds and the state of
13 knowledge continues to evolve and we determine that is
14 not a path to ultimate success for resolution of the
15 Generic Safety Issue, then we will take additional
16 actions as needed. That concludes my presentation.
17 CHAIRMAN WALLIS: I'm wondering about this
18 knowledge base. You started me thinking a little bit
19 here. The knowledge base has been expanding in the
20 last few years. There have been some surprises. For
21 instance, there was no consideration of the chemical
22 effects. It was considered in certain significant --
23 really significant effects or discovered. We don't
24 have much of a handle on quantifying them.
25 We just know there is a significant effect

1 on the sump conditions being demonstrated. On the
2 business of head loss we have discovered that certain
3 things can happen in the way in which the stuff is put
4 on the screen which make a considerable difference to
5 the pressure drop. These are things that were
6 discovered by research. It seems likely that there
7 might be similar discoveries as the knowledge base
8 evolves.
9 MR. SCOTT: There could well be.
10 CHAIRMAN WALLIS: But you guys are not
11 doing research anymore. Is that right?
12 MR. SCOTT: There is some research that --
13 well, you heard what was happening yesterday.
14 Mostly --
15 CHAIRMAN WALLIS: It's winding up. They
16 are writing reports.
17 MR. SCOTT: Most of it is winding up and
18 the staff has made the decision to require the
19 industry to do the testing necessary to determine --
20 CHAIRMAN WALLIS: Your expectation is that
21 any future surprises or effects which weren't
22 anticipated, let's say, will be discovered by
23 industry, not by the staff.
24 MR. SCOTT: In general the information
25 that remains to be found we believe will be found by

1 this testing. If, however, it comes from another
2 source, then we will adjust the plan accordingly.
3 Again, we have flexibility in how to proceed with
4 this. Any other questions? Okay. Next up is Paul
5 Klein.
6 CHAIRMAN WALLIS: Let's see, this
7 knowledge base. The knowledge base you have
8 established is in the open literature or is available.
9 Isn't it?
10 MR. SCOTT: It will be.
11 CHAIRMAN WALLIS: The testing that's done
12 is not going to be in the open literature. Is that
13 true? How does the public or somebody of interest
14 know the results of the testing done by these vendors?
15 Is that all proprietary?
16 MR. SCOTT: The results of the testing as
17 applicable to a particular plant will need to be
18 submitted to us by that plant.
19 CHAIRMAN WALLIS: But it will be in the
20 public record?
21 MR. SCOTT: It may or may not be. If it's
22 proprietary information, then it might be withheld.
23 PARTICIPANT: It's still available to
24 whoever signs in on proprietary nondisclosure.
25 MR. SCOTT: Correct, but it won't be in

1 public Adams.

2 CHAIRMAN WALLIS: It won't be public.

3 What would be interesting would be to compare the

4 designs and the tests. You've got five different

5 vendors or six. Is it five or six?

6 MR. SCOTT: Five.

7 CHAIRMAN WALLIS: Five each doing

8 different tests with different screens and so on.

9 There must be some commonality in the approaches.

10 MR. SCOTT: Yes.

11 CHAIRMAN WALLIS: It's very interesting to

12 make a comparison and see if the conclusions have been

13 upheld by the comparison between these five different

14 approaches. You will presume to be doing that.

15 MR. SCOTT: You'll hear a little bit more

16 about that kind of thing from Shanlai Lu.

17 CHAIRMAN WALLIS: I'm just wondering how

18 much of that will be available rather than being sort

19 of proprietary and protected?

20 MR. SCOTT: Shanlai, do you have any

21 answer to give to that? I don't know at this point

22 because we certainly don't have those --

23 CHAIRMAN WALLIS: Would it be a NUREG or

24 something that looks at these?

25 MR. SCOTT: We'll have closeout packages

1 for the Generic Letter.

2 CHAIRMAN WALLIS: We'll see that perhaps

3 later.

4 DR. LU: We can talk about that later.

5 MEMBER DENNING: I just have one more

6 question for you, Mike, and that is are there any

7 specific plants or categories of plants that just

8 really don't have enough space to give as much

9 additional size to the screens as one would like? Are

10 there some obvious potential limiting plants?

11 MR. SCOTT: There are two plants currently

12 that are considering active strainers and one could

13 infer from that that they might have space

14 considerations. The strainers that are being talked

15 about by in large are on the order of a couple of

16 thousand square feet. That's of stuff. Takes up lots

17 of floor space. Any other questions for me? Thank

18 you.

19 CHAIRMAN WALLIS: Thank you very much,

20 Mike.

21 MR. KLEIN: Good morning. I'm Paul Klein.

22 Today I would like to provide you an update on status

23 and plans in the chemical effects area.

24 MR. YODER: My name is Matt Yoder and I'll

25 be assisting Mr. Klein this morning.

1 MR. KLEIN: We really have two purposes of
2 the presentation. One is to provide an update of
3 staff and industry activities since the last time we
4 spoke to you in the spring. And also to try and
5 discuss some of the plans moving forward to resolve
6 some of the technical issues related to the chemical
7 effects.
8 In particular I would like to address
9 three different areas today. The first bullet is
10 related to a PWR Owners Group WCAP report that we
11 received, "Evaluation of Post-Accident Chemical
12 Effects in Containment Sump Fluids to Support GSI-
13 191." We received that report. We accepted it for
14 review and the review is in progress at this point.
15 The second area relates to some meetings that have
16 been referred to previously we had with NEI and
17 various vendors.
18 CHAIRMAN WALLIS: This WCAP you're
19 viewing, that is the one that says how to make
20 surrogates. Isn't it? It doesn't say anything about
21 their effect on head loss? Is that right?
22 MR. KLEIN: They have a very small section
23 on filterability in the WCAP.
24 CHAIRMAN WALLIS: There aren't a whole lot
25 of equations and things that say if you have aluminum

1 this is how you calculate the head loss due to gel.

2 MR. KLEIN: That is primarily related more

3 to generation of --

4 CHAIRMAN WALLIS: Generation of the stuff,

5 not its effects.

6 MS. LANE: Excuse me. I'm Ann Lane from

7 Westinghouse. I was the program lead on that WCAP.

8 The intent of the WCAP was to provide input to the

9 individual screen vendors for head loss testing so the

10 filter --

11 CHAIRMAN WALLIS: On how to produce the

12 materials?

13 MS. LANE: Yes.

14 CHAIRMAN WALLIS: Not on the expected

15 defecto.

16 MS. LANE: No. The filterability test

17 which Paul referred to were actually a criteria

18 established to determine if the surrogates were

19 adequate.

20 MR. KLEIN: The third area we will discuss

21 this morning is related to staff visit to observe some

22 of the alternate buffer tests that are being sponsored

23 by the PWR Owners Group. With respect to WCAP-16530,

24 as I mentioned before, we are currently reviewing --

25 at this point the staff has only done a partial review

1 of the documents so I had not planned to discuss many
2 details from that document at this point today,
3 although I will in a few slides address some of the
4 issues that we see that might generate RAIs related to
5 this document.
6 As far as schedule, the target date for
7 draft RAIs is the end of July of '06. We put a target
8 date for an SE in May '07 with the understanding that
9 there may be additional testing that is necessary in
10 order to address some of the staff RAIs.
11 What the staff has done since the last
12 time we spoke to the Committee we developed action
13 plans in a number of the key technical areas including
14 chemical effects. The purpose of the action plan was
15 to try and highlight some of the key technical issues
16 to show important interfaces that exist between NRR
17 research and industry. Also to try and identify a
18 path forward to resolve these issues.
19 We had a three-day meeting in May of those
20 six where we discussed these issues with NEI, the
21 industry, and screen vendors and established paths
22 forward for issue resolution. We also heard from the
23 screen vendors who outlined their approach in the
24 chemical effects area. We have a total of five
25 vendors and their approach varies.

1 Some vendors are further along in how they
2 plan to address chemical effects and others. Staff
3 will be making a number of visits to vendors over the
4 summertime to gain a greater understanding of how they
5 intend to approach chemical effects from the test
6 standpoint.
7 MR. CARUSO: Would it be possible for us
8 to get a copy of this action plan and the path
9 forward?
10 MR. KLEIN: I think the path forward will
11 be described in some of the slides that we'll present
12 this morning. The action plan, I don't know the
13 answer to that. I will discuss that with management.
14 MR. CARUSO: Path forward. Is there a
15 document that is written down that says this is our
16 current path forward?
17 MR. KLEIN: Yes, it's part of a document.
18 MR. CARUSO: Would it be possible to get
19 a copy of that document?
20 MR. KLEIN: I'll discuss that with
21 management. It is a working document. It is
22 certainly not ready to be shared with the Committee at
23 this point.
24 MR. YODER: The document in question is an
25 internal staff document. If you look at the notes

1 from the NEI meeting as well as the slides that we are
2 going to present today, the issues that we're talking
3 about are essentially that action plan. When we are
4 describing the path to resolution, that essentially is
5 the action plan we are referring to.
6 MR. SCOTT: Ralph, just to add a little
7 more to that, the action plans amount to a table or a
8 matrix and you have the gist of those in the
9 discussions that we're doing today.
10 CHAIRMAN WALLIS: I reviewed the visual
11 aids for this meeting that you had in May and it
12 seemed to be words describing approach and plans which
13 sounded okay. My conclusion from it all is the devil
14 is going to be in the details. It's a bit like in
15 1943 saying, "We are going to land troops on the west
16 south of Naples and we are going to sweep the Germans
17 out of Italy." That is a big plan but, as you know,
18 it took a lot of doing and the devil was in the
19 details. I think that may well be the case with this
20 one.
21 MR. KLEIN: I agree with you that will be
22 the case here. As we get to the tail end of this and
23 we start talking about review guidance, I think you
24 will hear it will be an iterative process and we will
25 be learning as we go along and we digest information

1 from a number of sources.

2 MEMBER SHACK: Paul, as I read the WCAP it

3 seems to me the plan is they are going to make up a

4 certain amount of chemical product and argue about how

5 representative that is and they are going to basically

6 add that to their demonstration test. Is that the

7 basic approach that most of the vendors are taking?

8 They are following the WCAP recipe to make a product

9 and then adding it for a head loss test?

10 MR. KLEIN: I think it varies depending on

11 the vendor. Certainly some of them have indicated

12 they will be following the WCAP so we think it will be

13 critical to interact with the Owners Group on the

14 details of how you generate these products and assure

15 ourselves that those really are representative

16 products.

17 Really there's a number of technical

18 facets I think that are involved and this slide tries

19 to hit on the chemical model itself since some of the

20 vendors will be relying on that and it will become an

21 area of focus for the staff. I think we have a few

22 questions, more than a few questions, that will be

23 interaction with the Owners Group on the chemical

24 model.

25 CHAIRMAN WALLIS: How long you do the test

1 for, too. We heard yesterday with some of these
2 chemical effects that they may not show up
3 significantly for several days.
4 MR. KLEIN: That's a good point. The test
5 may depend on the environment that the test is
6 conducted with.
7 MEMBER DENNING: Are you using some of
8 Research's contractors to help you in the technical
9 review of that report in coming up with REIs?
10 MR. KLEIN: Yes, we have a member of the
11 peer review panel that has been contracted to help
12 with the review of the WCAP.
13 MEMBER DENNING: Now, is that the peer
14 review panel we heard about yesterday as opposed to
15 the contractors that have been doing the research on
16 the chemical effects?
17 MR. KLEIN: It's the peer review panel you
18 heard about yesterday from the Office of Research.
19 CHAIRMAN WALLIS: I would think you would
20 use some of the people who have learned from their own
21 research, people we heard from yesterday.
22 MR. KLEIN: We have discussed that as well
23 with Research and it is a point well received. The
24 top three bullets here really identify interactions
25 that the staff will have with various members of

1 industry and licensees. The bottom two things that
2 we'll discuss at the backend of the presentation
3 related to more internal activities trying to
4 coordinate efforts with the Office of Research and
5 then also develop review guidance.
6 CHAIRMAN WALLIS: Are you going to have
7 some sort of acceptance criteria? That's all based on
8 the cooling, isn't it, head loss and so on?
9 MR. KLEIN: I think the overall acceptance
10 criteria will be related to demonstrating that you
11 meet the available NPSH margin so there is a head loss
12 requirement.
13 CHAIRMAN WALLIS: Is it going to be
14 probablistic? How are you going to handle
15 uncertainties? Are you going to look for 95/95 or
16 something? What are you going to do? There are a lot
17 of uncertainties associated with these things.
18 MR. KLEIN: I agree there are a lot of
19 uncertainties. I don't know that we will get that a
20 95/95 solution. The licensees will need to
21 demonstrate to us that whatever design decisions they
22 have made have satisfied the uncertainties associated
23 with chemical effects. Within the review of the WCAP
24 itself I tried to highlight in this slide a few of the
25 key issues to be addressed. You might argue that the

1 first sub-bullet validation of the WCAP chemical model
2 covers everything.
3 We obviously have questions about
4 limitations of separate effect testing. I believe
5 separate effect testing can be informative. It
6 probably has its place along with integrated testing.
7 There are questions as to whether you get synergistic
8 effects when you start to combine different plant
9 containment materials.
10 CHAIRMAN WALLIS: You certainly do.
11 MR. KLEIN: Yes. We will be questioning
12 Westinghouse about their model. I think some of the
13 other items that I've listed here, main areas of
14 discussion will include chemical surrogates, whether
15 the surrogate that you are generating is the
16 appropriate surrogate and then if you can identify the
17 appropriate surrogate, can you assure yourselves in a
18 follow-on head loss test that you have the materials
19 behaving in a similar manner as it would in a plant
20 situation.
21 There will be questions about evaluation
22 of materials that might not be included within the
23 test matrix and the last item, "Test matrix
24 assumptions may include things that were considered
25 but not included within the test matrix."

1 MEMBER SHACK: There are some things that
2 are really strange in the WCAP. If you reduce the
3 amount of aluminum oxy hydroxide you get taking the
4 aluminum off and then the sodium aluminum silicate
5 which you sort of never saw in an integrated test.
6 Eliminate 90 percent of your aluminum hydroxides by
7 taking it off and illuminating. Very strange.
8 MR. KLEIN: One of the areas in the WCAP
9 that the staff will question they have a table that
10 identifies their best guess estimate of precipitates
11 that were formed. I think we have some questions
12 about how those were identified and whether there
13 might be more appropriate techniques to better
14 quantify what precipitated during those tests.
15 This next slide here is related to
16 interactions with strainer vendors. One of the points
17 we made with the vendors at the May meeting is that
18 the staff really needed to get their hands around the
19 strainer vendor approach. We need to understand if
20 they are planning to introduce chemical surrogates how
21 that will be done, how they will assure themselves
22 that they are simulating both chemically and
23 physically the properties of expected chemical
24 product. I would say at this point we have five
25 vendors and a number of them are further ahead than

1 others in their development of chemical effects.

2 CHAIRMAN WALLIS: So the status of things,

3 we heard from Mike that most of these vendors have

4 already tested their strainers but they haven't yet

5 used chemical effects. Is that right? The new aspect

6 is the chemical effects testing?

7 MR. KLEIN: I think it is vendor specific.

8 Some vendors have completed their strainer tests.

9 Others still have a number of tests to be performed.

10 You are correct, the chemical effects part seems to be

11 a part that will be developed after some of these

12 other tests.

13 Another item identified on the slide and

14 one of the questions the staff has is if you don't

15 form a continuous bed or you form a sparse bed, can

16 you claim not to worry about chemical effects as a

17 result of that? One of the things we'll be looking

18 for is some type of demonstration that if you generate

19 chemical effects, will there be any type of bridging

20 over a clean screen or partially covered screen.

21 CHAIRMAN WALLIS: It might be synergistic

22 effects. If you have fibers that somehow slip through

23 the screen and go around the loop, then when they get

24 sticky with some sort of aluminum gel, then they might

25 stick around so it's not just a question of one effect

1 by itself. The things affect each other.

2 MR. KLEIN: I agree.

3 CHAIRMAN WALLIS: That formation in itself

4 may be affected by the chemical effects. What was a

5 sparse bed without chemical effects may not be a

6 sparse bed with chemical effects.

7 MR. KLEIN: I think that is one of the

8 items we are asking licensees to demonstrate to us by

9 testing.

10 CHAIRMAN WALLIS: You're going to think up

11 a lot of questions like that.

12 MR. KLEIN: Unfortunately we have a lot

13 more questions than answers at this point.

14 CHAIRMAN WALLIS: But they are going to

15 give you the answers. If you have too many questions,

16 it will take them too long to do the experiments. You

17 will have to slip your schedule.

18 MR. KLEIN: It's possible that chemical

19 effects may be addressed later than many of the other

20 issues within GSI.

21 CHAIRMAN WALLIS: Addressed after they put

22 the screens in. It seems to be.

23 MR. KLEIN: Yes.

24 CHAIRMAN WALLIS: They are rushing to put

25 half the screens in this year. It may just not be

1 possible to do all the chemical effects testing this
2 year so they will find out afterwards.
3 MR. KLEIN: I think that there are
4 strainers that have been installed already that they
5 have to do the work after the fact to verify that
6 their strainer is adequate.
7 The next two slides try to put in tabular
8 format some of the items we discussed with industry
9 and that we have covered in the past few slides. The
10 intent was to not walk through each one of these with
11 you but to show that there are a number of actions
12 that both the NRC and industry is expected to take to
13 make progress on some of the issues that we have
14 identified in the chemical effects area.
15 I think some of the key things are the
16 chemical model, the use of chemical surrogates,
17 understanding conditions outside of what might have
18 been tested within the number of tests that have been
19 performed thus far.
20 CHAIRMAN WALLIS: To go back to my
21 schedule here, you're not going to have this SE out
22 until May next year, is it?
23 MR. KLEIN: That's the target date at this
24 point.
25 CHAIRMAN WALLIS: And so the method will

1 not be approved by you until then presumably unless
2 they are going to go ahead and use it now because of
3 the schedule they are on.
4 MR. MARTIN: If I could just interject
5 here for a moment. I'm Tom Martin, Director of
6 Division of Safety Systems. Actually, this week I'm
7 also the Associate Director of Engineering and
8 Systems.
9 I am picking up a theme here of some
10 uncomfortableness with regard to our overall approach.
11 Let me just remark that we recognize the situation is
12 an unorthodox situation but if you look at the facts
13 as we understand them now, these plants are operating
14 with screens that are quite marginal. The sizes are
15 on the order of, as Mike mentioned, tens of square
16 feet.
17 There is a huge variety of designs and
18 configurations that really makes large scale testing
19 quite challenging. It would be wonderful if we could
20 design some kind of a large scale test but in reality
21 we would have to do many different configurations in
22 order to make that practical.
23 Also the industry volunteered to proceed
24 with these modifications before sending the RAI
25 responses. Actually before having developed a

1 complete understanding of this issue, we discussed
2 that internally at relatively high levels within the
3 staff and we determined that the most optimum approach
4 to mitigating this situation was to proceed in this
5 direction. I recognize that puts the ACRS in an
6 awkward situation.
7 As we go through this, we are hopeful that
8 the Committee could help us to identify some of these
9 situations. You have been helpful in pushing us in
10 the direction of focusing more on downstream effects,
11 of looking at some of these synergistic effects that
12 have been pointed out.
13 We still are providing feedback to the
14 industry, to Westinghouse, on the WCAP, to the Owners
15 Groups, to the screen vendors because we are going out
16 and witnessing all of these tests so that we are still
17 staying involved as we go through this process. We
18 still have an opportunity to interject ourselves in
19 hopefully key areas so we get an opportunity to make
20 some changes.
21 I recognize that there is a distinct
22 possibility and the industry recognized that there is
23 a distinct possibility that this may turn out to be an
24 iterative approach. However, given the fact that we
25 have these 69 plants operating now with marginal

1 screens, we believe this is in the best interest of
2 everyone to proceed in this direction.
3 Our approach on resolving this issue also
4 is largely deterministic. We are applying a
5 reasonable assurance that the limiting situations are
6 appropriately handled. We are trying to incorporate
7 risk insights whenever possible using that general
8 approach. If there are some other opportunities that
9 the Committee has to point us in the direction where
10 we might be more risk informed, we would also welcome
11 that opportunity.
12 I thank you for your attention.
13 CHAIRMAN WALLIS: That's helpful. You
14 mentioned that ACRS might be in an awkward situation.
15 Actually, it may be an easier situation for us because
16 you are going ahead and there is nothing much we can
17 do to change your force. We just have to wait and see
18 how it works out. We may not have to do anything.
19 We have had our say. We have written some
20 letters. We have encouraged certain kinds of
21 research. We have asked some questions and you have
22 responded and now I feel you are ready to take some
23 action and you are taking it. It may be that this is
24 the time to bow out and see how it works out.
25 MR. MARTIN: If that is your --

1 CHAIRMAN WALLIS: I'm just speculating.

2 MR. MARTIN: That would be your call.

3 However, we do feel it is an opportunity for us to

4 allow the members of the Committee to give us some

5 insight --

6 CHAIRMAN WALLIS: Sure, if we can help.

7 MR. MARTIN: -- as we are going through

8 this direction. We recognize, you know, that there is

9 not a high level of comfort here that when we are done

10 with this that we are going to have as high a level of

11 assurance that we have nailed this issue, so to speak,

12 that it might actually be an iterative type process.

13 Given that, I think --

14 CHAIRMAN WALLIS: That's all right. You

15 are following a plan, though, and you have this

16 process and you realize there may be some things you

17 have to fix along the way that you can't predict

18 everything ahead of time.

19 MEMBER SIEBER: Well, the proof of the

20 pudding will be when all is said and done and the

21 installations are made do they actually satisfy the

22 requirements.

23 MEMBER DENNING: And are those technically

24 defensible requirements. But I think that there is an

25 important issue and that relates to what ACRS is going

1 to have to consider and that is is there any reason
2 that one would say don't go ahead with these until you
3 learn more. Personally I don't think that is the
4 right answer.
5 I mean, right now I think you are on the
6 right course. I think although we have concerns about
7 downstream effects and that type of thing, were I in
8 your position I would do exactly what you're doing
9 right now which is have them proceed expeditiously to
10 increase screen size.
11 MEMBER MAYNARD: I agree with that. I
12 believe that the interest of safety is best served by
13 the current pethidine. It may be frustrating. It may
14 still have some iterative processes to go through but
15 I think that overall it is the responsible thing to
16 do. I also believe that some of these uncertainties,
17 especially with the chemical effects.
18 I'm not sure that the screens are going to
19 ultimately be the solution to that anyway. I believe
20 even the screens themselves, I think the issue is
21 really going to be in removing or changing the
22 chemical effects to where they are not -- I don't
23 think the screen is necessarily the solution. I think
24 they are on a good path here.
25 MEMBER SIEBER: I hope that enough comes

1 out of all the research to be able to say the screens
2 will work or they will not work. That is still a
3 little --
4 CHAIRMAN WALLIS: That's up to industry.
5 MEMBER SIEBER: That's up to the staff
6 really, you know. The industry will say, "Yeah, they
7 work and here's all the things we considered and we
8 made them so big that the next step will be to enlarge
9 containment to fit in a bigger screen."
10 MEMBER DENNING: Since there are more
11 people of the staff here today than there were
12 yesterday, I think one of the messages that at least
13 some of us were trying to convey yesterday is that you
14 reduce the risk of having a major embarrassment at the
15 end of this by continuing to do some focused research.
16 I think there has been very good progress
17 made in this area of chemical effects and I'm more
18 optimistic now that if one continued to do that work,
19 that you'll be in a position to put to bed some of
20 these issues rather than stopping the research now and
21 saying we are far enough along in our understanding.
22 MEMBER KRESS: I would like to second that
23 notion. Particularly on the chemical effects I think
24 the idea would be to find out what level of aluminum
25 it takes in containment to research this depth of

1 function where it takes off on the delta P. I
2 wouldn't do delta P measurements. I would find out
3 where the break point is and then the fix is not have
4 that much aluminum in your containment.
5 I particularly think more research is
6 needed also on the coatings, particularly in two
7 areas. One is I don't think we have a good notion of
8 the particle size generated by the LOCA from these
9 coatings and I don't think we have definitive
10 transport models. I think we should continue the
11 research in those areas.
12 MR. MARTIN: Thank you for your feedback.
13 One comment on the chemical effects issues. There are
14 parallel paths that are being pursued and one of those
15 paths involves the industry looking for alternate
16 buffers. As we become more educated on the impacts of
17 trisodium phosphate and sodium hydroxide as buffering
18 agents, the industry may very proceed to remove those
19 and choose some other buffer at some point. These
20 parallel paths are ongoing and I do believe this is
21 the most -- maybe not the most efficient but it is the
22 most effective path at the moment. Thank you.
23 MEMBER SIEBER: Well, I agree that it's
24 the quickest path. I also agree that I think the
25 predominant effects have been identified and enough

1 testing has been done to demonstrate that those
2 effects are there, chemical effects, downstream
3 effects.
4 There are a couple areas that I think
5 deserve some more attention. Going back to the
6 basics, janam pinchment I think requires a little more
7 attention, how much do you generate in the first
8 place. On the other hand, if the idea is to improve
9 safety as soon as one can practically do so, I think
10 the path is correct.
11 CHAIRMAN WALLIS: There is also the
12 question about what you are going to do about head
13 loss which is the bottom line of this thing. You are
14 going to calculate a head loss and see if it's
15 adequate but small enough that the pump can operate.
16 Is this head loss going to be predicted just from the
17 tests where they throw in a lot of stuff and see what
18 the head loss is on the screen and then extrapolate to
19 the plant? Or is there some way it's going to be
20 interpreted using some sort of theoretical model?
21 If it is, then there needs to be some work
22 on that model. If you are not going to use a model,
23 if the decision has been made just to use purely
24 empirical approaches, then maybe you don't need more
25 research on the model. If you are going to use a

1 model, we have a model we heard about yesterday which
2 is an improved window with the previous and takes
3 account of the facts which were not considered before
4 which have been observed. Is that model going to be
5 left sort of half finished and not properly validated
6 to be looked at some time in the future, or is it
7 going to be used?
8 I don't know if you have made a decision
9 yet if you are going to use models and what kind of
10 models, or is it all going to be empirical, or are you
11 just going to wait and see what industry comes up with
12 and then respond? What have you done about the head
13 loss? What are you going to accept for a prediction
14 of the head loss for these installations?
15 MR. SCOTT: Shanlai, do you want to come
16 up and speak to that?
17 CHAIRMAN WALLIS: Are you going to talk
18 about that later today?
19 MR. SCOTT: Okay. We'll talk about it in
20 his presentation.
21 CHAIRMAN WALLIS: Research that might need
22 to be done which is why I brought it up here. You may
23 need to do more research on the head loss, too.
24 MR. KLEIN: Shall I continue?
25 CHAIRMAN WALLIS: Unless you want us to do

1 some more research.

2 MEMBER SIEBER: If you know where you

3 were.

4 MR. KLEIN: At the risk of going

5 backwards, I did want to make one comment, Dr. Wallis.

6 You had mentioned we wouldn't have an SE out until May

7 of '07. I did want to point out we have had a number

8 of discussions with Westinghouse on their WCAP both

9 prior to when they performed those tests and during

10 public meetings so they do have a number of the stat

11 spots on some of the issues related to that testing.

12 I'll try to cover this relatively quickly

13 here. The only thing probably to point out here is

14 the recognition that there probably will be additional

15 issues that are raised in the chemical effects area

16 and we do expect to continue to learn as we go as we

17 receive more information from tests that are both

18 performed by research and industry and screen vendors.

19 Before we get to the latter two focus

20 areas that talk about internal NRC staff activities,

21 I wanted to give you a brief update on some of the

22 alternate buffer tests that are being performed. For

23 the PWR Owners Group at Fauske & Associates the staff

24 visited that facility in April of 2006. The project

25 involves trying to identify potential replacement

1 buffering agents for sodium hydroxide and trisodium
2 phosphate which reduce the potential for chemical
3 precipitate generation.
4 They are carrying buffers that they are
5 evaluating in addition to benchmarking the sodium
6 hydroxide and TSP. They are looking at sodium
7 tetraborate which is currently in use in all these
8 condenser plants as well as several new buffering
9 candidates. Their approach is a multi-phased
10 investigation.
11 CHAIRMAN WALLIS: The sodium
12 tripolyphosphate is somehow much better than trisodium
13 phosphate?
14 MR. KLEIN: Yes, sir. Tripolyphosphate is
15 different than the orthophosphate such as TSP in that
16 it's less likely to form precipitates.
17 CHAIRMAN WALLIS: It doesn't make calcium
18 phosphates then when you mix it with cal-sil?
19 MR. KLEIN: One of the things that they
20 did as part of these tests on the bottom bullet here,
21 they added either calcium chloride in one case or
22 aluminum nitrate in another case to try and evaluate
23 suspectability to precipitate formation. In the
24 calcium case they added an amount to get about 400 PPM
25 dissolved calcium level. With that addition, of

1 course, with TSP you saw a whole lot of precipitate.
2 With the tripolyphosphate it was a very, very small
3 amount.
4 MEMBER KRESS: TSP was put into the sprays
5 to enhance the movement of iodine?
6 MR. KLEIN: TSP is not injected in the
7 sprays. It's in baskets in the bottom of containers.
8 Yes, the idea is to buffer the containment pool pH to
9 remove iodine.
10 MEMBER KRESS: To enhance the spray
11 effectiveness?
12 MR. KLEIN: I think the goal is to get the
13 pH above a value of 7.
14 MEMBER KRESS: That is to keep the iodine
15 from re-evolving from the sun. It is also to enhance
16 the effectiveness of the spray.
17 MR. KLEIN: Correct.
18 MEMBER KRESS: I don't see on here any
19 evaluation of the new buffers effectiveness in
20 enhancing the spray. I'm sure the pH control will do
21 the thing for the sun for the re-evaluation but I'm
22 not sure it effectively enhances the sprays. Are
23 there any plans to look at that?
24 MR. KLEIN: The staff at the backend of
25 the one-day visit to Fauske we discussed a number of

1 issues with Westinghouse and Fauske. I guess our
2 overall perception is that these were good tests but
3 they seemed to be screening tests which is appropriate
4 when you are looking at new materials. There may need
5 to be additional tests needed in order to develop an
6 appropriate technical basis for a plant to use one of
7 these new buffers.
8 MR. SCOTT: If I might add, clearly if a
9 plant were to come in with an application to change
10 its buffer and it has design or licensing criteria
11 that relate to the functions of that buffer, then they
12 are going to have to show that those criteria continue
13 to be met.
14 MEMBER SIEBER: I think one thing to
15 consider are the plants that were designed in the late
16 1960s and early 1970s did not have hardware provisions
17 for a buffer so the adequacy of spray systems was
18 established without considering that effect. Then
19 those plants were backfit in order to control iodine
20 and to get Part 100 down. If it was adequate with no
21 buffer, it is probably adequate now. I think that is
22 just a secondary benefit that one gets out of a
23 buffered system
24 MEMBER DENNING: But you saw an advantage
25 there because the TID source term. I think alternate

1 source term would not be, you know, less important.
2 I think it's important to be above seven to prevent
3 iodine evolution in the longer term.
4 MEMBER SIEBER: But I would rather
5 physically take steps to reduce iodine if it's
6 practical to do so than to go to an alternate source
7 term where the dose is really still there. We just
8 count for it differently.
9 MEMBER MAYNARD: But, again, I think
10 the --
11 MEMBER SIEBER: Personal preference.
12 MEMBER MAYNARD: I think any change that
13 a plant does make whether it be in hardware, the
14 chemicals, or whatever, they are going to have to
15 address any of that that affects their licensing.
16 MR. KLEIN: The next slide provides, I
17 guess, a staff perspective on buffers. We have
18 learned a good deal of information from the research
19 sponsored tests both at the University of New Mexico
20 and at A&L. Within the TSP environments we observed
21 that you can get significant head loss if you have
22 dissolved calcium levels for that particular loop
23 configuration greater than 25 parts per million.
24 With the sodium hydroxide it appears to be
25 a more complex process. It depends on a number of

1 things including time, temperature, and pH. We did
2 see that with concentrations on the order of 30
3 percent of the ICET 1 value there was significant head
4 loss.
5 Contrast that with what was observed for
6 sodium tetraborate it was tested -- when it was tested
7 at a level that was consistent with ICET 5 there was
8 no increase in head loss. It was only after they
9 added another 50 PPM of dissolved aluminum that the
10 head loss began to take off.
11 Based on those observations and also on
12 some of the precipitation observation we have at
13 Fauske we think there are options for industry
14 depending on their plant specific environment to
15 choose a buffer that may produce less chemical effects
16 than they have in their existing configuration. The
17 staff is encouraging industry to take a hard look at
18 alternate buffers as one of the potential solutions.
19 Given the amount of information from a
20 variety of sources, the question that I'm sure you
21 have for us is where are we headed. I think there are
22 really two key things that we need to do at this
23 point. One, we need to have continued interaction
24 with research but it is important that we -- research
25 has done a lot of good work in the area of chemical

1 effects.

2 I think it is very important that NRR

3 digest that information, that we understand the

4 important parameters. As Robin indicated yesterday,

5 there will be an RIL coming out that will identify

6 remaining technical issues in the area of chemical

7 effect.

8 Based on the information that is available

9 from both that, from what we have learned from vendor

10 visits, licensee audits, and observing industry-

11 sponsored head loss tests, our intent is to provide

12 recommendations for our management around the

13 September time frame on what might be appropriate

14 additional confirmed for research moving forward.

15 Then in conjunction with that another key

16 part is to try and use all the information that we

17 have --

18 CHAIRMAN WALLIS: So if you recommended

19 research -- excuse me -- in September, this would get

20 into the 2007 budget?

21 MR. KLEIN: I think there is some money

22 available in the 2007 budget that we might be able to

23 take advantage of. I'm not sure of the amount but our

24 intent would be to try and do some of that work within

25 the next budget if necessary.

1 With respect to review guidance I think it
2 would use a similar approach as to what I described
3 for recommendations on additional research. We need
4 to try and digest a lot of the information that has
5 been made available. We also need to hear from
6 industry on the results that they are obtaining in
7 some of their own testing. We need to assemble that
8 all and put together review guidance.
9 We understand that it may not be a final
10 product at this point but it certainly is something
11 that needs to be put together to help focus us to
12 ensure consistent reviews moving forward. We do
13 expect to iterate on that guidance over time as we
14 learn new information from various sources.
15 In summary, though, it is important to
16 remember that licensees have the lead and the ultimate
17 responsibility on evaluating their plant specific
18 chemical effects and resolving the outstanding
19 technical issues. Part of what the acceptance
20 criteria would be in the area of chemical effects, of
21 course, is that they would demonstrate that their head
22 loss from all sources including chemical effects is
23 less than the available NPSH for the entire ECCS
24 mission time.
25 It would also need to have a good

1 technical basis that shows that any uncertainty in
2 chemical effects head loss is bounded by their
3 available margins and they would need to evaluate
4 potential chemical effects on downstream components.
5 Our plan is to use confirmed research to independently
6 evaluate those licensee evaluations.
7 CHAIRMAN WALLIS: That would include any
8 sort of heat exchanges, cold spots, and things like
9 that and everything. Downstream is everything the
10 water goes through in the long-term cooling.
11 MR. KLEIN: Downstream would include all
12 the heat exchangers, piping, vessel, etc.
13 That concludes my presentation material.
14 MEMBER DENNING: I have a question. I'm
15 not sure you are the proper recipient of it but the
16 source term that can potentially wind up on the
17 screens has various stages. There is the production
18 of insulation material and then transport down to the
19 sump. Then within the sump there is transport. Then
20 in the near vicinity of the screen there's transport.
21 The industry previously developed an
22 approach for production and transport down to the sump
23 that I think NRR has blessed previously. Is that
24 basically the state of affairs today? That is, as you
25 look at the source term that now can potentially get

1 onto the screen, do you accept what industry had
2 previously proposed as far as the techniques they used
3 to say how much material is produced and then the
4 transport fraction down to the sump and then you are
5 going to take it from the sump on through the screen
6 testing. Is that basically the way it is?
7 MR. KLEIN: I'm going to look for help to
8 address that question. I think with respect to
9 chemical effects, one of the things that we would look
10 for is that the relative arrival time of chemical
11 products will be consistent with how we think they
12 might be generated and transported in a plant
13 condition.
14 In other words, if you have a calcium
15 phosphate that might form immediately, we would expect
16 that to potentially be added with debris relative to
17 one that might be generated over time that might
18 arrive after the debris is formed.
19 DR. LU: Shanlai Lu from SSIB. Overall we
20 consider that SE proved the NEI guidance report. In
21 terms of transport it's still conservative. In terms
22 of the chemical effects and the precipitates, at this
23 point I think it is the assumption that it is 100
24 percent transportable. Therefore, I don't think that
25 is an issue in terms of --

1 MEMBER DENNING: That the chemical
2 products are 100 percent transportable?
3 DR. LU: At this point, yes.
4 MEMBER DENNING: But as far as the amount
5 of fibrous insulation and debris that make it to the
6 sump, you are kind of accepting -- you still consider
7 that conservative.
8 DR. LU: We still consider that
9 conservative, yes.
10 MEMBER DENNING: And I assume that when
11 the applicants make their case, they will take credit
12 for stuff that is retained back along the way.
13 DR. LU: Yes. We take the credit from
14 interceptor test and their own specific test.
15 MEMBER DENNING: Okay.
16 DR. LU: Relating to near-field effect I
17 am going to cover that. It is close to the sump
18 strainer and then we can talk about that.
19 CHAIRMAN WALLIS: So shall we move along
20 to the next subject? The next subject appears to be
21 coatings. Is the next subject coatings?
22 MR. YODER: Correct. My name is Matt
23 Yoder, NRR.
24 CHAIRMAN WALLIS: Do we have a handout?
25 MR. YODER: I believe you have copies.

1 I'm going to address the coatings issues that are
2 still on the table for GSI-191 and the staff's
3 proposed resolution path for those issues. To refresh
4 your memory, the key issues that are still on the
5 table for coatings are the zone of influence and the
6 area immediately around the pipe break where the
7 coatings can be destroyed.
8 The amount of unqualified coatings. These
9 are coatings that were never assumed to be able to
10 survive a DBA. Some testing has been done to try to
11 prove that some percentage of these will remain
12 adhered to the subtract and won't become a debris
13 source. I'll discuss that.
14 Transport of coatings which you heard a
15 little bit about yesterday. Then assessment of the
16 coatings that are assumed to be DBA qualified to
17 ensure that they are still intact. So that's current
18 activities. Regarding the zone of influence, we
19 expect by July 15th to receive two reports from
20 industry groups.
21 CHAIRMAN WALLIS: Wait a minute. I'm
22 trying to stay with these activities. What is the
23 status of predicting what effective coatings is on
24 head loss. Is that something you are satisfied with?
25 MR. YODER: I don't plan on addressing

1 head loss but I think when we talk about transport
2 maybe that would be a better time to discuss the head
3 loss implications.
4 CHAIRMAN WALLIS: I don't think we have a
5 tool for predicting head loss with coatings yet. Do
6 we?
7 MEMBER SIEBER: No.
8 CHAIRMAN WALLIS: Not one that I know of.
9 MEMBER DENNING: Well, I think it's a
10 matter of if the debris is fine debris, then I think
11 one assumes --
12 CHAIRMAN WALLIS: It's ground up very
13 small.
14 MEMBER DENNING: Yes.
15 CHAIRMAN WALLIS: But if it's flakes --
16 MEMBER DENNING: If it's flakes, then it's
17 different.
18 MEMBER SIEBER: Well, I gather the outcome
19 of yesterday's discussion on coatings was it doesn't
20 transport very well.
21 CHAIRMAN WALLIS: That may solve it.
22 MEMBER SIEBER: So you don't need to know
23 too much about it.
24 MR. YODER: We'll get into it in a little
25 more depth in the transport section. The bottom line

1 is if it's particulate, we would expect it to behave
2 like other particulate debris. If it's chips, it's
3 probably not going to get there anyway.
4 CHAIRMAN WALLIS: How big is a particle
5 before it's chip?
6 MR. YODER: The testing that was done for
7 our transport went down to a 64th of an inch so that
8 is pretty fine. We consider that a chip.
9 CHAIRMAN WALLIS: It's still thin compared
10 with its dimensions.
11 MEMBER SIEBER: Right.
12 CHAIRMAN WALLIS: It's still a flake.
13 MEMBER SIEBER: Still a flake.
14 MR. YODER: A that size it's still more
15 the shape of a flake. So for zone of influence we
16 expect to get data by July 15th. As I said, there are
17 two different industry groups that did testing to
18 reduce the size of that zone of influence. I'll talk
19 more about each of these topics as we go on.
20 There has been some testing on the
21 unqualified coating performed by EPRI to try to take
22 credit for some of these coatings remaining on their
23 substraight where the staff position before was that
24 all of these things are going to fail and become a
25 debris source. We are currently reviewing that

1 report.

2 As you heard yesterday, Office of Research

3 is analyzing the transport results. We continue to

4 interact with the industry groups on this issue of

5 assessment of the coatings and what is the proper way

6 to ensure that these coatings that are qualified are

7 going to stay on the wall.

8 CHAIRMAN WALLIS: Maybe we can help you

9 when you come up with a draft position where you are

10 going to say we are going to accept a zone of

11 influence of a certain size for certain kinds of

12 coatings. They are going to accept certain proportion

13 of unqualified coatings being taken off or whatever it

14 is, or within some zone or whatever. We are going to

15 accept certain transport tests as being valid or if

16 you have a velocity less than some certain size. When

17 you come up with a position or draft position on these

18 matters, that is perhaps where we can help you?

19 MR. YODER: I agree. I expect we will do

20 just that, we will form a staff position, X percent of

21 these coatings will fail. This is the size of the

22 ZOI, etc. We would welcome your feedback on those

23 positions.

24 I'll talk in a little more depth about the

25 zone of influence testing. The staff guidance that is

1 currently out called for a spherical zone of influence
2 of 10 L/D. A radius of 10 pipe diameters around that
3 break location, all the coatings within that area
4 would be assumed to fail and fail as fine particulate.
5 What we have seen from some of the testing
6 is that when these things fail within that two-phase
7 jet area it is by erosion and the failing is very fine
8 pigment almost, 10 micron size pigments. That is the
9 assumption. Everything within that zone of influence
10 is very fine. It is going to transport. It is going
11 to play into your debris bed.
12 As I said, two different groups. These
13 are groups that were sponsored by different subsets of
14 plants to perform this kind of testing have taken
15 coupons of these qualified coatings, subjected them to
16 a two-phase jet in an attempt to reduce the size of
17 that ZOI. We'll get those reports July 15th and as we
18 go forward our review will focus on that two-phase
19 jet. Is it realistic of what you would expect from a
20 real pipe break, how were those coupons prepared, the
21 actual coatings that were used, and how did those
22 apply to the coatings that are actually in the plant.
23 Moving forward, we'll provide the staff
24 position to the industry, to NEI, and we would expect
25 that any concerns that we have with this testing would

1 be addressed by licensees when they submit their
2 generic letter supplemental response. If we say do
3 not address the irradiation of the coatings or any
4 other aspect, we would expect that they would possibly
5 perform more testing to address that or find another
6 way to address that concern if they plan on taking
7 credit for reducing the size of the zone of influence.
8 Regarding the unqualified coatings test,
9 and I'll explain these tests a little bit because I
10 know the Committee hasn't perhaps seen this report or
11 hasn't been privy to this, what they did is they went
12 into plants and took actual electrical cabinets, pipe
13 hangers, various equipment out of the plants.
14 These things have been aged, been in the
15 plant, been irradiated, been subjected to normal
16 service. They put these things in an autoclave where
17 they simulated a DBA temperature and pressure history
18 and subjected them to spray. The result was that some
19 percentage of the coatings failed and some remained
20 adhered to the equipment.
21 CHAIRMAN WALLIS: I just looked at it very
22 briefly. It wasn't always consistent, was it? I
23 mean, the difficulty was that you tested some
24 electrical box and some of them behaved one way and
25 some behaved in different ways. What are you going to

1 conclude?

2 MR. YODER: Right. Certain coatings types

3 perform better. Certain pieces of equipment perform

4 better. I envision when we come up with a staff

5 position for this it will be if you can prove that you

6 have coating X we would accept some percentage of it

7 will stay on. If you have coating Y, maybe a lesser

8 percentage will stay on. Maybe we won't give you

9 credit for any of it staying on.

10 As I said, the intended use is to reduce

11 the amount, the percentage that will fail. Also they

12 captured some data about the size of the debris. Once

13 it did fail they were downstream filters. I alluded

14 to yesterday during the research presentation that the

15 debris that was captured downstream was all fine

16 debris. The largest pieces were around 1,000 microns.

17 CHAIRMAN WALLIS: You say this indicates

18 some licensees will use the data, test data.

19 Presumably it would be better if it were in the form

20 of some sort of NEI guidance or something so that they

21 all were using this data in a consistent way.

22 MR. YODER: This report has been put out

23 as essentially a data report.

24 CHAIRMAN WALLIS: It can be interpreted

25 different ways by different licensees.

1 MR. YODER: That's correct. That is why
2 the staff wants to review this thing in advance and
3 provide a position so that licensees when they do use
4 this data in whatever way they want to use it will be
5 aligned with --
6 CHAIRMAN WALLIS: You are not going to ask
7 someone like NEI to synthesize it all into a position.
8 You're going to do it.
9 MR. YODER: Correct. We are going to tell
10 them what we will and will not accept.
11 I heard yesterday from the Office of
12 Research about our coatings transport work. Licensees
13 who plan on crediting lack of transport such as the
14 chips that we saw under representative losses probably
15 will not transport to the surface. Of they do
16 transport to the surface --
17 CHAIRMAN WALLIS: Where do these chips
18 come from? You told us the debris is actually eroded
19 into very small particles. Where do the chips get
20 formed?
21 MR. YODER: Okay. And we'll get there
22 also but I'll go ahead and -- within the zone of
23 influence you are going to have fine particulate,
24 okay? Unqualified coatings outside of that zone of
25 influence they are weaker.

1 CHAIRMAN WALLIS: You assume they all come
2 off?
3 MR. YODER: They will come off and those
4 we've shown like that EPRI test will probably end up
5 in fine particulate. You also have some qualified
6 coatings which are much more rigid, much more robust
7 coating system outside of that zone of influence.
8 Some of those are degraded either because they were
9 misapplied, they have aged in some way. When those
10 fail, we have seen some data and there is one plant
11 that has taken some of those coatings in large chips
12 and run a similar autoclave test and much of them stay
13 in a chip form. Some of these coatings will remain in
14 a chip form.
15 CHAIRMAN WALLIS: Some may even fall off
16 without a LOCA.
17 MR. YODER: Those are the kind of coatings
18 that I'm talking about. The plant that performed this
19 testing actually used some of those coatings that had
20 fallen off the wall, scraped them up, and said, "What
21 is going to happen to these things in the DBA? Are
22 they going to turn into dust or are they going to stay
23 in chips?"
24 CHAIRMAN WALLIS: You didn't assume how
25 much of these coatings come off. Are you going to

1 grade each plant? You've got 10 percent degraded
2 coatings or whatever?
3 MR. YODER: There is another slide in this
4 presentation.
5 CHAIRMAN WALLIS: Another slide that says
6 that?
7
8 MR. YODER: That goes to the assessment of
9 the qualified coatings. As I said, there have been
10 plants recently where we have seen some of these
11 coatings that are supposedly qualified to a standard
12 DBA falling off the walls under normal conditions.
13 Industry has historically performed visual assessments
14 of these coatings. Do a containment walk down and
15 identify areas where you see blisters or cracking and
16 chipping, etc.
17 Staff as a result of these failures where
18 they were performing visual assessment but either
19 something went wrong in their program or they weren't
20 performing the assessment properly or the technique is
21 not good enough to ensure the stuff is going to stay
22 on, we formed a position that the industry either
23 needs to take one of these three options that I've
24 listed out here. They either need to demonstrate, do
25 some test program that visual assessment is adequate

1 to prove these things will stay on. They need to go
2 and perform physical testing, perform some sampling of
3 their coatings with physical tests that can prove that
4 these things are going to withstand --
5 CHAIRMAN WALLIS: In the May meeting the
6 industry was very resistant to the second one.
7 MR. YODER: That's correct.
8 CHAIRMAN WALLIS: You could just have a
9 coating pullover or something that you put on the wall
10 and pull.
11 MEMBER MAYNARD: There are pull tests.
12 CHAIRMAN WALLIS: Pull tests. That would
13 be rather easy to do. What is the problem? You don't
14 like to go into containment?
15 MEMBER SIEBER: It's the result that is
16 the problem.
17 MR. YODER: I won't commend on that.
18 CHAIRMAN WALLIS: What did you say, John?
19 MEMBER SIEBER: It's the result that is
20 the problem.
21 CHAIRMAN WALLIS: They don't like what
22 they find?
23 MEMBER SIEBER: Sometimes.
24 MR. YODER: The feedback we've gotten on
25 that second option, performance and destructive tests,

1 is that it is a destructive test and they don't want
2 to go and rip paint off the wall.
3 CHAIRMAN WALLIS: It's going to be local
4 presumably.
5 MEMBER SIEBER: You still have to repair
6 it.
7 MEMBER MAYNARD: Yeah, you still have to
8 repair it.
9 CHAIRMAN WALLIS: That's part of the test.
10 You pull and you repair right away.
11 MEMBER SIEBER: Well, but when you repair
12 a missing paint chip, you end up doubling up in some
13 spots.
14 CHAIRMAN WALLIS: It might be worse.
15 MEMBER SIEBER: That basically is a non-
16 tested system then and the repair is unqualified.
17 MR. YODER: Correct. Aside from the fact
18 that if you wanted to go back on as a qualified system
19 there's a lot of QA you have to go through and a lot
20 of processes to prove that it is going to be a
21 qualified coating.
22 MEMBER SIEBER: It's got to be compatible
23 with the original coating and sometimes you can't
24 buy --
25 CHAIRMAN WALLIS: If you pull it one place

1 and it comes off, then you would have to pull
2 everywhere to see if it comes off.
3 MR. YODER: I think the other issue is if
4 you performed a random sampling and you found that
5 some percentage failed, where do you stop the
6 sampling. It might expand.
7 CHAIRMAN WALLIS: That might be a good
8 thing for you guys to determine.
9 MR. YODER: This is the position we took.
10 We suggested that they do this. Alternately the third
11 option that we provided is that you assume all the
12 coatings fail and then you consider the transport
13 implications and the head loss implications.
14 CHAIRMAN WALLIS: What size do they fail,
15 too.
16 MR. YODER: That's correct. In order to
17 do that you are going to have to prove that you get
18 chips or you get particles of whatever size. Maybe if
19 some percentages fails as chips, some percentage fails
20 as particles of a very fine nature you have to account
21 for it in your evaluation.
22 MEMBER SIEBER: That is pretty tough
23 because when you really think about it there's a lot
24 of coatings inside containment. I mean, there's tons
25 of stuff.

1 CHAIRMAN WALLIS: It's on the order of
2 100,000 square feet, isn't it?
3 MEMBER SIEBER: Yeah, it's real thin. On
4 the other hand, there's a lot of paint that goes in
5 there.
6 MR. YODER: There is a lot of paint.
7 Another issue is say you have a plant that goes ahead
8 and assumes that all their paint fails. They have
9 another large amount of debris in the sump and in the
10 chemical effects area we have asked that they evaluate
11 the impact that amount of material could have. Is it
12 going to leach out some other chemical constituent
13 that could add to the chemical effects problem? We
14 have asked them to address that concern.
15 MEMBER MAYNARD: This is an area where it
16 is important to be conservative but not overly
17 conservative because the additional work that can be
18 generated you can actually cause additional problems.
19 Also you are working in an area the more people that
20 you send into there to be working, testing, and doing
21 other things, you are picking up radiation exposure.
22 It is important to be conservative but I think we have
23 to be careful we're not overly conservative and that
24 generating a lot more radiation exposure and other
25 problems.

1 MR. YODER: As we move forward with this,
2 I expect licensees to take different approaches. Some
3 will say that all the coatings fail and maybe they
4 have enough margin with their head loss that they can
5 accept that. Others will say that some percentage
6 fails. Others will prove through physical testing
7 that the coatings are still good.
8 CHAIRMAN WALLIS: What are these vendors
9 doing, these vendors that are doing large-scale tests
10 in a flume or something with a full-scale strainer and
11 that throwing debris in and then seeing what happens?
12 Are they throwing in coating debris as well?
13 MR. YODER: They are throwing in coating
14 debris and they are throwing in a tremendous amount of
15 coating debris.
16 CHAIRMAN WALLIS: They are? Okay.
17 MR. YODER: And one of the things that
18 we've asked is for these plants that are throwing in
19 such a large amount of coating debris, they are going
20 to need to address the near-field effect and the other
21 issues, the scaling issues that we have with the flume
22 testing. You will hear more about that when Dr. Lu
23 gives his presentation this afternoon.
24 As I said, we are going to evaluate each
25 plant's response as they come in. We have provided

1 the three options that we expect them to take. We
2 will evaluate them each accordingly. We are going to
3 continue to work with the industry on this, with ASTM,
4 EPRI, Nuclear Utilities Coating Counsel.
5 There is a workshop, an ASTM workshop in
6 July the staff will attend. That is focused on trying
7 to identify the proper way to assess your coatings,
8 perhaps some new assessment techniques that aren't
9 currently used. There's an EPRI/Nuclear Utilities
10 Coating Council workshop in August that focuses on the
11 aging of these coatings.
12 Is this an aging problem, are these
13 coatings nearing the end of their life expectancy, or
14 is this some other phenomena, these coatings that you
15 are seeing failing? Was it just an application error
16 and if they were applied right they would continue to
17 serve their function?
18 The last bullet here, this came out of a
19 workshop, the recent workshop with NEI. An industry
20 group has proposed to try to validate that first
21 option I provided, the visual assessment, to
22 demonstrate that the visual assessment is good enough.
23 What they proposed is to go into a handful of plants,
24 find areas that they deem visually acceptable, and do
25 destructive tests to prove that. We said it was

1 visually acceptable.

2 We said it would survive a LOCA. We did

3 a physical test and that backs up the fact that we

4 said it was visually good. The initial feedback that

5 the staff has given them is, "We'll work with you on

6 this. We'll come observe. It's not going to fly if

7 you go into a pristine containment with good paint and

8 you do this. You are going to have to find some bad

9 paint as well to try to validate this effort. That's

10 in the early stages and the staff will be working with

11 them to --

12 CHAIRMAN WALLIS: Well, if you go into a

13 containment where a small region is shown visually

14 that there's a problem, then you could look and see if

15 the places which you didn't detect visually are okay.

16 That sort of thing is what you're going to do.

17 MR. YODER: Correct. We have asked that,

18 you know, if you find a bad section of paint, we like

19 to start close to that area and work your way away.

20 See how far you really can predict and maybe you come

21 up with a model that says within a radius of however

22 many feet visual is okay and then you apply that

23 conservatively when you do your walk down. Maybe it

24 won't work at all. Maybe we have to fall on the

25 second or third option which is do physical testing or

1 assume these things fail. We'll see and we'll update
2 you.
3 MEMBER SIEBER: So you want to see how
4 much the bad painter was able to paint.
5 MR. YODER: To wrap up, I would just like
6 to reiterate that for all of these areas, these
7 coatings issues, we have identified paths forward. We
8 may not be in total agreement on what the end result
9 will be but I think we have a clear path to work our
10 way out of these problems and industry is on board
11 interacting with us to try to solve these issues. In
12 many of these areas we have test data so I think we
13 are in good shape in the coatings area.
14 MEMBER SIEBER: I have a question.
15 Without discussing any specific licensee, I'm sure
16 that the staff as seen some variability in the quality
17 of coatings from plant to plant. Are there plants
18 that have superior well adhered and intact coatings
19 and are there other plants that have bad coatings
20 where you see a lot of deterioration? If so, what is
21 the proportion?
22 MR. YODER: As I said, one of the industry
23 groups that we're working with is EPRI and NUCC
24 Coatings Aging Task Group. One of the outcomes of
25 that is they performed a survey to try to assess how

1 extensive is the problem. Is this happening
2 everywhere? Is it only at certain plants? One of the
3 things that came out of that is it seems that certain
4 coating systems, primarily inorganic zinc primer with
5 a phenolic epoxy topcoat tend to be the bad actors.
6 The initial thought is that this inorganic
7 zinc primer is difficult to apply. If you apply it
8 too thickly it becomes dry and the top coat won't
9 adhere. It will come off. Too thin or some other
10 problems. Because of the difficulty of the
11 application, the thought is perhaps it's an
12 application issue and that it may be isolated to
13 certain subset of coding systems.
14 Staff is working with that group. We have
15 not fully bought into that yet but it is one possible
16 resolution. We are not convinced that it's not an
17 aging problem. It could be other coatings may also be
18 susceptible to similar --
19 MEMBER SIEBER: It would seem to me then
20 that if there are plants out there that have coatings
21 that are suspect, that the solution would not be to
22 replace the coating but to make the sump pit larger.
23 In that case, do you have the tools to evaluate how
24 large the sump needs to be made just to accommodate
25 the coating issue in the plant that has susceptible

1 coatings?

2 MR. YODER: There are licensees who have
3 susceptible coatings, have bad coatings, have coatings
4 falling off the walls and they have taken the approach
5 that, "Well, we are going to make our sump big enough
6 to deal with it." They will either say it all gets to
7 our strainer and consider the head loss implications
8 and the downstream implications or perform some
9 testing to prove that it will be chips and maybe it
10 all won't get there.

11 MEMBER SIEBER: I think there is some
12 uncertainty involved in those kinds of calculations
13 that you need to pay attention to. That's it.

14 CHAIRMAN WALLIS: Anymore questions or
15 comments from the Committee? Thank you very much.

16 MEMBER SIEBER: Thank you.

17 CHAIRMAN WALLIS: Now, yesterday we met
18 and after we were off the record and discussed whether
19 or not what we heard yesterday should come before the
20 full Committee. I think the Committee should consider
21 carefully whether or not what we are hearing today is
22 something that the full Committee should hear, our
23 colleagues should hear and would actually want to
24 comment on.

25 This path forward rather than the research

1 we heard about yesterday is something that we want to
2 comment on as a Committee and then have a meeting in
3 July about. I'm just throwing that out for you to
4 think about today.
5 We are going to take a break until 10:30.
6 Is there anyone who objects to taking a break until
7 10:30? We'll take a break until 10:30 then.
8 (Whereupon, at 10:10 a.m. off the record
9 until 10:35 a.m.)
10 CHAIRMAN WALLIS: Come back into session.
11 We are going to hear about something you always wanted
12 to hear about, downstream effects.
13 MR. UNIKEWICZ: Good morning. My name is
14 Steven Unikewicz with the Division of Component and
15 Shearing, Component and Testing Branch. This morning
16 we are going to talk about -- what I'm going to talk
17 about is downstream effects, specifically non-vessel.
18 The areas of my topic is really downstream the screen
19 to the inlet vessel into the feedwater nozzle into the
20 vessel. We'll talk about the pump valves and all the
21 other intermediate components.
22 What I'm going to cover is the current
23 status of our evaluation, the challenges remaining,
24 how we plan on going forward, and I'll provide a very
25 short summary of where we are today.

1 Where we are and what the current status
2 is is, as we've talked about for the last year, almost
3 all licensees are using the PWR Owners Group WCAP-
4 16406P which is the Downstream Sump Debris Effects in
5 Support of GSI-191.
6 What this was, this was initially a report
7 given to us for information only last June. What we
8 have done since last June is we did take a preliminary
9 look at that. We provided the WOG and now the PWR
10 Owners Group with roughly 43 comments, if you will,
11 since we did not have that for formal review.
12 Since that time we have spent a
13 considerable amount of time talking with them about
14 our comments and what some of our very general
15 concerns are. Since we didn't have it for specific
16 review, it was meant to be a high-level type
17 discussion and we have had a series of them over the
18 last year, most recently about a month ago.
19 CHAIRMAN WALLIS: Did you find the
20 research useful on downstream effects and valves and
21 that sort of thing?
22 MR. UNIKEWICZ: It was useful in that it
23 confirmed a lot of the things that we had already
24 felt. We had some inclination and we had some good
25 engineering judgment about how the valves would clog

1 and some of the other things. Really that provided I
2 think useful information to us and that provided good
3 confirmation of what as engineers we felt we knew
4 anyway. It provides a solid basis for some of our
5 ongoing evaluations.
6 CHAIRMAN WALLIS: It certainly showed
7 there could be effects.
8 MR. UNIKEWICZ: Absolutely.
9 CHAIRMAN WALLIS: It showed there were
10 effects on the valve coefficient and so on. I don't
11 think it got to the point of predictive tool. Sort of
12 given this stuff you know exactly how to predict what
13 a valve will do. It is up to industry to presume to
14 provide that.
15 MR. UNIKEWICZ: That's correct. By the
16 same token, it did do some very useful things. It
17 confirmed what we had said early on a couple of years
18 ago that there are some effects. In fact, people do
19 need to consider this and, because of that, a number
20 of licensees are, in fact, changing out throttle
21 valves.
22 They are going to different designs. They
23 are doing a lot of different things. I guess on a
24 personal basis some of the research was gratifying in
25 that it confirmed that we had talked about from an

1 engineering basis to people a number of years ago.

2 Because of our conversations with the

3 Westinghouse Owners Group and on initial Rev. 0 they

4 provided us a redline strikeout version. Now, that

5 redline/strike-out data provided us for topical

6 review. We just received it June 5th. A quick read

7 of it says they have addressed some of our comments.

8 They haven't necessarily addressed all of our

9 comments. That report right now is in acceptance

10 review. I'll talk about we plan on going forward with

11 that.

12 The June 5th date and the June 5th

13 submittal, at least from our evaluation, really is a

14 key point going forward because it finally gives us

15 something tangible in-house to speak very openly and

16 honest with the industry about.

17 The challenges I think are the same

18 challenges you've heard all along. Very specific to

19 the downstream evaluations is because of the methods

20 and how utilities stacked up to priorities, a lot of

21 the initial responses to the generic letter were

22 incomplete.

23 A lot of that reason was we believe

24 because they were concentrating very much on I'll call

25 them the upstream effects, the head loss modeling, the

1 transport, a lot of those earlier issues, with the
2 thought that once they get that behind them, the next
3 step would be to address what happens once we get by
4 the screen.
5 For that reason a lot of initial responses
6 were incomplete. As I said, what has happened is
7 since virtually all of the licensees are using this
8 WCAP it does require acceptance and they submitted it
9 for topical review.
10 CHAIRMAN WALLIS: Considering downstream
11 effects because some of the designs that I've seen in
12 the screens have slower holes than they had before.
13 MR. UNIKEWICZ: Yes.
14 CHAIRMAN WALLIS: They even have a
15 supplementary device which is supposed to catch stuff
16 which gets through the holes. They are certainly not
17 -- they certainly have not ignored downstream effects
18 in their screen design.
19 MR. UNIKEWICZ: If I said that, that's
20 what I meant to imply. I think with a resource
21 looking at different engineering solutions you put it
22 on where you feel you need to make the most progress
23 in the lest amount of time and that was really on
24 screen design. Once you deal with the screen design,
25 then we can deal with pumps and valves, instruments,

1 low-flow areas and things of that nature.

2 As I said a little bit earlier, the WCAP

3 will require acceptance and detailed review by staff.

4 It's a relatively voluminous document. There is a lot

5 of information in there. It is going to take some

6 time.

7 CHAIRMAN WALLIS: I guess the detailed

8 review comes before the acceptance. Doesn't it?

9 MR. UNIKEWICZ: Again, this project has

10 been like a lot of others that, yes, in effect we have

11 done a lot of detailed review prior to acceptance

12 review. That is a true statement. It is the nature

13 of this project.

14 MR. SCOTT: But to be clear, the detailed

15 review that ultimately results in our report on our

16 evaluation follows acceptance for that review.

17 MR. UNIKEWICZ: That's correct.

18 CHAIRMAN WALLIS: I guess I have to

19 question what you mean by acceptance. You accept it

20 as being worthy of review.

21 MR. SCOTT: Acceptance means there is

22 enough information the staff can begin to review.

23 CHAIRMAN WALLIS: That doesn't mean that

24 you agree to everything that is in there.

25 MR. UNIKEWICZ: That is correct. I use

1 the term acceptance review in the context of a topical
2 report.
3 CHAIRMAN WALLIS: I was thinking of
4 acceptance in the form of endorsement really.
5 MR. UNIKEWICZ: No, sir. It does not
6 imply endorsement at all. It implies that it has
7 enough information for us to enable to begin our
8 review.
9 CHAIRMAN WALLIS: I see.
10 MR. UNIKEWICZ: A quick read of it and,
11 again, we've only got it a scant week ago, it is not
12 clear that they have addressed all of our comments.
13 I guess that is not terribly unusual. We do expect a
14 lot of continued conversation with them on those
15 details and very specifically to some of them more
16 detailed reviews of how they are dealing with pump
17 rotating dynamics, how they are dealing with some of
18 their wear evaluations.
19 CHAIRMAN WALLIS: How do you pronounce P-
20 W-R-O-G?
21 MR. UNIKEWICZ: We haven't figured that
22 out yet.
23 CHAIRMAN WALLIS: WOG was easy. This is
24 a difficult one.
25 MR. UNIKEWICZ: We'll have to come up with

1 something. People need to recognize that there are a
2 large amount of very plant specific data that are
3 required to apply this WCAP. The WCAP is not a
4 methodology. It is, in effect, a reference document
5 for all intents and purposes.
6 It provides you a lot of good reference
7 material that they gleaned and gathered from a lot of
8 different sources whether it's from the pulp and paper
9 industry, whether it's from the fossil powered
10 industry, from the petro chemical industry.
11 It is not in the methodology and it is not
12 a cookbook to say if I start on page 1 and end up on
13 page 387 I've got an engineered solution to the
14 problem. It is not that. It is a collection of
15 different materials. It is at this point in time a
16 fairly decent copenium of good information.
17 CHAIRMAN WALLIS: Does it contain
18 discussions of the core?
19 MR. UNIKEWICZ: It does but at this point
20 in time the decision in one of our comments was the
21 core is sort of a unique beast and it was decided, and
22 we'll talk about this in the next presentation, to
23 really pull it out of it and let's sort of make this
24 into three pieces. That is everything up to and
25 including the screen itself.

1 Let's deal from a systematic standpoint
2 just downstream to the screen, to the inlet, to the
3 vessel, a very sort of clean, closed system, if you
4 will, to be able to deal with from a parametric
5 standpoint than from a parametric standpoint how do we
6 deal with in-vessel materials.
7 CHAIRMAN WALLIS: There is a different
8 presentation we have on that.
9 MR. UNIKEWICZ: Yes, sir. That is
10 correct. That will be the next one. Because there
11 is, I'll say, a lot of reference material and because
12 of a relatively large document and a lot of
13 information in it, my expectation is that people are
14 going to need to understand how to apply this
15 information and how to apply this reference to their
16 particular evaluations.
17 Like everything else, there is a lot of
18 variance within the plants. There is a lot of very
19 plant-specific data. The concern, and one of the
20 things we talked to the Owners Group about, is we want
21 to ensure that people are not taking information out
22 of context. They are not taking a bit of reference
23 out of context. That is put into the whole scheme of
24 things.
25 I suspect, and it is something that we are

1 continuing to talk with the industry about, is it may
2 be very, very worthwhile to make sure that people are
3 applying this reference material appropriately so
4 additional training may be required.
5 Now, people have had, or licensees have
6 had, draft copies of this since last June. As a
7 result of that some of the things that the WCAP does
8 talk about is determining how you deal with the
9 downstream source term and based upon what that is the
10 evaluation of the components.
11 It is kind of interesting that as a result
12 of going through at least their first cut of looking
13 at the information is that they are going to start to
14 use vendor testing to determine the downstream source
15 term. I believe the reason for that is is using
16 conservative assumptions that we had before they're
17 failing.
18 There are failing pumps, failing valves,
19 failing a lot of other things just because of
20 conservative assumptions both contained in our initial
21 safety evaluation and in some of the parameters that
22 are being used within the WCAP report.
23 CHAIRMAN WALLIS: They are failing these
24 things in a theoretical sense.
25 MR. UNIKEWICZ: Yes, sir. They are

1 meaning that they may fail them because they find that
2 a throttle valve with a 3 mil opening is clogging.
3 CHAIRMAN WALLIS: So you didn't say that
4 in the testing that the vendors are doing they were
5 failing downstream.
6 MR. UNIKEWICZ: No, sir. They are failing
7 along the lines of when they look at where rates of
8 particular stainless steels that they are finding gaps
9 opening up three, four times nominal. When they
10 compared that to the rotor dynamic data, it does not
11 necessarily provide a good operable piece of
12 equipment.
13 MEMBER SIEBER: But there has been some
14 testing. For example, data species pump.
15 MR. UNIKEWICZ: There has been some
16 testing. In fact, the PWR Owners Group has contacted
17 and they have been working through flow serve and flow
18 serve did a pump and they did some testing with a set
19 of materials to look at wear rates again for a
20 particular 410 stainless leaded components.
21 Again, what I talked earlier about, our
22 concern is to make sure there are roughly half a dozen
23 or a dozen different pump manufacturers, a dozen
24 different configurations. Almost every plant operates
25 them a little bit differently. Stage to stage

1 pressures are a little different. How they apply that
2 flow serve data and other data to their particular
3 pump, or even if it is applicable are some of the
4 things that we are talking about.
5 MEMBER SIEBER: Well, some of the
6 important parameters even within a given pump model
7 will vary. For example, water lubrication, does it
8 come from the pump fluid or does it come from some
9 other strain.
10 MR. UNIKEWICZ: Absolutely.
11 MEMBER SIEBER: Seals, bearings.
12 MR. UNIKEWICZ: That is why we already see
13 that one of the recommendations will be made early on
14 was to look at such things as cycle and separators.
15 In fact, as people have looked at them they are
16 saying, "Gosh, we can't survive with this. We need to
17 do a different modification working with the pump
18 measures to come up with a different solution rather
19 than a cycle and separator." A cycle and separator is
20 a great piece of equipment. It has its place and it
21 has its uses.
22 MEMBER SIEBER: Difficult to install.
23 MR. UNIKEWICZ: So they are looking at
24 other options. You are right, it's because of bearing
25 cooling. It's because of other reasons, bits and

1 pieces and parts specific to pump design.

2 MEMBER SIEBER: I guess my question is is

3 there enough detail in the WCAP to allow for a

4 thorough engineering analysis of a given plant to

5 determine whether it is acceptable or not. Secondly,

6 what is the assumed mission time, 30 days?

7 MR. UNIKEWICZ: Let me address both. One

8 is, is there enough information contained within the

9 WCAP? I have a tough time answering that right now

10 really without a detailed review. Part of that is --

11 one of the really nice things about the report is they

12 did a very thorough industry survey where I've now got

13 make and model of LPSI pumps, HPSI pumps, containment

14 spray pumps, anything within the ECCS train.

15 I've got make and model of the various and

16 sundry sizes of throttle valves, all different types

17 of things. Based upon that, a lot of plant specific

18 data will be able to do that. I'm really hesitant to

19 say without giving a detailed review that it's -- I

20 feel right now there are holes in it.

21 Again, I'm kind of reluctant to say more

22 than that without going through because of some of the

23 comments we had and some of our discussions with them

24 it became clear in our discussions that all of a

25 sudden the light bulb went on later on and, "Ah, we

1 understand. We didn't address that fully." There was
2 sort of a recognition that once the light comes on and
3 you understand the problem a little better, the
4 solution is closer.
5 They are closer. Is the report complete?
6 My gut feeling is no. Will there be a final revision?
7 I think the answer to that is yes. Will every plant
8 be able to use parts of it? Yes. Will it be able to
9 use all of it? I doubt it just because of the variety
10 of plants.
11 MEMBER SIEBER: You just got the latest
12 version for your review.
13 MR. UNIKEWICZ: Yes, sir.
14 MEMBER SIEBER: I would be very interested
15 in reviewing it, too, but it is premature for us, I
16 think, to look at it now. When will it be available
17 for us to look at?
18 MR. UNIKEWICZ: I defer to Mr. Scott.
19 MR. SCOTT: I would say you could
20 certainly look at it now. When the time is right for
21 comments is another question but we can --
22 Ralph, did we not give you a copy of that
23 report?
24 MR. UNIKEWICZ: Yes, Ralph got a copy.
25 MR. SCOTT: So you all have it.

1 MEMBER SIEBER: Well, do we have it? We
2 could have it.
3 PARTICIPANT: You will have it.
4 MEMBER SIEBER: Could you make it PDF?
5 CHAIRMAN WALLIS: Could you answer the
6 question that Jack had about mission time?
7 MR. UNIKEWICZ: Oh, sure.
8 MEMBER SIEBER: Thirty days.
9 MR. UNIKEWICZ: The mission time is really
10 very plant specific. We have repair mission and ECCS
11 mission times and from plant to plant that varies. On
12 the next slide that becomes part of the acceptance
13 criteria. There are plants that have longer than 30-
14 day mission times. If a plant has longer than a 30-
15 day mission time, the expectation is the evaluation
16 extends out to that point in time. It depends on a
17 detailed review of their design and license basis.
18 This is truly an ECCS operability review,
19 system flows, process fluids, what are my acceptance
20 criteria. I need to have 3,200 GPM for this period of
21 time. It may very well be time dependent meaning that
22 at a certain period of time, zero to 24 hours my
23 required flow may be 3,000 GPM. However, post 24
24 hours it may be something less. Therefore, if there
25 is leakage in between seals or stages and the plant is

1 not -- the particular piece of equipment is not
2 operating at its peak, that may be okay.
3 It may be okay as long as the pump doesn't
4 self destruct and it performs whatever it is that fits
5 your Chapter 14, Chapter 15 Acts analysis and what is
6 the mission time. It is sort of a round-about say to
7 say is the mission time 30 days. Maybe sometimes it
8 sort of depends depending on the situation.
9 There are modifications ongoing. There
10 are plants that are hard facing internal components.
11 There are plants that are replacing throttle valves.
12 One of the extensions on the review is, in fact, that.
13 They determined that they had very, very tight
14 clearances.
15 Again, I think as a result of our review
16 and confirmation via the research work that they, in
17 fact, would plug the throttle valves in a very
18 considered method looking to make sure that their
19 pressure breakdown within their system, again this
20 being sort of a system question, that the combination
21 of possibly other orfi and valve design that they
22 could solve this problem. Licensees are considering
23 changing orifice material because of worries. They
24 are planned and they are ongoing.
25 Again, it is detailed design, it's

1 detailed design review. A lot of it goes back to some
2 of the things that people are doing is they are
3 looking very closely at process fluid constituents.
4 Based upon their process fluid constituents, that is
5 how they are doing the rest of the evaluation. Again,
6 sort of wavering back and forth.
7 The early plants took a very, very
8 conservative approach. They are making modifications.
9 I think some of the plants later on in life, if you
10 will, are looking back, "Gosh, if I don't have to
11 replace internal HPSI throttle valve based upon good
12 representative test data, then that good test data is
13 something worthwhile to look at."
14 When we talk about vendor trips, and Mike
15 alluded to it earlier, that is one of the things we
16 are going to be looking at over the next couple days
17 at one particular vendor in the active strainer
18 because this does become a very critical piece.
19 How you deal with the pass-through fluid,
20 if you will -- again, I'm going to stay away from the
21 term bypass. It's not bypass fluid, it's a pass-
22 through fluid. Responses to our RAI and our RAI to
23 the industry earlier this year were really how are you
24 going to apply and how are you going to use this WCAP.
25 Tell us very specifically I'm going to use

1 Chapter 6, paragraph 4.35 so that in some cases it was
2 really for us to make sure we focused our reviews on
3 the right things at the right time understanding that
4 people are doing modifications and making evaluations.
5 The unfortunate, unfortunate in some
6 cases, is that those responses were really not going
7 to see probably until at least the end of the year and
8 most probably later than January '07. One concern
9 expressed earlier are we sort of looking and doing
10 design reviews on the backside? Yes, we are.
11 The hope is that if there are challenges
12 and modifications, there are a lot of other
13 operational strategies which other folks within the
14 team can address. There are solutions to the problem
15 and a lot of times they are called engineered
16 solutions and it is a combination of a lot of
17 different things. Will be looking at some of their
18 evaluations on the backside? I think the answer to
19 that is yes. Are we concerned about that? Yes, we
20 are.
21 I would prefer to have somebody up front
22 come and tell us what specific sections. The other
23 thing I'm concerned about is that we are looking at
24 this report in real time. If I can expend my
25 resources on things that the vast majority of

1 licensees are using, that is where I prefer to spend
2 my time right now and spend less time on other ones.
3 MEMBER SIEBER: The most important
4 parameter in my mind is the first bullet on this slide
5 which is the source term.
6 MR. UNIKEWICZ: Yes, sir.
7 MEMBER SIEBER: And you're saying that
8 licensees are using vendor testing to determine the
9 source term?
10 MR. UNIKEWICZ: Many are.
11 MEMBER SIEBER: How are they doing that,
12 you know, because if you use the surrogate as
13 descriptive of the included constituents of the fluid
14 that you are trying to pump around, they may not fully
15 represent what the source term will be.
16 MR. UNIKEWICZ: Herein lies the challenge
17 that I think Shanlai is going to talk about later in
18 the evaluation of people's prototypical testing. That
19 is, why we are spending some time at a number of these
20 vendors to make sure that, in fact, we agree with the
21 test methods, how they are collecting samples, and,
22 more importantly, what they are doing with their
23 samples.
24 I agree because that is the key input
25 parameter, input assumption, if you will, to a lot of

1 our evaluations. They are going to this because,
2 quite frankly, they are failing when they go on the
3 conservative end so the idea --
4 MEMBER SIEBER: I would expect that.
5 MR. UNIKEWICZ: I think a lot of us
6 expected that. They expected it also.
7 MEMBER SIEBER: What kind of bounds are
8 you going to put on the licensee's selection of a
9 source term? Are you going to look for a medium kind
10 of a source term or conservative so that you bound all
11 possible cases?
12 MR. UNIKEWICZ: We have to take it on a
13 case-by-case basis. We are going to have to see how
14 they apply it and assure that the method that they use
15 and the results that they use are conservative and/or
16 realistic.
17 MEMBER SIEBER: I would suggest they
18 should be realistic but I think that you have to apply
19 your same criteria to every licensee.
20 MR. UNIKEWICZ: That is correct.
21 MEMBER SIEBER: Well, okay. Thanks.
22 MR. UNIKEWICZ: How are we moving forward?
23 Well, as I said, we just received a report. We expect
24 to have a lot of interaction with the PWR Owners
25 Group. There is a lot of information. We have a

1 fairly good -- there is an open communication right
2 now. We expect to continue that. I suspect it is
3 going to increase somewhat over the summer.
4 There are some very site-specific issues
5 and there are some responses to additional
6 information. Part of the questions and answers are
7 going to come through ongoing audits which, again,
8 staff is going to talk about later. I suspect that as
9 we ask these questions and do more evaluations on
10 these very site-specific audits, how people are going
11 to apply it and to make sure there is consistency of
12 use I think will become more and more apparent.
13 Once we complete our review and acceptance
14 of the WCAP, what it will do is it will provide a good
15 reference to ensure compliance and operability.
16 Again, going back to making sure it is in compliance
17 with design and license. It's a piece in that whole
18 ECCS evaluation process.
19 We are reviewing modifications and, as I
20 said, we are looking at continuing tests. The biggest
21 test of concern is, again, I believe, and we need to
22 have more conversation, there may be at least one more
23 pump test of what I'll call a representative specific
24 style multi-stage pump. We haven't got quite details
25 on that yet.

1 Should that happen, we are very interested
2 to make sure there are tests set up again going back
3 to we have witnessed these types of tests before in a
4 very specific plant basis before. We are watching the
5 modifications to at least understand why they are
6 doing what they are doing, how they are changing
7 throttle valves if they are, and as they are changing
8 pump internals to make sure they are not affecting
9 operation of the pump, and all those things that go on
10 including proof testing and appropriate in-service
11 testing and those types of things. All of that is
12 ongoing.
13 As I said, the WCAP has been submitted for
14 topical review. There are definitely technical issues
15 that remain. We are not over. We expect a lot of
16 interaction with the industry. Licensees need to
17 address whether it's in their RAI, what are the
18 responses to the generic letter, how they are
19 specifically applying this WCAP to their plant.
20 We are going to continue to work with them
21 and, again, plant specific evaluations are ongoing.
22 Everything will be verified by December 2007, sooner
23 for some plants depending on where they are and how
24 they submit information to us. We are moving forward
25 and I think we are moving forward in a considered

1 manner at this point in time.

2 MR. CARUSO: Did you say you planned to do

3 plant-specific evaluations for every one of the 69

4 plants?

5 MR. UNIKEWICZ: No, sir. What I mean by

6 that is our series of audits that we are doing in

7 general. Part of that is our evaluation of

8 downstream. Now, when they come in we will certainly

9 look at all 69 responses. By looking at the specific

10 evaluation, no, we are not. We are doing that within

11 the context of the plan for issue resolution. We'll

12 talk about plant specific later, but no.

13 MEMBER DENNING: Okay. Any other

14 questions on the external downstream effects? Then

15 we'll move on to fuel.

16 MR. HAFERA: Good morning. I'm Tom Hafera

17 from the NRR staff. I have Walt Jensen with me from

18 Reactor Systems and Bill Krotiuk from the Office of

19 Research. We are going to provide you with an

20 overview of downstream effects related to reactor

21 fuel.

22 The topics I'll go over, I'll give you a

23 current status of what our evaluation efforts are,

24 what challenges we see as remaining, what our path

25 forward is. We will provide some preliminary

1 evaluation results. I must stress the word
2 preliminary there. Then we'll wrap up with a summary.
3 I think I will also try to build on what
4 Steve just presented because WCAP-16406P does provide
5 basic input and there are some sections in that WCAP
6 that provide evaluations for in-vessel. There is a
7 chapter specifically related to reactor internals and
8 fuels.
9 The debris source term and debris
10 ingestion term is certainly important,
11 characterization, depletion co-efficients and there is
12 also an appendix for the acceptance criteria for in-
13 vessel reactors. There are sections in that WCAP that
14 apply and we will use that as a baseline to then go
15 forward.
16 As part of that going forward, the Owners
17 Group is planning to develop a specific guidance for
18 evaluation of the fuel and that will be in the form of
19 an additional WCAP. As I understood, we originally
20 were trying to have them come and present as part of
21 this but they were having their meetings this week to
22 discuss the scope and the path forward for that WCAP.
23 One of the things that we have previously
24 identified with the Owners Group is milestones where
25 the staff will interact. They will make interim steps

1 in development of their WCAP and they will present
2 those interim phases to us so we can review and
3 determine, provide feedback in terms of what we feel
4 should be done with that.
5 I think another thing we just started
6 performing some independent confirmatory analysis as
7 part of our plant audits. That will be covered a
8 little later. We are using two different analysis
9 tools and both are still in development and that is
10 what Mr. Jensen and Mr. Krotiuk will cover a little
11 later. We are doing that in concert as Mr. Krotiuk
12 with the Office of Research.
13 We are going to continue to meet with the
14 Owners Group to identify plant-specific inputs. One
15 of the things we're learning is when you evaluate fuel
16 it's not just a fuel. It's the reactor internals
17 packages, it's different reactor designs. Is it a
18 two-loop plant or a four-loop plant? Is it a B&W
19 plant or CE plant? How many different reactor
20 internals packages are there? You put all these
21 combinations together and you need those inputs to
22 make sure that you are doing at least a bounding
23 evaluation.
24 Challenges. I think Mr. Sieber
25 appropriately picked up on that. Downstream source

1 term. That is without a doubt a large challenge. I
2 will cover that. Another challenge is schedule. We
3 need a timely submittal of the new WCAP if we are
4 going to proceed forward and the Owners Group
5 understands that.
6 The review. At this point in time it is
7 very difficult to say what is our review going to
8 entail since we haven't even seen it or know what it
9 is. We do believe we need to fully develop our
10 confirmatory analysis models. We are progressing with
11 that fairly quickly and I think we are making a lot of
12 progress in that area. And we need, as I mentioned
13 previously, the relevant information that is needed to
14 input for these models has got to be obtained and
15 analyzed.
16 For our path forward, we are going to
17 continue to interact with the Owners Group, discuss
18 the site-specific issues that need to be identified,
19 and responses to RAIs that were previously generated
20 as part of review of the previous WCAP.
21 We are going to continue to perform our
22 confirmatory analysis and develop that as needed. We
23 will interact with the Owners Group, as I mentioned,
24 at interim milestones as they develop their new WCAP.
25 At the end, obviously, we will have to provide a

1 review and acceptance of that new WCAP. That should
2 provide complete.
3 I'll now turn it over to Mr. Jensen.
4 He'll go over our first confirmatory analysis tool
5 RELAP5 that we are using to evaluate downstream
6 effects.
7 MR. JENSEN: Okay. I'm Walt Jensen from
8 the NRR Fuels and Code Review Branch. We picked up
9 existing RELAP5 model and started blocking out the
10 core. This model doesn't have core barrel flow holes
11 or slots modeled but we thought it would be good just
12 to have kind of a first cut of what core blockage will
13 do as far as core cooling.
14 MEMBER KRESS: Are you looking to see if
15 you still meet the Appendix K figures?
16 MR. JENSEN: Well, yes. That is in the
17 back of my mind. Right now this is just to see what
18 will happen.
19 MEMBER KRESS: Just to see.
20 MR. JENSEN: To see if it's going to get
21 hotter. See how much we have to worry about meeting
22 Appendix K. Okay. Dr. Krotiuk is going to talk about
23 more detailed analyses we plan to do with TRACE. We
24 understand the PWR Owners Group also plans to do some
25 generic calculations with their code.

1 MEMBER KRESS: Are you just looking at
2 blockages of the core or are you including the whole
3 circuit with the blockages of the valves and blockages
4 of the screens?
5 MR. HAFERA: Anything outside the vessel,
6 again, was covered by Steve Unikewicz. This is
7 strictly in the vessel.
8 MEMBER KRESS: Yeah, but when we get
9 around to actually seeing what the total effect is,
10 you'll have to include those effects on the flow.
11 MR. JENSEN: Yes, sir. I guess what we
12 want to do is look at one thing at a time first to see
13 what effect each one has. This is what we are doing
14 now with RELAP. Let me move to the next figure. This
15 is what we got and this is a 99.9 percent core
16 blockage. We ran 90 percent core blockage, 99 percent
17 core blockage without heat up. This is a 99.9 percent
18 core blockage which is an area in the bottom of the
19 reactor core like a hole about three inches in
20 diameter. The core remained --
21 MEMBER KRESS: This is one specific
22 channel?
23 MR. JENSEN: No. this is just a whole
24 lumped RELAP model. I think it had six actual nodes
25 going up the core and it modeled the whole core as one

1 dimensional.

2 MEMBER KRESS: One dimensional. So this

3 flow was all spread out over the whole core cross

4 section.

5 MEMBER SIEBER: In the model.

6 MR. JENSEN: In the model it is. This

7 assumes this model, like you said, the flow goes in

8 and immediately spreads.

9 MEMBER KRESS: That's why you will need a

10 TRACE.

11 MR. JENSEN: We would like to look at some

12 more detailed two and three dimensional.

13 So what this did, the flow going into the

14 reactor vessel from the down tunnel, it just matches

15 boiloff. This is the cold leg break and it is assumed

16 that the rest of the ECCS flow just spills right out

17 of the hole. Core flow, about 100 pounds per second,

18 and core bypass flow, which in normal operation was

19 positive, this goes negative and makes a natural

20 circulation.

21 The next slide. What is happening here is

22 that the flow is going up in the core and down in this

23 bypass region between the baffle and the core barrel

24 and then, of course, down in the down tunnel. RELAP5

25 has had kind of a unfortunate history of having

1 extraneous internal circulation patterns, particularly
2 when we model the core up into a lot of segments for
3 AP600. I thought it would be good to do a little hand
4 check.
5 This is a very simple-minded look of the
6 reactor vessel. The core is about 50 percent voided,
7 steam coming up, water. Then it is carried out of the
8 core, flows down to the core bypass region and makes
9 its circulation.
10 Water coming into the reactor vessel is
11 that which is needed to make up the boiloff. The
12 driving force is the fraction. The RELAP predicted a
13 little bit higher than 50 percent. I've seen 50
14 percent in some of the industries. I think that is
15 the fairly accepted number.
16 Then matching the standard delta P with
17 the frictional delta P. Now we have this simple-
18 minded equation that we can use then to back out the
19 core flow. Actually, we have more driving heads than
20 would be in this calculation because six feet of water
21 in the down cone is up above the core but that is not
22 included here.
23 Anyway, as we ran this we then were by
24 hand able to predict about what RELAP was calculating
25 which is a core flow of about 100 pounds per second

1 for this very severe core blockage. That is about
2 twice as what is needed to obtain core cooling which
3 is 50 pounds per second. Based on that, then it would
4 take an even smaller area of about 1.8 inches based on
5 this RELAP model to provide adequate core cooling.
6 Again, this is an old RELAP model and I
7 think core frictional pressure drops have increased
8 with more recent fuel. This was a Babcock and Wilcox
9 plan. They had core barrels and valves. It's able to
10 release steam more readily than a plant with U tube
11 steam generators that have to push the steam around
12 the loops.
13 We need some actual field data. Last week
14 we up to Westinghouse and got a Watts Bar audit and we
15 obtained accurate field pressure drop data and core
16 internals data from Westinghouse from the RELAP and
17 RELAP still showed adequate core cooling for 99.9
18 percent core blockage for a Westinghouse plant. We
19 are still looking at that. I wouldn't want to just
20 assume that number is right but give it a lot of
21 margin.
22 For the Westinghouse case instead of
23 having negative flow going down the core bypass, it
24 started to push the flow up in a positive direction so
25 the core was cooled both from the top and the bottom.

1 Again, we need --

2 MEMBER BONACA: That seems to presume that

3 every channel in the core will have some flow. You

4 are inferring that from a one channel representing the

5 whole core. Secondly, whatever you do to restrict it,

6 you still have some flow-through. My question is some

7 of the channels may not have any flow-through any of

8 the assemblies.

9 MR. JENSEN: This is an open core.

10 MEMBER BONACA: I understand that.

11 MEMBER SIEBER: Boxes.

12 MEMBER BONACA: I know it's open. I know

13 it's not PWR.

14 MR. JENSEN: You have a good question. We

15 hope to investigate that.

16 MEMBER DENNING: I have another question

17 which is basically what you're seeing is you can have

18 a lot of global core blockage and still be able to

19 cool the core. Have you looked at all at debris

20 occurring at good spacers and causing small local

21 blockage around pins because there the capability to

22 remove heat is really limited because there is very

23 little delta P across a blockage that would occur of

24 that type. Do you understand what I'm saying?

25 The little collar of fibrous material

1 around a small section of pin just like an inch or two
2 inches of pin filling a channel and you are not able
3 to cool that local pin. That is not global failure in
4 any sense. Even if you melted that little part of the
5 pin, I'm sure overall it probably arrests that. Have
6 you taken any look at this local effect of fibrous
7 debris bed forming around the pin? I was amazed when
8 I did it and found how little amount of material it
9 takes to cause overeating of the pin.
10 MR. JENSEN: I thought about that, Dr.
11 Denning. If something is blocking the bottom of the
12 spacer grid so the water can flow in from the top, it
13 might be cool.
14 MEMBER DENNING: If you look at just a
15 debris bed around the small section of pin, there is
16 no delta P across it to drive flow through that debris
17 bed. You know, we kind of have the feeling that the
18 water will find its way and cool things but if you
19 look at a little debris bed of fibrous material around
20 a single pin, small collar, small height, you can't
21 remove the heat from that because the delta P is so
22 small across that to drive flow through that little
23 debris bed.
24 MR. JENSEN: You are talking about not
25 just a blockage. You're talking about material

1 actually back behind between the pin.

2 MEMBER DENNING: Essentially filling the

3 channel underneath the grid spacer for some distance.

4 MR. HAFERA: We've had discussions

5 regarding that issue with the Owners Group and we've

6 also had internal discussions on that. Obviously

7 RELAP is not the tool for that. We have had the same

8 question now three times.

9 MEMBER DENNING: It's a simple hand

10 calculation.

11 MR. HAFERA: We've said we are going to

12 use TRACE to analyze local effects and we are going to

13 confirm TRACE with other effects. Yes, we understand

14 that RELAP is not the right tool.

15 MEMBER DENNING: It is a simple hand

16 calculation.

17 MR. HAFERA: Okay. Yes.

18 MEMBER DENNING: It's a question do you

19 form that debris bed or don't you.

20 MR. HAFERA: We've had this discussion

21 with the owners and I know I asked the last time if

22 you could provide us with your hand calculation and

23 the inputs and the assumptions, we would graciously

24 appreciate that so then we could evaluate that. We

25 have turned that over to the Owners Group and they are

1 going to do that. We are also going to independently
2 confirm that but right now we are using that with
3 TRACE for localized effect.
4 MEMBER SIEBER: That is truly a local
5 effect and there will be flow around that blockage.
6 MR. HAFERA: Correct.
7 MEMBER SIEBER: As you said, assemblies
8 are open. Assemblies are not in boxes so there is
9 cross-communication but you are going to have a hot
10 spot and the question becomes will that hot spot lead
11 to a local failure at that point. A local failure is
12 likely to cause an expansion of the tube which makes
13 the situation worse.
14 The question is how widespread is it going
15 to be. If it's low in the core, it doesn't make a lot
16 of difference because the power production low in the
17 core is not that high. You do have a flux profile.
18 If it's in the middle of the core or the upper half of
19 the core, that could be a problem.
20 MEMBER BONACA: It would be up the core,
21 I think, because it would have this cross effect. I
22 think the concern is really --
23 MEMBER DENNING: What I was thinking was
24 a very local effect. Then the question is does that
25 propagate which is unlikely that it is going to --

1 MEMBER BONACA: In many locations so there
2 will be tens of thousands of pins there. Locally you
3 are going to have some blockage.
4 MEMBER SIEBER: I think it's inevitable.
5 If you have a source term that has a sufficient amount
6 of fibers and particles in it to cause that to occur
7 in one place is going to occur in a lot of others,
8 too. Part of that goes into the assumption that you
9 are down to a 10th of a percent of flow or something
10 like that. On the other hand, you are going to have
11 a lot of local spots where you've got some problems.
12 I think that needs to be analyzed.
13 MR. JENSEN: I agree with that. Local hot
14 spots is something we need to look at. I have done
15 calculations. You have an area in the core or length
16 of core that is not getting radio heat transfer out
17 the pin, it's going to get hot. There is no doubt
18 about that.
19 DR. LU: Shanlai Lu from NRR. Let me add
20 a little bit here. In terms of the localized heating
21 and localized hot spot, I think this issue was raised
22 last time during ACRS meeting. In terms of the heat
23 transfer mechanism, we can consider also that
24 basically that self can be a good conductor if you
25 have localized blockage. This is No. 1. Additional,

1 the realistic heat transfer mechanism can be
2 considered.
3 MEMBER DENNING: A little bit. But if you
4 look at axial heat transfer, if you block it up
5 against the spacer grid and go down below there, the
6 actual heat transfer doesn't buy you very much. It is
7 just amazing how little heat transfer you can get
8 axially out of the pin.
9 DR. LU: I agree with you. That is in
10 terms the axial heat conduction. But in terms of
11 redirection, you still have a spacer grid touching the
12 surface of the hot spot there. That can be one way to
13 conduct heat from the surface of the cladding to the
14 fluid.
15 MEMBER DENNING: I think what you find is
16 that you can't get the transfer axial up to the spacer
17 grid because even if you have water above that, it
18 doesn't --
19 DR. LU: Yes.
20 MEMBER DENNING: I agree it can help a
21 little bit.
22 DR. LU: Can help a little bit. In
23 addition, if you have fibers, sparse fibers to build
24 a localized accumulation and not only the fiber comes
25 itself a very fine fiber, then it is very hard to form

1 a very condensed localized accumulation. We are
2 looking into that issue. I think that is a very valid
3 question but I think that is something we can --
4 MEMBER DENNING: I think that you put your
5 finger on an important element of it, and that is with
6 very little pressure gradient there can you really
7 compact the bed the way we see compact beds.
8 DR. LU: That's exactly my point. You may
9 not have the compressed bed. You can see from there
10 your vertical head loss loop. You have very sparse
11 and high-level fraction accumulation of the fiber.
12 MEMBER DENNING: You don't know the true
13 answer.
14 DR. LU: We don't.
15 MEMBER SIEBER: Another thing you have to
16 consider is while this localized blockage occurs, you
17 can get boiling and boiling will have a tendency to
18 clear away the blockage. At least I could picture it
19 that way. I don't think there is any testing that is
20 out there that would prove that.
21 MEMBER BONACA: The bottom line is that
22 still you have this issue. The cross-flow is going to
23 be only effective above a certain elevation. You have
24 to have some space for it. Below that you have all
25 this blockage so you are going to have some localized

1 effects of that measure.

2 MR. JENSEN: Moving on, conclusions from

3 the RELAP analysis. Core cooling can be maintained

4 with a considerable amount of blockage in the bottom.

5 If some plants have small holes or large holes in the

6 core barrel, these should be effective in cooling the

7 core if the bottom of the core is blocked.

8 There are significant circulation patterns

9 within the reactor vessel that may affect debris

10 transport or carrying of debris within the core and

11 perhaps causing problems behind the spacer grids. We

12 are going to back out some loss coefficients for both

13 the RELAP and TRACE, equivalent loss coefficients

14 based on the whole core area.

15 We can use those to compare to tests that

16 industry is doing for pressure drops through beds of

17 debris and can then based on the losses from those

18 tests we are going to say, "Well, our results show

19 that adequate core cooling or not adequate core

20 cooling would be obtained."

21 MEMBER DENNING: Do you have the feeling

22 as to how much fibrous -- with the large area screens,

23 will be get more fibrous material through that or does

24 that not happen? I mean, how much circulation of

25 fibrous material are we expecting with these large

1 screens?

2 MR. HAFERA: Again, you are asking what is

3 the downstream source term.

4 MEMBER DENNING: Yeah.

5 MR. HAFERA: The downstream source term,

6 again, is very complex. It can be related to a number

7 of things. It is not just -- it is the screen whole

8 size. It is the screen configuration. It is the

9 velocity at the screen. It is the differential

10 pressure across the screen. It is the ligament size

11 of the screen. There are many, many complex variables

12 involved in the downstream source term.

13 That is why, again, we have said this, the

14 downstream source term is very critical. The WCAP

15 1646P is very conservative. It used the LANL research

16 on a flat screen penetration. Therefore, it is very

17 conservative in divining what the source term would

18 be. That is why I believe, as Steve mentioned, a lot

19 of plants are not surviving because it's just so

20 conservative.

21 The strainer vendors they are paying

22 attention to downstream effects in their sampling and

23 what have you. Clearly the modern screens are much,

24 much better at trapping debris at the strainer where

25 it belongs and the downstream source terms are going

1 to be much less.

2 Currently the one plant that we have

3 looked at their source term is much less. They cannot

4 -- they don't have enough fiber going through in their

5 source term to create a core concern right now. But

6 that's only one. That is the only one that we have

7 kind of looked at so far.

8 MEMBER DENNING: You probably also want to

9 look carefully at active screens because --

10 MR. HAFERA: Active strainers are the

11 major concern for this issue. This issue goes

12 directly coupled to active strainers and that is where

13 we are going tomorrow.

14 Are you done, Walt?

15 MR. JENSEN: I will move on to the next

16 one here.

17 MR. HAFERA: That's TRACE.

18 MR. JENSEN: Yeah, this is TRACE. What I

19 wanted to say is we at NRR asked the Office of

20 Research to do the TRACE analysis and that is, of

21 course, because we recognize that RELAP has

22 deficiencies being a one-dimensional model and TRACE

23 has the capability for three dimensions. It also will

24 allow us to look at core blockages inside the core and

25 look at the flow distributions inside the core.

1 Just like RELAP we need to have adequate
2 and detailed accurate data on the fuel flows as it
3 says on the flow patterns or in the reactor vessel to
4 be able to input that into TRACE. I would like to
5 pass the microphone then to Dr. Krotiuk.
6 MR. KROTIUK: As Walt mentioned, starting
7 to do the TRACE analysis. What I'm going to be
8 reporting here is primarily just preliminary
9 assessments. They are definitely not completed.
10 What I've done so far is basically I'm using an
11 existing model that we have for a four-loop PWR plant
12 and it includes the reactor core and includes steam
13 generators, all the piping and network and everything.
14 The key thing I'm concentrating on is the
15 core itself. Basically this is the schematic of the
16 core that is modeled in TRACE and it is basically
17 broken up into a number of vertical segments. Then
18 there is within each segment a number of volumes. The
19 core itself is broken up into eight circumferential
20 volumes and then two radial segments, I should say.
21 There is eight here and eight over here and then two
22 segments like this.
23 There is an area outside of the core
24 region itself that is between -- there is an area
25 between the outside of the baffle region that is also

1 modeled. There is a fair amount of detail within the
2 core region itself. As I said, eight radial segments,
3 four rings, and 14 elevations.
4 There is no bypass flow between the inside
5 of the core and the area outside the baffles so that's
6 ignored. Right now there are some plants that may
7 have that. We don't really know. The analysis that
8 I'm doing is assuming -- this is just the first shot
9 through. I mean, we'll look at other things but 80
10 percent doubled-ended cold leg break.
11 Full high flow, high and low pressure
12 injection. The key thing is that the way I have done
13 this analysis we run a steady state and then run out
14 a transient out to the time of recirculation at 1,200
15 seconds at recirculation. Basically I restart the
16 model, block off sections of the core, and then see
17 what the effect is. Let me just show you what we're
18 doing.
19 Run, of course, an unblocked core case
20 just to have a basis. This is starting at an assumed
21 time of recirculation. Then we are running a case
22 whereby we would block 75 percent of the core inlet.
23 That means that all this area is blocked and the only
24 place that would have flow is this section right here.
25 Then we would run a similar thing with 87.5 percent

1 blockage so this is all blocked except for this one
2 segment here. Then 94.8 percent blockage.
3 Everything is blocked except for that one
4 location right there. I have done some preliminary
5 work with that but the key thing is that, as Walt had
6 mentioned, we met with Westinghouse last week and we
7 got some better data in terms of flow resistances and
8 areas and basically a geometrical description of the
9 core itself. Based on that I'm in the process of
10 refining the model for the adjusting core part so that
11 we have a more accurate representation of what is in
12 there.
13 I could say just some preliminary results
14 I would have done previously is that up until the 75
15 percent of the blockage I did not really see any
16 increase or effect on peak clad temperature after
17 recirculation so 75 percent seems to indicate that --
18 or below even if you have a full blockage area that
19 you are not really affecting core temperatures. For
20 the area blockage up to 94.8 percent I did see some
21 increases in local temperature, peak temperature.
22 Again, I don't want to state a number
23 right now until I finish the analysis. The better
24 input, the more correct input into the core model. I
25 have seen some increases in temperature but they are

1 small. You are only talking about 100 degrees
2 fahrenheit or something of that nature. They are not
3 large increases.
4 MEMBER SIEBER: But all of your blockages
5 that you assumed are at the core inlet.
6 MR. KROTIUK: That's correct.
7 MEMBER SIEBER: Do you plan to try any
8 calculations where the blockage is partway up the
9 core?
10 MR. KROTIUK: We have a whole scoping plan
11 set up and that probably will be one of the items but
12 first --
13 PARTICIPANT: The short answer is yes.
14 MR. KROTIUK: Yes.
15 MEMBER SIEBER: Okay. I would be
16 interested in knowing what happens on that one.
17 MR. KROTIUK: But, you know, once we have
18 the model all set up you can vary different things and
19 get the different effects.
20 The one concern that we do have is that we
21 wanted to make sure that the TRACE code itself would
22 be able to correctly calculate, how to say, the flow
23 distribution. Say we are assuming a blockage on part
24 of the inlet. We want to make sure that the TRACE
25 code itself is calculating that flow distribution

1 correctly around for both the axial and the radial and
2 the circumferential flows.
3 We are independently developing a three-
4 dimensional CFD model using fluids. For that model we
5 are just looking at the core itself. We are looking
6 at the various assemblies. We have modeling in each
7 one of the assemblies and then looking at using the
8 TRACE flows as input into this.
9 If the TRACE is calculating a flow into,
10 say, the unblocked portion of the inlet of the core,
11 we will put that as an input into the CFD model and
12 then compare the circulation that we calculate with
13 the CFD with the TRACE code to make sure that we have
14 similar type of results and consistency. That is
15 going and the only thing just as of yesterday we just
16 developed a model but that as of yesterday so we
17 haven't had any results out of that at all yet.
18 MEMBER DENNING: And you're seeing in that
19 blocked area -- I'm sorry, yes. You are seeing the
20 kinds of recirculation patterns that you would expect
21 to see, I assume.
22 MR. KROTIUK: I'm seeing a recirculation
23 pattern. To be honest I haven't looked at it to a
24 large degree so I don't know what the void fraction
25 relationships are, what the distribution is or

1 anything else. I can't answer too much. This is
2 really ongoing work. I mean, it needs more study to
3 make sure that everything is correct. In other words,
4 do a sanity check to make sure that what we are seeing
5 in terms of what the code is calculating makes sense.
6 MEMBER DENNING: As far as cross-flow
7 resistance are there standard algorithms one uses to
8 set up those cross-flow resistances?
9 MR. KROTIUK: That was a very important
10 question that we asked last week when we met with
11 Westinghouse because the original model that I had did
12 not have good values for that cross-flow resistance.
13 last week when we met with Westinghouse we did get
14 their guidelines that they have developed for coming
15 up with the cross-flow resistance, the areas and the
16 resistances. That has to be put into the model yet.
17 MEMBER BONACA: Assume the number of hours
18 into the transient, I guess, to determine the decay
19 heat you have at that point?
20 MR. KROTIUK: Could you repeat the
21 question? I'm sorry.
22 MEMBER BONACA: I said this happens within
23 the recirculation phase.
24 MR. KROTIUK: Right. Correct.Generic
25 Letter responses

1 MEMBER BONACA: Therefore, you assume some
2 number of hours from the LOCA event?
3 MR. KROTIUK: Starting at 1,200 seconds.
4 MEMBER BONACA: 1,200 seconds.
5 MR. KROTIUK: The decay heat recorresponds
6 to that time.
7 MEMBER BONACA: Conservative, I guess.
8 MR. HAFERA: In summary, we are trying to
9 develop some detailed analysis tools and models for
10 evaluation of downstream effects and reactor fuel. We
11 think we are making good progress. We know we still
12 have some ways to go but we also think we have
13 identified plans to get the information that we need
14 and the support that we need to make that happen in a
15 fairly short time frame.
16 We will be engaged in industry activities
17 and we have identified a formal process with the
18 Owners Group to provide feedback on their new WCAP so
19 we will be engaged with them there. We are going to
20 continue to perform confirmatory analysis for the
21 plants that we audit. I'm sure we're going to learn
22 lessons from that and we will apply those lessons as
23 we develop our tools. We stand by our original
24 statement that evaluations by licensees should be
25 complete by December 2007.

1 MEMBER KRESS: Most of their ECCS codes
2 are like RELAP. They are not three dimensional. We
3 ought to use those to calculate the same thing you're
4 calculating.
5 MR. HAFERA: Actually, no. We have made
6 this clear to the Owners Group. The Owners Group, as
7 mentioned by Walt, is doing some generic analyses for
8 downstream effects and blockage in the fuel. We made
9 it clear to them what we would like to do is do
10 independent analysis. We don't want them to do an
11 analysis and then us audit their analysis. We want to
12 do independent. We want to use our own tools. We
13 want to make sure that we get the inputs from them so
14 that our inputs and assumptions are used consistently.
15 At the same time, no. We are not auditing their
16 process. We are doing confirmatory independent.
17 MR. SCOTT: One clarification on that
18 slide that I would like to add. That last bullet
19 says, "Evaluations of licensee submittals are expected
20 to be essentially complete by December '07." We'll
21 expect to have them in house by December '07. Our
22 evaluation will not be fully complete in December '07.
23 That is going to run into '08.
24 MEMBER DENNING: It would be kind of
25 interesting to do something to see where fibers wind

1 up within a core under low-flow rates. I don't know
2 just how one does that or what kind of mock up one
3 could do but it would be kind of interesting to see
4 that. I don't have a good feeling. Certainly one
5 would expect fibers to catch up on stuff.
6 I don't know how they pack and whether the
7 adhesive forces between fibers are sufficient to make
8 them form a fairly tight bed or not. It wouldn't be
9 a very difficult experiment to do in some kind of a
10 simulation. I would certainly be curious to get a
11 better idea as to where these fibers are really
12 winding up as they go through the system.
13 MEMBER BONACA: There has been such an
14 effort in the industry to have debris catchers on the
15 bottom of the assemblies. I would expect that you
16 would have -- that's really where you're going to have
17 it. At least in past experience where you have had a
18 significant amount of debris we found the majority,
19 all of them, at the bottom and they get caught.
20 MEMBER SIEBER: Those are pretty big holes
21 in those things.
22 MR. HAFERA: When we discussed this with
23 the Owners Group and the fuel suppliers, it becomes a
24 lot of variables. There are a lot of variables.
25 While that is a good question, that may be a second or

1 third order or level of concern because if you do
2 analyses and you find out you can complete block
3 something and your fuel can survive, well, then why
4 continue.
5 But the other reality is we have had those
6 discussions and it becomes a question of do you have
7 a hot leg break or a cold leg break. What type of
8 internals package do you have. Do you have a two-loop
9 plant or four-loop plant. Do you have a Westinghouse
10 plant or BMW plant. Do you have Framatome fuel or
11 Westinghouse Fuel.
12 The number of variables gets to be very
13 large. It is one of those things that, yeah, you're
14 right it would be nice to do but from our standpoint
15 we have to tie it back to 10 CFR 50.46 and what we're
16 saying is we are telling the Owners Group, "Prove that
17 you can meet 50.46 long-term cooling criteria." If
18 they are, then it becomes difficult.
19 DR. LU: Tom, let me add a little bit. I
20 think the strainer vendors and the fuel vendors are
21 actually conducting tests to address specifically the
22 question you asked. That is exactly the question we
23 are trying to identify, what is the type of
24 distribution, how that is being formed inside of the
25 fuel channel.

1 If you have a given amount of debris
2 source or debris bypass, fibers come into the vessel
3 and into the core. The details are very commercially
4 sensitive to the design of the fuel filter and the
5 spacer grid itself. I don't think we can comment too
6 much on that but an effort has been made by the
7 industry to address specifically this question, too.
8 MEMBER BONACA: This debris will come in
9 and then get out again through the break. You will
10 flush it through the core and then accumulation in
11 preferred locations and the accumulation will take a
12 number of passes maybe you could imagine. It will be
13 different locations for --
14 DR. LU: You are absolutely right.
15 Actually it may take several circulations for the
16 fiber or particular to settle at a certain spot of the
17 entire loop if we consider the containment to pool,
18 sump screen, heat exchanger and reactor vessel core
19 itself so many circulations to settle.
20 MR. HAFERA: There are differences in
21 modeling removal from the system, i.e., the system
22 being the containment floor, the strainer, the RHR,
23 everything outside the vessel. Then also modeling
24 debris settlement within the vessel. Again, there
25 becomes a number of variables involved. It becomes

1 complex. It is being considered. The current
2 thinking is take a conservative approach and don't
3 assume any settlement. You assume removal from the
4 strainer as the only mechanism that can remove debris
5 from the recirculating fluid. Then if you can survive
6 that, that is conservative.
7 MEMBER DENNING: Well --
8 MR. HAFERA: The other question gets to be
9 anything that's infinitely -- all other debris is
10 considered to be suspended infinitely for time. Then
11 you say take that volume of debris. Now that volume
12 that is infinitely suspended, since in a cold leg
13 break I have to assume that my reactor is a boiling
14 pot and it's 100 percent efficient.
15 Won't I take all my infinitesimally fine
16 debris and I dump it in the bottom of the reactor
17 vessel. Can I survive or not? If I can survive, I
18 can survive. Those are the kind of -- I guess that is
19 the other thing that we have to stress. This is the
20 kind of discussions we've had with the Owners Group in
21 terms of them developing their WCAP.
22 Their thought processes right now is can
23 we do some up front work, evaluate some bounding
24 conditions, evaluate the bounding conditions in terms
25 of debris filtration both not only from the system

1 standpoint but also from the reactor vessel standpoint
2 evaluated from what is the most bounding condition
3 from the reactor internals and the fuel supplier's
4 standpoint and run some cases and see how that turns
5 out. If it turns out that the sensitivity is very
6 low, then you've kind of done a bounding analysis and
7 it becomes difficult to justify doing more sensitive
8 analyses.
9 MEMBER DENNING: Have you looked to see
10 relative to the 99.9 percent blockage that you were
11 talking about early on how big of a debris bed does it
12 take a fiber to give you that if all you have for your
13 height is the downcomer height? Do you know what the
14 answer is to that?
15 MR. JENSEN: It would take a lot. We
16 looked at some of the blockage debris pressure drop
17 data that industry did. This case that we're talking
18 about with the 99 percent blockage, it worked out to
19 be equivalent inlet loss factor into the bottom of the
20 core over 160,000 which is a very large loss factor
21 and then we can compare that with some of the
22 industries, unfortunately very proprietary data, and
23 it will look like there is a lot of capability for a
24 fairly large debris bed down there.
25 MEMBER DENNING: A pretty large debris

1 saying you're saying to give you --

2 MEMBER SIEBER: Tolerated.

3 MEMBER DENNING: That could be tolerated.

4 DR. LU: I'll add just one more thing.

5 Actually with that debris bed and realistically bed

6 formation so sparse and with ECCS flow goes through

7 the core. We really don't think that's possible to

8 have a complete 99.9 percent blockage for even bed

9 like that. The bed will be porus and the water will

10 go through so 99.9 percent is really a bounding

11 calculation.

12 MR. JENSEN: Well, Dr. Shanlai, you work

13 them both out to an equivalent loss factor so whether

14 the core is all the way blocked with a porus bed or

15 whether it's completely blocked by a little hole, as

16 far as RELAP is concerned RELAP doesn't care.

17 MEMBER DENNING: Any other comments? I

18 don't think we do. Okay. Then I think we will

19 adjourn now.

20 MEMBER SIEBER: Recess.

21 MEMBER DENNING: We'll recess now. The

22 question is do we want to make it until 1:00 or until

23 10 of 1:00?

24 MEMBER SIEBER: 1:00. We're already

25 ahead.

1 MEMBER DENNING: Until 1:00.

2 (Whereupon, at 11:53 a.m. off the record

3 for lunch to reconvene at 1:00 p.m.)

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1 A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

2 1:02 p.m.

3 MEMBER DENNING: We are now going to come

4 back into session. Graham will be back at some time

5 but it's not clear exactly when he'll be able to make

6 it back.

7 DR. LU: Okay. I'm going to start.

8 Shanlai Lu from the staff, the Safety Issue Resolution

9 Branch, NRR. I'm going to talk about prototypical

10 head loss testing. That is industry prototypical head

11 loss testing as part of the new strainer design

12 effort.

13 Ever since we issued the SE, I think two

14 months later we had a public meeting with NEI and all

15 the licensees. We told them either they have to

16 develop their plant specific correlation or they have

17 to come up with prototypical head loss testing to

18 justify the head loss across the new strainers. Ever

19 since then they have already started -- the industry

20 has started to have an extensive testing program.

21 What I am going to do is give the Subcommittee's

22 overall status of this program.

23 Since this started I think one half year

24 ago we start to have the observation trips to

25 different vendors. I am going to give you the overall

1 staff review activities. I think in May we had a
2 public meeting with all the strainer vendors and many
3 licensees. We spent almost one and a half days to go
4 through their testing program and identify issues.
5 What I plan to do is give you a snapshot of what we
6 heard from them for one and a half days.
7 MR. SCOTT: Clarification. We spent a
8 half a day with each vendor. The whole thing with
9 vendors ran over a full day.
10 DR. LU: What I plan to do is just give
11 you one slide per vendor and actually each vendor
12 during that meeting gave probably 70 to 80 pages of
13 slides talking about their testing program. With that
14 I also will talk about common technical issues we
15 identified with vendors through our audit and our
16 pilot audits and also the vendors observation trips.
17 At the end I'm going to discuss the path forward.
18 The background. I think this question was
19 asked this morning regarding how they come up with
20 this debris generation and transport term as the input
21 for their strainer testing. I think most of the
22 licensees we interacted with followed the NEI guidance
23 report and the staff SE and used conservative debris
24 generation and transport methodology to predict the
25 total amount of the debris deposited on the surface of

1 the strainer.

2 That is the analysis part of the design.

3 With that input to the strainer testing they assume

4 all the debris arrives out of the strainer or nearby

5 region as the onset of recirculation.

6 MEMBER SHACK: How do they precondition

7 the debris? Shredder, blended?

8 DR. LU: Oh, yes. That is a lot of --

9 yeah, we will talk about that. That is one of the

10 technical issues I'm going to touch on. At a very

11 high level with the assumption of the onset of

12 recirculation, they assume all the debris arrives at

13 the strainer. It is very conservative because all the

14 ocean terms, all the history of the debris generation

15 is considered as -- is not considered as part of

16 analysis so it is very conservative to be assumed it's

17 all here. They are all at the strainer at the

18 beginning of recirculation.

19 MEMBER DENNING: Does it mean in the

20 vicinity of the strainer rather than on the strainer

21 or do different vendors make different assumptions?

22 DR. LU: That's a good question there.

23 After the strainer or nearby region, that means they

24 have a different testing methodology. Either they put

25 the debris right on the strainer surface or they want

1 to integrate at a nearby or near field transport with
2 the head loss into one test.
3 The next step, the overall approach of the
4 industry is they perform the prototypical head loss
5 tests to validate the strainer sizing and net positive
6 suction head. So far we have observed three types of
7 head loss testing. The first one is prototypical head
8 loss testing combined with near field transport. That
9 is the nearby region as they assume the debris arrives
10 at the nearby region.
11 Second, which can be considered as very
12 conservative, is prototypical head loss test without
13 debris settlement upstream. They use some kind of
14 turbulence agitator to try to force the debris flow
15 towards the surface of the strainer. At the end of
16 the testing all the fibers, or most of the fibers end
17 up on the surface of the strainer.
18 The third type of head loss testing we
19 observed was they developed head loss correlations,
20 too, but using plant specific material like mineral
21 oil or BK. They assume very conservative debris
22 distribution across the strainer. Our responses
23 towards this testing effort was conduct the pilot
24 audits and observation trips. With that I'm going to
25 give you a snapshot of what we learned from --

1 MEMBER SHACK: How many tests are in a
2 test program for a given plant?
3 DR. LU: Say it again?
4 MEMBER SHACK: How many tests are in a
5 test program for a given plant?
6 DR. LU: It can be very plant specific
7 depending on their test matrix.
8 MEMBER SHACK: Obviously they have to
9 consider different radios of particulates and fiber.
10 Say it's a cal-sil plant with a fiberglass, is it five
11 tests, 20 tests, 50 tests?
12 DR. LU: In terms of magnitude, the number
13 of magnitude is about five to eight or around 10 or
14 less than 10 because it is very expensive to conduct
15 for the prototypical head loss testing to generate so
16 much debris and then dump into the flume or testing
17 facility.
18 Normally they prefer to use a NUREG CR
19 6224 correlation or their own proprietary correlation
20 to perform the initial scoping analysis to determine
21 the size of the strainer and to use very conservative
22 sizing of methodology and to put that strainer into
23 the test loop and test for the given debris loading.
24 To reduce the number of tests they have to come up
25 with a test matrix to justify why they can reduce the

1 number of tests because that is a lot of money.

2 With that, I will just give one slide

3 about Framatome PCI and Applied Research Lab vendor

4 group. Okay. They are using the PCI sure-flow

5 strainer which is stacked disk of strainer with a

6 perforated plate on the surface and there are gaps in

7 between. This is a reduced scale strainer itself and

8 then the average size is about this large.

9 This vendor group right now is supporting

10 14 units at this point. They only have one test loop

11 that is the rectangular shape of the flume and they

12 use reduced scale of the strainer or surface area to

13 a very small testing section under that middle head

14 loss.

15 MEMBER DENNING: Of course, the hole sizes

16 are not scaled. They are full scale.

17 DR. LU: Yes.

18 MEMBER DENNING: And that one unit is what

19 they are going to use for all 14 of the PWR -- that

20 model is what they are going to use for all 14?

21 DR. LU: No.

22 MEMBER DENNING: No?

23 DR. LU: The shape of the strainer itself

24 because that is a PCI sure-flow strainer is about the

25 same. But the surface area and the gap in between and

1 orientation can be different for different plants.
2 For this one it is horizontally marked. It can be
3 vertically marked. It's very small holes.
4 I think this morning Dr. Wallis mentioned
5 the devil is in the details. I want to point out the
6 approach velocity range is about this much. It is a
7 maximized 0.027 which is about four times less than
8 the testing we have been doing with the vertical test
9 holder and the PNNL. What really matters for the head
10 loss testing what we observed when we went to the ARL
11 and looked at the testing, we observed the testing,
12 the accumulation of the fiber debris becomes very
13 interesting.
14 They never had a condensed bed with this
15 approach. What we saw is very high fraction and
16 sparse. Even see before they dump the particular into
17 the flume we can see the fibers are tangling around
18 and floating on the surface of the strainer surface.
19 It does not condense and does not form a very
20 condensed bed.
21 MR. CARUSO: Is that approached velocity
22 the value in the stream away from the strainer or is
23 that the value that you use when you average the flow
24 over the whole area of the strainer?
25 DR. LU: That is the average flow across

1 the surface of the strainer.

2 MR. CARUSO: So what would the flow be

3 like far away from that thing? What sort of velocity

4 range would be a foot away from it?

5 DR. LU: That can be much higher. That is

6 the reason we raise the issue about a near-field

7 effect. It's just for this vendor. I'm going to

8 touch on that issue here.

9 MR. CARUSO: Okay.

10 DR. LU: I want to talk about this

11 approached velocity. Once you have low approached

12 velocity very sparse and high-water fraction debris

13 bed and after the end of the particulate we saw the

14 particulate was not being captured by that very course

15 debris bed at all and running through all the time.

16 Most of the time it just runs through that strainer

17 and comes back.

18 MEMBER SHACK: So they do a consecutive

19 debris bed construction. They put the fibers in first

20 and then add the --

21 DR. LU: They have this kind of sequencing

22 of the testing as part of the text matrix. I don't

23 want to talk too much because somehow this relates to

24 their testing approach of proprietary. I just want to

25 give you a sense of what is going on.

1 Going back to the question of the time
2 sequence of the debris, if you have very sparse debris
3 bed which has a very low filtration efficiency, the
4 time sequence or time history of the arrival of
5 different debris may or may not be that important for
6 normal debris. It goes back to the chemical effect.
7 You can have precipitates with nanometers in the range
8 of the size of the precipitate coming in. It is very
9 hard for this kind of a sparse debris bed to capture
10 the particulate or the precipitates there.
11 There might be one way out for them if you
12 say I have such a sparse debris bed and I may not have
13 to address the question of how long I need to run the
14 test, for three days or four days or one week. It may
15 not even reach that point. The debris by itself has
16 such high filtration it can capture very small
17 particles.
18 MEMBER DENNING: In this particular test
19 series do they have the chemical debris?
20 DR. LU: They do.
21 MEMBER DENNING: Generated according to
22 the WCAP?
23 DR. LU: Yes. In the Watts Bar audit we
24 observed that they added chemical precipitates into
25 the test loop.

1 MS. LANE: Excuse me. Ann Lane from
2 Westinghouse. I don't believe that this particular
3 vendor is using the method presented in the WCAP for
4 generating the chemical precipitate.
5 DR. LU: Paul may have something to say.
6 MR. KLEIN: I was just going to add a
7 similar note. Paul Klein. The one particular test
8 that you referred to showed why they attempted to
9 simulate chemical effects before any of the WCAP
10 information was available. They just tried to
11 simulate a product based on conversations with various
12 people.
13 MEMBER SHACK: Was it a calcium phosphate
14 type product, an aluminum product?
15 MR. KLEIN: No, it was an aluminum
16 hydroxide and calcium carbonate they added for the one
17 licensee. They tried to simulate chlorine levels that
18 they observed in an ICET 5 environment.
19 MEMBER SIEBER: With these low approach
20 velocities, I would presume that the typical strainer
21 installation would be very large.
22 DR. LU: It is. That is in the range of
23 the screen areas but up to 7,500 square feet.
24 MEMBER SIEBER: Even that seems small to
25 me for that kind of an approach velocity. I mean,

1 there's hardly any velocity at all there.

2 MR. MARTIN: That's actually a face

3 velocity. Isn't it, Shanlai?

4 DR. LU: Yes, surface approach velocity.

5 MR. MARTIN: Face velocity. If you

6 divided the volumetric flow rate by the surface area,

7 I think that is probably what you would get.

8 DR. LU: That's true.

9 MR. MARTIN: Actually, like you said, that

10 velocity is a little higher as you go a little further

11 away from the screen.

12 DR. LU: That is the near-field effect.

13 We are going to talk about that.

14 MEMBER BONACA: Tell me the configuration

15 of that strainer, the size of it.

16 DR. LU: The perforated plate has an

17 average rate of .045 and .095. Here is the disk

18 surface area. In between you have several disks laid

19 out.

20 MEMBER BONACA: You say in between. What

21 is that?

22 DR. LU: Okay. Between the perforated

23 plate has the star shape of the bones.

24 MEMBER BONACA: It seems to have vertical

25 sides to the strainer. They are also hole diameter

1 range? I can't see it there visually.

2 DR. LU: For this particular testing the

3 water is flowing from here towards this strainer.

4 Then the water is being sent into the pump downwards.

5 At the center there is the pipe taking all the water

6 and going downwards.

7 MR. ACHITZL: Is the question just whether

8 there is a series, a set of probably or six stacked on

9 the other side of the disk. The difference -- Achitzl

10 from NRR. Excuse me. There is a set of stacked

11 disks. The thing about the PCI strainer is their

12 claim to fame is that they flow average it so if you

13 are near or further they try and get the flow. Some

14 of the vendors don't but these guys try and distribute

15 the flow evenly across the complete set of disks.

16 MEMBER BONACA: So there is a series of

17 similar --

18 MR. ACHITZL: They have hydraulic

19 complexity inside the suction pipe to get --

20 MEMBER BONACA: From here it seems as if

21 you have these large spaces on the sides. There are

22 layer of filters.

23 MR. ACHITZL: Yes.

24 DR. LU: For the actual strainer it may

25 have much more number of stacked disks there. They

1 can be horizontal and vertically, too. It depends on
2 the plant's configuration there. The gap size between
3 those two disks can be changed, too. It depends on
4 the loading of the debris.
5 So what we have done for this particular
6 vendor we conducted Watts Bar audit and then we had
7 three staff visits and we plan to have future audits,
8 too, on this particular vendor group.
9 MEMBER DENNING: When they take their
10 prototypic source term, do they just divide by the
11 number of proportional areas and assume that
12 everyone --
13 DR. LU: Yes. It depends on the area
14 ratio.
15 MEMBER DENNING: So they use area ratio to
16 determine what their source term ought to be.
17 DR. LU: Yes. This is test section and
18 they calculate how much the total surface area of the
19 test section and then divide it by the total surface
20 area of the entire strainer area. For the given
21 amount of debris just divide that ratio that dump into
22 the flume. We have some issues related to the near-
23 field effect. That is something that I am going to
24 talk about that. At this point I am going to move to
25 the next vendor group, Alion/Enercon.

1 We have a different shape of the strainer,
2 what is called the top-hat strainer. It is a
3 cylindrical shape of strainer. Then they can have two
4 rings or one ring only. What is shown here is the
5 vertically oriented. It can be horizontal or
6 vertical. It depends on the plant configuration. In
7 the deep sump pit they can put a vertical one. For
8 the very shallow water they can use horizontal
9 orientation.
10 This particular group is supporting 15 PWR
11 units at this point. They have very extensive testing
12 program. They have vertical test loop like in Los
13 Alamos and the PNNL test loop. They have vertical
14 chemical loop which can heat water to certain degrees
15 and the temperature can be controlled. They also have
16 a large flume to perform the prototypical head loss
17 testing and large water tank loop. This vendor group
18 has extensive testing facility as part of the program
19 and also the analysis too.
20 MR. CARUSO: Do all the test facilities
21 just recirc the water?
22 DR. LU: Yes.
23 MR. CARUSO: Do any of the test facilities
24 have a setup like what exist in a plant where you have
25 a strainer to catch some of the debris and then a core

1 to catch the rest of the debris so you can see how it
2 gets proportionally distributed between the two sets
3 of strainers?
4 DR. LU: At this point we have not seen
5 that type of configuration to model the entire
6 containment system including the vessel, the --
7 MR. CARUSO: I'm not saying so much the
8 model, the vessel itself, but the core acts like
9 another strainer downstream of the screens. If you
10 put a screen downstream and you put a screen, two
11 serial screens, you are going to see a distribution of
12 the debris which is what's going to occur in the
13 plant.
14 DR. LU: What we did see actually to
15 capture the debris downstream they have some kind of
16 screen.
17 MR. CARUSO: They do?
18 DR. LU: Yeah, for the downstream effect
19 evaluation. It is not intended to model the debris
20 transport or the position inside of the vessel or the
21 heat exchanger. The approach velocity range is also
22 very small. The maximum is four times less than the
23 research test and loop velocity there.
24 The screen size is very similar and the
25 entry range is almost the same. The entire industry

1 is trying to use very small hose with a perforated
2 plate to reduce the downstream source term. NRR
3 visited this particular vendor four times and we plan
4 to have a future audit.
5 MEMBER SIEBER: That particular strainer,
6 again, must be huge in size if you --
7 DR. LU: This one?
8 MEMBER SIEBER: Yeah. If you look at
9 7,500 square feet --
10 DR. LU: They have many of them.
11 MEMBER SIEBER: Okay.
12 DR. LU: They have like 20 or 30 of them
13 each one being three feet or five feet. It depends on
14 the configuration.
15 MEMBER SIEBER: What do you do, put a
16 plate over the top of it to block?
17 DR. LU: Actually they have the manifold
18 to connect all the small modules into a large one.
19 MEMBER SIEBER: Okay.
20 DR. LU: Either horizontally or
21 vertically.
22 MEMBER SHACK: When they do this, when you
23 run the test, you are dumping your debris in, you are
24 filtering it through this, you're capturing the pass-
25 throughs so you have your downstream source. How many

1 times do they recycle this? How long does the test go
2 on? How many recycles do you go through?
3 DR. LU: That is related to -- I think
4 that is a question related to termination criteria and
5 also related to the downstream effect. All the
6 vendors actually right now have the grand central line
7 so downstream all the vendors can grab the samples and
8 measure the concentration of the particulate and the
9 fiber. They all have that one.
10 MEMBER SHACK: So they do a grab sample
11 where they are going to filter downstream.
12 DR. LU: Yes. That's right. Or they just
13 take the sample out and send it to a lab and measure
14 the concentration of the fiber or particulate. That's
15 where they started the downstream effect in source
16 term.
17 MEMBER SHACK: Do you get a
18 characterization of what this looks like, the fibers
19 of such and such a length of distribution?
20 DR. LU: With this approach velocity and
21 with such small holes there, they found that fibers
22 passing through the strainer is very short. It is
23 dependent on the specific plant and dependent on the
24 specific vendor. It is very short.
25 MEMBER SHACK: That is a characterization

1 they do for each plant as part of the test program
2 then?
3 DR. LU: Yes. Some plants can afford to
4 use the very conservative WCAP debris source term for
5 the pass-through as a debris source term. If some
6 plant wants to take the advantage, they can use this
7 data. But how they would use this data whether we
8 buying that one is a question. That is one issue I am
9 going to discuss there.
10 I'll move onto the next vendor, CCI. We
11 have the test facility located in Switzerland close to
12 Zurich. They are supporting about 60 units. They
13 have a very interesting shape of strainer. I took
14 shot once when I went to that test facility. It is
15 what they call the pocket.
16 They have this surface area and this
17 surface all covered with perforated plate. Even at
18 the end there is the complex shape of the surface of
19 the perforated plate. What is happening is the debris
20 accumulation on the surface of the pocket strainer
21 becomes very nonuniform so head loss can be very small
22 if you compare the test results with the correlation
23 calculated based on the uniform debris bed.
24 MR. CARUSO: Then the debris just
25 collapses at the end of the --

1 DR. LU: This is after they drain the
2 water. For very high head loss case they actually
3 have this debris accumulated on all four surfaces.
4 For very low approach velocity case they may not. It
5 can be very nonuniform and the head loss can be small.
6 MR. CARUSO: If you compared the velocity
7 into the pocket to the approach velocity of the
8 surface of the perforated plate, what sort of ratio do
9 you see for something like this?
10 DR. LU: Of course that is just continued.
11 It can be higher.
12 MR. CARUSO: Is it a factor of 10? Is it
13 a factor of 100?
14 DR. LU: Four or five. I don't know the
15 exact number.
16 MR. CARUSO: Four or five.
17 DR. LU: I don't know the exact number.
18 MEMBER DENNING: I don't quite understand
19 on these little kind of mail slots is it really
20 composed of two plates so it can flow into either
21 side?
22 DR. LU: Yes. This wall itself has two
23 surfaces. This surface has a perforated plate. On
24 the other side it has a perforated plate. In the
25 middle is about a quarter inch gap. After the water

1 flows through the perforated plate it goes into the
2 gap in the center of this unit. That is the CCI
3 strainer and actually this strainer is being installed
4 probably for half of the French plants.
5 MR. WHITNEY: This is Leon Whitney, SSIV.
6 If I could be permitted to describe the actual shape
7 of the pocket, it is kind of like if you had a shoe
8 bag and you had a shoe in it. It necks down towards
9 the back there and then there is a plenum and then the
10 plenum allows the water to go down and out that way.
11 Or a nose cone that is not sharp so the gap closes to
12 the edge here is very small and it grows as you go
13 deeper into the pocket.
14 When there is nonuniform a lot of times
15 with very low flow velocities you will see almost no
16 fiber at the top quarter of the pocket. Then these
17 other pieces here would fall down naturally like they
18 do but you might during the test have no fiber or
19 whatever at the very top because it just can't lift
20 because the velocity is just so low.
21 DR. LU: This vendor has three test loops.
22 The vertical test loop is very small scale but they
23 put the pocket vertically and tested the pocket
24 strainer, the hydraulic characteristics there. They
25 have performed almost 2,000 rounds of tests with this

1 small scale test loop.

2 They have large water tank and also multi-
3 functional test loop to perform the prototypical
4 modular strainer head loss testing. The multi-
5 functional test loop was designed to have different
6 temperature and also was intended to have a different
7 chemical precipitates there. We plan to visit them
8 one more time, at least one more time, in July of this
9 year. We visit them last year in July and we also
10 plan to have future audits.

11 That is a snapshot of CCI and another one,
12 GE and CDI. CDI testing facility is in New Jersey and
13 GE/CDI vendor group is supporting 13 units. I cannot
14 show the pictures because the closed meeting we had
15 with them and the proprietary information they did not
16 want to disclose.

17 The test facility they have is a pool, a
18 swimming pool type of testing for loop. Water tank
19 loop, gravity drain testing and downstream effect loop
20 for the fuel. You asked for that particular issue
21 related to where the debris are being deposited, how
22 it is going to form in the bed and actually they had
23 this kind of loop.

24 MEMBER DENNING: In that downstream effect
25 loop what are they actually simulating in there?

1 DR. LU: I cannot talk too much about
2 that. The next time, I think in August, I heard that
3 ACRS is planning to meet with each individual vendor
4 and you can talk with them. I don't think I can
5 comment on that at this point. We have already got
6 two observation trips and we performed one pilot audit
7 and we plan to have future audits, too. One thing I
8 want to mention they have both passive and active
9 strainer design which is unique.
10 MEMBER MAYNARD: Are you talking about for
11 the same plant or they have two options whether you
12 want passive or active?
13 DR. LU: Okay. I think even for the
14 plants using the active strainer, they want to --
15 well, they may want to have a sacrificial passive
16 section of the strainer, too.
17 MR. SCOTT: Shanlai, I think what they
18 told us at the vendor meeting was that they have to
19 have a passive section to catch what the active side
20 choose up so to speak.
21 DR. LU: That's right. The sacrificial
22 section has to be there. Okay. That's all I can say
23 right now. It's all proprietary information. I
24 cannot talk too much about it.
25 AECL. They came in a little bit late in

1 the game but already got the audits from four PWR
2 units. It's passive strainer. They have small tank
3 loop and large water tank loop to perform the
4 prototypical modular head loss testing. We went there
5 last year and we plan to have more staff this year to
6 visit them and future audits there, too.
7 Over all the industry has five vendor
8 groups to perform prototypical head loss testing for
9 the entire PWR fleet. It is extensive effort for them
10 and the total budget we don't know exactly but when we
11 visited each vendor there were dozens of people
12 working on each test to perform one prototypical head
13 loss testing modular testing. It cost a lot of money
14 and needed a lot of manpower there to perform the
15 test.
16 I think last time the ACRS raised the
17 question can the scaled strainer module/section test
18 results be extrapolated to plant conditions? How they
19 scale this module test and extrapolate the head loss
20 data to the plant condition. The vendors' approach is
21 they assume uniform debris loading on the entire
22 array. For each array they assume it is uniform
23 debris loading. Then they scale the debris loading
24 based on the test section area ratio. It is a very
25 simple approach.

1 We have the issues related to their near
2 field transport. For the head loss tests without near
3 field transport, that means they introduce the debris
4 either right on top of the strainer or they dump the
5 debris directly on the surface of the strainer, or use
6 some kind of turbulent activator to force the debris
7 to settle on the surface of the strainer. In that
8 type of test we consider the uniform debris settlement
9 assumption is conservative.
10 MEMBER DENNING: And the reason for that
11 is that you think then those parts that get the lowest
12 amount are going to be free and have little pressure
13 drop? That's why you think that?
14 DR. LU: That is exactly the reason.
15 For the combined head loss and near field
16 transport test, that is something we talked about last
17 time. We consider this particular approach or request
18 more attention from the staff. We estimated that
19 about 20 PWR units plan to take the credit for the
20 near-field effect. The question here is what kind of
21 scaling and testing procedure have been developed to
22 scale the near field transport.
23 At the same time you have the head loss
24 measurement there. For both transport and head loss
25 when you combine those two phenomena together with a

1 simple test loop like a flume, it can be very
2 difficult to justify whether that head loss data
3 measured from that test facility is conservative.
4 Our position is the proper scaling and
5 testing procedures are needed to ensure adequate
6 strainer size and/or sufficient removal of the problem
7 debris.
8 MR. CARUSO: Is the staff going to
9 document this position in some written document at
10 some point?
11 DR. LU: That is part of the plan of the
12 staff review guidance. We are developing this review
13 guidance as part of this effort. We are documenting
14 that.
15 Okay. I am going to hit the common
16 issues. Instead of talking about specific vendors,
17 what are comments to specific vendors, we want to
18 cover the issues identified can be applied to all the
19 vendors. First, of course, the debris surrogate
20 material preparation. I think one of the tests
21 demonstrated that the debris preparation, you talked
22 about it.
23 You asked me this question right at the
24 beginning of my presentation. It affects the pressure
25 drop across the debris bed significantly. What is the

1 proper way to prepare the debris and the fibers
2 becomes very important. You can get effect of two
3 different head loss across the debris bed with
4 different procedures for shredding the NUKON fibers.
5 We communicate with the vendors in the May meeting and
6 I told them this is something that they need to look
7 into that.
8 The scaling of the debris circumferential
9 accumulation. For the strainer design if it has
10 significant amount of debris loading and if the amount
11 of debris is sufficient to jam the disks so the
12 circumferential accumulation becomes significant and
13 dominant in terms of head loss, that needs to be
14 scaled properly.
15 We talked about the debris addition timing
16 sequence. The formation of the debris bed is
17 sensitive to the debris introduction sequence. When
18 did you add the fiber, when did you add the
19 particulate, when did you add the chemical
20 precipitants is very important. The question here is
21 it might be sensitive if you have a very sparse fiber
22 bed.
23 Temperature dependency. All five vendors
24 are conducting head loss testing at room temperature
25 so they scaled back or extrapolated the head loss data

1 to the onset of recirculation contained at room
2 temperature to simply use the proportional viscosity
3 equation.
4 In terms of this particular equation and
5 approach, I think over all we have already asked
6 Research to conduct some test over either Argonne or
7 PNNL. At this point the preliminary test results show
8 that this may not be an issue. We may be able to use
9 this proportional viscosity equation to extrapolate
10 the head loss data and measure at room temperature
11 back to onset of recirculation 180 degree fahrenheit
12 or 200 degree fahrenheit.
13 However, there is a possible temperature
14 dependence. Debris bed structure morphology may
15 subject to change in which maybe you have fibers which
16 are sensitive to the temperature and the elasticity of
17 the fibers are sensitive to the temperature and that
18 can change the compression characteristic. This may
19 be something to cause uncertainty there.
20 For the constant flow the debris bed
21 compression is subject to change if you have a
22 different temperature because of the pressure gradient
23 across the debris bed is going to change for even the
24 same debris bed with the same approach velocity but
25 different temperature because of the delta P changes

1 and the pressure gradient changes across the debris
2 bed.
3 CHAIRMAN WALLIS: The elasticity of the
4 fibers change.
5 DR. LU: Yes. That is the exact reason we
6 raised this issue and why they need to look into this.
7 Another is the bore hole phenomenon or the
8 channeling effect. If they have different pressure
9 gradient and a different temperature and approach
10 velocity, at room temperature if they observe the bore
11 hole phenomenon, that may not be proportionately
12 related to the viscosity if you have the higher
13 temperature. The bore hole phenomenon itself may
14 introduce nominal effect although bore hole phenomenon
15 is good for the strainer because it does reduce the
16 head loss, but how does the vendor to extrapolate the
17 data at room temperature back to higher temperature?
18 CHAIRMAN WALLIS: The bore hole presumably
19 lets through material.
20 DR. LU: Yes.
21 CHAIRMAN WALLIS: A hole.
22 DR. LU: Yes. The entire debris bed
23 actually.
24 Okay. The last common issues I want to
25 touch on is the integrated head loss and downstream

1 bypass testing or the downstream pass-through test.
2 As I mentioned, all five vendors right now have the
3 graph sample downstream of the strainer so they can
4 measure the fiber content or the particular contents.
5 Once they start the pump through the prototypical head
6 loss testing.
7 The question here is what we had to the
8 vendors is what exactly can be done to use the
9 prototypical head loss testing and provide the screen
10 bypass debris concentration data. Can it be done at
11 all? We understand that the head loss test is
12 normally designed to maximize the head loss, maximize
13 the filtration efficiency of the debris bed. The
14 testing objective of the downstream pass-through test
15 or bypass test is to maximize the debris bypass or the
16 pass-through, through the screen. Can these two
17 testing objectives meet?
18 CHAIRMAN WALLIS: If you want to maximize
19 you want to minimize head loss presumably.
20 DR. LU: That's right. That's right.
21 CHAIRMAN WALLIS: The minimum value is
22 zero but you have an infinitely big screen so minimum
23 isn't a very good term. Making it adequate and
24 producing it to the point where it satisfies the
25 suction head may introduce some other effects.

1 DR. LU: That is exactly true.

2 CHAIRMAN WALLIS: But don't use the term

3 maximizing or minimizing.

4 DR. LU: That's right. So that are the

5 issues we raised to the strainer vendors during the

6 May meeting. We told them these are our concerns and

7 they told us they understood and they have not

8 answered how they are going to respond to this.

9 MEMBER MAYNARD: When do they take the

10 graph sample and how often? Is it a continuous graph

11 sample?

12 DR. LU: They cannot take it as

13 continuous. They have to take it as a time interval,

14 every three minutes or every five minutes do the test.

15 MEMBER SHACK: On this one he must do his

16 testing for a range of loads.

17 DR. LU: They did.

18 MEMBER SHACK: His maximum load is a

19 conservative estimate of the total fiber loading but

20 he may well get his maximum pass-through with a much

21 smaller fiber loading which, in fact, may be

22 representative of some of his breaks. I mean, he has

23 to be prepared to handle all breaks.

24 DR. LU: That is exactly true.

25 MEMBER SHACK: He should be sampling that

1 downstream bypass for that whole range of beds and
2 hopefully --
3 CHAIRMAN WALLIS: You might want to risk
4 inform. If you are going to design this thing for the
5 worse possible large break LOCA, it may not be very
6 good for the most likely LOCA. I don't know.
7 DR. LU: On the debris bed filtration,
8 yes. Filtration efficiency, yes. It can be difficult
9 for the industry to come up with answers to address
10 this.
11 CHAIRMAN WALLIS: You may need to make
12 some determinations of acceptance criteria. Look at
13 the spectrum of LOCAs and how much are you going to
14 weigh these various ones in terms of the way in which
15 the screen performs. Go on to give weight too much to
16 the large break LOCA to the detriment of the small
17 break or the other way around perhaps. You've got to
18 have some kind of way of balancing these things.
19 Unless you are assuming it is always going to work
20 perfectly for everything. Maybe that's what you
21 require, it is going to work perfectly for everything.
22 MEMBER SIEBER: I think for a very small
23 break LOCA it's not going to generate that much
24 debris.
25 CHAIRMAN WALLIS: It's less of a problem

1 keeping the core cool.

2 MR. SCOTT: Of course, it doesn't have to

3 work perfectly for everything. It has to work

4 adequately for everything.

5 CHAIRMAN WALLIS: That's what I meant.

6 Adequate is perfect. In NRC parlance adequate is

7 perfect. There is no perfection in NRC, only

8 adequacy.

9 MEMBER MAYNARD: I do think that more

10 thought needs to be put into what is the worse case

11 condition. Is it when the screens are fully loaded or

12 when the screens are very, very lightly loaded? Which

13 one creates the worst effect?

14 CHAIRMAN WALLIS: Biggest problem.

15 MEMBER MAYNARD: Biggest problem. Right.

16 DR. LU: But also with such a low approach

17 velocity for the fibers to pass through the strainer

18 surface, the chance is very low.

19 All right. The path forward. Regarding

20 all those issues that were raised to the industry we

21 have developed RAIs as part of General Letter response

22 to RAIs. We sent to them and we asked for request

23 justifications for taking the credit for near field

24 debris settlement. That is one of the issues.

25 We are developing review guidance to

1 document our positions regarding near-field effect
2 transport and all those common issues, the positions
3 I just talked about. We plan to issue this sometime
4 in the summer. We plan to have more staff observation
5 trips to different vendors.
6 We also plan to conduct plant audits so
7 that we can understand more in detail of the vendor
8 testing program. As part of this General Letter
9 response review we are going to evaluate the
10 supplemental response from the licensee regarding the
11 testing program and according to the SE and any
12 additional review guidance.
13 CHAIRMAN WALLIS: I wasn't here earlier.
14 You are going to develop plant specific head loss
15 correlation? That's what it says on slide 3.
16 DR. LU: Okay.
17 CHAIRMAN WALLIS: Is that true? There is
18 going to be something that is different for every one
19 in terms of correlation?
20 DR. LU: The third type of head loss
21 testing was very unique and we only observed for one
22 plant at this point. No other plant has been relying
23 on the plant specific correlation at all. Most of
24 them will rely on the prototypical head loss testing.
25 CHAIRMAN WALLIS: They are going to do

1 tests and then prototypically develop a correlation
2 which they are going to use for the plant. Is that
3 what their approach is?
4 DR. LU: They are not going to develop
5 correlation. They are going to --
6 CHAIRMAN WALLIS: Plant specific.
7 DR. LU: For this particular plant, yes.
8 You are right. They actually did develop a head loss
9 correlation based on the CRs before.
10 CHAIRMAN WALLIS: Is it just an
11 alternative or is that --
12 MR. ACHITZL: Shanlai, could I just make
13 a comment there? That is GE. There is an approved
14 topical report for that correlation so that vendor was
15 GE. Correct, Shanlai, in the correlation?
16 DR. LU: No, Alion.
17 CHAIRMAN WALLIS: But the other vendors
18 are not developing correlations?
19 MR. ACHITZL: At least GE has the
20 correlation.
21 DR. LU: Let me just comment on this one
22 more time. The head loss correlation approach itself
23 requires extensive testing for a specific plant with
24 a specific material. At this point it is a very small
25 subset of the plants are relying on this head loss

1 correlation to come up with a justification.

2 CHAIRMAN WALLIS: What are the other ones

3 relying one?

4 DR. LU: They are relying on the first two

5 type of tests.

6 CHAIRMAN WALLIS: Do you just take the

7 numbers from the tests without any equations at all?

8 DR. LU: For the prototypical head loss

9 testing that is the way they are doing it.

10 CHAIRMAN WALLIS: So you simply make a

11 plot. You say flow versus --

12 DR. LU: Debris loading.

13 CHAIRMAN WALLIS: Three dimensional thing

14 for different kinds of LOCAs, flow versus pressure

15 drop and here's what you get. Use it in the plant.

16 Don't even ask what it means.

17 DR. LU: Well, okay.

18 CHAIRMAN WALLIS: Is that the approach?

19 DR. LU: I think I actually discussed the

20 overall approach. The vendors are taking it at this

21 point. They just performed conservative analysis and

22 determined the debris loading and the transport to the

23 strainer. They assume it's all right. At the same

24 time at the onset of recirculation and perform the

25 bounding --

1 CHAIRMAN WALLIS: They measure the
2 pressure drop?
3 DR. LU: Yes. They measure the pressure
4 drop.
5 CHAIRMAN WALLIS: That's what they use in
6 the plant, the pressure drop that they measured.
7 DR. LU: That's right.
8 CHAIRMAN WALLIS: Okay.
9 MR. CARUSO: One last question. When I
10 add up the number of plants I come up with 65. Does
11 that mean four plants are not using these vendors?
12 DR. LU: I think there are some plants
13 that are still deciding to use which vendor yet.
14 MR. SCOTT: But there are also the ones
15 that are already done. For example, Davis-Besse who
16 has already installed and Diablo Canyon had already
17 installed enlarged strainers so that gets you to three
18 and there's one more. Not sure.
19 MR. CARUSO: Just wondered.
20 DR. LU: I think that concludes my
21 presentation.
22 MR. SCOTT: Okay. We now have Dave
23 Cullison who is going to come and talk to you about
24 audits.
25 MR. CULLISON: Good afternoon. Dave

1 Cullison. I'm in the Safety Issue Resolution Branch.
2 I am here today to talk to you about our plant audit
3 program where we are going to go to a selected number
4 of plants and review their resolution of GSI-191.
5 Shanlai is up here with me because at the
6 end of the presentation about our program, we'll have
7 a discussion about some of the things we have been
8 seeing in the Watts Bar audit. Shanlai is the team
9 leader for that audit so he can answer any questions
10 you may have.
11 The purpose of our audit program is to
12 perform in depth assessments of licensee's actions
13 taken in response to Generic Letter 2004-02. I want
14 to point out the last two bullets on the slide where
15 we identify where additional evaluation of licensee
16 resolutions through the NRC inspection program is
17 necessary.
18 What that means is that when we go through
19 the audits if we determine that we may need a change
20 to the inspection program to look at this issue, we
21 will recommend that. There is a temporary instruction
22 that has been issued where the regions will go out and
23 look at every plant and verify the licensees installed
24 what they said they were going to install. Because
25 the auditors were only going to do a certain number of

1 plants, we wanted to make sure that everybody does
2 what they are supposed to do and that is why we have
3 the TI.
4 Also another function of these audits are
5 to determine whether additional audits are needed. If
6 we find out there are some generic issues that go
7 beyond the few plants we are looking at, we can
8 enlarge the scope of the audits..
9 MEMBER SHACK: Do you have a number for
10 few?
11 MR. CULLISON: On the very next slide.
12 CHAIRMAN WALLIS: Do you have any idea of
13 the size of the submittals? Are they going to be 500
14 pages of technical information or are they going to be
15 one paragraph or what are they going to look like?
16 MR. CULLISON: The supplements?
17 CHAIRMAN WALLIS: All the stuff. RAIs and
18 there's going to be a description of their screens and
19 why they work and all that. It's going to be a fairly
20 substantial document. Isn't it?
21 MR. CULLISON: The honest answer is I
22 don't have any idea.
23 MR. SCOTT: I think it's safe to assume
24 that it's not going to be a paragraph. They got a
25 number of RAIs and their responses need to address the

1 RAIs at a minimum and also address all the generic
2 letter criteria. I think they are going to be
3 substantive. I don't think we have a number to attach
4 to that.
5 MEMBER MAYNARD: I would also expect they
6 would probably be referencing parts of a number of
7 other larger documents to take credit for, too.
8 MR. CULLISON: Yes.
9 CHAIRMAN WALLIS: It's going to be
10 substantial. A substantial amount of material to
11 review.
12 MR. CULLISON: Yes. We expect -- one of
13 the benefits of not having them all come in at the
14 same time is to kind of spread that workload out for
15 the staff, although there will still be a big bulge in
16 the workload, if you will, right at the end of 2007.
17 MR. SCOTT: It's 13 as of right now.
18 CHAIRMAN WALLIS: That's more than we
19 heard before, isn't it?
20 MR. CULLISON: We have included some
21 additional ones. That includes the two pilot audits
22 which we have already done and this is the break down
23 for the calendar years. It includes Watts Bar. We
24 are still identifying the plants that we are going to
25 audit.

1 MEMBER MAYNARD: Are you going to tell us
2 a little bit about your selection criteria?
3 MR. CULLISON: The very next slide. Plant
4 selection criteria.
5 MEMBER SIEBER: You guys are cheating.
6 You're looking ahead.
7 CHAIRMAN WALLIS: We always ask the right
8 questions.
9 MEMBER SIEBER: Let's see what's on the
10 next one.
11 MR. CULLISON: We are selecting plants
12 based on the analysis vendor, the screen vendor, any
13 unique analyses, and also trying to spread it out
14 throughout the regions and also looking at the screen
15 installation schedule. The idea is that we are trying
16 to look at at least one or two plants from every
17 analysis vendor and every screen vendor so we get a
18 selection from each.
19 That way we can determine if there is
20 possibly an issue with that vendor where we have to
21 expand scope. The region part is we want to make sure
22 -- since we encourage region participation in the
23 audits, we want to make sure all the regions get the
24 same opportunities.
25 How are we going to conduct the audits?

1 This is from now on. This doesn't discuss how we
2 conducted the Watts Bar audit but based on some
3 lessons learned from that we are changing the way we
4 conduct the audits.
5 The audits will have eight to 10 team
6 members, staff and contractors. Like I said, we are
7 going to encourage regional participation. They can
8 send anybody they want. They are going to be focused.
9 We will try to keep them about two months from start
10 to finish. Have an in-house review of licensee
11 documents and one or two weeks onsite.
12 The idea is loosely based on my experience
13 at the region where you have inhouse review, a week
14 onsite, go back to the office for a week, and then if
15 we need to go back to the site for another week.
16 After the second onsite period the all the auditors
17 should be submitting their reports to the team leader.
18 MEMBER BONACA: Slide 2 you said that you
19 assess the adequacy of licensee responses of the
20 Generic Letter the adequacy of licensee corrective
21 actions. You do expect to have a full detailed plan.
22 I'm not saying SRP but some plan on what is adequate
23 and what is appropriate, what is acceptable, what is
24 not.
25 MR. CULLISON: Well, we have an audit plan

1 which I am currently revising and in that we will have
2 some review elements in which we are going to have to
3 update because when they were written six or eight
4 months ago we have learned a lot since then. That is
5 going to be guides for the auditors when they go out
6 what to look for. Hopefully if we get it in there,
7 with acceptance criteria. The auditors are usually
8 the subject area matter expert from our office or DCI
9 in that area so they would know what is okay and
10 what's not.
11 MR. SCOTT: Let me add something to that,
12 please. One issue that we have is that we can't do
13 all the audits at the end of 2007 or the first month
14 or two in 2008. We are starting the audits now and if
15 you think about the timeline we described to you,
16 particularly in the chemical effects area, there are
17 still a number of open items. When we do an audit in
18 calendar year 2006, we will basically be doing a
19 partial audit.
20 We'll audit what they finished and what
21 they have not finished we will carry as an open item
22 that will be addressed in Generic Letter responses.
23 It's an unfortunate situation that we simply can't
24 wait until the very end and do them all at the same
25 time.

1 That is somewhat mitigated by the fact
2 that we are doing in 2006 and early 2007 audits on
3 plants that will have installed their strainers in
4 2006 and, therefore, they are committed to provide us
5 the Generic Letter information by the end of this year
6 so that will mitigate it somewhat.
7 MR. CULLISON: As Mike said, any open
8 items coming from the audits will be resolved during
9 our review of the supplemental responses to the
10 Generic Letter.
11 Onto the Watts Bar audit. Watts Bar is
12 our first real audit, if you want to call it that. It
13 really started when the licensee came in on March 2nd
14 of this year a large group of them came in. We had an
15 off-site meeting where they gave presentations on
16 their analyses, what actions they are taking, the
17 whole gambit.
18 That was after they had sent us all the
19 documents and there had been some in-house review.
20 During this audit staff was covering all the baseline
21 analyses and strainer testing. We issued RAIs which
22 we will get something probably the end of this month,
23 knock on wood.
24 We are performing confirmatory
25 calculations on FLOW-3D. We expect to have the report

1 out by the end of July. You will notice that there is
2 a large time gap between March 2nd and the end of July
3 and that is one reason why we are changing the way we
4 are doing business so we can get these completed and
5 the reports out a little faster. Some of the key
6 observations from audit -- of course, this is all
7 preliminary. The report is not issued and has not
8 been reviewed by management.
9 MEMBER MAYNARD: Briefly, when the report
10 is issued would that mean that Watts Bar is done or
11 you still would have --
12 DR. LU: We anticipate open items through
13 this audit so the audit open items will be addressed
14 as part of a Generic Letter response review at the end
15 of December '07.
16 MEMBER MAYNARD: All right.
17 MR. CARUSO: Has Watts Bar sent in their
18 Generic Letter 2004 response then?
19 MR. CULLISON: The supplement? Everybody
20 sent in their September '05 --
21 MR. CARUSO: Their supplement. Have they
22 sent in their supplement?
23 MR. CULLISON: No, but --
24 DR. LU: They did as part of that one.
25 It's part of the draft RAI response to us that

1 addressed all the RAIs we asked them as part of the
2 September response review.
3 MR. CARUSO: That was draft?
4 DR. LU: That was draft. The official one
5 will be sent to us at the end of this month.
6 CHAIRMAN WALLIS: Let me go back to the
7 previous slide. You said staff confirmatory
8 calculations are being performed. What does Watts Bar
9 do? Does TVA run some sort of a code to predict these
10 things or how did they justify that --
11 DR. LU: TVA, I think, contracted a line
12 to perform the transport calculation.
13 CHAIRMAN WALLIS: Did they use CFD?
14 DR. LU: Yes, they used CFD.
15 CHAIRMAN WALLIS: Did they use some sort
16 of a code for downstream core evaluation too?
17 DR. LU: They actually decided to use
18 conservative approach to determine the source term and
19 then perform the analysis. Their position was there
20 was no issue related to the downstream core.
21 CHAIRMAN WALLIS: Didn't do any analysis
22 of the downstream core?
23 DR. LU: They did and they have that
24 analysis there but they performed a very conservative
25 analysis instead of performing a code calculation.

1 MR. CULLISON: Some of the key
2 observations. They are a low fiber plant, mostly RMI.
3 They are assuming that all containment coatings fail.
4 They are not taking any credit for qualified coatings.
5 Transport. Everything but the RMI
6 transporting to the strainer. They used CFD to
7 calculate the RMI debris.
8 CHAIRMAN WALLIS: Did they know how to
9 calculate the effects of coatings on a strainer?
10 DR. LU: They assume entire containment
11 coating failed and 100 percent transportable to the
12 strainer.
13 CHAIRMAN WALLIS: But in what form? Was
14 it in chips or particles or what?
15 DR. LU: In chips.
16 CHAIRMAN WALLIS: In chips? Did they know
17 how to calculate the pressure drop across the strainer
18 with chips?
19 DR. LU: Hold on. Matt is going to talk
20 about that.
21 MR. YODER: Watts Bar actually used chips
22 and particulate debris. Because they are a low-fiber,
23 almost no-fiber plant, the thought is a chip if it
24 makes it to the strainer surface is going to plug that
25 hole so they took chips roughly the size of the

1 strainer hole or slightly larger under the thought
2 that -- this is in the staff guidance as well. For a
3 plant without fiber we told them to assume chip
4 debris. Then they took particulate debris for the
5 zone of influence and the other --
6 CHAIRMAN WALLIS: But the area of the
7 containment covered with coating is much bigger than
8 the area of the screen so if you take all that coating
9 and put it on all the holes, you've blocked them all.
10 MR. YODER: They actually put the coating
11 debris into their flume test and at the end of that
12 test actually shoved all of these coatings onto the
13 strainer itself and they were still able to maintain
14 flow.
15 CHAIRMAN WALLIS: It was based on a test?
16 MR. YODER: Correct.
17 CHAIRMAN WALLIS: It wasn't based on some
18 kind of semi-theoretical let's say.
19 MR. YODER: They actually put the debris
20 in and used the test to prove that.
21 MEMBER SIEBER: That was confirmed by
22 another test also that stacked up paint chips will
23 pass flow.
24 MR. YODER: I think in some of the PNL
25 work that we heard about yesterday even when they put

1 all the chips on there was enough of a tortuous path
2 that the flow could get through.
3 MEMBER SIEBER: Right. So this is not
4 inconsistent with all the other tests.
5 MR. CULLISON: And for head loss the --
6 CHAIRMAN WALLIS: I'm just wondering what
7 ACRS should do. You have done all this. At some
8 point would it be appropriate for us to audit your
9 audit or something? I don't really want to do that.
10 I would just like to say that you have done a good job
11 but do we get involved at all in checking the quality
12 of what industry does and your evaluation?
13 MEMBER BONACA: I have the same question.
14 I mean, I guess I misunderstand the word audit. To me
15 audit means you are looking at the compliance with
16 certain specific requirements.
17 DR. LU: That is exactly true.
18 MEMBER BONACA: Now, it would seem to me
19 that you have four or five different kind of
20 approaches to the resolution of this problem. A
21 number of clients have used one type or the other one
22 and so on. There will be a phase where you are
23 reviewing the approaches taken on a generic basis but
24 you are not doing that.
25 DR. LU: I think based on what we observed

1 so far most of the licensees are following the
2 guidance report to perform debris generation and
3 transport calculations. The only difference there
4 comes from vendor testing, the head loss data or the
5 choice of the strainer itself.
6 MEMBER BONACA: So you decided that the
7 NEI process is appropriate?
8 MR. SCOTT: Well, it's not a simple answer
9 to that. There is the staff's SE from two years ago
10 which provides review guidance in some but not all
11 areas. The other areas, chemical effects, you heard
12 we are going to develop review guidance for that.
13 You heard Shanlai mention that we are
14 going to develop review guidance for the head loss
15 testing in the near-field effect and review guidance
16 in a couple of other areas, too. I think you also
17 heard that we are expecting that some of that review
18 guidance will be iterative. The review guidance will
19 be applied to the audits and those will be the
20 criteria we will use.
21 As for the question of ACRS review of the
22 audits --
23 MEMBER SIEBER: Give us the report.
24 MR. SCOTT: Well --
25 CHAIRMAN WALLIS: Review of something.

1 Shouldn't we be reviewing something to sort of play a
2 role of checking that things are going okay or should
3 we just leave it all up to you and then you come back
4 at some later date with something for us to see? How
5 do we get involved with this stuff?
6 MR. SCOTT: One suggestion, if I might.
7 You might want to look at the review guidance that
8 we've told you we are going to develop and weigh in on
9 that.
10 CHAIRMAN WALLIS: While it's being
11 developed?
12 MR. SCOTT: At some point during its
13 development.
14 CHAIRMAN WALLIS: When we can be most
15 useful. Okay. Review guidance.
16 MEMBER MAYNARD: I really don't think the
17 ACRS should get in the role of independent audit of
18 the NRC's audit.
19 CHAIRMAN WALLIS: That's not really our
20 job.
21 MEMBER MAYNARD: Right.
22 CHAIRMAN WALLIS: That's not our job.
23 MEMBER SHACK: But the scaling arguments,
24 for example, to support the near field transport
25 sounds like something that --

1 DR. LU: Be part of the review guidance.
2 That will be part of review guidance.
3 CHAIRMAN WALLIS: Technical guidance.
4 MEMBER BONACA: I think we should make a
5 judgement of whether or not we think this is all
6 technically adequate. Otherwise we are spinning our
7 wheels and wasting our time.
8 MEMBER SIEBER: Before you leave this
9 slide, I have a question about the transport bullet.
10 Maybe you can tell me what RMI debris looks like. My
11 picture of it is a bunch of ripped up sheet metal. I
12 would not think even if you transported all this stuff
13 to a strainer some place that it would impede the flow
14 very much. It would just provide surface for other
15 debris to accumulate on. Do I have that right or
16 wrong?
17 DR. LU: You're right. I think based on
18 our observation of the test most of the RMI just
19 settles at the bottom of the flume and becomes like
20 porous medium for the water to go through. It really
21 does not add additional head loss on the surface of
22 the strainer so you are right. In terms of the
23 transport we are trying to figure out how much RMI
24 would be transported based on the safety of analysis.
25 MEMBER SIEBER: It really doesn't make any

1 difference how much is transported since it has no
2 effect on head loss.
3 DR. LU: That's correct. For this
4 particular plant, yes.
5 MR. SCOTT: So being an RMI plant is
6 arguably a good thing.
7 CHAIRMAN WALLIS: Well, now, you're saying
8 all containment coatings fail and then you're saying
9 they are all transported to the strainer?
10 DR. LU: That's right.
11 CHAIRMAN WALLIS: The strainer area is
12 4,600 feet square. The typical containment coatings
13 area is several hundred thousand square feet and so I
14 have to do some math here but it looks as if you've
15 got something like whatever it is. It is probably 70
16 square feet of container coating per square foot of
17 strainer. You are going to put 70 layers of coating
18 and put it on the strainer and it's not going to have
19 trouble?
20 DR. LU: Actually that's what we observed.
21 CHAIRMAN WALLIS: That's what you
22 observed?
23 DR. LU: Yes. First we dumped all the
24 coating chips, RMI, and the fibers upstream of the
25 strainer so we questioned whether this was because of

1 the artificial near field transport. They did not
2 take enough credit from the near field transport and
3 then later say, "Okay, let's just shovel everything
4 upstream in the flume and bury the entire strainer and
5 see what is the head loss." The head loss was higher
6 than the previous condition but it was still
7 significantly lower than the --
8 CHAIRMAN WALLIS: Something like an inch
9 of debris on the strainer? Is that right?
10 DR. LU: Actually it's the entire
11 strainer.
12 CHAIRMAN WALLIS: What is the thickness of
13 stuff you get on the strainer?
14 MR. YODER: Matt Yoder from NRR. One
15 thing that we observed is it's physically impossible
16 to get all of this debris onto the strainer. There is
17 just so much debris it cannot be done.
18 CHAIRMAN WALLIS: Where does it go?
19 MR. YODER: In a mound around the base of
20 the strainer and piled --
21 CHAIRMAN WALLIS: One reason the strainer
22 works is that it's not uniformly coated.
23 DR. LU: That's right.
24 CHAIRMAN WALLIS: That helps a lot. So
25 the stuff piles on the bottom of the strainer and the

1 top part of the strainer is relatively clear then.

2 DR. LU: I don't have a picture but

3 visually you can consider because of very low approach

4 velocity the chip itself becomes very -- there's a

5 huge mountain but it was such a high void fraction

6 that --

7 CHAIRMAN WALLIS: That's what bothered me

8 when you said all debris is assumed to be transported

9 to the strainer. You don't really mean that it gets

10 to the holes. You mean it gets to the vicinity of the

11 strainer.

12 DR. LU: That's right.

13 CHAIRMAN WALLIS: Then use CFD to figure

14 out where it goes, whether it goes up into the

15 strainer or falls on the floor.

16 DR. LU: They calculate the fraction of

17 the debris, RMI debris, from the containment pool.

18 CHAIRMAN WALLIS: So it doesn't all go

19 onto the strainer. It does not all go onto the

20 strainer.

21 DR. LU: No.

22 MEMBER DENNING: So would you say this is

23 credit for a near-field effect?

24 DR. LU: Yes. Right at the very beginning

25 of the test.

1 MEMBER DENNING: I thought you were
2 telling us the opposite here.
3 DR. LU: Right at the beginning. They
4 calculated the total amount of debris close to the
5 nearby region of the strainer. Then they dumped all
6 the debris in the testing flume and the testing flume
7 demonstrated that most of the debris actually did not
8 end up on the surface of the strainer. We questioned
9 that testing approach and they decided to shovel in as
10 much of the debris as they can to bury the entire
11 testing section.
12 CHAIRMAN WALLIS: If you know what the
13 size of the debris is but these are coatings. Do you
14 know how to predict the size of the coating flakes or
15 particles or whatever they are?
16 MR. YODER: The justification for the size
17 of the coatings that were used, as I said, these were
18 all ruffled, the size of the holes or larger, and the
19 distribution --
20 CHAIRMAN WALLIS: Then they would fall
21 out.
22 MR. YODER: That's correct, but since this
23 is a no fiber plant, that's the only way the coating
24 is going to impact the head loss. If you have
25 particulate coating they are going to pass straight

1 through and not impact the head loss at all.

2 CHAIRMAN WALLIS: If the containment

3 coatings are small enough they would all pass through?

4 MR. YODER: If you don't have a fiber bed

5 to filter them out on, yes.

6 CHAIRMAN WALLIS: You get 300,000 square

7 feet of coatings in the reactor?

8 MR. YODER: Some portion of it would pass

9 into the reactor, yes.

10 MEMBER DENNING: You mean particulate.

11 CHAIRMAN WALLIS: Whatever the coatings

12 became. The coatings are going to become very tiny

13 particles now and they are all going to go through the

14 strainer because they are assumed to be all

15 transported.

16 MEMBER SIEBER: That's a nice color.

17 CHAIRMAN WALLIS: Then presumably then end

18 up going through the reactor, too, and coming back

19 around again.

20 MEMBER DENNING: Now, wait a second. They

21 are not double treating the -- I mean, in their tests

22 I gather what happened was they took all the coatings

23 and pretended they were chips. Right? Okay. Then

24 they fell out. A lot of them fell out so they did

25 something to maximize how much of it they could get

1 onto the strainer. It's not totally clear to me how
2 they did that but even in that process of trying to
3 maximize it, a fair amount of it still did not go onto
4 the surface of the strainer. Is that correct?
5 MR. YODER: They actually buried. I mean,
6 they physically shoved this stuff onto the strainer
7 and on top of it and all around it as much as you
8 possibly could to get this stuff on it and around it
9 and still were able to have a flow.
10 MEMBER DENNING: You piled it up.
11 MR. YODER: Right. To address Dr. Wallis'
12 comment, remember they are running five to 10 tests so
13 they ran another case where they introduced all the
14 coating debris as particulate and they did sample the
15 downstream so they have that data.
16 CHAIRMAN WALLIS: Did a lot of it go
17 through?
18 MR. YODER: Yes.
19 CHAIRMAN WALLIS: A lot of it did go
20 through so then we have to think about downstream
21 effects maybe.
22 MEMBER SIEBER: You know, there is one
23 very conservative assumption piled onto another all
24 the way through this. I can't imagine, for example,
25 in any space other than regulatory space where you

1 would assume that all the coating failed and ended up
2 at the sump. Secondly, the transport models in the
3 tests and experiments that were performed showed the
4 stuff really doesn't transport.
5 Those two things combined say that the
6 amount of deposits that actually end up on the
7 strainer is going to be relatively small. Even if
8 they end up there, they will pass water. I think it
9 is fair to use all these conservative assumptions,
10 particularly if you come out looking good anyway. On
11 the other hand, I think it is fair to recognize how
12 conservative a position this really is. I think it's
13 extremely conservative.
14 MEMBER BONACA: I imagine it will be
15 piling up with debris all over the area.
16 MR. ACHITZL: I would just like to make
17 one comment about Watts Bar. Going way back when this
18 thing started there were a set of plants that we felt
19 nobody had to do anything for any accident. I would
20 like to reflect with an RMI plant like you mentioned
21 with the coatings and stuff like that with a fairly
22 big strainer before they spent the $5 million here,
23 that was one of the plants that we decided didn't have
24 to do anything for any accidents. I mean, yes, they
25 are making changes but I'm not sure those are

1 necessarily dollars well spent I guess is my thought.
2 DR. LU: Bottom line I think the head loss
3 is very conservative in terms of the margins they
4 have. The new trainer they are going to put it in.
5 CHAIRMAN WALLIS: The only kind of reason
6 you have a little bit of reticence perhaps in that is
7 that people that thought before that everything was
8 fine. Before the thin bed effect was discovered
9 everyone thought things were fine. Then something
10 happened in the BWRs and it was discovered that a
11 rather small amount of debris just left there because
12 they hadn't cleaned the suppression pools enough to
13 block the strainer so there were surprises.
14 When people come in with a lot of these
15 things like, "I think it's okay because we are very
16 conservative and this isn't going to happen," and so
17 on, it sounds good but there have been surprises
18 before. I can't tell you that you're going to have
19 surprises again and maybe the ACRS isn't going to be
20 involved in trying to guess but you might find there
21 are surprises.
22 MR. WHITNEY: This is Leon Whitney from --
23 CHAIRMAN WALLIS: I think I am reluctant
24 to say everything you are doing is fine. I am
25 reluctant to say its lousy. I may be reluctant to say

1 anything about it. Just wait and see.

2 MR. WHITNEY: This is Leon Whitney from

3 SSIB. Indeed, the licensees' strategies are no

4 surprises 10 years from now and that's why they go to

5 these large strainers in part even when you could

6 argue that maybe they don't need such massive

7 strainers in a particular plant. They use all the

8 conservatism in the analysis and then they can back

9 off those conservatisms if there is a surprise. There

10 is a lot to do with in the psychology of licensees.

11 CHAIRMAN WALLIS: What was the size of

12 that strainer before?

13 DR. LU: I cannot remember the exact

14 number.

15 CHAIRMAN WALLIS: Was it smaller?

16 DR. LU: It's much, much smaller. It's

17 about 40 or less square feet. I cannot remember the

18 exact number.

19 CHAIRMAN WALLIS: I thought Ralph implied

20 it was not a very big change.

21 MR. YODER: The change was significant but

22 I think what Ralph was saying is that because they are

23 a low fiber plant and all these other factors, they

24 didn't have the kind of problems that a plant with a

25 lot of fiber that creates a bed has.

1 CHAIRMAN WALLIS: Are they changing the
2 whole size and the strategy now?
3 DR. LU: Yes, they did.
4 CHAIRMAN WALLIS: What kind of strainer is
5 it?
6 DR. LU: It's a PCI strainer. I think we
7 can go back to slide --
8 CHAIRMAN WALLIS: Is it the pigeon hole
9 one?
10 DR. LU: It's the stacked disk, flat,
11 square shaped.
12 CHAIRMAN WALLIS: Okay. That's the one
13 where you have to worry about whether or not the stuff
14 can get into the area because it might jam on the
15 outside.
16 MEMBER SIEBER: Right.
17 DR. LU: That's right.
18 CHAIRMAN WALLIS: Okay. Thank you.
19 MR. CULLISON: Moving on to chemical
20 effects, Watts Bar uses sodium tectraborate as their
21 buffer agent which means ICET test 5 is most
22 applicable for their plant specific environment.
23 There is insufficient fiber to form a debris bed.
24 That's what we have been discussing. The licensee
25 added a significant amount of margin to the screen

1 area to accommodate chemical effects.

2 MEMBER SIEBER: What about aluminum

3 content in containment? Do you know anything about

4 that?

5 MR. CULLISON: I think Paul is going to

6 answer your question.

7 MR. KLEIN: Paul Klein. The aluminum

8 content, I believe, is less than 1 percent of the ICET

9 5 value that was tested.

10 CHAIRMAN WALLIS: Well, the 5 percent it

11 would seem to be gratuitous, not something that really

12 is necessary, the 50 percent margin.

13 MR. KLEIN: I think Leon had discussed

14 earlier that they wanted to add plenty of margin to

15 account for surprises down the road.

16 CHAIRMAN WALLIS: Well, we know that

17 chemical effects in the wrong social senses can have

18 an effect which is larger than 50 percent on pressure

19 drop.

20 MR. SCOTT: The other consideration I

21 think for the licensees is that the marginal cost of

22 adding another module of strainers is not that great

23 once you've made the investment in the design for the

24 whole set.

25 DR. LU: This particular plant has

1 sufficient space to put the strainer so that is the
2 reason they made it as conservative as they can.
3 MEMBER SIEBER: So this is not a good
4 plant to test your prototype audit plan.
5 MEMBER DENNING: Exactly.
6 MR. SCOTT: Actually, we wanted to start
7 with a relatively less challenging one. We are
8 working our way up to the more challenging ones.
9 MEMBER SHACK: I was going to ask you how
10 Ford Calhoun came out because that's not so trivial.
11 DR. LU: I think we issued a pilot audit
12 about Ford Calhoun. I don't think this particular
13 presentation was intended to address that particular
14 issue. However --
15 MEMBER SIEBER: We'll just read about
16 that.
17 DR. LU: Yes.
18 MEMBER DENNING: Now, definitely tell us
19 how you do an in-vessel evaluation that was performed
20 conservatively. I want to know.
21 DR. LU: I don't know whether Tom is here.
22 My understanding is -- before Tom starts maybe I can
23 make a few comments. My understanding is they applied
24 that very conservative debris source term to the
25 downstream evaluation for the core.

1 MR. HAFERA: As I mentioned during my
2 presentation, this is a plant that doesn't even have
3 enough fiber to make a bed in their reactor so it
4 becomes very difficult to say you are going to have
5 some kind of a thin bed or any kind of bed on the
6 lower core plate or on the fuel nozzle inlet or at the
7 grid straps because they just don't have enough fiber.
8 MEMBER DENNING: What analysis did they
9 actually do?
10 MR. HAFERA: They did a hand calculation.
11 Now, one of the other things that they are doing,
12 though, is they are deferring --
13 CHAIRMAN WALLIS: How many calculations
14 did they do? They used their hand but what was the
15 calculation? Can you sketch out what it was?
16 MR. HAFERA: Let me finish. They did a
17 hand calculation that basically said they didn't have
18 enough fiber to create a bed and, therefore, it's not
19 a problem. What they also did was they deferred
20 essentially. We asked them a number of RAIs and at
21 that point they deferred to the new Owners Group WCAP
22 that's being developed so they are not considering
23 that to be final.
24 CHAIRMAN WALLIS: What was the hand
25 calculation then? What was it based on? It must have

1 been based on some sort of principle or balance of
2 mass or something. Can you sketch out the logic of
3 the calculation?
4 MR. HAFERA: 2 is equal to M delta H.
5 That's how you move heat. You don't effect the --
6 CHAIRMAN WALLIS: How much product for the
7 matter came through the screen and where it went.
8 What did they do about that?
9 MR. HAFERA: Again, the particulate matter
10 becomes an analysis of whole size in your reactor
11 because what you find is they had enough adequate
12 bypass paths that would not capture small particulates
13 because the bypass paths are on the order of an inch
14 to an inch and a half.
15 CHAIRMAN WALLIS: What goes through the
16 screen would not block the flow to the reactor.
17 MR. HAFERA: Correct because the bypass
18 paths are on the order of an inch to an inch and a
19 half and their strainer size hole was 1/12th of an
20 inch I believe, the final strainer hole.
21 CHAIRMAN WALLIS: Don't they have debris
22 catchers at the bottom of the core that catch debris?
23 MR. HAFERA: Well, again, your lower fuel
24 nozzle has -- your core plate has debris holes and
25 your lower fuel nozzle, depending on your fuel design,

1 has debris catchers and that can catch certain debris
2 but it wouldn't catch small particulates because
3 actually those holes are typically larger than the
4 ECCS strainer because by design the ECCS strainer is
5 supposed to be smaller.
6 CHAIRMAN WALLIS: Do you know the size of
7 the holes in these strainers?
8 MR. HAFERA: Not off the top of my head.
9 They were larger than the holes in the ECCS strainer.
10 CHAIRMAN WALLIS: The people who sell
11 these strainers emphasis how effective they are at
12 catching stuff.
13 MR. HAFERA: Right.
14 CHAIRMAN WALLIS: And you're telling me
15 how ineffective they are.
16 MR. HAFERA: Well --
17 MEMBER MAYNARD: I think it's for a
18 different purpose.
19 MR. HAFERA: It's for a different purpose.
20 That's right. Unfortunately you missed the
21 presentation, Dr. Wallis --
22 CHAIRMAN WALLIS: Very sorry.
23 MR. HAFERA: -- where we basically showed
24 that you can block 99.9 percent and still okay.
25 CHAIRMAN WALLIS: All right.

1 MEMBER MAYNARD: The strainer size should
2 be smaller than what your nozzles are for your fuel.
3 The debris catchers in the fuel design in case you
4 have some sort of lose part that gets into the RCS or
5 something else in there, it is sized so that --
6 PARTICIPANT: They are not for particles.
7 MEMBER KRESS: In the aerosol business,
8 which may not be an exact analogy, if you continue to
9 flow aerosols out a leakage path that is a pipe of six
10 inches in diameter. It will eventually plug the
11 entrance to that pipe if you just continue flowing it
12 through. These aerosol particles are 10 microns down.
13 I don't know if the same thing would happen if you
14 continued to recirculate particles through a bigger
15 opening. Would it eventually plug up that anyway even
16 though they are much smaller than the opening? I know
17 it happens with aerosols.
18 MEMBER BONACA: That's right. That is
19 what we were discussing this morning about the core,
20 about recirculation and having certain areas where you
21 begin to have accumulation and then you have
22 blockages.
23 MEMBER KRESS: I don't know if we run
24 these tests long enough and recirculate enough to
25 decide whether or not eventually you are going to plug

1 a pipe situation.

2 CHAIRMAN WALLIS: If you pour all your

3 salad dressing down the drain in your kitchen it would

4 probably block it up, too.

5 MR. HAFERA: To address that issue, you

6 have to recognize also (a) how the LOCA event

7 progresses.

8 MEMBER KRESS: That's true.

9 MR. HAFERA: (b) how is the plant

10 constructed; (c) what are the emergency procedures and

11 how is the plant operated post LOCA. One of the key

12 factors to recall is every pressurized water reactor

13 in the country after a period of time goes on to

14 simultaneous or hot leg recirculation to flush braun

15 precipitation out of the reactor vessel. We would not

16 expect that these precipitants would behave

17 significantly different than that.

18 MR. CULLISON: To finish up, over all our

19 preliminary finding is the design of the Watts Bar

20 strainer appears to be robust with sufficient margin.

21 CHAIRMAN WALLIS: That's preliminary.

22 That's why it appears to be.

23 MR. CULLISON: Right.

24 CHAIRMAN WALLIS: When you reach a final

25 conclusion you will state it is adequate.

1 MR. CULLISON: When it gets signed off by
2 management, then it is instead of appears.
3 CHAIRMAN WALLIS: So now you are going to
4 do some difficult ones later on.
5 MR. CULLISON: Yes.
6 CHAIRMAN WALLIS: Good. Thank you very
7 much.
8 MR. SCOTT: Okay. Our final presentation
9 of the day is Leon Whitney is going to talk to you
10 about the process that we are planning to use to
11 ultimately close out the Generic Safety Issues. You
12 all had some process oriented questions so please bear
13 with us when we give you a process oriented discussion
14 here.
15 MR. WHITNEY: Good day. Leon Whitney from
16 Safety Issues Resolution Branch. I'm going to talk
17 about the end game in the Generic Safety Issue 191.
18 We are going to talk about the top level activities.
19 We are going to resolve all the technical
20 issues that we've talked about both yesterday and
21 today. Chemical effects, downstream effects including
22 in-vessel, retransport and near-field effect,
23 qualified and unqualified coating adhesion, coating
24 debris characteristics and transport, and debris head
25 loss.

1 CHAIRMAN WALLIS: What do you mean by
2 resolve technical issues?
3 MR. WHITNEY: Well, at least get to the
4 point of review guidance where we can --
5 CHAIRMAN WALLIS: That means review
6 guidance.
7 MR. WHITNEY: Implication thereof.
8 MR. SCOTT: But there is a proceduralized
9 NRC process for resolving and closing generic safety
10 issues and that is what we are ultimately talking
11 about.
12 CHAIRMAN WALLIS: It depends upon the
13 context. If you want to publish in a journal
14 something about chemical effects, that is something
15 but if you want to say that you are satisfied that the
16 design is adequate or assure public safety for certain
17 plants, you may be able to make a very crude
18 assessment of chemical effects and, therefore, there
19 is no chemical effect. Resolving depends very much on
20 the context.
21 MR. WHITNEY: We need to declare the
22 adequacy in accordance with 5046.
23 CHAIRMAN WALLIS: That's what you mean by
24 it.
25 MR. WHITNEY: That's the over-arching

1 goal.

2 CHAIRMAN WALLIS: So you don't mean that

3 you have to get a debris head loss correlation which

4 is accurate to one part in a thousand or something.

5 You mean that because of the experiments that are

6 being performed you have adequate assurance that the

7 strainer will meet its specifications.

8 MR. WHITNEY: And that the entire plant

9 during the LOCA operates as required by design --

10 CHAIRMAN WALLIS: Oh, that's what you mean

11 by resolving technical issues. It really means

12 assurance that the core will be adequately cooled.

13 MR. WHITNEY: Long-term cooling is

14 assured.

15 CHAIRMAN WALLIS: Okay.

16 MR. WHITNEY: Well, the steps are to

17 observe the strainer testing at vendor testing

18 facilities, document any issues and make NRC staff

19 comments available to affected licensees. I s s u e

20 NUREGs addressing results of NRC confirmatory testing,

21 obviously in conjunction with the Office of Research.

22 CHAIRMAN WALLIS: NRC confirmatory

23 testing. That's the ones which have been done so far

24 really.

25 MR. WHITNEY: Research has taken the lead

1 in most --

2 MR. SCOTT: And in the future if the need

3 is determined to do more, than that would go in here

4 as well.

5 MR. WHITNEY: Revise the Generic Letter

6 audit plan as needed based on evolving technical

7 knowledge. We have talked about individual sets of

8 review guidance for various technical issues. Process

9 license amendment requests to support licensee Generic

10 Letter schedules. Those are in process. There's a

11 small number of those, five to eight as I remember.

12 Conduct Generic Letter plant audits for a

13 sample of 12 selected PWRs. We are going to have to

14 reach closure on the open items. As we talked about

15 that, it may be during the supplemental response time

16 period and not necessarily during the plant audit. We

17 will consider based on the audit results whether to

18 increase the audit sample size to ensure adequate PWR

19 fleet response to Generic Letter.

20 Also we will verify the adequacy of the

21 2006 and 2007 Generic Letter supplemental responses

22 and/or responses to February 2006 requests for

23 additional information for each PWR. As you remember,

24 the RAI response --

25 CHAIRMAN WALLIS: I guess 12 is equal to

1 13?

2 MR. WHITNEY: Well, you would have 12

3 more and I guess Watts Bar --

4 CHAIRMAN WALLIS: Oh, you counted 12 more.

5 Okay. That's why you get 13.

6 MR. WHITNEY: As you'll remember, the RAI

7 responses may be folded into the Generic Letter

8 supplemental responses. The regions will be

9 conducting inspections under the TI-2515/166 to verify

10 implementation of the Generic Letter plant

11 modifications and procedural changes as described in

12 the Generic Letter supplemental responses and RAI

13 responses.

14 MEMBER BONACA: How different are these

15 inspections from the audits?

16 MR. WHITNEY: They are looking at

17 implementation not technical adequacy. What did you

18 promise and did you do what you promised as opposed to

19 is that strainer big enough, is this --

20 MR. SCOTT: What did you say you going to

21 install versus what you actually installed.

22 MR. WHITNEY: And/or procedural changes.

23 Evaluate extension requests for Generic Letter

24 modifications and procedural changes based on SECY-06-

25 0078 extension criteria. There have been five of

1 those, six actually on our plate.

2 One denied, four approved, and one in

3 progress and there are other ones coming, two or three

4 that we know about. None of them have gone past

5 spring 2008 in their request. And develop Generic

6 Letter closure letters for each PWR based on

7 supplemental responses, RAI responses, pilot results,

8 if any, because we're not doing audits of every plant

9 at this point, and/or the TI-2515/166 implementation

10 inspections.

11 MEMBER DENNING: What does the closure

12 letter actually say? Does it say we accept? It just

13 says we agree that you have submitted the information

14 or does it say more than that?

15 MR. WHITNEY: When it's submitted we are

16 going to have to assess the adequacy as it appears in

17 the documentation. Remember we are writing RAIs so

18 that whatever holes we can fill the holes.

19 MEMBER DENNING: But you only look into

20 TIL at 13 but you basically tell everybody else the

21 results.

22 MR. WHITNEY: The sample size of which we

23 can increase if we had indication that there was a

24 generic failure out there or something significant

25 that drove us to audit more.

1 MEMBER DENNING: What is your schedule for
2 when those closure letters would be written?
3 MR. WHITNEY: They are subject to these
4 supplemental responses so there are two tiers, 2006
5 and the 2007, tiers of responses based on when the
6 strainers are installed. They all can't be written
7 soon.
8 MEMBER DENNING: But for 2006 would you
9 write them as soon as you could after?
10 MR. WHITNEY: I would expect in late 2006
11 and early 2007 we would be writing the 2006 ones.
12 Depending, again, if there was an audit at one of
13 those plants we would not issue the letter until the
14 audit. When we actually issue the letters there would
15 be a management decision.
16 MR. SCOTT: As soon as for a particular
17 plant all the pieces are in place that we have talked
18 to you about and we've gotten sufficient information
19 to verify that they are in compliance, then we can go
20 ahead and write that letter.
21 That at the earliest, I assume none of the
22 responses will come in until right at the end of this
23 calendar year so then we'll start looking at them. If
24 there are no remaining open issues, RAIs, etc., then
25 we can write the letter. Now, whether that is going

1 to be the case for the early plants that come in,
2 that's questionable.
3 MEMBER MAYNARD: Also, for the audits, 13
4 audits probably covers close to 18 or 20 plants. Some
5 multi-unit sites would be covered in that.
6 CHAIRMAN WALLIS: Then there are some
7 plants which are quite similar to other plants.
8 MR. WHITNEY: And in 2008 we will be
9 briefing ACRS. We'll be updated the standard review
10 plan based on the knowledge gained and the information
11 that we understand about the Generic Safety Issue
12 closure. We will ensure that Regulatory Guide 1.82,
13 "Water Sources for Long-term Recirculation Cooling
14 Following a Loss-of Coolant Accident," is updated with
15 the latest GSI-191 related information. Maybe we'll
16 still be auditing and writing letters.
17 CHAIRMAN WALLIS: Might still be doing
18 research.
19 MR. WHITNEY: There are only so many
20 people in the section and then DCI.
21 CHAIRMAN WALLIS: It would be nice to move
22 on from this issue and do other things which might
23 actually be more important for reactor safety.
24 MR. WHITNEY: It would be very nice to
25 move on.

1 CHAIRMAN WALLIS: Are you going to finish
2 up, Mike? Are you going to have a few final remarks
3 for us?
4 MR. SCOTT: Yes. A very few, yes. In
5 closing, I would just like to say that, again, we
6 appreciate the opportunity to come in and brief you
7 again and we are looking forward to a number of
8 additional opportunities. I believe we are going to
9 be talking to you again in August along with the
10 vendors.
11 I think the vendor presentations will
12 hopefully answer a number of your detailed questions
13 if we didn't fully fill the bill on those today. Of
14 course, we only had one slide per vendor so you didn't
15 get much detail.
16 Ralph, I assume you're looking at several
17 hours with each vendor in August?
18 CHAIRMAN WALLIS: Something with
19 Westinghouse or the PWROG.
20 MR. SCOTT: The OG, whatever the OG is.
21 We'll work that acronym out. Anyhow, so you are going
22 to get some of that information in August. You are
23 going to hear a lot more from us, I think, right
24 around the new year when we start getting these
25 packages in and we start getting a look at them and

1 finding out how much they are filling the bill for us
2 and whether we need to adjust the plan to deal with
3 what comes in.
4 Between now and then we'll start having
5 the guidance documents drafted and we'll keep in touch
6 with Ralph and let you know when we think they are
7 right for a look from the Committee.
8 We do appreciate the fact, as you all
9 noted in your March letter, and as several of the
10 members talked about today, we appreciate your
11 agreement that we basically put an appropriate
12 emphasis on making near-term enhancements to the sump
13 designs as our top priority. We will, as I mentioned,
14 integrate information from many sources to determine
15 when the generic safety issue is resolved.
16 We are certainly not in a position to
17 resolve it and close it today. It is a very so to
18 speak fluid situation because the solutions are not
19 always clear. The industry, as we've noted, is doing
20 significant work and possibly going to alternate
21 buffers so for us to say we have the solution for a
22 particular configuration is at this point premature.
23 We don't know what the configuration is that the
24 plants are going to be using.
25 All of this will become more and more

1 clear to us towards the end of this year and
2 particularly into next year. We look forward to
3 continuing to work with you all in that time and to
4 benefit from your feedback. Thank you.
5 CHAIRMAN WALLIS: We wrote a letter in
6 March which was fairly substantial and direct. Now
7 you have gone to work. You told us what's going on.
8 We haven't really had substantial technical issues we
9 can help with at this time. Are you expecting us to
10 write some sort of letter this time or just more an
11 informative thing to go along with and then when we
12 have something more substantial down the road, we can
13 write another letter which is more substantial?
14 MR. SCOTT: Well, I guess our perspective
15 is that there is not much new that has occurred since
16 your last letter. If there is some particular subject
17 area on this that you believe having heard where we're
18 going today that you all --
19 CHAIRMAN WALLIS: Change direction we
20 would do something.
21 MR. SCOTT: If that's where you want to
22 go, yes. It really hasn't from our perspective
23 changed that much. You still hear the same story
24 which is that we got the research. It's coming in
25 now. We are just starting to use it. We are just

1 starting to develop review guidance. We are just
2 starting to do audits. It's a lot of stuff that's
3 kicking off now or has kicked off in the last couple
4 of months. It's pretty early in the process.
5 CHAIRMAN WALLIS: Your team has thought
6 about many of the things that they have to do. That's
7 evident. Lots of plans. As you said before, how it
8 works out will depend upon what sort of detail is in
9 the details. We'll find out from the plans in
10 industry and so on.
11 MR. SCOTT: If you believe having heard
12 the questions that we're asking that there are
13 questions that we should be asking, then that would be
14 obviously something we would want to hear about.
15 CHAIRMAN WALLIS: So you are not asking
16 for another letter unless we have something
17 substantial to say.
18 MR. SCOTT: Right.
19 CHAIRMAN WALLIS: I think before you leave
20 we might give an indication as to whether or not we
21 want to write a letter? Can we do that? Are they
22 going to sway the Committee's view? What do you
23 think, John?
24 MEMBER SIEBER: Well, I think that
25 particularly the plans that evolved from today's

1 session is something the full committee should hear.
2 We have time scheduled for the next meeting and I
3 think there is progress being made here. On the other
4 hand, everything is arriving at the goal line at the
5 same time but I think the Committee would benefit from
6 the fact that there is resolution coming.
7 I think the idea that the research is sort
8 of just catching up to NRR, NRR is moving ahead and
9 the industry is moving ahead and the research is maybe
10 a little later than just in time. I think that
11 requires some kind of explanation and some progress as
12 to where the research is right now because I think
13 there is enough done that you can reach some
14 conclusions.
15 On the other hand, I think that it's
16 important for the Committee to recognize that the
17 schedules that are out there and the emphasis on
18 answering the Generic Letter and the goal to actually
19 improving the plants is what drives this process.
20 CHAIRMAN WALLIS: If we have a
21 presentation on research, what I would like to see
22 would be a very short one where we don't see the
23 individual actors but we see someone who knows what's
24 going on saying, "These are the research programs.
25 This is what we've learned from them." Maybe NRR are

1 the appropriate people and we are showing awareness of
2 what is being done and what has been useful and what
3 you're going to do with it.
4 MEMBER SIEBER: That is my sentiment
5 exactly.
6 CHAIRMAN WALLIS: Have a presentation by
7 each researcher.
8 MR. SCOTT: The only thing I would caution
9 on that is that in July we still won't have a lot of
10 the reports.
11 CHAIRMAN WALLIS: That's right, so it
12 would be a progress report saying we think we are
13 learning this from this one and it's going to appear
14 in the report and we have learned this from this one.
15 We have learned about aluminum. We have learned
16 something about whatever. Are you ready to do that or
17 are you going to want to wait?
18 MR. SCOTT: If you want a progress report
19 we can give you one. No problem. If you are looking
20 for --
21 CHAIRMAN WALLIS: For the benefit of the
22 whole Committee.
23 MR. SCOTT: I understand. If the whole
24 Committee would like to hear about where we stand with
25 looking at research, then we can do that.

1 CHAIRMAN WALLIS: We're not in a position
2 to hear any kind of evaluation of it until we see the
3 final thing.
4 MR. SCOTT: Not a detailed evaluation.
5 MEMBER SIEBER: The question is whether we
6 write a letter or not. Probably in my opinion I don't
7 think a letter is necessary at this time to comment on
8 the plans or progress. On the other hand, we have a
9 letter that is outstanding that the EDO has sent us.
10 CHAIRMAN WALLIS: Response to the EDO you
11 mean?
12 MEMBER SIEBER: Yeah. As I look at that
13 and listen to the last two days of presentation, I
14 have a better appreciation from where the staff is
15 coming from. We may want to in our deliberations on
16 whether we write a letter or not to take that into
17 consideration and --
18 CHAIRMAN WALLIS: It should be a
19 meaningful one which contains a message of importance.
20 MEMBER SIEBER: Right.
21 CHAIRMAN WALLIS: I'm not sure at this
22 stage there is such an importance.
23 MEMBER SIEBER: Right now other than just
24 keeping informed I don't think --
25 CHAIRMAN WALLIS: We do have meetings with

1 the full Committee where we don't write letters so
2 that's a possibility.
3 MEMBER SIEBER: Anyway, that's my opinion.
4 MEMBER MAYNARD: First of all, I would
5 like to say that between yesterday and today I've
6 heard a lot of good information and I think it gave me
7 a better feeling for what has been done and what is
8 being done than the perspective that I had before the
9 meeting so I think the meeting was very helpful and I
10 thought the presenters all did a good job.
11 As far as a full Committee meeting, I
12 think it would probably be worthwhile to have a
13 progress report. I'm kind of neutral on whether it is
14 actually them giving a progress report or whether it's
15 a Subcommittee report. I think that the full
16 Committee needs to be apprized. I'm neutral on how
17 that's done.
18 As far as a letter, I don't believe there
19 is a need for a letter specifically from this meeting
20 as far as a response to what's on the table. I think
21 we can talk about that. I think there are still some
22 areas. I tend to agree with what Tom said yesterday.
23 I think there are a few specific areas that we might
24 be able to provide some input that recognize they made
25 a lot of progress and there is some good information

1 available now.

2 There may be a couple of key areas that

3 maybe some additional focus could be on. Perhaps we

4 could help in providing input on guiding those

5 activities. That is where we would probably be best

6 suited in identifying that.

7 MEMBER KRESS: I personally think you

8 could handle this with a Subcommittee report. I don't

9 think a letter is needed at this time.

10 CHAIRMAN WALLIS: Only two members are not

11 here.

12 MEMBER KRESS: I don't think a letter is

13 needed at this time because I can't think of anything

14 that I would put in it to either complain about or

15 make a substantial change in direction. I do think

16 that our other letter is still appropriate because I

17 think there's need for additional experimental work

18 and I think we could spell those out. I think --

19 CHAIRMAN WALLIS: It could be a brief one.

20 MEMBER KRESS: Yeah. I think one area

21 that I haven't thought much about but if the fix to

22 the chemical effects problem is to change the buffer,

23 I think there would be a need to test the new buffers

24 to see if they have chemical effects that we aren't

25 aware of. I think for the --

1 CHAIRMAN WALLIS: Excuse me. Will there
2 need to tests about their affect on iodine and so on
3 as well or is that something understood so well that
4 you wouldn't need it?
5 MEMBER KRESS: I think maybe it's just the
6 pH to worry about and I think I buy what Rich said
7 about don't really need to enhance the sprays. They
8 are good enough so I think maybe not. There may be
9 chemical effects that we're not thinking about on the
10 debris.
11 CHAIRMAN WALLIS: They are looking at
12 those. They are looking at buffers from the point of
13 view of chemical effects.
14 MEMBER KRESS: I think also that for the
15 calcium nucon that there should be a criteria on the
16 maximum amount of dissolved aluminum that would be
17 allowed to prevent the chemical effect all together.
18 I mean, prevent a significant chemical effect. I
19 don't see that being pulled out of the data yet and I
20 think it could be.
21 On the coatings, at this point they don't
22 look like a problem to me. Can we just dispose of
23 them and say they are not a problem? I don't know. It
24 looks like that's the way we're going.
25 CHAIRMAN WALLIS: They are a problem in

1 regulatory space.

2 MEMBER KRESS: Yeah. I think there is

3 still going to be a need to complete the multi-layer

4 head loss criteria as a tool to assess whether or not

5 you believe the integral test that the vendors are

6 doing. I think I would like to see that carried on

7 and completed up to some level of fruition.

8 CHAIRMAN WALLIS: These messages are

9 getting through to them.

10 MEMBER KRESS: Yeah, I think so. I'm just

11 repeating mostly what I said yesterday. I'm still

12 convinced that we have put the downstream effects to

13 bed. In particular I'm worried about long-term

14 recirculation of debris over and over and over through

15 the core and through the various regions. I don't

16 know what the fate of that debris is going to be or

17 where it's going to go. Maybe it blocks up parts of

18 the core and gives you enough release to violate 10

19 CFR 100 as opposed to being a real risk. It may be a

20 compliance problem.

21 CHAIRMAN WALLIS: You have a 30-day

22 mission?

23 MEMBER KRESS: Yeah, for 30 days.

24 CHAIRMAN WALLIS: If it's plugged up with

25 stuff, you've still got to call them so it's not as if

1 things are over in 30 days.

2 MEMBER KRESS: I think there may be a need

3 for some long-term recirculation tests. I don't know

4 what the nature of them would be. I don't know if

5 there is a facility out there to do that or not.

6 MR. SCOTT: If I might interject

7 something. A point that the industry made with us at

8 a recent meeting we had with the Owners Group, and

9 Ralph Caruso was there, too, they raised the question

10 about what the long-term objective is here post LOCA.

11 They were concerned that the staff might be too

12 focused on, for example, localized effects on the

13 fuel.

14 They have asked us informally and we told

15 them they need to ask us formally for an

16 interpretation on what the applicable requirements are

17 long-time post LOCA. That is a subject that is still

18 under discussion.

19 MEMBER KRESS: 10 CFR 100 but I don't know

20 that.

21 MEMBER SIEBER: You have that and Appendix

22 K. I think you have to meet Appendix K.

23 MR. SCOTT: Tom's going to answer that.

24 MEMBER SIEBER: Or some version of it.

25 MR. HAFERA: The discussion at the Owners

1 Group came down to 10 CFR 5046 long-term cooling.
2 Post LOCA you are going to have cladding perforation
3 from over pressurization and cladding perforation so
4 10 CFR 100 as a release issue is not necessarily the
5 problem. The real problem gets to be long-term
6 cooling.
7 If you look at 10 CFR 5046 long-term
8 cooling says it has success criteria that is pretty
9 vague and nebulous. It maintained temperature and
10 acceptably low value long-term cooling. We had a
11 number of discussions on that. You have to recognize
12 that means you have to maintain your core geometry.
13 Core geometry, the structural integrity of a fuel
14 assembly is from the control guide tubes and the grid
15 straps.
16 The fuel itself does not add structural
17 integrity to the fuel assembly. As Mike said, we are
18 in the process of discussing that, coming up with a
19 position, and we are going to discuss that with the
20 Owners Group so there are discussions going on in that
21 area.
22 CHAIRMAN WALLIS: Thank you. That was
23 very helpful, Tom. That is going to be in the
24 transcript and everyone, I'm sure, heard it.
25 MEMBER DENNING: I'm in total agreement

1 with Tom. I think you did a great summary job and I
2 kind of agree also with where you are standing on
3 whether we really need a presentation. I don't think
4 we truly do. I think we have a pretty thorough
5 summary of this but I don't think we really need the
6 presentation.
7 CHAIRMAN WALLIS: You're not allowed to
8 say anything.
9 MEMBER BONACA: He can't say anything. I
10 don't think we need a letter at this stage. In fact,
11 we shouldn't write a letter. I also think we should
12 have only a Subcommittee report.
13 CHAIRMAN WALLIS: The Subcommittee report
14 I think will be longer perhaps than some of them we've
15 had and I would hope other members could jump in
16 besides myself. Tom might be more articulate on some
17 matters I'm sure than I would be. People who have
18 opinions could express them.
19 MEMBER BONACA: We need to see what the
20 vendors are doing and I think we'll see that at the
21 Subcommittee meeting at the end of August and probably
22 that will give us the opportunity for a presentation
23 of the full Committee after that.
24 I think I'm pleased to see there is
25 progress going on so far as implementing certain

1 solutions. They will really give us the opportunity
2 to test the solutions to questions in a specific way.
3 We may see some dramatic solutions actually that they
4 are implementing by doing certain things. I thought
5 the presentations were very good from yesterday to
6 today.
7 I think we got a lot of good information.
8 I think the downstream effects are pretty optimistic
9 as far as the calculations. You may not agree but I
10 believe they may be. But I also agree that a certain
11 level of localized clad damage is within the
12 regulation for this particular kind of event so I
13 don't have a problem with that.
14 I'm interested also in seeing what some of
15 the audits will do. I still have the question in my
16 mind about how much do we know already what is
17 acceptable, what is adequate and what is not adequate.
18 There are certainties there and we recognize some
19 additional research may be required to clear some
20 issues. All in all I think it was a very useful
21 meeting. I think it was very constructive.
22 CHAIRMAN WALLIS: So it looks as if we are
23 headed for a Subcommittee report. I'm not going to
24 ask you folks to come to the full Committee meeting in
25 July.

1 MEMBER DENNING: Of course they are
2 invited to visit.
3 CHAIRMAN WALLIS: I'm not going to ask you
4 to make a presentation. I am more reassured than I
5 was. I think the staff is serious about this, that
6 you are aware of how difficult parts of it are, that
7 you guys have thought about some of the things you
8 have to do.
9 As I said before, I think the devil is
10 going to be in the details. We know what industry is
11 doing and what some of these vendors conclude and how
12 well they conclude from experiments, how comprehensive
13 the experiments are, how much they really dig into
14 what might happen and how much they investigate that
15 and so on.
16 The general quality of their work is going
17 to be crucial. Let's hope that works out well. Very
18 much of this is in the hands of the vendors of these
19 strainers and industry. We will hear about that
20 somewhere down the road.
21 MR. SCOTT: You can rest assured we are
22 serious about it. We've got a whole branch that is
23 nothing but GSI-191 and we use resources from outside,
24 too. We are very much focused on getting this issue
25 resolved.

1 CHAIRMAN WALLIS: Still you are at the
2 point of having made plans of how you are going to
3 conduct this campaign and now you have to conduct it.
4 It is a bit like a battle that things happen along the
5 way that you have to face.
6 MR. SCOTT: And we have to be flexible
7 enough to deal with those. That is correct.
8 MEMBER SIEBER: Roadside bombs.
9 CHAIRMAN WALLIS: I think our previous
10 letters have emphasized these things. I don't think
11 we need to say it again so thank you very much. Now
12 being 3:00 it's time to knock the gavel and we finish
13 again ahead of time because of the nobel efforts of my
14 colleagues and the staff. Thank you very much.
15 (Whereupon, at 3:04 p.m. the meeting was
16 adjourned.)
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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 Thermal Hydraulic Phenomena Subcommittee

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.

Lindsey Barnes

Lindsey Barnes
Official Reporter
Neal R. Gross & Co., Inc.

Overview of Resolution Status and Plans for Generic Safety Issue (GSI)-191, "Assessment of Debris Accumulation on PWR Sump Performance"

Presented by:
Michael Scott
Office of Nuclear Reactor Regulation

Presented to: ACRS Subcommittee on Thermal Hydraulics
June 14, 2006

Purpose of Presentation

- Update the Subcommittee on activities regarding GSI-191 since last briefing for the Committee (March 2006), challenges and issues that remain, and plans for addressing the challenges

Recent Activities

- Sent requests for additional information to all licensees to address gaps in Generic Letter 2004-02 responses
- Subsequently agreed to industry request to defer responses
  - Keeps industry focus on design and installation of larger sump strainers
  - Ongoing work (e.g., alternate buffer testing) may change the solution for some plants, which would change RAI responses
  - Strainers installed in 2006: Responses due 12/06
  - Strainers installed after 2006: Responses due 90 days after outage or by 12/07
- Submittals are expected to fully address GL 2004-02 (including basis for adequacy of sump)

Recent Activities

- Submitted SECY-06-0078 to Commission – Provided status of GSI-191, plans, and criteria for review of any requests from licensees to extend installation and mechanistic analysis beyond 12/07
- Reviewed 5 extension requests, all for a period of a few months – approved 4, rejected 1

Recent Activities

- Conducted audit of Watts Bar implementation of actions to address Generic Letter 2004-02
- Met with PWR Owners Group to discuss concerns and industry plans regarding in-vessel downstream effects
- Accepted topical report on chemical effects for review

Recent Activities

- Received revised topical report on downstream effects
- Developed plan to perform confirmatory analysis of potential in-vessel flow blockage
- Conducting multiple observations of vendor strainer testing, documenting results
- Discussed planned topical report on in-vessel downstream effects with Owners Group

Action Plans

- Developed action plans for major GSI-191 technical subissues (chemical effects, coatings, downstream effects, head loss testing); communicated those plans and related expectations to industry in public meeting
  - Focus NRC and industry on additional work needed to resolve GSI-191
  - Include plans for review guidance as recommended by ACRS
- As staff reviews topical reports, NRC-sponsored research reports (expect to receive about 10 this year), and GL and RAI response submittals, results will indicate whether changes to plans will be needed

Enhanced Sump Installation

- Top near-term NRC priority for GSI-191 – confident this will substantially reduce risk of sump clogging
- Changes generally involve much larger strainers, often in concert other measures, such as:
  - Removal of fibrous and particulate debris sources
  - Change in containment pH buffer
  - Installation of debris interceptors

Enhanced Sump Installation

- Spring 2006 or earlier: 8 plants
- Fall 2006: 25 plants
- Spring 2007: 17 plants
- Fall 2007: 16 plants
- Spring 2008: 3 plants

Summary

- Industry is moving forward to reduce risk of sump clogging and develop licensing basis for new configurations
- Path forward to issue resolution consistent with NRC-developed action plans
- NRC approach remains that issues have been identified to industry, and NRC expects industry to show resolution in accordance with NRC schedule
- Plans will be adjusted as knowledge base continues to evolve

Chemical Effects: Status and Plans

Presented by:
Paul Klein
Office of Nuclear Reactor Regulation

Presented to: ACRS Subcommittee on Thermal Hydraulics
June 14, 2006

Purpose of Presentation

- Provide an update on NRC staff and industry activities since March 2006 ACRS meeting
- Discuss plans to resolve technical issues related to chemical effects

Recent Activities

- PWR Owners Group Report WCAP-16530, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191" accepted by staff for review
- May 23-25, 2006 public meeting with industry and vendors to communicate NRC expectations and establish a path forward for issue resolution
- Staff visit to observe Owners Group alternate buffer tests

WCAP 16530-NP Review Schedule

- NRC has accepted WCAP for review
- Review is in progress; target date for draft requests for additional information (RAIs) is July 06
- Safety evaluation (SE) draft target date is May 07
- SE target date was set with the recognition that additional testing may be necessary to address staff RAIs

NRC-Industry Public Meetings

- Staff developed action plan to highlight technical issues and to identify a path forward for issue resolution
- NRC, industry and screen vendors met in May 2006:
  - Discussed technical issues and path forward for issue resolution
  - Strainer vendors described their approach to chemical effects testing

Chemical Effects Action Plan
Areas of Focus

- WCAP (chemical model)
- Strainer vendor testing
- Licensee plant-specific evaluations
- Office of Nuclear Regulatory Research (RES) Interactions
- Review guidance

Chemical Effects WCAP

- Key issues to be addressed through RAI process include:
  - Validation of WCAP chemical model
  - Limitations of separate effects testing
  - Chemical surrogates behavior and testing in non-representative environments
  - Evaluation of containment materials (e.g., paints) and plant conditions outside test matrix
  - Test matrix assumptions

Strainer Vendor Testing

- Individual strainer vendor's' chemical effects evaluation plans are needed for staff review
- Issues
  - Chemical surrogates – simulating the chemical and physical properties of the actual product
  - Justify introduction of surrogate into non-representative environments or conduct head loss tests in representative environments
  - Demonstrate if representative amorphous type chemical products can create head loss across a sparse bed or bare strainer surface
  - Chemical precipitate introduction in head loss tests is consistent with expected chemical product generation and arrival in the plant-specific environment

Chemical Effects – Path Forward

ITEM	NRC Action/Expectation	Industry Action
1. chem. model 2. separate effects	WCAP RAI & WCAP SE	RAI response
3. use of chem. surrogates & non-represent. environments	WCAP RAI & WCAP SE	Provide justification or conduct testing in representative environments
4. plant specific conditions outside tested conditions	WCAP Review, Licensee audits, GL supplements review	Plant-specific evaluations have a sufficient technical basis
5 screen vendor chemical effects evaluation plans	NRC staff review and comment. Ongoing vendor visits&interaction	Chemical effects test plans for various strainer types provided to NRC staff

Chemical Effects – Technical Issues

ITEM	NRC Action/Expectation	Industry Action
6. chemical products on bare screen	Basis provided if licensee credits bare screen	Tests to demonstrate if chem products can cause head loss without a pre-existing bed
7. chemical product arrival time	NRC staff will verify relative arrival time is consistent with ICET observations	Screen vendor chemical precipitate additions relative to other debris are consistent with expected plant tests
8. downstream effects –chemical effects cycle	Addressed by cognizant staff in downstream area	Plant-specific downstream effect evaluations include potential chemical products
9. additional issues	Provide test results and peer review panel results to industry	Provide results from chemical effects testing to staff

Alternate Buffer Test Observations

- April 2006 staff visit to Fauske & Associates to observe alternate buffer testing sponsored by PWR Owners Group
- Project objective is to identify a replacement buffering agent for sodium hydroxide (NaOH) and trisodium phosphate (TSP) which reduces the potential for chemical precipitate generation
- Candidate buffers include:
  - Sodium tetraborate decahydrate ($Na_2B_4O_7.10H_20$)
  - Sodium metaborate tetrahydrate ($NaBO_2.8H_20$)
  - Sodium tripolyphosphate ($Na_5P_3O_{10}$)
  - Sodium gluconate ($NaC_6H_{11}O_7$)

Alternate Buffer Test Observations

- Multi-phase buffer tests to investigate:
  - buffer dissolution in water and borated solutions
  - quantity needed to buffer borated solution
  - solubility limit of boric acid in candidate buffers
  - effects of storage at elevated temperatures
  - corrosion of aluminum and steel in buffered solutions
- Sodium gluconate did not meet pH criteria for candidate buffer
- Calcium chloride or aluminum nitrate were added to the various buffered solutions to evaluate precipitation in candidate buffers relative to NaOH, TSP

Buffers – Staff Perspective

- RES-sponsored head loss tests at ANL have shown:
  - TSP environments - significant head loss can occur with dissolved calcium levels $\geq$ 25 ppm
  - NaOH environments - significant head loss can occur with dissolved aluminum concentration approx. 30% of ICET 1. This appears to be a complex process dependent on time, temperature, and pH
  - Sodium tetraborate environments - No indication of increased head loss for a dissolved aluminum concentration consistent with ICET 5

- Based on RES results and observations from industry alternate buffer tests, there are buffers that have less potential for chemical effects relative to NaOH and TSP. Staff encouraging industry to continue investigation of alternate buffers

RES Interaction

- Staff to evaluate need for additional confirmatory research considering:
  - RES-sponsored test results
  - Research Information Letter on remaining technical issues
  - Industry-sponsored test results
  - Vendor visits, licensee audits
- Provide recommendations to management in September 2006

Review Guidance

- Draft review guidance for chemical effects to be developed based on:
  - RES-sponsored test results – provided in a series of NUREGs
  - Industry test results
  - Research Information Letter
  - Audit experience
  - Peer review panel committee comments

- Target - fall 2006

Chemical Effects Summary

- Licensee responsibility:
  - Demonstrate head loss resulting from plant specific conditions, including chemical effects, is less than available pump net positive suction head margin for the entire emergency core cooling system mission time
  - Uncertainty in chemical effects head loss is bounded by head loss margin
  - Downstream analysis includes consideration of chemical products
- Staff will use confirmatory research to independently evaluate licensee chemical effects evaluations

GSI-191
Path Forward to Resolution of Coatings Issues

Presented by:
Matthew Yoder,
Office of Nuclear Reactor Regulation

Presented to: ACRS Subcommittee on Thermal Hydraulics
June 14, 2006

Current NRC Activities

- Staff awaiting submittal of coatings zone of influence (ZOI) test reports (Expected 7/15/06)
- Staff reviewing Electric Power Research Institute (EPRI) test reports for Original Equipment Manufacturer (OEM) unqualified coatings
- NRC Office of Nuclear Regulatory Research analyzing results of NRC-sponsored coating transport tests
- Staff interacting with industry to resolve concerns about assessment of qualified coatings for degradation in service

Qualified Coating ZOI Tests

- Industry testing was performed to reduce the conservative spherical coatings ZOI of 10 L/D called for in the staff safety evaluation (SE)
- Two sets of test data, from 2 different industry groups, will be provided to staff by 7/15/06

- Path Forward:
  - Staff's review will focus on the characteristics of the two-phase jets and the associated calculations of ZOI size
  - Staff's review will examine the specific coating systems tested and the applicability of the test data to actual plant coatings
  - Staff will provide technical concerns, if any, to industry for resolution in supplemental GL responses

Unqualified Coatings Tests

- Industry has indicated that some licensees will use the test data for:
  - % of unqualified coatings that delaminate
  - Characteristics of debris generated

- Path Forward:
  - Staff will examine the specific coating systems tested and the applicability of the test data to actual plant coatings
  - Staff will provide technical concerns, if any, to industry for resolution in supplemental responses to Generic Letter 2004-02

Coating Transport

- Licensees who take credit for settling of coating debris in their transport analysis and/or strainer proof tests must demonstrate:
  - Adequacy of test procedures and analysis
  - Staff concerns about flume testing have been addressed (near field, scaling, debris introduction)
  - Debris is prepared for testing, or modeled in analysis, consistent with its expected failure mode – based on test data or staff position in SE

- Path Forward:
  - Staff will use NRC-sponsored coatings transport testing (Carderock) results to confirm the adequacy of licensees' coating transport analysis, transport testing, and/or replacement strainer proof testing

Qualified Coating Assessment

- Recent observations of coating degradation in several containments have caused the staff to question the adequacy of industry's visual coating assessments
- Staff expects licensees to pursue one of the following options for coating debris in their final strainer design:
  - Demonstrate that visual assessment provides adequate assurance that qualified coatings will not fail during a design basis accident (DBA)
  - Perform physical testing of the containment coatings that provides assurance that the qualified coatings will remain adhered in a DBA
  - Assume 100% failure of the containment coatings and perform transport testing and strainer proof testing to ensure adequate head loss margin exists to account for the coating debris

Qualified Coating Assessment

- Path Forward:
  - Staff will evaluate licensees' approaches to resolve this issue on a plant-specific basis
  - Staff will continue to interact with the Nuclear Energy Institute, EPRI, and ASTM to improve coating assessment techniques
  - Industry plans to conduct destructive testing of visually sound qualified coatings in several (4-6) containments, to provide assurance that visually sound coatings have sufficient adhesive strength to remain attached to their substrate during a DBA
    - NRC staff will observe these tests and determine if this effort provides sufficient data to justify the use of visual inspections as an adequate means to identify degraded coatings

Summary: Coatings Issues

- NRC staff and industry have agreed upon paths forward for resolving each of the outstanding coatings issues
  - ZOI
  - Unqualified coatings debris generation
  - Transport of coatings debris
  - Assessment of qualified coatings

Downstream Effects Issues
Non-Vessel

Presented by:
Steve Unikewicz
June 14, 2006

Purpose of Presentation

Provide the ACRS Thermal-Hydraulic Subcommittee with an update on NRC activities and positions on issues related to evaluation of GSI-191 downstream effects

Presentation Topics

- Current status of evaluation efforts for non-vessel downstream effects
- Challenges remaining
- Path forward
- Summary

Current Status

- Almost all licensees are using the PWR Owners Group (PWROG) report WCAP-16406P, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191" as a primary evaluation reference
- Staff performed a preliminary review of Rev. 0 of WCAP 16406-P and provided comments to the Owners Group. Discussions with PWROG on this approach continue
- A redline/strike-out version of the WCAP intended to address preliminary staff comments was submitted for NRC Topical Review June 5, 2006

Challenges

- Licensee responses to GL for Downstream Effects were incomplete
- WCAP 16406-P requires acceptance and detailed reviews by NRC
- It is not clear that the PWROG addressed previous staff comments
- Large amounts of plant-specific information are required for application of the WCAP
- Industry training on the application and use of the WCAP may be needed

Challenges

- Many licensees are using vendor testing to determine downstream source term
- Staff is reviewing validation of non-vessel wear and blockage models in the WCAP
- Plant modifications are planned and ongoing
- Responses to the NRC RAI regarding use and application of WCAP not expected until Jan 07 or later

Path Forward – NRC Actions

- Staff continues to interact with PWROG and licensees on WCAP, site-specific issues, and responses to staff requests for additional information
- NRC review and acceptance of WCAP will provide an approved reference to determine compliance and operability (in addition to plant design & license bases)
- Staff is reviewing licensee modifications and industry tests for downstream issues

Summary

- PWROG WCAP (topical report) on downstream effects has been issued for NRC staff review
- Technical issues remain
- Licensees must address how generic guidelines apply to their plants
- Staff will continue to interact with PWROG and licensees as needed
- Plant-specific evaluations of downstream effects are expected to be verified by December 2007 (sooner for many plants)

Downstream Effects Issues Related to Reactor Fuel

Presented by:

Thomas Hafera

Walt Jensen

Bill Krotiuk

June 14, 2006

Purpose of Presentation

Provide the ACRS Thermal-Hydraulic Subcommittee an update on NRC activities related to the evaluation of GSI-191 downstream effects on reactor fuel

Presentation Topics

- Current status of evaluation efforts for downstream effects on reactor fuel
- Challenges remaining
- Path forward
- Preliminary evaluation results
- Summary

Current Status

- PWR Owners Group (PWROG) report WCAP-16406P contains some basic inputs for evaluation of fuel
- PWROG plans to develop specific guidance for evaluation of fuel
  - additional WCAP
  - expected 3-4 months to develop
  - Schedule defines milestones for staff interaction
- Staff just started performing some independent confirmatory analysis as part of GSI-191 audits using two different analysis tools (still in development with Office of Research)
- Meeting with PWROG to identify inputs needed for plant-specific confirmatory analysis

Challenges

- Downstream source term – discussed as part of generic downstream effects & vendor testing presentations
- Timely submittal of new WCAP
- Acceptance and detailed review by NRC
- Full development of confirmatory analysis models
- Identification, collection, and proper use of relevant reactor internals and fuel design information for analysis models

Path Forward – NRC Actions

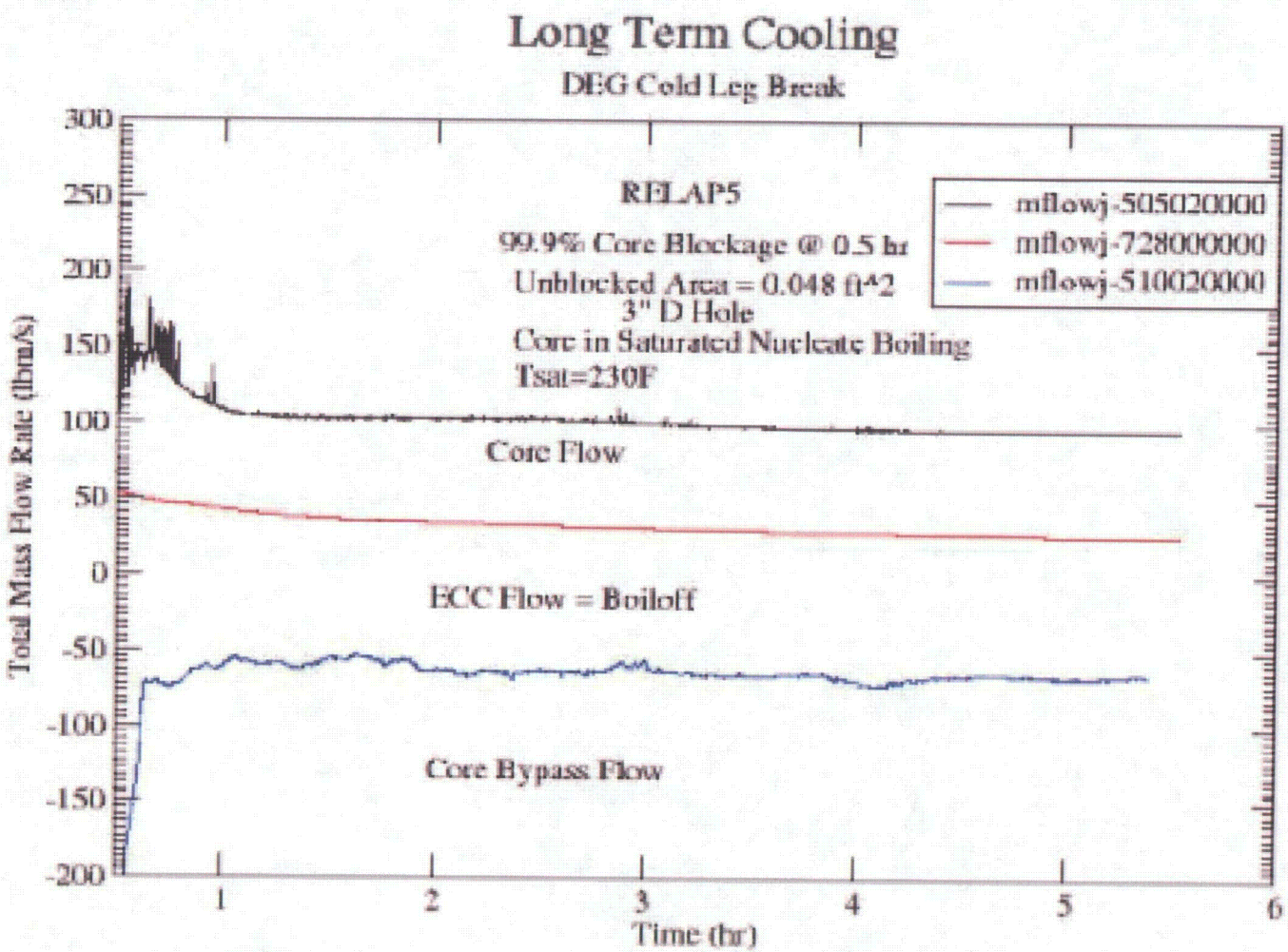
- Staff continues to interact with PWROG and licensees on site-specific issues and responses to staff requests for additional information
- Staff will continue to perform confirmatory analysis as part of GSI-191 audit process as needed
- Staff interaction with PWROG at designated milestones for new WCAP development
- NRC review and acceptance of new WCAP

Confirmatory Fuel Evaluation – Preliminary Results (Tool #1 RELAP 5)

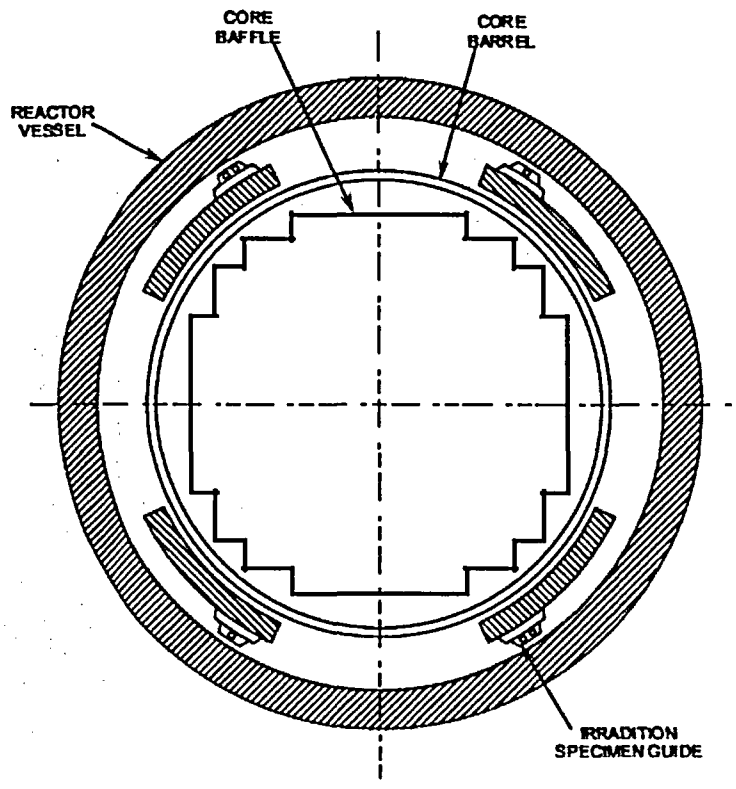
RELAP5 Core Blockage Study

- Used an existing RELAP5 PWR input model (fuel inlet pressure drops not representative of current designs)
- Core Barrel flow holes and slots not modeled
- Examined core flow patterns with the effect of core blockage
- Needed: Inputs from industry on core inlet strainers and core barrel flow holes for current fuel designs to examine effect of alternate flow paths for core cooling
- More detailed analyses using TRACE are planned

Confirmatory Fuel Evaluation – Preliminary Results (Tool #1 RELAP 5)



Confirmatory Fuel Evaluation – Preliminary Results (Tool #1 RELAP 5)

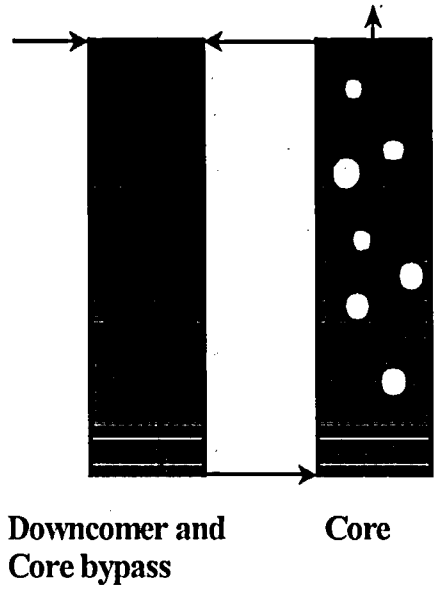


Reactor Vessel Cross Section

Confirmatory Fuel Evaluation – Preliminary Results (Tool #1 RELAP 5)

Hand Calculation (Check of RELAP5)

ECCS flow into downcomer = steam out



Assume core is 50% voided (from RELAP%)

Confirmatory Fuel Evaluation – Preliminary Results (Tool #1 RELAP 5)

Hand Calculation (Check of RELAP5)

$$\Delta P = \rho(\Delta Z) = KW_c^2/(2\rho A_c^2)$$

where:

ΔP = Natural Circulation driving pressure

ρ = liquid density

ΔZ = static driving head = $Z_{bp} - 0.5Z_c$

Z_{bp} = core bypass height

Z_c = core height

K = core inlet flow loss coefficient

W_c = core inlet flow rate

A_c = core inlet unblocked area

Confirmatory Fuel Evaluation – Preliminary Results (Tool #1 RELAP 5)

- Confirmed the RELAP5 core flow prediction of ~100lb/sec

Can also use to find core area to support a core flow of 50lb/sec for core cooling

- An inlet area of 0.0171ft^2 would be needed, equivalent to a 1.8 inch diameter hole

Confirmatory Fuel Evaluation – Preliminary Results (Tool #1 RELAP 5)

Conclusions from RELAP5 analysis:

- Core cooling can be maintained with a considerable amount of flow blockage
- Any small flow holes in the core barrel should be effective in maintaining core cooling even if the core is completely blocked
- Significant circulation patterns exist in the reactor vessel which may affect debris transport
- The core blockage used in the RELAP5 analysis can be converted to an equivalent flow loss K-factor. (The industry has gathered flow loss data for fibrous debris beds which when compared to the RELAP5 analysis indicate that core cooling can be maintained with a considerable debris bed thickness)

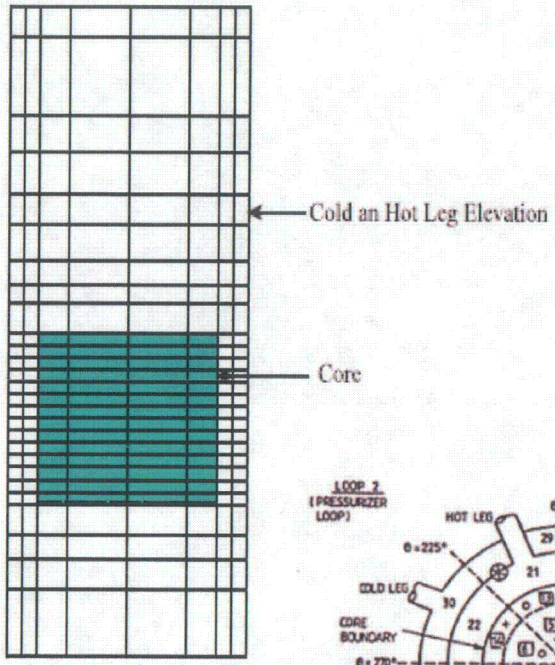
Confirmatory Fuel Evaluation – Preliminary Results (Tool #2 TRACE)

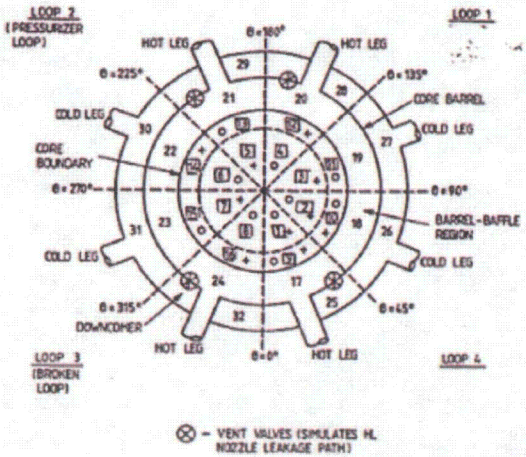
Core blockage analyses using TRACE

- TRACE can provide 3-dimensional treatment of the reactor core thermal/hydraulics
- Purpose: Investigate reactor core flow distributions and core cooling following inlet and internal flow blockages
- Needed: Inputs from industry on core inlet strainers and core barrel flow holes to examine effect of alternate flow paths for core cooling

Confirmatory Fuel Evaluation – Preliminary Results (Tool #2 TRACE)

- Scoping study for typical four-loop PWR plant
- TRACE model description
  - Full primary and secondary system modeled
  - Core divided into 8 radial segments, with 4 rings and 14 elevations
  - No bypass flow between core and volume outside baffles
  - 80% double ended cold leg break assumed
  - Full high and low pressure injection
  - Recirculation starts at 1200 sec



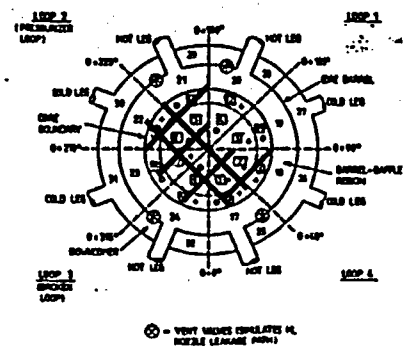


Confirmatory Fuel Evaluation – Preliminary Results (Tool #2 TRACE)

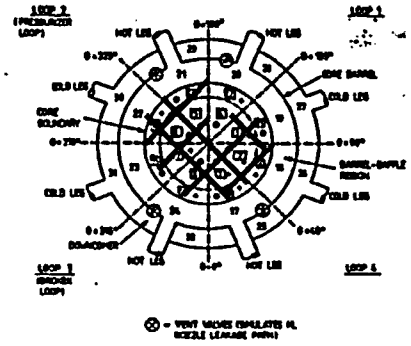
Cases Analyzed

(Assume instant blockage at 1200 sec)

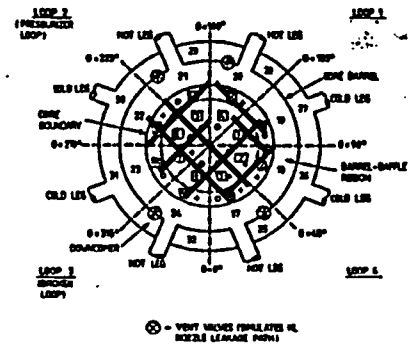
- Unblocked core inlet
- 75% core inlet blockage



- 87.5% core inlet blockage



- 94.8% core inlet blockage



Confirmatory Fuel Evaluation – Preliminary Results (Tool #2 TRACE)

- **PRELIMINARY RESULTS**
  - Post-recirculation peak clad temperature unaffected with core inlet blockages less than 75%
  - Small post-recirc peak clad temperatures rise with core inlet blockage up to 94.8%
  - TRACE scoping studies continuing
- Computational fluid dynamics (CFD) core model being built to verify core flow distributions predicted by TRACE

Summary

- Detailed analysis tools and models for evaluation of downstream effects on reactor fuel are currently being developed
- Staff will be engaged in industry activities, particularly in providing feedback on and reviewing new WCAP
- Staff will continue to perform confirmatory analyses for various reactor designs
- Evaluations of licensee submittals regarding downstream effects are expected to be essentially complete by December 2007

Prototypical Head Loss Testing

Presented by:
Shanlai Lu
Office of Nuclear Reactor Regulation

Presented to: ACRS Subcommittee on Thermal Hydraulics
June 14, 2006

Purpose of the presentation

- Update the subcommittee on the overall status of industry's prototypical head loss testing and staff review activities
- Identify common technical issues
- Discuss path forward

Background

Industry's approach

- Use conservative debris generation and transport methodology to predict the total amount of debris deposited on the surface of the strainer
- Assume that all the debris arrives at the strainer or nearby region at the onset of recirculation
- Perform prototypical head loss tests to validate the strainer sizing and net positive suction head

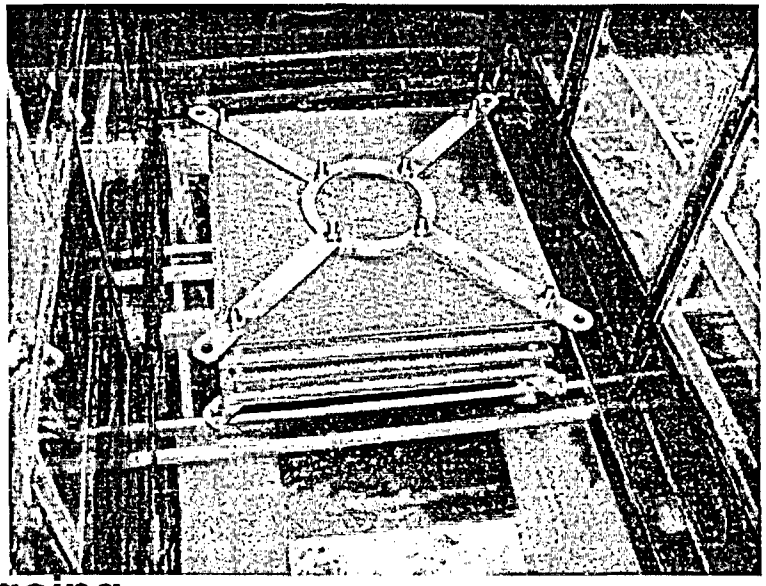
Three types of head loss testing

- Prototypical head loss testing combined with near field transport
- Prototypical head loss test without debris settlement upstream
- Plant-specific head loss correlation development coupled with conservative debris distribution assumptions

NRC Staff Responses

Pilot audits, audits and observation trips

Strainer Vendor Overview



Framatome Areva/PCI/ARL

Strainer Type: PCI Sure-flow strainer

Number of PWR units: 14

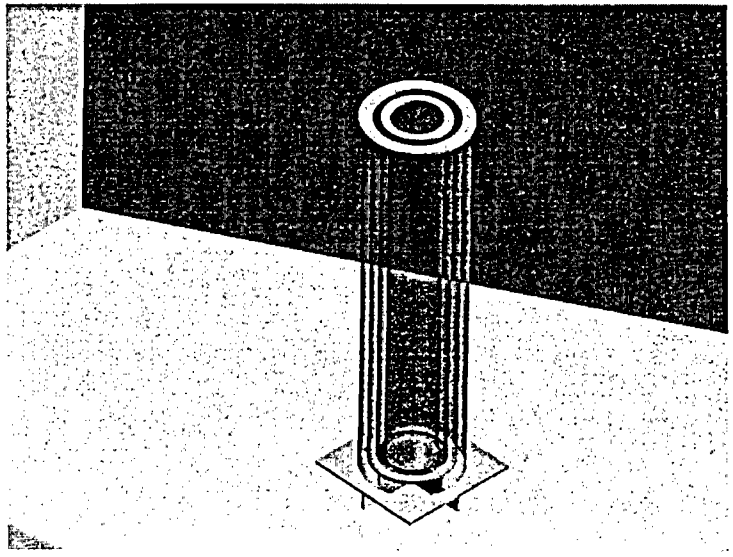
Test facility: *2.25ft x 3.25 ft x 20.9 ft*
Flume

Testing status: 2 units finished, 12 units ongoing

Key design parameters: Approach velocity range: 0.0033 – 0.0272 ft/s
Screen area range: 770 – 7,500 ft^2
Strainer hole diameter range: 0.045 – 0.095 in

Staff Activities: Watts Bar audit, 3 observation trips, future audit(s)

Strainer Vendor Overview



Alion/Enercon

Strainer Type: Top-hat strainer

Number of PWR units: 15

Test facility:
1. **Vertical Test Loop**
2. **Vertical Chemical Loop**
3. **Flume Loop**
4. **Water Tank Loop**

Key Strainer Design Parameters: Approach velocity range: 0.002 – 0.023ft/s
Screen area range: 770 – 7,500 ft^2
Strainer hole diameter range: 3/16 – 3/32 in

Staff Activities: 4 observation trips, future audit(s)

Strainer Vendor Overview

CCI

Strainer Type: Pocket Shape Strainer

Number of PWR units: 16

Test facility: 1. Vertical Test Loop
2. Water Tank Loop
3. Multi-functional Test Loop

Staff activities: one observation trip in July 2005
one more planned in July 2006
future audit(s)

Strainer Vendor Overview

General Electric/CDI

Strainer Type: GE Passive and Active

Number of PWR units: 13

Test facility:
1. Test Pool Loop
2. Water Tank Loop
3. Gravity Drain Testing Rig
4. Downstream Effect Loop - Fuel

Staff review activities: two observation trips
one pilot audit
future audit(s)

Strainer Vendor Overview

AECL

Chalk River National Laboratory

Strainer Type: AECL Passive

Number of PWR units: 7

Test facility: 1. Small Test Tank Loop
2. Water Tank Loop

Staff activities: one observation trip in 2005
one more observation trip planned in 2006
future audit(s)

ACRS Comment - Scaling

ACRS question:

Can the scaled strainer module/section test results be extrapolated to plant conditions?

Strainer vendors' approach

- Assume uniform debris loading on the entire strainer array
- Scale the debris loading for the test section using the strainer surface area ratio

Staff Observations – Common Issues

1. **Scaling for head loss tests without near field transport**

   The staff considers the uniform debris settlement assumption conservative

2. **Scaling for combined head loss and near field transport tests**

   It is estimated that twenty PWR units plan to take the credit for "near field effect"

   Staff position: Proper scaling and testing procedures are needed to ensure adequate strainer size and/or sufficient removal of problem materials

Staff Observations – Common Issues

3. **Debris surrogate material preparation**

   Both industry and NRC confirmatory research test program confirmed that shredding process affects pressure drop across the debris bed

4. **Scaling of Debris Circumferential Accumulation**

   For high fiber/particulate case, when circumferential accumulation becomes significant, the scaled strainer section may experience lower head loss than that of the actual strainer module

5. **Debris addition timing sequence**

   The formation of the debris bed is sensitive to the debris introduction sequence

Staff Observations - Common Issues

6. Temperature dependency

- Room temperature head loss data is usually scaled to high temperature condition using proportional viscosity equation

  $$\Delta P = F(\mu)$$

- Debris bed structure morphology may subject to change
- For a constant flow, the debris bed compression is subject to change
- "Bore Hole" phenomenon may introduce non-linear effect

Staff Observations - Common Issues

7. Integrated head loss and downstream bypass test

- Prototypical head loss tests were conducted to provide screen bypass debris concentration data
- Maximizing debris bed head loss may result in non-conservative debris bed filtration efficiency measurement

Path Forward

- RAIs were issued to request justifications for taking credit for near field debris settlement
- Draft staff review guidance is being developed
- More observation trips planned
- Plant audits planned
- Staff will evaluate supplemental responses to GL2004-02 against staff safety evaluation (SE) and any additional review guidance available

GSI-191 Plant Audits

Presented by:
David Cullison
Office of Nuclear Reactor Regulation

Presented to: ACRS Subcommittee on Thermal Hydraulics
June 14, 2006

Audit Purpose/Objectives

- To perform in-depth assessments of licensees' actions taken in response to Generic Letter (GL) 2004-02, Specifically:
  - assess the adequacy of licensee responses to the GL
  - assess the adequacy of licensee corrective actions
  - identify whether additional evaluation of licensee resolutions through the NRC inspection program is necessary
  - determine whether additional audits are needed

Audit Plans

- Staff plans to audit a total of 13 plants
  - 2 pilot audits - completed
  - 4 in CY06 (including Watts Bar)
  - 6 in CY07
  - 1 in CY08 (completed by Spring 08)
- Plant selection continuing

Plant Selection

- Plant Selection Criteria
  - Analysis Vendor
  - Screen Vendor
  - Unique analyses/corrective actions
  - Region
  - Screen installation schedule

Conduct of Audits

- 8-10 team members
  - Staff and contractors
  - Regional participation is encouraged
- Focused
  - About 2 months from start to finish
  - In-house review of licensee documents
  - 1 or 2 weeks onsite
  - Open items to be resolved during staff review of supplemental responses to GL

Watts Bar Audit

- Audit Activities
  - First phase of audit focused on the strainer head loss testing
  - Second phase of audit was kicked off on March 2, 2006
  - Staff review covers all baseline analyses and strainer testing including downstream and chemical effects
  - Requests for additional information (RAI) were issued
  - Staff confirmatory calculations are being performed using FLOW-3D computational fluid dynamics (CFD) code for transport analysis review and TRACE/RELAP-5 code for downstream core evaluation
  - TVA will provide RAI responses by 06/30/2006
  - Staff plans to complete the audit report by 07/30/2006

Watts Bar Audit

- Key Observations
  - Debris
    - Reflective metal insulation (RMI), coatings particulate and chip debris, small amount of fiber and latent debris
    - Licensee assumes all containment coatings fail
  - Transport
    - All the debris is assumed to be transported to the strainer except RMI. CFD was performed to calculate the RMI debris amount transferred to the strainer
  - Headloss
    - The measured maximum head loss was less than the minimum NPSH margin by a factor of ten. The new replacement strainer area is about 4600 ft^2

Watts Bar Audit

- Key Observations
  - Chemical Effects
    - Sodium Tetraborate – buffer agent
    - ICET-5 most applicable to plant specific environment
    - Insufficient fiber to form a debris bed
    - Added 50% margin to screen area to accommodate chemical effects
  - Downstream Effects
    - Downstream valve components to be replaced
    - In-vessel evaluation was performed conservatively
- Overall, the design appears to be robust with sufficient margin

Resolution of Generic Safety Issue (GSI)-191

Presented by:
Leon Whitney
Office of Nuclear Reactor Regulation
June 14, 2006

Purpose of Presentation

- Inform Subcommittee of top-level NRC activities needed and planned to bring GSI-191 to closure

GSI-191 Path Forward

- Resolve technical issues
  - Chemical effects
  - Downstream effects, including in-vessel
  - Debris transport and near-field effect
  - Qualified and unqualified coating adhesion
  - Coating debris characteristics and transport
  - Debris head loss

GSI-191 Path Forward

- Observe strainer testing at vendor testing facilities – document any issues and make NRC staff comments available to affected licensees
- Issue NUREGs addressing results of NRC confirmatory testing
- Revise GL 2004-02 audit plan as needed based on evolving technical knowledge
- Process license amendment requests to support licensee GL 2004-02 schedules
- Conduct GL 2004-02 plant audits for a sample of 12 selected PWRs
  - **Reach closure on open items**
  - **Consider, based on audit results, whether to increase audit sample size to ensure adequate PWR fleet response to GL 2004-02**

GSI-191 Path Forward

- Verify adequacy of 2006 and 2007 GL 2004-02 supplemental responses and/or responses to February 2006 requests for additional information (RAIs) for each PWR
- Conduct inspections under TI-2515/166 to verify implementation of GL 2004-02 plant modifications and procedural changes as described in GL 2004-02 supplemental responses and RAI responses
- Evaluate extension requests for GL 2004-02 modifications and procedure changes based on SECY-06-0078 extension criteria
- Develop GL 2004-02 closure letters for each PWR based on supplemental responses, RAI responses, audit results and/or TI-2515/166 implementation inspections

GSI-191 Closure

- GSI-191 safety issue closeout (2008)
  - ACRS briefing(s)
  - Update Standard Review Plan (SRP)
  - Ensure Regulatory Guide 1.82, "Water Sources for Long-term Recirculation Cooling Following a Loss-of Coolant Accident," is updated with the latest GSI-191 related information