Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
Thermal Hydraulic Phenomena Subcommittee

Docket Number: (not applicable)

Location: Rockville, Maryland

Date: Wednesday, June 14, 2006

Work Order No.: NRC-1091 Pages 1-230

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

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

SUBCOMMITTEE ON THERMAL HYDRAULICS PHENOMENA

+ + + + +

RESEARCH ACTIVITIES RELATED TO RESOLUTION OF GSI-191

+ + + + +

WEDNESDAY,

June 14, 2006

+ + + + +

The Subcommittee meeting convened at the Nuclear Regulatory Commission, Two White Flint North, Room T-2B3, 11545 Rockville Pike, at 8:30 a.m., Graham B. Wallis, Chair, presiding.

SUBCOMMITTEE MEMBERS PRESENT:

GRAHAM B. WALLIS	Chair
MARIO BONACA	ACRS Member
RICHARD B. DENNING	ACRS Member
THOMAS S. KRESS	ACRS Member
OTTO L. MAYNARD	ACRS Member
WILLIAM J. SHACK	ACRS Member
JOHN D. SIEBER	ACRS Member

ACRS STAFF PRESENT:

RALPH CARUSO

NRR STAFF PRESENT:

RALPH ARCHITZL

DAVE CULLISON

THOMAS HAFERA

WALT JENSEN

PAUL KLEIN

WILLIAM KROTIUK

SHANLAI LU

TOM MARTIN

MIKE SCOTT

STEVE UNIKEWICZ

LEON WHITNEY

MATT YODER

ALSO PRESENT:

ANN LANE Westinghouse

A-G-E-N-D-A

Overview/Introduction, M. Scott, NRR 4
Chemical Effects, P. Klein, NRR 28
Coatings, M. Yoder, NRR 61
Downstream Effects
General, S. Unikewicz 82
Fuel, T. Hafera, W. Jensen, W. Krotiuk . 104
Prototypical Strainer Testing, S. Lu, NRR . . . 137
Audit Progress, D. Cullison, NRR 172
Path to Resolution, L. Whitney, NRR 205
Concluding Remarks, M. Scott, NRR 212

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

8:32 a.m.

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

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

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

Since we last talked to you, actually

right about the same time as we talked to you, we sent requests for additional information to all the PWR licensees to address gaps in the Generic Letter responses. We subsequently agreed to an industry request to defer those responses for several reasons. No. 1 is we agreed that the industry should keep its focus on the design and installation of larger sump strainers.

As we discussed with you the last time we were here, we see that as the most important thing that we can do in the near-term, especially given the various technical issues and uncertainties regarding GSI-191. We strongly believe that installation of larger strainers will enhance safety.

Also, as we discussed yesterday, there is ongoing work. For example, the alternate buffer testing that the industry is currently doing that may in the end change the solution to GSI-191 for one or more plants. We believe that it is appropriate at this point to not require additional information responses because the answers simply aren't available for those plants. The work is ongoing.

We sent the industry a letter in March that said that we would agree to the following that you see in the second two sub-bullets under the second

bullet which is for plants that install their new strainers, or their enhanced strainer sump installations in 2006, we have requested and they have agreed to provide responses to our RAIs and/or supplemental responses to the Generic Letter by the end of December of 2006. I'll show you in a few slides how many plants that involves.

For plants that install strainers after 2006 we are expecting the responses within 90 days after the outage that installs those strainers or at the latest by December of 2007. Those submittals are expected to fully address the Generic Letter 2004-02 items including providing basis for the adequacy of the sump designs.

We also submitted a SECY paper to the Commission which provided a status on GSI-191, discussed our plans for path forward, and also provided criteria that the staff plans to use for review of any requests from any licensees for extension beyond the December 2007 deadline for completing actions to address Generic Letter 2004-02.

Since that time we have received -- I guess this is slightly behind the times now. We have six extension requests in. One of them we are still considering. We approved four and rejected one. We

approved the four consistent with the second criteria which involved showing a substantial improvement in the sump design, typically a much larger strainer.

Some of the plants came in with requests that said, "We are going to put our new larger strainers in in fall 2006 but we have additional modifications that we want to make."

For example, to downstream valves that are going to necessitate waiting until the next outage for all the plants that have made these requests those outages would be in spring 2008. We are going to have a much better design but we have some details to take care of that we are asking for those to be taken care of in the 2008 spring outage.

CHAIRMAN WALLIS: Mike, you are going to have responses from how many different utilities?

MR. SCOTT: Are you speaking of the previous slide?

CHAIRMAN WALLIS: Well, both of these together. There were 69 reactors or something like that?

MR. SCOTT: There are 69 and so if you --

CHAIRMAN WALLIS: Are they going to have an RAI for each one of those, RAI responses?

MR. SCOTT: What they have the option to

do is either respond to the RAIs item by item or to provide a supplemental Generic Letter 2004-02 response that addresses all those RAIs.

CHAIRMAN WALLIS: Have to describe the basis for the sump design and operations and everything.

MR. SCOTT: That's correct.

CHAIRMAN WALLIS: Someone has to review all these?

MR. SCOTT: Yes. The staff.

CHAIRMAN WALLIS: This is a full-time job for how many people?

MR. SCOTT: Well, right now there are eight staff members working on GSI-191. Of course, we have some folks who are working on it part-time, too. As I'll show you in a couple of slides here, because we are asking for some of the responses to be in by the end of 2006 and other to be in throughout 2007, we don't anticipate getting all of these responses in in the last quarter of December '07 but there will be a substantial number of them.

CHAIRMAN WALLIS: It is conceivable that some of these sump designs will prove to be inadequate when examined by your staff?

MR. SCOTT: Yes, that is conceivable in

which case additional actions may be needed.

CHAIRMAN WALLIS: Is there some way -- would we have any involvement in this process at all, the ACRS?

MR. SCOTT: We will continue to brief you on the audits and we will brief you at the time we get the Generic Letter responses on what we are finding.

CHAIRMAN WALLIS: Okay. And there will in the public record these responses?

MR. SCOTT: They will.

CHAIRMAN WALLIS: And the sump designs will be in the public record?

MR. SCOTT: To the extent the information is not proprietary.

CHAIRMAN WALLIS: But they have to include in their responses what you call the basis for adequacy of sumps.

MR. SCOTT: Correct.

CHAIRMAN WALLIS: So there must be quite a bit of technical basis which is in the public record.

MR. SCOTT: That would be my assumption, yes.

CHAIRMAN WALLIS: Okay. So if we wish to,

or if someone else wished to, they could examine these and see how believable they were and hopefully they would all be believable.

MR. SCOTT: Right. As you know, and as I mentioned to you all yesterday, because we don't have these responses yet, we don't know at this point the approaches that the industry -- we don't know in detail the approaches that the industry are going to take plant by plant to address the issue. Once we start getting those responses in, we are going to get a lot more informed.

CHAIRMAN WALLIS: So let's say a master student at a university could take as his thesis examination of these sump designs and efficacy or efficacy or however you want to pronounce it.

MR. SCOTT: Sure.

CHAIRMAN WALLIS: Okay. That might be interesting to do. Thank you.

MEMBER DENNING: It might give a feeling to the experimental work that is going to go on with models of their screens. How does the timing of that relate to when the installation will occur? Do you have a feeling? I mean, will some of that testing occur after installation has actually occurred?

MR. SCOTT: Okay. The testing I assume

you are referring to is the vendor testing?

MEMBER DENNING: The vendor testing.

MR. SCOTT: Most of the vendor testing that was scheduled has been done. As a matter of fact, we are leaving today to watch some of the last of it after we are done briefing you.

MEMBER DENNING: Most vendor testing has been done?

MR. SCOTT: Right. There is a fair chance that because they did most of that testing before chemical affects issues have been resolved, there may be additional testing needed. We'll have to see how that plays out.

MEMBER DENNING: And when will you -- you say you are going to observe the results or something?

MR. SCOTT: We'll talk to you. Shanlai Lu will talk to you in some detail about each of the -- well, not much detail but he'll mention the vendor designs and talk about the fact that we are going to see, or have been to see all of the vendor designs. Some of the testing is actually going to happen this summer so there is some of it yet to come but a lot of it is already completed.

MEMBER DENNING: So you haven't actually seen their experimental design yet as to what their

plans really were and what the spectrum of conditions are that they are running with. You'll see that after you go talk with them now?

MR. SCOTT: We have seen some vendor testing of some plants. Remember, each vendor will have half a dozen or more licensees. Each licensee will have a plant specific situation so the testing is not identical one to one. We are not attempting to watch the testing for every licensee. We are watching representative testing so we have seen some of that and we have some more to do.

CHAIRMAN WALLIS: There will be testing for each plant based on the particular conditions at that plant do you think?

MR. SCOTT: That is correct.

CHAIRMAN WALLIS: And there will be some module which is tested and then there will be many modules installed in a plant so there has to be some way of designing for the many-module situation.

MR. SCOTT: As we have mentioned to them, and I think we noted for you all a couple of months ago, we expect them to show that the vendor testing can be scaled to actual plant conditions.

MR. WHITNEY: This is Leon Whitney of NRR. Just for the record, we expect approximately 40

responses for the 69 plants. Some plants are tested identical.

MEMBER BONACA: So there will be groupings?

CHAIRMAN WALLIS: It looks to me as if everything is going along so fast that most decisions, not all, will be made before ACRS has any chance to comment on any of this.

MR. SCOTT: Well, I don't see it playing out fast. Now, what is going on expeditiously is the installation of the strainers that we have talked about and I'll show you a slide in a minute that will give you a time line for that. The resolution of the generic letter is going to be an ongoing process over the next 24 months. I guess I don't see how that is going to happen rapidly.

CHAIRMAN WALLIS: I just wonder if we have any influence at all and it would not be good for us to come in after it's all being done with some criticism of what has been done. That is not the way we like to operate. We like to operate by influencing what is going to be done in the proper way.

MR. SCOTT: Right. We can come in and brief you in the responses. When responses start coming in, which we anticipate is the end of this

year, we can come in and talk to you about that.

CHAIRMAN WALLIS: I think it is very much up to you to design it so that we are going to have some effect that can be useful and not be in anyway upsetting at the end. We don't want to have to look at something at the end after it's all been done and then have to wait a letter if we find there are some holes in what has been done. If there is any place where we can influence events in a way which is positive, we would like to do it early.

MR. SCOTT: I agree, but the issue, though, is until we start getting the responses in it will be limited. The staff is going to talk to you today about some review guidance that we are developing. We believe that review guidance is going to tend to be iterative based on what we see when responses come in. There are going to be several opportunities along the way here for you all to be involved, as you said.

CHAIRMAN WALLIS: Thank you.

MEMBER SIEBER: I think the greatest difficulty that I see in this whole thing is the licensees are being asked to design and install strainers before the research is completed that will tell the NRC staff to review it and what the design

parameters ought to be. To me that is sort of a perplexing situation.

One outcome of that would be that the strainers the licensees design won't be adequate to meet the conditions that we eventually determine are going to be in the plant. I think there will be modifications that will come later as a result of the review. The strainer goes in before the letter is written.

MR. SCOTT: Let me make a point on that if I might. Having looked at the designs that the utilities are coming up with, they are installing very large strainers. At least in order of magnitude greater than the size that is in there now. It may well be that at the end of the day if the analysis shows that those very large strainers are not enough in some plants, then those plants will have to consider modifications that aren't likely to include larger strainers.

They could include and we have encouraged the industry to remove problem materials when they can. If a very large strainer won't handle it, then there is probably a problem materials issue that the plant needs to address.

MEMBER SIEBER: That's what I would do

first if I were a licensee now.

MR. SCOTT: Some of them are actually doing those things in parallel. They are removing insulation that is a problem at the same time they are enlarging their strainers.

CHAIRMAN WALLIS: We know very little about downstream effects so far.

MR. SCOTT: We are going to talk to you some about that today.

CHAIRMAN WALLIS: This could change what is a good strainer, what is a bad strainer.

MR. SCOTT: I suggest we hold that in abeyance.

CHAIRMAN WALLIS: Okay. We'll hear about it later today.

MR. SCOTT: Okay. Moving on here we have conducted an audit of Watts Bar implementation of actions to address Generic Letter 2004-02. This is our first audit and we are not completely done with it yet. We are done with the looking part and we are in the writing the report part and waiting on the RAI responses from the licensee. We'll talk to you all about this audit also today.

We met with the PWR Owners Group, previously known as the Westinghouse Owners Group to

discuss concerns and industry plans regarding in-vessel downstream effects. We accepted a topical report on chemical effects review that you'll hear a little bit more about today.

CHAIRMAN WALLIS: This is a Westinghouse report?

MR. SCOTT: Yes. A WOG, PWR Owners Group Report. Paul Klein will talk to you all about that today.

CHAIRMAN WALLIS: It's a WCAP report of some sort?

MR. SCOTT: Yes, it is a WCAP.

CHAIRMAN WALLIS: I think we have that, don't we? This is the one which tells you how to make your surrogates.

MR. SCOTT: Yes.

CHAIRMAN WALLIS: Okay.

MR. SCOTT: We have also received a revised topical report on downstream effects. A little bit of background on this. The staff had made some informal comments on the downstream effects topical report late last year and Westinghouse addressed those comments and submitted a topical report formally for staff review. We just got it, I believe, last week. That is, by the way, downstream

effects mostly X vessel.

CHAIRMAN WALLIS: That's a WCAP?

MR. SCOTT: It is, yes.

CHAIRMAN WALLIS: Is there anything on in-vessel effects?

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

CHAIRMAN WALLIS: Okay.

MR. SCOTT: We developed a plan to perform confirmatory analysis of the potential for in-vessel flow blockage and we are going to talk to you about some of the results of that today.

CHAIRMAN WALLIS: That means research when you say confirmatory analysis?

MR. SCOTT: It means NRR and research working together. We'll talk to you about that.

We are conducting multiple observations of strainer testing as I mentioned earlier and documenting the results of that. What we are doing in the way of documentation is making the trip reports that show our comments on the various vendor testing practices available to the licensees that are using the services of that vendor by putting them on Adams and informing the licensee of the availability of the document in the public library.

We also discussed a planned topical report on in-vessel downstream effects with the Owners Group and the Owners Group plans to begin development of the WCAP to address that subject. They were to get approval from their management to start that report this month so obviously since they haven't started writing that one yet, that is a few months down the line before we are actually going to see it.

We developed action plans for the major GSI-190.

CHAIRMAN WALLIS: Go back to this. You are going to have this report written. Is there enough knowledge available to write this report?

MR. SCOTT: Which report are you referring to?

CHAIRMAN WALLIS: The in-vessel downstream report.

MR. SCOTT: The knowledge will be developed. Again, we are going to talk to you about that.

CHAIRMAN WALLIS: I remember from the other report I read, I think it was WCAP, it seemed to say these are the things you need to calculate but it didn't indicate if it was known how to do it.

MR. SCOTT: Clearly the purpose of the

report is to provide that guidance.

CHAIRMAN WALLIS: So you are confident that it is known how to predict these downstream effects?

MR. SCOTT: I'll just wait and see what they come up with when they write their report.

CHAIRMAN WALLIS: Because we don't know. Maybe you don't know either.

MR. SCOTT: I don't know. However, I do have staff who are more knowledgeable than I am who will talk to you more a little later today and maybe they will be able to provide you more perspective.

As I said, we developed action plans for the major technical sub-issues. For any of you who were at the May meeting, then you are aware that we discussed those chemical effects, coatings, downstream effects, and head loss testing plans with NEI and the industry in May. We communicated the plans and the related expectations.

The purpose of those meetings, actually we met with NEI and we also met separately one at a time with each strainer vendor, was to focus the industry and the NRC on the additional work needed to resolve the GSI. Also another point that we came up with was to include plans for review guidance which you all

recommended to us in your last letter.

As the staff reviews the topical reports, two are in and one more to come, NRC sponsored research reports, as you heard yesterday, research is busy writing their NUREGs and getting them approved. We'll be looking at them over the next several months and determining how best to use those research results.

We'll also have the generic letter and the REI response submittals that will start to come in towards the end of this year. Those results will provide us the information we need to determine whether changes to our plans are needed.

As I mentioned to you yesterday, we can't say with security that the information the licensees is going to provide us is going to fully address GSI-101. Once we have the information you see on the slide available, we will better be able to determine if a course change is needed.

Enhanced sump installation, as we have said several times, that remains the top near-term NRC priority. We are confident that will substantially reduce the risk posed by this issue. Changes generally involve much larger strainers also in concert with other things that you see here. There is

discussion among the industry regarding changes in containment, pH buffers based on the research results that have been appearing and that you all were briefed on yesterday, as well as the ongoing work that the Owners Group is doing to address alternate buffers.

CHAIRMAN WALLIS: You say will substantially reduce risk of sump clogging. Do you have a measure of that risk and how much it has to be reduced by?

MR. SCOTT: We do not have a quantitative analysis of the risk. When you take a strainer that previously had 40 square foot of surface area and you raise that 2,400 square feet, then we have an expectation that risk is reduced.

CHAIRMAN WALLIS: Well, yeah, but is it reduced enough or what? How do you know it's good enough?

MR. SCOTT: We don't. Again, when we get the information, we will then have that information in hand to make a determination as to whether enough has been done and if enough has not been done, then we will determine how best to proceed.

CHAIRMAN WALLIS: You better we sure that it doesn't enhance the risk of some downstream effects.

MR. SCOTT: We believe that is not the case and, again, we will talk to you about that today. This just shows you --

CHAIRMAN WALLIS: The main risk is, of course, to the core and it's not really sump clogging. It's what is the effect of all of this on the effectiveness of long-term core cooling and all the effects that this will have on that.

MR. SCOTT: That is correct.

CHAIRMAN WALLIS: Thank you.

MR. SCOTT: This slide shows the time line for installation of larger sump strainers. As you can see, some plants -- a few of them, actually, had already done it, Davis-Besse, for example, and Diablo Canyon. Several are doing it this spring. Many are doing it this fall and then the remainder -- most of the remainder over spring and fall of 2007. The spring 2008 plants are associated with the extensions that I talked to you about a few minutes ago. As you can see, the industry is proceeding on this and moving forward.

CHAIRMAN WALLIS: So that means that 33 we finished this year and they will give their responses to the letter by December?

MR. SCOTT: That is correct, 33.

CHAIRMAN WALLIS: About half of them will be done this year.

MR. SCOTT: Close to half, yes. As I said, industry is moving forward to reduce the risk of sump clogging and to develop their licensing bases for the new configurations they are going to install. The path forward to issue resolution is consistent with the NRC developed action plans that we are going to talk to you all about today.

The NRC approach remains that the issues have been identified to the industry and the industry needs to show resolution in accordance with the schedule that we've established. As I mentioned to you earlier, as the issue proceeds and the state of knowledge continues to evolve and we determine that is not a path to ultimate success for resolution of the Generic Safety Issue, then we will take additional actions as needed. That concludes my presentation.

CHAIRMAN WALLIS: I'm wondering about this knowledge base. You started me thinking a little bit here. The knowledge base has been expanding in the last few years. There have been some surprises. For instance, there was no consideration of the chemical effects. It was considered in certain significant -- really significant effects or discovered. We don't

have much of a handle on quantifying them.

We just know there is a significant effect on the sump conditions being demonstrated. On the business of head loss we have discovered that certain things can happen in the way in which the stuff is put on the screen which make a considerable difference to the pressure drop. These are things that were discovered by research. It seems likely that there might be similar discoveries as the knowledge base evolves.

MR. SCOTT: There could well be.

CHAIRMAN WALLIS: But you guys are not doing research anymore. Is that right?

MR. SCOTT: There is some research that -- well, you heard what was happening yesterday. Mostly --

CHAIRMAN WALLIS: It's winding up. They are writing reports.

MR. SCOTT: Most of it is winding up and the staff has made the decision to require the industry to do the testing necessary to determine --

CHAIRMAN WALLIS: Your expectation is that any future surprises or effects which weren't anticipated, let's say, will be discovered by industry, not by the staff.

MR. SCOTT: In general the information that remains to be found we believe will be found by this testing. If, however, it comes from another source, then we will adjust the plan accordingly. Again, we have flexibility in how to proceed with this. Any other questions? Okay. Next up is Paul Klein.

CHAIRMAN WALLIS: Let's see, this knowledge base. The knowledge base you have established is in the open literature or is available. Isn't it?

MR. SCOTT: It will be.

CHAIRMAN WALLIS: The testing that's done is not going to be in the open literature. Is that true? How does the public or somebody of interest know the results of the testing done by these vendors? Is that all proprietary?

MR. SCOTT: The results of the testing as applicable to a particular plant will need to be submitted to us by that plant.

CHAIRMAN WALLIS: But it will be in the public record?

MR. SCOTT: It may or may not be. If it's proprietary information, then it might be withheld.

PARTICIPANT: It's still available to

whoever signs in on proprietary nondisclosure.

MR. SCOTT: Correct, but it won't be in public Adams.

CHAIRMAN WALLIS: It won't be public. What would be interesting would be to compare the designs and the tests. You've got five different vendors or six. Is it five or six?

MR. SCOTT: Five.

CHAIRMAN WALLIS: Five each doing different tests with different screens and so on. There must be some commonality in the approaches.

MR. SCOTT: Yes.

CHAIRMAN WALLIS: It's very interesting to make a comparison and see if the conclusions have been upheld by the comparison between these five different approaches. You will presume to be doing that.

MR. SCOTT: You'll hear a little bit more about that kind of thing from Shanlai Lu.

CHAIRMAN WALLIS: I'm just wondering how much of that will be available rather than being sort of proprietary and protected?

MR. SCOTT: Shanlai, do you have any answer to give to that? I don't know at this point because we certainly don't have those --

CHAIRMAN WALLIS: Would it be a NUREG or

something that looks at these?

MR. SCOTT: We'll have closeout packages for the Generic Letter.

CHAIRMAN WALLIS: We'll see that perhaps later.

DR. LU: We can talk about that later.

MEMBER DENNING: I just have one more question for you, Mike, and that is are there any specific plants or categories of plants that just really don't have enough space to give as much additional size to the screens as one would like? Are there some obvious potential limiting plants?

MR. SCOTT: There are two plants currently that are considering active strainers and one could infer from that that they might have space considerations. The strainers that are being talked about by in large are on the order of a couple of thousand square feet. That's of stuff. Takes up lots of floor space. Any other questions for me? Thank you.

CHAIRMAN WALLIS: Thank you very much, Mike.

MR. KLEIN: Good morning. I'm Paul Klein. Today I would like to provide you an update on status and plans in the chemical effects area.

MR. YODER: My name is Matt Yoder and I'll be assisting Mr. Klein this morning.

MR. KLEIN: We really have two purposes of the presentation. One is to provide an update of staff and industry activities since the last time we spoke to you in the spring. And also to try and discuss some of the plans moving forward to resolve some of the technical issues related to the chemical effects.

In particular I would like to address three different areas today. The first bullet is related to a PWR Owners Group WCAP report that we received, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191." We received that report. We accepted it for review and the review is in progress at this point. The second area relates to some meetings that have been referred to previously we had with NEI and various vendors.

CHAIRMAN WALLIS: This WCAP you're viewing, that is the one that says how to make surrogates. Isn't it? It doesn't say anything about their effect on head loss? Is that right?

MR. KLEIN: They have a very small section on filterability in the WCAP.

CHAIRMAN WALLIS: There aren't a whole lot of equations and things that say if you have aluminum this is how you calculate the head loss due to gel.

MR. KLEIN: That is primarily related more to generation of --

CHAIRMAN WALLIS: Generation of the stuff, not its effects.

MS. LANE: Excuse me. I'm Ann Lane from Westinghouse. I was the program lead on that WCAP. The intent of the WCAP was to provide input to the individual screen vendors for head loss testing so the filter --

CHAIRMAN WALLIS: On how to produce the materials?

MS. LANE: Yes.

CHAIRMAN WALLIS: Not on the expected defecto.

MS. LANE: No. The filterability test which Paul referred to were actually a criteria established to determine if the surrogates were adequate.

MR. KLEIN: The third area we will discuss this morning is related to staff visit to observe some of the alternate buffer tests that are being sponsored by the PWR Owners Group. With respect to WCAP-16530,

as I mentioned before, we are currently reviewing -- at this point the staff has only done a partial review of the documents so I had not planned to discuss many details from that document at this point today, although I will in a few slides address some of the issues that we see that might generate RAIs related to this document.

As far as schedule, the target date for draft RAIs is the end of July of '06. We put a target date for an SE in May '07 with the understanding that there may be additional testing that is necessary in order to address some of the staff RAIs.

What the staff has done since the last time we spoke to the Committee we developed action plans in a number of the key technical areas including chemical effects. The purpose of the action plan was to try and highlight some of the key technical issues to show important interfaces that exist between NRR research and industry. Also to try and identify a path forward to resolve these issues.

We had a three-day meeting in May of those six where we discussed these issues with NEI, the industry, and screen vendors and established paths forward for issue resolution. We also heard from the screen vendors who outlined their approach in the

chemical effects area. We have a total of five vendors and their approach varies.

Some vendors are further along in how they plan to address chemical effects and others. Staff will be making a number of visits to vendors over the summertime to gain a greater understanding of how they intend to approach chemical effects from the test standpoint.

MR. CARUSO: Would it be possible for us to get a copy of this action plan and the path forward?

MR. KLEIN: I think the path forward will be described in some of the slides that we'll present this morning. The action plan, I don't know the answer to that. I will discuss that with management.

MR. CARUSO: Path forward. Is there a document that is written down that says this is our current path forward?

MR. KLEIN: Yes, it's part of a document.

MR. CARUSO: Would it be possible to get a copy of that document?

MR. KLEIN: I'll discuss that with management. It is a working document. It is certainly not ready to be shared with the Committee at this point.

MR. YODER: The document in question is an internal staff document. If you look at the notes from the NEI meeting as well as the slides that we are going to present today, the issues that we're talking about are essentially that action plan. When we are describing the path to resolution, that essentially is the action plan we are referring to.

MR. SCOTT: Ralph, just to add a little more to that, the action plans amount to a table or a matrix and you have the gist of those in the discussions that we're doing today.

CHAIRMAN WALLIS: I reviewed the visual aids for this meeting that you had in May and it seemed to be words describing approach and plans which sounded okay. My conclusion from it all is the devil is going to be in the details. It's a bit like in 1943 saying, "We are going to land troops on the west south of Naples and we are going to sweep the Germans out of Italy." That is a big plan but, as you know, it took a lot of doing and the devil was in the details. I think that may well be the case with this one.

MR. KLEIN: I agree with you that will be the case here. As we get to the tail end of this and we start talking about review guidance, I think you

will hear it will be an iterative process and we will be learning as we go along and we digest information from a number of sources.

MEMBER SHACK: Paul, as I read the WCAP it seems to me the plan is they are going to make up a certain amount of chemical product and argue about how representative that is and they are going to basically add that to their demonstration test. Is that the basic approach that most of the vendors are taking? They are following the WCAP recipe to make a product and then adding it for a head loss test?

MR. KLEIN: I think it varies depending on the vendor. Certainly some of them have indicated they will be following the WCAP so we think it will be critical to interact with the Owners Group on the details of how you generate these products and assure ourselves that those really are representative products.

Really there's a number of technical facets I think that are involved and this slide tries to hit on the chemical model itself since some of the vendors will be relying on that and it will become an area of focus for the staff. I think we have a few questions, more than a few questions, that will be interaction with the Owners Group on the chemical

model.

CHAIRMAN WALLIS: How long you do the test for, too. We heard yesterday with some of these chemical effects that they may not show up significantly for several days.

MR. KLEIN: That's a good point. The test may depend on the environment that the test is conducted with.

MEMBER DENNING: Are you using some of Research's contractors to help you in the technical review of that report in coming up with REIs?

MR. KLEIN: Yes, we have a member of the peer review panel that has been contracted to help with the review of the WCAP.

MEMBER DENNING: Now, is that the peer review panel we heard about yesterday as opposed to the contractors that have been doing the research on the chemical effects?

MR. KLEIN: It's the peer review panel you heard about yesterday from the Office of Research.

CHAIRMAN WALLIS: I would think you would use some of the people who have learned from their own research, people we heard from yesterday.

MR. KLEIN: We have discussed that as well with Research and it is a point well received. The

top three bullets here really identify interactions that the staff will have with various members of industry and licensees. The bottom two things that we'll discuss at the backend of the presentation related to more internal activities trying to coordinate efforts with the Office of Research and then also develop review guidance.

CHAIRMAN WALLIS: Are you going to have some sort of acceptance criteria? That's all based on the cooling, isn't it, head loss and so on?

MR. KLEIN: I think the overall acceptance criteria will be related to demonstrating that you meet the available NPSH margin so there is a head loss requirement.

CHAIRMAN WALLIS: Is it going to be probablistic? How are you going to handle uncertainties? Are you going to look for 95/95 or something? What are you going to do? There are a lot of uncertainties associated with these things.

MR. KLEIN: I agree there are a lot of uncertainties. I don't know that we will get that a 95/95 solution. The licensees will need to demonstrate to us that whatever design decisions they have made have satisfied the uncertainties associated with chemical effects. Within the review of the WCAP

itself I tried to highlight in this slide a few of the key issues to be addressed. You might argue that the first sub-bullet validation of the WCAP chemical model covers everything.

We obviously have questions about limitations of separate effect testing. I believe separate effect testing can be informative. It probably has its place along with integrated testing. There are questions as to whether you get synergistic effects when you start to combine different plant containment materials.

CHAIRMAN WALLIS: You certainly do.

MR. KLEIN: Yes. We will be questioning Westinghouse about their model. I think some of the other items that I've listed here, main areas of discussion will include chemical surrogates, whether the surrogate that you are generating is the appropriate surrogate and then if you can identify the appropriate surrogate, can you assure yourselves in a follow-on head loss test that you have the materials behaving in a similar manner as it would in a plant situation.

There will be questions about evaluation of materials that might not be included within the test matrix and the last item, "Test matrix

assumptions may include things that were considered but not included within the test matrix."

MEMBER SHACK: There are some things that are really strange in the WCAP. If you reduce the amount of aluminum oxy hydroxide you get taking the aluminum off and then the sodium aluminum silicate which you sort of never saw in an integrated test. Eliminate 90 percent of your aluminum hydroxides by taking it off and illuminating. Very strange.

MR. KLEIN: One of the areas in the WCAP that the staff will question they have a table that identifies their best guess estimate of precipitates that were formed. I think we have some questions about how those were identified and whether there might be more appropriate techniques to better quantify what precipitated during those tests.

This next slide here is related to interactions with strainer vendors. One of the points we made with the vendors at the May meeting is that the staff really needed to get their hands around the strainer vendor approach. We need to understand if they are planning to introduce chemical surrogates how that will be done, how they will assure themselves that they are simulating both chemically and physically the properties of expected chemical

product. I would say at this point we have five vendors and a number of them are further ahead than others in their development of chemical effects.

CHAIRMAN WALLIS: So the status of things, we heard from Mike that most of these vendors have already tested their strainers but they haven't yet used chemical effects. Is that right? The new aspect is the chemical effects testing?

MR. KLEIN: I think it is vendor specific. Some vendors have completed their strainer tests. Others still have a number of tests to be performed. You are correct, the chemical effects part seems to be a part that will be developed after some of these other tests.

Another item identified on the slide and one of the questions the staff has is if you don't form a continuous bed or you form a sparse bed, can you claim not to worry about chemical effects as a result of that? One of the things we'll be looking for is some type of demonstration that if you generate chemical effects, will there be any type of bridging over a clean screen or partially covered screen.

CHAIRMAN WALLIS: It might be synergistic effects. If you have fibers that somehow slip through the screen and go around the loop, then when they get

sticky with some sort of aluminum gel, then they might stick around so it's not just a question of one effect by itself. The things affect each other.

MR. KLEIN: I agree.

CHAIRMAN WALLIS: That formation in itself may be affected by the chemical effects. What was a sparse bed without chemical effects may not be a sparse bed with chemical effects.

MR. KLEIN: I think that is one of the items we are asking licensees to demonstrate to us by testing.

CHAIRMAN WALLIS: You're going to think up a lot of questions like that.

MR. KLEIN: Unfortunately we have a lot more questions than answers at this point.

CHAIRMAN WALLIS: But they are going to give you the answers. If you have too many questions, it will take them too long to do the experiments. You will have to slip your schedule.

MR. KLEIN: It's possible that chemical effects may be addressed later than many of the other issues within GSI.

CHAIRMAN WALLIS: Addressed after they put the screens in. It seems to be.

MR. KLEIN: Yes.

CHAIRMAN WALLIS: They are rushing to put half the screens in this year. It may just not be possible to do all the chemical effects testing this year so they will find out afterwards.

MR. KLEIN: I think that there are strainers that have been installed already that they have to do the work after the fact to verify that their strainer is adequate.

The next two slides try to put in tabular format some of the items we discussed with industry and that we have covered in the past few slides. The intent was to not walk through each one of these with you but to show that there are a number of actions that both the NRC and industry is expected to take to make progress on some of the issues that we have identified in the chemical effects area.

I think some of the key things are the chemical model, the use of chemical surrogates, understanding conditions outside of what might have been tested within the number of tests that have been performed thus far.

CHAIRMAN WALLIS: To go back to my schedule here, you're not going to have this SE out until May next year, is it?

MR. KLEIN: That's the target date at this

point.

CHAIRMAN WALLIS: And so the method will not be approved by you until then presumably unless they are going to go ahead and use it now because of the schedule they are on.

MR. MARTIN: If I could just interject here for a moment. I'm Tom Martin, Director of Division of Safety Systems. Actually, this week I'm also the Associate Director of Engineering and Systems.

I am picking up a theme here of some uncomfortableness with regard to our overall approach. Let me just remark that we recognize the situation is an unorthodox situation but if you look at the facts as we understand them now, these plants are operating with screens that are quite marginal. The sizes are on the order of, as Mike mentioned, tens of square feet.

There is a huge variety of designs and configurations that really makes large scale testing quite challenging. It would be wonderful if we could design some kind of a large scale test but in reality we would have to do many different configurations in order to make that practical.

Also the industry volunteered to proceed

with these modifications before sending the RAI responses. Actually before having developed a complete understanding of this issue, we discussed that internally at relatively high levels within the staff and we determined that the most optimum approach to mitigating this situation was to proceed in this direction. I recognize that puts the ACRS in an awkward situation.

As we go through this, we are hopeful that the Committee could help us to identify some of these situations. You have been helpful in pushing us in the direction of focusing more on downstream effects, of looking at some of these synergistic effects that have been pointed out.

We still are providing feedback to the industry, to Westinghouse, on the WCAP, to the Owners Groups, to the screen vendors because we are going out and witnessing all of these tests so that we are still staying involved as we go through this process. We still have an opportunity to interject ourselves in hopefully key areas so we get an opportunity to make some changes.

I recognize that there is a distinct possibility and the industry recognized that there is a distinct possibility that this may turn out to be an

iterative approach. However, given the fact that we have these 69 plants operating now with marginal screens, we believe this is in the best interest of everyone to proceed in this direction.

Our approach on resolving this issue also is largely deterministic. We are applying a reasonable assurance that the limiting situations are appropriately handled. We are trying to incorporate risk insights whenever possible using that general approach. If there are some other opportunities that the Committee has to point us in the direction where we might be more risk informed, we would also welcome that opportunity.

I thank you for your attention.

CHAIRMAN WALLIS: That's helpful. You mentioned that ACRS might be in an awkward situation. Actually, it may be an easier situation for us because you are going ahead and there is nothing much we can do to change your force. We just have to wait and see how it works out. We may not have to do anything.

We have had our say. We have written some letters. We have encouraged certain kinds of research. We have asked some questions and you have responded and now I feel you are ready to take some action and you are taking it. It may be that this is

the time to bow out and see how it works out.

MR. MARTIN: If that is your --

CHAIRMAN WALLIS: I'm just speculating.

MR. MARTIN: That would be your call. However, we do feel it is an opportunity for us to allow the members of the Committee to give us some insight --

CHAIRMAN WALLIS: Sure, if we can help.

MR. MARTIN: -- as we are going through this direction. We recognize, you know, that there is not a high level of comfort here that when we are done with this that we are going to have as high a level of assurance that we have nailed this issue, so to speak, that it might actually be an iterative type process. Given that, I think --

CHAIRMAN WALLIS: That's all right. You are following a plan, though, and you have this process and you realize there may be some things you have to fix along the way that you can't predict everything ahead of time.

MEMBER SIEBER: Well, the proof of the pudding will be when all is said and done and the installations are made do they actually satisfy the requirements.

MEMBER DENNING: And are those technically

defensible requirements. But I think that there is an important issue and that relates to what ACRS is going to have to consider and that is is there any reason that one would say don't go ahead with these until you learn more. Personally I don't think that is the right answer.

I mean, right now I think you are on the right course. I think although we have concerns about downstream effects and that type of thing, were I in your position I would do exactly what you're doing right now which is have them proceed expeditiously to increase screen size.

MEMBER MAYNARD: I agree with that. I believe that the interest of safety is best served by the current pethidine. It may be frustrating. It may still have some iterative processes to go through but I think that overall it is the responsible thing to do. I also believe that some of these uncertainties, especially with the chemical effects.

I'm not sure that the screens are going to ultimately be the solution to that anyway. I believe even the screens themselves, I think the issue is really going to be in removing or changing the chemical effects to where they are not -- I don't think the screen is necessarily the solution. I think

they are on a good path here.

MEMBER SIEBER: I hope that enough comes out of all the research to be able to say the screens will work or they will not work. That is still a little --

CHAIRMAN WALLIS: That's up to industry.

MEMBER SIEBER: That's up to the staff really, you know. The industry will say, "Yeah, they work and here's all the things we considered and we made them so big that the next step will be to enlarge containment to fit in a bigger screen."

MEMBER DENNING: Since there are more people of the staff here today than there were yesterday, I think one of the messages that at least some of us were trying to convey yesterday is that you reduce the risk of having a major embarrassment at the end of this by continuing to do some focused research.

I think there has been very good progress made in this area of chemical effects and I'm more optimistic now that if one continued to do that work, that you'll be in a position to put to bed some of these issues rather than stopping the research now and saying we are far enough along in our understanding.

MEMBER KRESS: I would like to second that notion. Particularly on the chemical effects I think

the idea would be to find out what level of aluminum it takes in containment to research this depth of function where it takes off on the delta P. I wouldn't do delta P measurements. I would find out where the break point is and then the fix is not have that much aluminum in your containment.

I particularly think more research is needed also on the coatings, particularly in two areas. One is I don't think we have a good notion of the particle size generated by the LOCA from these coatings and I don't think we have definitive transport models. I think we should continue the research in those areas.

MR. MARTIN: Thank you for your feedback. One comment on the chemical effects issues. There are parallel paths that are being pursued and one of those paths involves the industry looking for alternate buffers. As we become more educated on the impacts of trisodium phosphate and sodium hydroxide as buffering agents, the industry may very proceed to remove those and choose some other buffer at some point. These parallel paths are ongoing and I do believe this is the most -- maybe not the most efficient but it is the most effective path at the moment. Thank you.

MEMBER SIEBER: Well, I agree that it's

the quickest path. I also agree that I think the predominant effects have been identified and enough testing has been done to demonstrate that those effects are there, chemical effects, downstream effects.

There are a couple areas that I think deserve some more attention. Going back to the basics, janam pinchment I think requires a little more attention, how much do you generate in the first place. On the other hand, if the idea is to improve safety as soon as one can practically do so, I think the path is correct.

CHAIRMAN WALLIS: There is also the question about what you are going to do about head loss which is the bottom line of this thing. You are going to calculate a head loss and see if it's adequate but small enough that the pump can operate. Is this head loss going to be predicted just from the tests where they throw in a lot of stuff and see what the head loss is on the screen and then extrapolate to the plant? Or is there some way it's going to be interpreted using some sort of theoretical model?

If it is, then there needs to be some work on that model. If you are not going to use a model, if the decision has been made just to use purely

empirical approaches, then maybe you don't need more research on the model. If you are going to use a model, we have a model we heard about yesterday which is an improved window with the previous and takes account of the facts which were not considered before which have been observed. Is that model going to be left sort of half finished and not properly validated to be looked at some time in the future, or is it going to be used?

I don't know if you have made a decision yet if you are going to use models and what kind of models, or is it all going to be empirical, or are you just going to wait and see what industry comes up with and then respond? What have you done about the head loss? What are you going to accept for a prediction of the head loss for these installations?

MR. SCOTT: Shanlai, do you want to come up and speak to that?

CHAIRMAN WALLIS: Are you going to talk about that later today?

MR. SCOTT: Okay. We'll talk about it in his presentation.

CHAIRMAN WALLIS: Research that might need to be done which is why I brought it up here. You may need to do more research on the head loss, too.

MR. KLEIN: Shall I continue?

CHAIRMAN WALLIS: Unless you want us to do some more research.

MEMBER SIEBER: If you know where you were.

MR. KLEIN: At the risk of going backwards, I did want to make one comment, Dr. Wallis. You had mentioned we wouldn't have an SE out until May of '07. I did want to point out we have had a number of discussions with Westinghouse on their WCAP both prior to when they performed those tests and during public meetings so they do have a number of the stat spots on some of the issues related to that testing.

I'll try to cover this relatively quickly here. The only thing probably to point out here is the recognition that there probably will be additional issues that are raised in the chemical effects area and we do expect to continue to learn as we go as we receive more information from tests that are both performed by research and industry and screen vendors.

Before we get to the latter two focus areas that talk about internal NRC staff activities, I wanted to give you a brief update on some of the alternate buffer tests that are being performed. For the PWR Owners Group at Fauske & Associates the staff

visited that facility in April of 2006. The project involves trying to identify potential replacement buffering agents for sodium hydroxide and trisodium phosphate which reduce the potential for chemical precipitate generation.

They are carrying buffers that they are evaluating in addition to benchmarking the sodium hydroxide and TSP. They are looking at sodium tetraborate which is currently in use in all these condenser plants as well as several new buffering candidates. Their approach is a multi-phased investigation.

CHAIRMAN WALLIS: The sodium tripolyphosphate is somehow much better than trisodium phosphate?

MR. KLEIN: Yes, sir. Tripolyphosphate is different than the orthophosphate such as TSP in that it's less likely to form precipitates.

CHAIRMAN WALLIS: It doesn't make calcium phosphates then when you mix it with cal-sil?

MR. KLEIN: One of the things that they did as part of these tests on the bottom bullet here, they added either calcium chloride in one case or aluminum nitrate in another case to try and evaluate suspectability to precipitate formation. In the

calcium case they added an amount to get about 400 PPM dissolved calcium level. With that addition, of course, with TSP you saw a whole lot of precipitate. With the tripolyphosphate it was a very, very small amount.

MEMBER KRESS: TSP was put into the sprays to enhance the movement of iodine?

MR. KLEIN: TSP is not injected in the sprays. It's in baskets in the bottom of containers. Yes, the idea is to buffer the containment pool pH to remove iodine.

MEMBER KRESS: To enhance the spray effectiveness?

MR. KLEIN: I think the goal is to get the pH above a value of 7.

MEMBER KRESS: That is to keep the iodine from re-evolving from the sun. It is also to enhance the effectiveness of the spray.

MR. KLEIN: Correct.

MEMBER KRESS: I don't see on here any evaluation of the new buffers effectiveness in enhancing the spray. I'm sure the pH control will do the thing for the sun for the re-evaluation but I'm not sure it effectively enhances the sprays. Are there any plans to look at that?

MR. KLEIN: The staff at the backend of the one-day visit to Fauske we discussed a number of issues with Westinghouse and Fauske. I guess our overall perception is that these were good tests but they seemed to be screening tests which is appropriate when you are looking at new materials. There may need to be additional tests needed in order to develop an appropriate technical basis for a plant to use one of these new buffers.

MR. SCOTT: If I might add, clearly if a plant were to come in with an application to change its buffer and it has design or licensing criteria that relate to the functions of that buffer, then they are going to have to show that those criteria continue to be met.

MEMBER SIEBER: I think one thing to consider are the plants that were designed in the late 1960s and early 1970s did not have hardware provisions for a buffer so the adequacy of spray systems was established without considering that effect. Then those plants were backfit in order to control iodine and to get Part 100 down. If it was adequate with no buffer, it is probably adequate now. I think that is just a secondary benefit that one gets out of a buffered system

MEMBER DENNING: But you saw an advantage there because the TID source term. I think alternate source term would not be, you know, less important. I think it's important to be above seven to prevent iodine evolution in the longer term.

MEMBER SIEBER: But I would rather physically take steps to reduce iodine if it's practical to do so than to go to an alternate source term where the dose is really still there. We just count for it differently.

MEMBER MAYNARD: But, again, I think the --

MEMBER SIEBER: Personal preference.

MEMBER MAYNARD: I think any change that a plant does make whether it be in hardware, the chemicals, or whatever, they are going to have to address any of that that affects their licensing.

MR. KLEIN: The next slide provides, I guess, a staff perspective on buffers. We have learned a good deal of information from the research sponsored tests both at the University of New Mexico and at A&L. Within the TSP environments we observed that you can get significant head loss if you have dissolved calcium levels for that particular loop configuration greater than 25 parts per million.

With the sodium hydroxide it appears to be a more complex process. It depends on a number of things including time, temperature, and pH. We did see that with concentrations on the order of 30 percent of the ICET 1 value there was significant head loss.

Contrast that with what was observed for sodium tetraborate it was tested -- when it was tested at a level that was consistent with ICET 5 there was no increase in head loss. It was only after they added another 50 PPM of dissolved aluminum that the head loss began to take off.

Based on those observations and also on some of the precipitation observation we have at Fauske we think there are options for industry depending on their plant specific environment to choose a buffer that may produce less chemical effects than they have in their existing configuration. The staff is encouraging industry to take a hard look at alternate buffers as one of the potential solutions.

Given the amount of information from a variety of sources, the question that I'm sure you have for us is where are we headed. I think there are really two key things that we need to do at this point. One, we need to have continued interaction

with research but it is important that we -- research has done a lot of good work in the area of chemical effects.

I think it is very important that NRR digest that information, that we understand the important parameters. As Robin indicated yesterday, there will be an RIL coming out that will identify remaining technical issues in the area of chemical effect.

Based on the information that is available from both that, from what we have learned from vendor visits, licensee audits, and observing industry-sponsored head loss tests, our intent is to provide recommendations for our management around the September time frame on what might be appropriate additional confirmed for research moving forward.

Then in conjunction with that another key part is to try and use all the information that we have --

CHAIRMAN WALLIS: So if you recommended research -- excuse me -- in September, this would get into the 2007 budget?

MR. KLEIN: I think there is some money available in the 2007 budget that we might be able to take advantage of. I'm not sure of the amount but our

intent would be to try and do some of that work within the next budget if necessary.

With respect to review guidance I think it would use a similar approach as to what I described for recommendations on additional research. We need to try and digest a lot of the information that has been made available. We also need to hear from industry on the results that they are obtaining in some of their own testing. We need to assemble that all and put together review guidance.

We understand that it may not be a final product at this point but it certainly is something that needs to be put together to help focus us to ensure consistent reviews moving forward. We do expect to iterate on that guidance over time as we learn new information from various sources.

In summary, though, it is important to remember that licensees have the lead and the ultimate responsibility on evaluating their plant specific chemical effects and resolving the outstanding technical issues. Part of what the acceptance criteria would be in the area of chemical effects, of course, is that they would demonstrate that their head loss from all sources including chemical effects is less than the available NPSH for the entire ECCS

mission time.

It would also need to have a good technical basis that shows that any uncertainty in chemical effects head loss is bounded by their available margins and they would need to evaluate potential chemical effects on downstream components. Our plan is to use confirmed research to independently evaluate those licensee evaluations.

CHAIRMAN WALLIS: That would include any sort of heat exchanges, cold spots, and things like that and everything. Downstream is everything the water goes through in the long-term cooling.

MR. KLEIN: Downstream would include all the heat exchangers, piping, vessel, etc.

That concludes my presentation material.

MEMBER DENNING: I have a question. I'm not sure you are the proper recipient of it but the source term that can potentially wind up on the screens has various stages. There is the production of insulation material and then transport down to the sump. Then within the sump there is transport. Then in the near vicinity of the screen there's transport.

The industry previously developed an approach for production and transport down to the sump that I think NRR has blessed previously. Is that

basically the state of affairs today? That is, as you look at the source term that now can potentially get onto the screen, do you accept what industry had previously proposed as far as the techniques they used to say how much material is produced and then the transport fraction down to the sump and then you are going to take it from the sump on through the screen testing. Is that basically the way it is?

MR. KLEIN: I'm going to look for help to address that question. I think with respect to chemical effects, one of the things that we would look for is that the relative arrival time of chemical products will be consistent with how we think they might be generated and transported in a plant condition.

In other words, if you have a calcium phosphate that might form immediately, we would expect that to potentially be added with debris relative to one that might be generated over time that might arrive after the debris is formed.

DR. LU: Shanlai Lu from SSIB. Overall we consider that SE proved the NEI guidance report. In terms of transport it's still conservative. In terms of the chemical effects and the precipitates, at this point I think it is the assumption that it is 100

percent transportable. Therefore, I don't think that is an issue in terms of --

MEMBER DENNING: That the chemical products are 100 percent transportable?

DR. LU: At this point, yes.

MEMBER DENNING: But as far as the amount of fibrous insulation and debris that make it to the sump, you are kind of accepting -- you still consider that conservative.

DR. LU: We still consider that conservative, yes.

MEMBER DENNING: And I assume that when the applicants make their case, they will take credit for stuff that is retained back along the way.

DR. LU: Yes. We take the credit from interceptor test and their own specific test.

MEMBER DENNING: Okay.

DR. LU: Relating to near-field effect I am going to cover that. It is close to the sump strainer and then we can talk about that.

CHAIRMAN WALLIS: So shall we move along to the next subject? The next subject appears to be coatings. Is the next subject coatings?

MR. YODER: Correct. My name is Matt Yoder, NRR.

CHAIRMAN WALLIS: Do we have a handout?

MR. YODER: I believe you have copies. I'm going to address the coatings issues that are still on the table for GSI-191 and the staff's proposed resolution path for those issues. To refresh your memory, the key issues that are still on the table for coatings are the zone of influence and the area immediately around the pipe break where the coatings can be destroyed.

The amount of unqualified coatings. These are coatings that were never assumed to be able to survive a DBA. Some testing has been done to try to prove that some percentage of these will remain adhered to the subtract and won't become a debris source. I'll discuss that.

Transport of coatings which you heard a little bit about yesterday. Then assessment of the coatings that are assumed to be DBA qualified to ensure that they are still intact.

So that's current activities. Regarding the zone of influence, we expect by July 15th to receive two reports from industry groups.

CHAIRMAN WALLIS: Wait a minute. I'm trying to stay with these activities. What is the status of predicting what effective coatings is on

head loss. Is that something you are satisfied with?

MR. YODER: I don't plan on addressing head loss but I think when we talk about transport maybe that would be a better time to discuss the head loss implications.

CHAIRMAN WALLIS: I don't think we have a tool for predicting head loss with coatings yet. Do we?

MEMBER SIEBER: No.

CHAIRMAN WALLIS: Not one that I know of.

MEMBER DENNING: Well, I think it's a matter of if the debris is fine debris, then I think one assumes --

CHAIRMAN WALLIS: It's ground up very small.

MEMBER DENNING: Yes.

CHAIRMAN WALLIS: But if it's flakes --

MEMBER DENNING: If it's flakes, then it's different.

MEMBER SIEBER: Well, I gather the outcome of yesterday's discussion on coatings was it doesn't transport very well.

CHAIRMAN WALLIS: That may solve it.

MEMBER SIEBER: So you don't need to know too much about it.

MR. YODER: We'll get into it in a little more depth in the transport section. The bottom line is if it's particulate, we would expect it to behave like other particulate debris. If it's chips, it's probably not going to get there anyway.

CHAIRMAN WALLIS: How big is a particle before it's chip?

MR. YODER: The testing that was done for our transport went down to a 64th of an inch so that is pretty fine. We consider that a chip.

CHAIRMAN WALLIS: It's still thin compared with its dimensions.

MEMBER SIEBER: Right.

CHAIRMAN WALLIS: It's still a flake.

MEMBER SIEBER: Still a flake.

MR. YODER: A that size it's still more the shape of a flake. So for zone of influence we expect to get data by July 15th. As I said, there are two different industry groups that did testing to reduce the size of that zone of influence. I'll talk more about each of these topics as we go on.

There has been some testing on the unqualified coating performed by EPRI to try to take credit for some of these coatings remaining on their substraight where the staff position before was that

all of these things are going to fail and become a debris source. We are currently reviewing that report.

As you heard yesterday, Office of Research is analyzing the transport results. We continue to interact with the industry groups on this issue of assessment of the coatings and what is the proper way to ensure that these coatings that are qualified are going to stay on the wall.

CHAIRMAN WALLIS: Maybe we can help you when you come up with a draft position where you are going to say we are going to accept a zone of influence of a certain size for certain kinds of coatings. They are going to accept certain proportion of unqualified coatings being taken off or whatever it is, or within some zone or whatever. We are going to accept certain transport tests as being valid or if you have a velocity less than some certain size. When you come up with a position or draft position on these matters, that is perhaps where we can help you?

MR. YODER: I agree. I expect we will do just that, we will form a staff position, X percent of these coatings will fail. This is the size of the ZOI, etc. We would welcome your feedback on those positions.

I'll talk in a little more depth about the zone of influence testing. The staff guidance that is currently out called for a spherical zone of influence of 10 L/D. A radius of 10 pipe diameters around that break location, all the coatings within that area would be assumed to fail and fail as fine particulate.

What we have seen from some of the testing is that when these things fail within that two-phase jet area it is by erosion and the failing is very fine pigment almost, 10 micron size pigments. That is the assumption. Everything within that zone of influence is very fine. It is going to transport. It is going to play into your debris bed.

As I said, two different groups. These are groups that were sponsored by different subsets of plants to perform this kind of testing have taken coupons of these qualified coatings, subjected them to a two-phase jet in an attempt to reduce the size of that ZOI. We'll get those reports July 15th and as we go forward our review will focus on that two-phase jet. Is it realistic of what you would expect from a real pipe break, how were those coupons prepared, the actual coatings that were used, and how did those apply to the coatings that are actually in the plant.

Moving forward, we'll provide the staff

position to the industry, to NEI, and we would expect that any concerns that we have with this testing would be addressed by licensees when they submit their generic letter supplemental response. If we say do not address the irradiation of the coatings or any other aspect, we would expect that they would possibly perform more testing to address that or find another way to address that concern if they plan on taking credit for reducing the size of the zone of influence.

Regarding the unqualified coatings test, and I'll explain these tests a little bit because I know the Committee hasn't perhaps seen this report or hasn't been privy to this, what they did is they went into plants and took actual electrical cabinets, pipe hangers, various equipment out of the plants.

These things have been aged, been in the plant, been irradiated, been subjected to normal service. They put these things in an autoclave where they simulated a DBA temperature and pressure history and subjected them to spray. The result was that some percentage of the coatings failed and some remained adhered to the equipment.

CHAIRMAN WALLIS: I just looked at it very briefly. It wasn't always consistent, was it? I mean, the difficulty was that you tested some

electrical box and some of them behaved one way and some behaved in different ways. What are you going to conclude?

MR. YODER: Right. Certain coatings types perform better. Certain pieces of equipment perform better. I envision when we come up with a staff position for this it will be if you can prove that you have coating X we would accept some percentage of it will stay on. If you have coating Y, maybe a lesser percentage will stay on. Maybe we won't give you credit for any of it staying on.

As I said, the intended use is to reduce the amount, the percentage that will fail. Also they captured some data about the size of the debris. Once it did fail they were downstream filters. I alluded to yesterday during the research presentation that the debris that was captured downstream was all fine debris. The largest pieces were around 1,000 microns.

CHAIRMAN WALLIS: You say this indicates some licensees will use the data, test data. Presumably it would be better if it were in the form of some sort of NEI guidance or something so that they all were using this data in a consistent way.

MR. YODER: This report has been put out as essentially a data report.

CHAIRMAN WALLIS: It can be interpreted different ways by different licensees.

MR. YODER: That's correct. That is why the staff wants to review this thing in advance and provide a position so that licensees when they do use this data in whatever way they want to use it will be aligned with --

CHAIRMAN WALLIS: You are not going to ask someone like NEI to synthesize it all into a position. You're going to do it.

MR. YODER: Correct. We are going to tell them what we will and will not accept.

I heard yesterday from the Office of Research about our coatings transport work. Licensees who plan on crediting lack of transport such as the chips that we saw under representative losses probably will not transport to the surface. Of they do transport to the surface --

CHAIRMAN WALLIS: Where do these chips come from? You told us the debris is actually eroded into very small particles. Where do the chips get formed?

MR. YODER: Okay. And we'll get there also but I'll go ahead and -- within the zone of influence you are going to have fine particulate,

okay? Unqualified coatings outside of that zone of influence they are weaker.

CHAIRMAN WALLIS: You assume they all come off?

MR. YODER: They will come off and those we've shown like that EPRI test will probably end up in fine particulate. You also have some qualified coatings which are much more rigid, much more robust coating system outside of that zone of influence. Some of those are degraded either because they were misapplied, they have aged in some way. When those fail, we have seen some data and there is one plant that has taken some of those coatings in large chips and run a similar autoclave test and much of them stay in a chip form. Some of these coatings will remain in a chip form.

CHAIRMAN WALLIS: Some may even fall off without a LOCA.

MR. YODER: Those are the kind of coatings that I'm talking about. The plant that performed this testing actually used some of those coatings that had fallen off the wall, scraped them up, and said, "What is going to happen to these things in the DBA? Are they going to turn into dust or are they going to stay in chips?"

CHAIRMAN WALLIS: You didn't assume how much of these coatings come off. Are you going to grade each plant? You've got 10 percent degraded coatings or whatever?

MR. YODER: There is another slide in this presentation.

CHAIRMAN WALLIS: Another slide that says that?

MR. YODER: That goes to the assessment of the qualified coatings. As I said, there have been plants recently where we have seen some of these coatings that are supposedly qualified to a standard DBA falling off the walls under normal conditions. Industry has historically performed visual assessments of these coatings. Do a containment walk down and identify areas where you see blisters or cracking and chipping, etc.

Staff as a result of these failures where they were performing visual assessment but either something went wrong in their program or they weren't performing the assessment properly or the technique is not good enough to ensure the stuff is going to stay on, we formed a position that the industry either needs to take one of these three options that I've

listed out here. They either need to demonstrate, do some test program that visual assessment is adequate to prove these things will stay on. They need to go and perform physical testing, perform some sampling of their coatings with physical tests that can prove that these things are going to withstand --

CHAIRMAN WALLIS: In the May meeting the industry was very resistant to the second one.

MR. YODER: That's correct.

CHAIRMAN WALLIS: You could just have a coating pullover or something that you put on the wall and pull.

MEMBER MAYNARD: There are pull tests.

CHAIRMAN WALLIS: Pull tests. That would be rather easy to do. What is the problem? You don't like to go into containment?

MEMBER SIEBER: It's the result that is the problem.

MR. YODER: I won't commend on that.

CHAIRMAN WALLIS: What did you say, John?

MEMBER SIEBER: It's the result that is the problem.

CHAIRMAN WALLIS: They don't like what they find?

MEMBER SIEBER: Sometimes.

MR. YODER: The feedback we've gotten on that second option, performance and destructive tests, is that it is a destructive test and they don't want to go and rip paint off the wall.

CHAIRMAN WALLIS: It's going to be local presumably.

MEMBER SIEBER: You still have to repair it.

MEMBER MAYNARD: Yeah, you still have to repair it.

CHAIRMAN WALLIS: That's part of the test. You pull and you repair right away.

MEMBER SIEBER: Well, but when you repair a missing paint chip, you end up doubling up in some spots.

CHAIRMAN WALLIS: It might be worse.

MEMBER SIEBER: That basically is a non-tested system then and the repair is unqualified.

MR. YODER: Correct. Aside from the fact that if you wanted to go back on as a qualified system there's a lot of QA you have to go through and a lot of processes to prove that it is going to be a qualified coating.

MEMBER SIEBER: It's got to be compatible with the original coating and sometimes you can't

buy --

CHAIRMAN WALLIS: If you pull it one place and it comes off, then you would have to pull everywhere to see if it comes off.

MR. YODER: I think the other issue is if you performed a random sampling and you found that some percentage failed, where do you stop the sampling. It might expand.

CHAIRMAN WALLIS: That might be a good thing for you guys to determine.

MR. YODER: This is the position we took. We suggested that they do this. Alternately the third option that we provided is that you assume all the coatings fail and then you consider the transport implications and the head loss implications.

CHAIRMAN WALLIS: What size do they fail, too.

MR. YODER: That's correct. In order to do that you are going to have to prove that you get chips or you get particles of whatever size. Maybe if some percentages fails as chips, some percentage fails as particles of a very fine nature you have to account for it in your evaluation.

MEMBER SIEBER: That is pretty tough because when you really think about it there's a lot

of coatings inside containment. I mean, there's tons of stuff.

CHAIRMAN WALLIS: It's on the order of 100,000 square feet, isn't it?

MEMBER SIEBER: Yeah, it's real thin. On the other hand, there's a lot of paint that goes in there.

MR. YODER: There is a lot of paint. Another issue is say you have a plant that goes ahead and assumes that all their paint fails. They have another large amount of debris in the sump and in the chemical effects area we have asked that they evaluate the impact that amount of material could have. Is it going to leach out some other chemical constituent that could add to the chemical effects problem? We have asked them to address that concern.

MEMBER MAYNARD: This is an area where it is important to be conservative but not overly conservative because the additional work that can be generated you can actually cause additional problems. Also you are working in an area the more people that you send into there to be working, testing, and doing other things, you are picking up radiation exposure. It is important to be conservative but I think we have to be careful we're not overly conservative and that

generating a lot more radiation exposure and other problems.

MR. YODER: As we move forward with this, I expect licensees to take different approaches. Some will say that all the coatings fail and maybe they have enough margin with their head loss that they can accept that. Others will say that some percentage fails. Others will prove through physical testing that the coatings are still good.

CHAIRMAN WALLIS: What are these vendors doing, these vendors that are doing large-scale tests in a flume or something with a full-scale strainer and that throwing debris in and then seeing what happens? Are they throwing in coating debris as well?

MR. YODER: They are throwing in coating debris and they are throwing in a tremendous amount of coating debris.

CHAIRMAN WALLIS: They are? Okay.

MR. YODER: And one of the things that we've asked is for these plants that are throwing in such a large amount of coating debris, they are going to need to address the near-field effect and the other issues, the scaling issues that we have with the flume testing. You will hear more about that when Dr. Lu gives his presentation this afternoon.

As I said, we are going to evaluate each plant's response as they come in. We have provided the three options that we expect them to take. We will evaluate them each accordingly. We are going to continue to work with the industry on this, with ASTM, EPRI, Nuclear Utilities Coating Counsel.

There is a workshop, an ASTM workshop in July the staff will attend. That is focused on trying to identify the proper way to assess your coatings, perhaps some new assessment techniques that aren't currently used. There's an EPRI/Nuclear Utilities Coating Council workshop in August that focuses on the aging of these coatings.

Is this an aging problem, are these coatings nearing the end of their life expectancy, or is this some other phenomena, these coatings that you are seeing failing? Was it just an application error and if they were applied right they would continue to serve their function?

The last bullet here, this came out of a workshop, the recent workshop with NEI. An industry group has proposed to try to validate that first option I provided, the visual assessment, to demonstrate that the visual assessment is good enough. What they proposed is to go into a handful of plants,

find areas that they deem visually acceptable, and do destructive tests to prove that. We said it was visually acceptable.

We said it would survive a LOCA. We did a physical test and that backs up the fact that we said it was visually good. The initial feedback that the staff has given them is, "We'll work with you on this. We'll come observe. It's not going to fly if you go into a pristine containment with good paint and you do this. You are going to have to find some bad paint as well to try to validate this effort. That's in the early stages and the staff will be working with them to --

CHAIRMAN WALLIS: Well, if you go into a containment where a small region is shown visually that there's a problem, then you could look and see if the places which you didn't detect visually are okay. That sort of thing is what you're going to do.

MR. YODER: Correct. We have asked that, you know, if you find a bad section of paint, we like to start close to that area and work your way away. See how far you really can predict and maybe you come up with a model that says within a radius of however many feet visual is okay and then you apply that conservatively when you do your walk down. Maybe it

won't work at all. Maybe we have to fall on the second or third option which is do physical testing or assume these things fail. We'll see and we'll update you.

MEMBER SIEBER: So you want to see how much the bad painter was able to paint.

MR. YODER: To wrap up, I would just like to reiterate that for all of these areas, these coatings issues, we have identified paths forward. We may not be in total agreement on what the end result will be but I think we have a clear path to work our way out of these problems and industry is on board interacting with us to try to solve these issues. In many of these areas we have test data so I think we are in good shape in the coatings area.

MEMBER SIEBER: I have a question. Without discussing any specific licensee, I'm sure that the staff as seen some variability in the quality of coatings from plant to plant. Are there plants that have superior well adhered and intact coatings and are there other plants that have bad coatings where you see a lot of deterioration? If so, what is the proportion?

MR. YODER: As I said, one of the industry groups that we're working with is EPRI and NUCC

Coatings Aging Task Group. One of the outcomes of that is they performed a survey to try to assess how extensive is the problem. Is this happening everywhere? Is it only at certain plants? One of the things that came out of that is it seems that certain coating systems, primarily inorganic zinc primer with a phenolic epoxy topcoat tend to be the bad actors.

The initial thought is that this inorganic zinc primer is difficult to apply. If you apply it too thickly it becomes dry and the top coat won't adhere. It will come off. Too thin or some other problems. Because of the difficulty of the application, the thought is perhaps it's an application issue and that it may be isolated to certain subset of coding systems.

Staff is working with that group. We have not fully bought into that yet but it is one possible resolution. We are not convinced that it's not an aging problem. It could be other coatings may also be susceptible to similar --

MEMBER SIEBER: It would seem to me then that if there are plants out there that have coatings that are suspect, that the solution would not be to replace the coating but to make the sump pit larger. In that case, do you have the tools to evaluate how

large the sump needs to be made just to accommodate the coating issue in the plant that has susceptible coatings?

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

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

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

MEMBER SIEBER: Thank you.

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

comment on.

This path forward rather than the research we heard about yesterday is something that we want to comment on as a Committee and then have a meeting in July about. I'm just throwing that out for you to think about today.

We are going to take a break until 10:30. Is there anyone who objects to taking a break until 10:30? We'll take a break until 10:30 then.

(Whereupon, at 10:10 a.m. off the record until 10:35 a.m.)

CHAIRMAN WALLIS: Come back into session. We are going to hear about something you always wanted to hear about, downstream effects.

MR. UNIKEWICZ: Good morning. My name is Steven Unikewicz with the Division of Component and Shearing, Component and Testing Branch. This morning we are going to talk about -- what I'm going to talk about is downstream effects, specifically non-vessel. The areas of my topic is really downstream the screen to the inlet vessel into the feedwater nozzle into the vessel. We'll talk about the pump valves and all the other intermediate components.

What I'm going to cover is the current status of our evaluation, the challenges remaining,

how we plan on going forward, and I'll provide a very short summary of where we are today.

Where we are and what the current status is is, as we've talked about for the last year, almost all licensees are using the PWR Owners Group WCAP-16406P which is the Downstream Sump Debris Effects in Support of GSI-191.

What this was, this was initially a report given to us for information only last June. What we have done since last June is we did take a preliminary look at that. We provided the WOG and now the PWR Owners Group with roughly 43 comments, if you will, since we did not have that for formal review.

Since that time we have spent a considerable amount of time talking with them about our comments and what some of our very general concerns are. Since we didn't have it for specific review, it was meant to be a high-level type discussion and we have had a series of them over the last year, most recently about a month ago.

CHAIRMAN WALLIS: Did you find the research useful on downstream effects and valves and that sort of thing?

MR. UNIKEWICZ: It was useful in that it confirmed a lot of the things that we had already

felt. We had some inclination and we had some good engineering judgment about how the valves would clog and some of the other things. Really that provided I think useful information to us and that provided good confirmation of what as engineers we felt we knew anyway. It provides a solid basis for some of our ongoing evaluations.

CHAIRMAN WALLIS: It certainly showed there could be effects.

MR. UNIKEWICZ: Absolutely.

CHAIRMAN WALLIS: It showed there were effects on the valve coefficient and so on. I don't think it got to the point of predictive tool. Sort of given this stuff you know exactly how to predict what a valve will do. It is up to industry to presume to provide that.

MR. UNIKEWICZ: That's correct. By the same token, it did do some very useful things. It confirmed what we had said early on a couple of years ago that there are some effects. In fact, people do need to consider this and, because of that, a number of licensees are, in fact, changing out throttle valves.

They are going to different designs. They are doing a lot of different things. I guess on a

personal basis some of the research was gratifying in that it confirmed that we had talked about from an engineering basis to people a number of years ago.

Because of our conversations with the Westinghouse Owners Group and on initial Rev. 0 they provided us a redline strikeout version. Now, that redline/strike-out data provided us for topical review. We just received it June 5th. A quick read of it says they have addressed some of our comments. They haven't necessarily addressed all of our comments. That report right now is in acceptance review. I'll talk about we plan on going forward with that.

The June 5th date and the June 5th submittal, at least from our evaluation, really is a key point going forward because it finally gives us something tangible in-house to speak very openly and honest with the industry about.

The challenges I think are the same challenges you've heard all along. Very specific to the downstream evaluations is because of the methods and how utilities stacked up to priorities, a lot of the initial responses to the generic letter were incomplete.

A lot of that reason was we believe

because they were concentrating very much on I'll call them the upstream effects, the head loss modeling, the transport, a lot of those earlier issues, with the thought that once they get that behind them, the next step would be to address what happens once we get by the screen.

For that reason a lot of initial responses were incomplete. As I said, what has happened is since virtually all of the licensees are using this WCAP it does require acceptance and they submitted it for topical review.

CHAIRMAN WALLIS: Considering downstream effects because some of the designs that I've seen in the screens have slower holes than they had before.

MR. UNIKEWICZ: Yes.

CHAIRMAN WALLIS: They even have a supplementary device which is supposed to catch stuff which gets through the holes. They are certainly not -- they certainly have not ignored downstream effects in their screen design.

MR. UNIKEWICZ: If I said that, that's what I meant to imply. I think with a resource looking at different engineering solutions you put it on where you feel you need to make the most progress in the lest amount of time and that was really on

screen design. Once you deal with the screen design, then we can deal with pumps and valves, instruments, low-flow areas and things of that nature.

As I said a little bit earlier, the WCAP will require acceptance and detailed review by staff. It's a relatively voluminous document. There is a lot of information in there. It is going to take some time.

CHAIRMAN WALLIS: I guess the detailed review comes before the acceptance. Doesn't it?

MR. UNIKEWICZ: Again, this project has been like a lot of others that, yes, in effect we have done a lot of detailed review prior to acceptance review. That is a true statement. It is the nature of this project.

MR. SCOTT: But to be clear, the detailed review that ultimately results in our report on our evaluation follows acceptance for that review.

MR. UNIKEWICZ: That's correct.

CHAIRMAN WALLIS: I guess I have to question what you mean by acceptance. You accept it as being worthy of review.

MR. SCOTT: Acceptance means there is enough information the staff can begin to review.

CHAIRMAN WALLIS: That doesn't mean that

you agree to everything that is in there.

MR. UNIKEWICZ: That is correct. I use the term acceptance review in the context of a topical report.

CHAIRMAN WALLIS: I was thinking of acceptance in the form of endorsement really.

MR. UNIKEWICZ: No, sir. It does not imply endorsement at all. It implies that it has enough information for us to enable to begin our review.

CHAIRMAN WALLIS: I see.

MR. UNIKEWICZ: A quick read of it and, again, we've only got it a scant week ago, it is not clear that they have addressed all of our comments. I guess that is not terribly unusual. We do expect a lot of continued conversation with them on those details and very specifically to some of them more detailed reviews of how they are dealing with pump rotating dynamics, how they are dealing with some of their wear evaluations.

CHAIRMAN WALLIS: How do you pronounce P-W-R-O-G?

MR. UNIKEWICZ: We haven't figured that out yet.

CHAIRMAN WALLIS: WOG was easy. This is

a difficult one.

MR. UNIKEWICZ: We'll have to come up with something. People need to recognize that there are a large amount of very plant specific data that are required to apply this WCAP. The WCAP is not a methodology. It is, in effect, a reference document for all intents and purposes.

It provides you a lot of good reference material that they gleaned and gathered from a lot of different sources whether it's from the pulp and paper industry, whether it's from the fossil powered industry, from the petro chemical industry.

It is not in the methodology and it is not a cookbook to say if I start on page 1 and end up on page 387 I've got an engineered solution to the problem. It is not that. It is a collection of different materials. It is at this point in time a fairly decent copenium of good information.

CHAIRMAN WALLIS: Does it contain discussions of the core?

MR. UNIKEWICZ: It does but at this point in time the decision in one of our comments was the core is sort of a unique beast and it was decided, and we'll talk about this in the next presentation, to really pull it out of it and let's sort of make this

into three pieces. That is everything up to and including the screen itself.

Let's deal from a systematic standpoint just downstream to the screen, to the inlet, to the vessel, a very sort of clean, closed system, if you will, to be able to deal with from a parametric standpoint than from a parametric standpoint how do we deal with in-vessel materials.

CHAIRMAN WALLIS: There is a different presentation we have on that.

MR. UNIKEWICZ: Yes, sir. That is correct. That will be the next one. Because there is, I'll say, a lot of reference material and because of a relatively large document and a lot of information in it, my expectation is that people are going to need to understand how to apply this information and how to apply this reference to their particular evaluations.

Like everything else, there is a lot of variance within the plants. There is a lot of very plant-specific data. The concern, and one of the things we talked to the Owners Group about, is we want to ensure that people are not taking information out of context. They are not taking a bit of reference out of context. That is put into the whole scheme of

things.

I suspect, and it is something that we are continuing to talk with the industry about, is it may be very, very worthwhile to make sure that people are applying this reference material appropriately so additional training may be required.

Now, people have had, or licensees have had, draft copies of this since last June. As a result of that some of the things that the WCAP does talk about is determining how you deal with the downstream source term and based upon what that is the evaluation of the components.

It is kind of interesting that as a result of going through at least their first cut of looking at the information is that they are going to start to use vendor testing to determine the downstream source term. I believe the reason for that is is using conservative assumptions that we had before they're failing.

There are failing pumps, failing valves, failing a lot of other things just because of conservative assumptions both contained in our initial safety evaluation and in some of the parameters that are being used within the WCAP report.

CHAIRMAN WALLIS: They are failing these

things in a theoretical sense.

MR. UNIKEWICZ: Yes, sir. They are meaning that they may fail them because they find that a throttle valve with a 3 mil opening is clogging.

CHAIRMAN WALLIS: So you didn't say that in the testing that the vendors are doing they were failing downstream.

MR. UNIKEWICZ: No, sir. They are failing along the lines of when they look at where rates of particular stainless steels that they are finding gaps opening up three, four times nominal. When they compared that to the rotor dynamic data, it does not necessarily provide a good operable piece of equipment.

MEMBER SIEBER: But there has been some testing. For example, data species pump.

MR. UNIKEWICZ: There has been some testing. In fact, the PWR Owners Group has contacted and they have been working through flow serve and flow serve did a pump and they did some testing with a set of materials to look at wear rates again for a particular 410 stainless leaded components.

Again, what I talked earlier about, our concern is to make sure there are roughly half a dozen or a dozen different pump manufacturers, a dozen

different configurations. Almost every plant operates them a little bit differently. Stage to stage pressures are a little different. How they apply that flow serve data and other data to their particular pump, or even if it is applicable are some of the things that we are talking about.

MEMBER SIEBER: Well, some of the important parameters even within a given pump model will vary. For example, water lubrication, does it come from the pump fluid or does it come from some other strain.

MR. UNIKEWICZ: Absolutely.

MEMBER SIEBER: Seals, bearings.

MR. UNIKEWICZ: That is why we already see that one of the recommendations will be made early on was to look at such things as cycle and separators. In fact, as people have looked at them they are saying, "Gosh, we can't survive with this. We need to do a different modification working with the pump measures to come up with a different solution rather than a cycle and separator." A cycle and separator is a great piece of equipment. It has its place and it has its uses.

MEMBER SIEBER: Difficult to install.

MR. UNIKEWICZ: So they are looking at

other options. You are right, it's because of bearing cooling. It's because of other reasons, bits and pieces and parts specific to pump design.

MEMBER SIEBER: I guess my question is is there enough detail in the WCAP to allow for a thorough engineering analysis of a given plant to determine whether it is acceptable or not. Secondly, what is the assumed mission time, 30 days?

MR. UNIKEWICZ: Let me address both. One is, is there enough information contained within the WCAP? I have a tough time answering that right now really without a detailed review. Part of that is -- one of the really nice things about the report is they did a very thorough industry survey where I've now got make and model of LPSI pumps, HPSI pumps, containment spray pumps, anything within the ECCS train.

I've got make and model of the various and sundry sizes of throttle valves, all different types of things. Based upon that, a lot of plant specific data will be able to do that. I'm really hesitant to say without giving a detailed review that it's -- I feel right now there are holes in it.

Again, I'm kind of reluctant to say more than that without going through because of some of the comments we had and some of our discussions with them

it became clear in our discussions that all of a sudden the light bulb went on later on and, "Ah, we understand. We didn't address that fully." There was sort of a recognition that once the light comes on and you understand the problem a little better, the solution is closer.

They are closer. Is the report complete? My gut feeling is no. Will there be a final revision? I think the answer to that is yes. Will every plant be able to use parts of it? Yes. Will it be able to use all of it? I doubt it just because of the variety of plants.

MEMBER SIEBER: You just got the latest version for your review.

MR. UNIKEWICZ: Yes, sir.

MEMBER SIEBER: I would be very interested in reviewing it, too, but it is premature for us, I think, to look at it now. When will it be available for us to look at?

MR. UNIKEWICZ: I defer to Mr. Scott.

MR. SCOTT: I would say you could certainly look at it now. When the time is right for comments is another question but we can --

Ralph, did we not give you a copy of that report?

MR. UNIKEWICZ: Yes, Ralph got a copy.

MR. SCOTT: So you all have it.

MEMBER SIEBER: Well, do we have it? We could have it.

PARTICIPANT: You will have it.

MEMBER SIEBER: Could you make it PDF?

CHAIRMAN WALLIS: Could you answer the question that Jack had about mission time?

MR. UNIKEWICZ: Oh, sure.

MEMBER SIEBER: Thirty days.

MR. UNIKEWICZ: The mission time is really very plant specific. We have repair mission and ECCS mission times and from plant to plant that varies. On the next slide that becomes part of the acceptance criteria. There are plants that have longer than 30-day mission times. If a plant has longer than a 30-day mission time, the expectation is the evaluation extends out to that point in time. It depends on a detailed review of their design and license basis.

This is truly an ECCS operability review, system flows, process fluids, what are my acceptance criteria. I need to have 3,200 GPM for this period of time. It may very well be time dependent meaning that at a certain period of time, zero to 24 hours my required flow may be 3,000 GPM. However, post 24

hours it may be something less. Therefore, if there is leakage in between seals or stages and the plant is not -- the particular piece of equipment is not operating at its peak, that may be okay.

It may be okay as long as the pump doesn't self destruct and it performs whatever it is that fits your Chapter 14, Chapter 15 Acts analysis and what is the mission time. It is sort of a round-about say to say is the mission time 30 days. Maybe sometimes it sort of depends depending on the situation.

There are modifications ongoing. There are plants that are hard facing internal components. There are plants that are replacing throttle valves. One of the extensions on the review is, in fact, that. They determined that they had very, very tight clearances.

Again, I think as a result of our review and confirmation via the research work that they, in fact, would plug the throttle valves in a very considered method looking to make sure that their pressure breakdown within their system, again this being sort of a system question, that the combination of possibly other orfi and valve design that they could solve this problem. Licensees are considering changing orifice material because of worries. They

are planned and they are ongoing.

Again, it is detailed design, it's detailed design review. A lot of it goes back to some of the things that people are doing is they are looking very closely at process fluid constituents. Based upon their process fluid constituents, that is how they are doing the rest of the evaluation. Again, sort of wavering back and forth.

The early plants took a very, very conservative approach. They are making modifications. I think some of the plants later on in life, if you will, are looking back, "Gosh, if I don't have to replace internal HPSI throttle valve based upon good representative test data, then that good test data is something worthwhile to look at."

When we talk about vendor trips, and Mike alluded to it earlier, that is one of the things we are going to be looking at over the next couple days at one particular vendor in the active strainer because this does become a very critical piece.

How you deal with the pass-through fluid, if you will -- again, I'm going to stay away from the term bypass. It's not bypass fluid, it's a pass-through fluid. Responses to our RAI and our RAI to the industry earlier this year were really how are you

going to apply and how are you going to use this WCAP.

Tell us very specifically I'm going to use Chapter 6, paragraph 4.35 so that in some cases it was really for us to make sure we focused our reviews on the right things at the right time understanding that people are doing modifications and making evaluations.

The unfortunate, unfortunate in some cases, is that those responses were really not going to see probably until at least the end of the year and most probably later than January '07. One concern expressed earlier are we sort of looking and doing design reviews on the backside? Yes, we are.

The hope is that if there are challenges and modifications, there are a lot of other operational strategies which other folks within the team can address. There are solutions to the problem and a lot of times they are called engineered solutions and it is a combination of a lot of different things. Will be looking at some of their evaluations on the backside? I think the answer to that is yes. Are we concerned about that? Yes, we are.

I would prefer to have somebody up front come and tell us what specific sections. The other thing I'm concerned about is that we are looking at

this report in real time. If I can expend my resources on things that the vast majority of licensees are using, that is where I prefer to spend my time right now and spend less time on other ones.

MEMBER SIEBER: The most important parameter in my mind is the first bullet on this slide which is the source term.

MR. UNIKEWICZ: Yes, sir.

MEMBER SIEBER: And you're saying that licensees are using vendor testing to determine the source term?

MR. UNIKEWICZ: Many are.

MEMBER SIEBER: How are they doing that, you know, because if you use the surrogate as descriptive of the included constituents of the fluid that you are trying to pump around, they may not fully represent what the source term will be.

MR. UNIKEWICZ: Herein lies the challenge that I think Shanlai is going to talk about later in the evaluation of people's prototypical testing. That is, why we are spending some time at a number of these vendors to make sure that, in fact, we agree with the test methods, how they are collecting samples, and, more importantly, what they are doing with their samples.

I agree because that is the key input parameter, input assumption, if you will, to a lot of our evaluations. They are going to this because, quite frankly, they are failing when they go on the conservative end so the idea --

MEMBER SIEBER: I would expect that.

MR. UNIKEWICZ: I think a lot of us expected that. They expected it also.

MEMBER SIEBER: What kind of bounds are you going to put on the licensee's selection of a source term? Are you going to look for a medium kind of a source term or conservative so that you bound all possible cases?

MR. UNIKEWICZ: We have to take it on a case-by-case basis. We are going to have to see how they apply it and assure that the method that they use and the results that they use are conservative and/or realistic.

MEMBER SIEBER: I would suggest they should be realistic but I think that you have to apply your same criteria to every licensee.

MR. UNIKEWICZ: That is correct.

MEMBER SIEBER: Well, okay. Thanks.

MR. UNIKEWICZ: How are we moving forward? Well, as I said, we just received a report. We expect

to have a lot of interaction with the PWR Owners Group. There is a lot of information. We have a fairly good -- there is an open communication right now. We expect to continue that. I suspect it is going to increase somewhat over the summer.

There are some very site-specific issues and there are some responses to additional information. Part of the questions and answers are going to come through ongoing audits which, again, staff is going to talk about later. I suspect that as we ask these questions and do more evaluations on these very site-specific audits, how people are going to apply it and to make sure there is consistency of use I think will become more and more apparent.

Once we complete our review and acceptance of the WCAP, what it will do is it will provide a good reference to ensure compliance and operability. Again, going back to making sure it is in compliance with design and license. It's a piece in that whole ECCS evaluation process.

We are reviewing modifications and, as I said, we are looking at continuing tests. The biggest test of concern is, again, I believe, and we need to have more conversation, there may be at least one more pump test of what I'll call a representative specific

style multi-stage pump. We haven't got quite details on that yet.

Should that happen, we are very interested to make sure there are tests set up again going back to we have witnessed these types of tests before in a very specific plant basis before. We are watching the modifications to at least understand why they are doing what they are doing, how they are changing throttle valves if they are, and as they are changing pump internals to make sure they are not affecting operation of the pump, and all those things that go on including proof testing and appropriate in-service testing and those types of things. All of that is ongoing.

As I said, the WCAP has been submitted for topical review. There are definitely technical issues that remain. We are not over. We expect a lot of interaction with the industry. Licensees need to address whether it's in their RAI, what are the responses to the generic letter, how they are specifically applying this WCAP to their plant.

We are going to continue to work with them and, again, plant specific evaluations are ongoing. Everything will be verified by December 2007, sooner for some plants depending on where they are and how

they submit information to us. We are moving forward and I think we are moving forward in a considered manner at this point in time.

MR. CARUSO: Did you say you planned to do plant-specific evaluations for every one of the 69 plants?

MR. UNIKEWICZ: No, sir. What I mean by that is our series of audits that we are doing in general. Part of that is our evaluation of downstream. Now, when they come in we will certainly look at all 69 responses. By looking at the specific evaluation, no, we are not. We are doing that within the context of the plan for issue resolution. We'll talk about plant specific later, but no.

MEMBER DENNING: Okay. Any other questions on the external downstream effects? Then we'll move on to fuel.

MR. HAFERA: Good morning. I'm Tom Hafera from the NRR staff. I have Walt Jensen with me from Reactor Systems and Bill Krotiuk from the Office of Research. We are going to provide you with an overview of downstream effects related to reactor fuel.

The topics I'll go over, I'll give you a current status of what our evaluation efforts are,

what challenges we see as remaining, what our path forward is. We will provide some preliminary evaluation results. I must stress the word preliminary there. Then we'll wrap up with a summary.

I think I will also try to build on what Steve just presented because WCAP-16406P does provide basic input and there are some sections in that WCAP that provide evaluations for in-vessel. There is a chapter specifically related to reactor internals and fuels.

The debris source term and debris ingestion term is certainly important, characterization, depletion co-efficients and there is also an appendix for the acceptance criteria for in-vessel reactors. There are sections in that WCAP that apply and we will use that as a baseline to then go forward.

As part of that going forward, the Owners Group is planning to develop a specific guidance for evaluation of the fuel and that will be in the form of an additional WCAP. As I understood, we originally were trying to have them come and present as part of this but they were having their meetings this week to discuss the scope and the path forward for that WCAP.

One of the things that we have previously

identified with the Owners Group is milestones where the staff will interact. They will make interim steps in development of their WCAP and they will present those interim phases to us so we can review and determine, provide feedback in terms of what we feel should be done with that.

I think another thing we just started performing some independent confirmatory analysis as part of our plant audits. That will be covered a little later. We are using two different analysis tools and both are still in development and that is what Mr. Jensen and Mr. Krotiuk will cover a little later. We are doing that in concert as Mr. Krotiuk with the Office of Research.

We are going to continue to meet with the Owners Group to identify plant-specific inputs. One of the things we're learning is when you evaluate fuel it's not just a fuel. It's the reactor internals packages, it's different reactor designs. Is it a two-loop plant or a four-loop plant? Is it a B&W plant or CE plant? How many different reactor internals packages are there? You put all these combinations together and you need those inputs to make sure that you are doing at least a bounding evaluation.

Challenges. I think Mr. Sieber appropriately picked up on that. Downstream source term. That is without a doubt a large challenge. I will cover that. Another challenge is schedule. We need a timely submittal of the new WCAP if we are going to proceed forward and the Owners Group understands that.

The review. At this point in time it is very difficult to say what is our review going to entail since we haven't even seen it or know what it is. We do believe we need to fully develop our confirmatory analysis models. We are progressing with that fairly quickly and I think we are making a lot of progress in that area.

And we need, as I mentioned previously, the relevant information that is needed to input for these models has got to be obtained and analyzed.

For our path forward, we are going to continue to interact with the Owners Group, discuss the site-specific issues that need to be identified, and responses to RAIs that were previously generated as part of review of the previous WCAP.

We are going to continue to perform our confirmatory analysis and develop that as needed. We will interact with the Owners Group, as I mentioned,

at interim milestones as they develop their new WCAP. At the end, obviously, we will have to provide a review and acceptance of that new WCAP. That should provide complete.

I'll now turn it over to Mr. Jensen. He'll go over our first confirmatory analysis tool RELAP5 that we are using to evaluate downstream effects.

MR. JENSEN: Okay. I'm Walt Jensen from the NRR Fuels and Code Review Branch. We picked up existing RELAP5 model and started blocking out the core. This model doesn't have core barrel flow holes or slots modeled but we thought it would be good just to have kind of a first cut of what core blockage will do as far as core cooling.

MEMBER KRESS: Are you looking to see if you still meet the Appendix K figures?

MR. JENSEN: Well, yes. That is in the back of my mind. Right now this is just to see what will happen.

MEMBER KRESS: Just to see.

MR. JENSEN: To see if it's going to get hotter. See how much we have to worry about meeting Appendix K. Okay. Dr. Krotiuk is going to talk about more detailed analyses we plan to do with TRACE. We

understand the PWR Owners Group also plans to do some generic calculations with their code.

MEMBER KRESS: Are you just looking at blockages of the core or are you including the whole circuit with the blockages of the valves and blockages of the screens?

MR. HAFERA: Anything outside the vessel, again, was covered by Steve Unikewicz. This is strictly in the vessel.

MEMBER KRESS: Yeah, but when we get around to actually seeing what the total effect is, you'll have to include those effects on the flow.

MR. JENSEN: Yes, sir. I guess what we want to do is look at one thing at a time first to see what effect each one has. This is what we are doing now with RELAP. Let me move to the next figure. This is what we got and this is a 99.9 percent core blockage. We ran 90 percent core blockage, 99 percent core blockage without heat up. This is a 99.9 percent core blockage which is an area in the bottom of the reactor core like a hole about three inches in diameter. The core remained --

MEMBER KRESS: This is one specific channel?

MR. JENSEN: No. this is just a whole

lumped RELAP model. I think it had six actual nodes going up the core and it modeled the whole core as one dimensional.

MEMBER KRESS: One dimensional. So this flow was all spread out over the whole core cross section.

MEMBER SIEBER: In the model.

MR. JENSEN: In the model it is. This assumes this model, like you said, the flow goes in and immediately spreads.

MEMBER KRESS: That's why you will need a TRACE.

MR. JENSEN: We would like to look at some more detailed two and three dimensional.

So what this did, the flow going into the reactor vessel from the down tunnel, it just matches boiloff. This is the cold leg break and it is assumed that the rest of the ECCS flow just spills right out of the hole. Core flow, about 100 pounds per second, and core bypass flow, which in normal operation was positive, this goes negative and makes a natural circulation.

The next slide. What is happening here is that the flow is going up in the core and down in this bypass region between the baffle and the core barrel

and then, of course, down in the down tunnel. RELAP5 has had kind of a unfortunate history of having extraneous internal circulation patterns, particularly when we model the core up into a lot of segments for AP600. I thought it would be good to do a little hand check.

This is a very simple-minded look of the reactor vessel. The core is about 50 percent voided, steam coming up, water. Then it is carried out of the core, flows down to the core bypass region and makes its circulation.

Water coming into the reactor vessel is that which is needed to make up the boiloff. The driving force is the fraction. The RELAP predicted a little bit higher than 50 percent. I've seen 50 percent in some of the industries. I think that is the fairly accepted number.

Then matching the standard delta P with the frictional delta P. Now we have this simple-minded equation that we can use then to back out the core flow. Actually, we have more driving heads than would be in this calculation because six feet of water in the down cone is up above the core but that is not included here.

Anyway, as we ran this we then were by

hand able to predict about what RELAP was calculating which is a core flow of about 100 pounds per second for this very severe core blockage. That is about twice as what is needed to obtain core cooling which is 50 pounds per second. Based on that, then it would take an even smaller area of about 1.8 inches based on this RELAP model to provide adequate core cooling.

Again, this is an old RELAP model and I think core frictional pressure drops have increased with more recent fuel. This was a Babcock and Wilcox plan. They had core barrels and valves. It's able to release steam more readily than a plant with U tube steam generators that have to push the steam around the loops.

We need some actual field data. Last week we up to Westinghouse and got a Watts Bar audit and we obtained accurate field pressure drop data and core internals data from Westinghouse from the RELAP and RELAP still showed adequate core cooling for 99.9 percent core blockage for a Westinghouse plant. We are still looking at that. I wouldn't want to just assume that number is right but give it a lot of margin.

For the Westinghouse case instead of having negative flow going down the core bypass, it

started to push the flow up in a positive direction so the core was cooled both from the top and the bottom. Again, we need --

MEMBER BONACA: That seems to presume that every channel in the core will have some flow. You are inferring that from a one channel representing the whole core. Secondly, whatever you do to restrict it, you still have some flow-through. My question is some of the channels may not have any flow-through any of the assemblies.

MR. JENSEN: This is an open core.

MEMBER BONACA: I understand that.

MEMBER SIEBER: Boxes.

MEMBER BONACA: I know it's open. I know it's not PWR.

MR. JENSEN: You have a good question. We hope to investigate that.

MEMBER DENNING: I have another question which is basically what you're seeing is you can have a lot of global core blockage and still be able to cool the core. Have you looked at all at debris occurring at good spacers and causing small local blockage around pins because there the capability to remove heat is really limited because there is very little delta P across a blockage that would occur of

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

The little collar of fibrous material around a small section of pin just like an inch or two inches of pin filling a channel and you are not able to cool that local pin. That is not global failure in any sense. Even if you melted that little part of the pin, I'm sure overall it probably arrests that. Have you taken any look at this local effect of fibrous debris bed forming around the pin? I was amazed when I did it and found how little amount of material it takes to cause overeating of the pin.

MR. JENSEN: I thought about that, Dr. Denning. If something is blocking the bottom of the spacer grid so the water can flow in from the top, it might be cool.

MEMBER DENNING: If you look at just a debris bed around the small section of pin, there is no delta P across it to drive flow through that debris bed. You know, we kind of have the feeling that the water will find its way and cool things but if you look at a little debris bed of fibrous material around a single pin, small collar, small height, you can't remove the heat from that because the delta P is so small across that to drive flow through that little debris bed.

MR. JENSEN: You are talking about not just a blockage. You're talking about material actually back behind between the pin.

MEMBER DENNING: Essentially filling the channel underneath the grid spacer for some distance.

MR. HAFERA: We've had discussions regarding that issue with the Owners Group and we've also had internal discussions on that. Obviously RELAP is not the tool for that. We have had the same question now three times.

MEMBER DENNING: It's a simple hand calculation.

MR. HAFERA: We've said we are going to use TRACE to analyze local effects and we are going to confirm TRACE with other effects. Yes, we understand that RELAP is not the right tool.

MEMBER DENNING: It is a simple hand calculation.

MR. HAFERA: Okay. Yes.

MEMBER DENNING: It's a question do you form that debris bed or don't you.

MR. HAFERA: We've had this discussion with the owners and I know I asked the last time if you could provide us with your hand calculation and the inputs and the assumptions, we would graciously

appreciate that so then we could evaluate that. We have turned that over to the Owners Group and they are going to do that. We are also going to independently confirm that but right now we are using that with TRACE for localized effect.

MEMBER SIEBER: That is truly a local effect and there will be flow around that blockage.

MR. HAFERA: Correct.

MEMBER SIEBER: As you said, assemblies are open. Assemblies are not in boxes so there is cross-communication but you are going to have a hot spot and the question becomes will that hot spot lead to a local failure at that point. A local failure is likely to cause an expansion of the tube which makes the situation worse.

The question is how widespread is it going to be. If it's low in the core, it doesn't make a lot of difference because the power production low in the core is not that high. You do have a flux profile. If it's in the middle of the core or the upper half of the core, that could be a problem.

MEMBER BONACA: It would be up the core, I think, because it would have this cross effect. I think the concern is really --

MEMBER DENNING: What I was thinking was

a very local effect. Then the question is does that propagate which is unlikely that it is going to --

MEMBER BONACA: In many locations so there will be tens of thousands of pins there. Locally you are going to have some blockage.

MEMBER SIEBER: I think it's inevitable. If you have a source term that has a sufficient amount of fibers and particles in it to cause that to occur in one place is going to occur in a lot of others, too. Part of that goes into the assumption that you are down to a 10th of a percent of flow or something like that. On the other hand, you are going to have a lot of local spots where you've got some problems. I think that needs to be analyzed.

MR. JENSEN: I agree with that. Local hot spots is something we need to look at. I have done calculations. You have an area in the core or length of core that is not getting radio heat transfer out the pin, it's going to get hot. There is no doubt about that.

DR. LU: Shanlai Lu from NRR. Let me add a little bit here. In terms of the localized heating and localized hot spot, I think this issue was raised last time during ACRS meeting. In terms of the heat transfer mechanism, we can consider also that

basically that self can be a good conductor if you have localized blockage. This is No. 1. Additional, the realistic heat transfer mechanism can be considered.

MEMBER DENNING: A little bit. But if you look at axial heat transfer, if you block it up against the spacer grid and go down below there, the actual heat transfer doesn't buy you very much. It is just amazing how little heat transfer you can get axially out of the pin.

DR. LU: I agree with you. That is in terms the axial heat conduction. But in terms of redirection, you still have a spacer grid touching the surface of the hot spot there. That can be one way to conduct heat from the surface of the cladding to the fluid.

MEMBER DENNING: I think what you find is that you can't get the transfer axial up to the spacer grid because even if you have water above that, it doesn't --

DR. LU: Yes.

MEMBER DENNING: I agree it can help a little bit.

DR. LU: Can help a little bit. In addition, if you have fibers, sparse fibers to build

a localized accumulation and not only the fiber comes itself a very fine fiber, then it is very hard to form a very condensed localized accumulation. We are looking into that issue. I think that is a very valid question but I think that is something we can --

MEMBER DENNING: I think that you put your finger on an important element of it, and that is with very little pressure gradient there can you really compact the bed the way we see compact beds.

DR. LU: That's exactly my point. You may not have the compressed bed. You can see from there your vertical head loss loop. You have very sparse and high-level fraction accumulation of the fiber.

MEMBER DENNING: You don't know the true answer.

DR. LU: We don't.

MEMBER SIEBER: Another thing you have to consider is while this localized blockage occurs, you can get boiling and boiling will have a tendency to clear away the blockage. At least I could picture it that way. I don't think there is any testing that is out there that would prove that.

MEMBER BONACA: The bottom line is that still you have this issue. The cross-flow is going to be only effective above a certain elevation. You have

to have some space for it. Below that you have all this blockage so you are going to have some localized effects of that measure.

MR. JENSEN: Moving on, conclusions from the RELAP analysis. Core cooling can be maintained with a considerable amount of blockage in the bottom. If some plants have small holes or large holes in the core barrel, these should be effective in cooling the core if the bottom of the core is blocked.

There are significant circulation patterns within the reactor vessel that may affect debris transport or carrying of debris within the core and perhaps causing problems behind the spacer grids. We are going to back out some loss coefficients for both the RELAP and TRACE, equivalent loss coefficients based on the whole core area.

We can use those to compare to tests that industry is doing for pressure drops through beds of debris and can then based on the losses from those tests we are going to say, "Well, our results show that adequate core cooling or not adequate core cooling would be obtained."

MEMBER DENNING: Do you have the feeling as to how much fibrous -- with the large area screens, will be get more fibrous material through that or does

that not happen? I mean, how much circulation of fibrous material are we expecting with these large screens?

MR. HAFERA: Again, you are asking what is the downstream source term.

MEMBER DENNING: Yeah.

MR. HAFERA: The downstream source term, again, is very complex. It can be related to a number of things. It is not just -- it is the screen whole size. It is the screen configuration. It is the velocity at the screen. It is the differential pressure across the screen. It is the ligament size of the screen. There are many, many complex variables involved in the downstream source term.

That is why, again, we have said this, the downstream source term is very critical. The WCAP 1646P is very conservative. It used the LANL research on a flat screen penetration. Therefore, it is very conservative in divining what the source term would be. That is why I believe, as Steve mentioned, a lot of plants are not surviving because it's just so conservative.

The strainer vendors they are paying attention to downstream effects in their sampling and what have you. Clearly the modern screens are much,

much better at trapping debris at the strainer where it belongs and the downstream source terms are going to be much less.

Currently the one plant that we have looked at their source term is much less. They cannot -- they don't have enough fiber going through in their source term to create a core concern right now. But that's only one. That is the only one that we have kind of looked at so far.

MEMBER DENNING: You probably also want to look carefully at active screens because --

MR. HAFERA: Active strainers are the major concern for this issue. This issue goes directly coupled to active strainers and that is where we are going tomorrow.

Are you done, Walt?

MR. JENSEN: I will move on to the next one here.

MR. HAFERA: That's TRACE.

MR. JENSEN: Yeah, this is TRACE. What I wanted to say is we at NRR asked the Office of Research to do the TRACE analysis and that is, of course, because we recognize that RELAP has deficiencies being a one-dimensional model and TRACE has the capability for three dimensions. It also will

allow us to look at core blockages inside the core and look at the flow distributions inside the core.

Just like RELAP we need to have adequate and detailed accurate data on the fuel flows as it says on the flow patterns or in the reactor vessel to be able to input that into TRACE. I would like to pass the microphone then to Dr. Krotiuk.

MR. KROTIUK: As Walt mentioned, starting to do the TRACE analysis. What I'm going to be reporting here is primarily just preliminary assessments. They are definitely not completed. What I've done so far is basically I'm using an existing model that we have for a four-loop PWR plant and it includes the reactor core and includes steam generators, all the piping and network and everything.

The key thing I'm concentrating on is the core itself. Basically this is the schematic of the core that is modeled in TRACE and it is basically broken up into a number of vertical segments. Then there is within each segment a number of volumes. The core itself is broken up into eight circumferential volumes and then two radial segments, I should say. There is eight here and eight over here and then two segments like this.

There is an area outside of the core

region itself that is between -- there is an area between the outside of the baffle region that is also modeled. There is a fair amount of detail within the core region itself. As I said, eight radial segments, four rings, and 14 elevations.

There is no bypass flow between the inside of the core and the area outside the baffles so that's ignored. Right now there are some plants that may have that. We don't really know. The analysis that I'm doing is assuming -- this is just the first shot through. I mean, we'll look at other things but 80 percent doubled-ended cold leg break.

Full high flow, high and low pressure injection. The key thing is that the way I have done this analysis we run a steady state and then run out a transient out to the time of recirculation at 1,200 seconds at recirculation. Basically I restart the model, block off sections of the core, and then see what the effect is. Let me just show you what we're doing.

Run, of course, an unblocked core case just to have a basis. This is starting at an assumed time of recirculation. Then we are running a case whereby we would block 75 percent of the core inlet. That means that all this area is blocked and the only

place that would have flow is this section right here. Then we would run a similar thing with 87.5 percent blockage so this is all blocked except for this one segment here. Then 94.8 percent blockage.

Everything is blocked except for that one location right there. I have done some preliminary work with that but the key thing is that, as Walt had mentioned, we met with Westinghouse last week and we got some better data in terms of flow resistances and areas and basically a geometrical description of the core itself. Based on that I'm in the process of refining the model for the adjusting core part so that we have a more accurate representation of what is in there.

I could say just some preliminary results I would have done previously is that up until the 75 percent of the blockage I did not really see any increase or effect on peak clad temperature after recirculation so 75 percent seems to indicate that -- or below even if you have a full blockage area that you are not really affecting core temperatures. For the area blockage up to 94.8 percent I did see some increases in local temperature, peak temperature.

Again, I don't want to state a number right now until I finish the analysis. The better

input, the more correct input into the core model. I have seen some increases in temperature but they are small. You are only talking about 100 degrees fahrenheit or something of that nature. They are not large increases.

MEMBER SIEBER: But all of your blockages that you assumed are at the core inlet.

MR. KROTIUK: That's correct.

MEMBER SIEBER: Do you plan to try any calculations where the blockage is partway up the core?

MR. KROTIUK: We have a whole scoping plan set up and that probably will be one of the items but first --

PARTICIPANT: The short answer is yes.

MR. KROTIUK: Yes.

MEMBER SIEBER: Okay. I would be interested in knowing what happens on that one.

MR. KROTIUK: But, you know, once we have the model all set up you can vary different things and get the different effects.

The one concern that we do have is that we wanted to make sure that the TRACE code itself would be able to correctly calculate, how to say, the flow distribution. Say we are assuming a blockage on part

of the inlet. We want to make sure that the TRACE code itself is calculating that flow distribution correctly around for both the axial and the radial and the circumferential flows.

We are independently developing a three-dimensional CFD model using fluids. For that model we are just looking at the core itself. We are looking at the various assemblies. We have modeling in each one of the assemblies and then looking at using the TRACE flows as input into this.

If the TRACE is calculating a flow into, say, the unblocked portion of the inlet of the core, we will put that as an input into the CFD model and then compare the circulation that we calculate with the CFD with the TRACE code to make sure that we have similar type of results and consistency. That is going and the only thing just as of yesterday we just developed a model but that as of yesterday so we haven't had any results out of that at all yet.

MEMBER DENNING: And you're seeing in that blocked area -- I'm sorry, yes. You are seeing the kinds of recirculation patterns that you would expect to see, I assume.

MR. KROTIUK: I'm seeing a recirculation pattern. To be honest I haven't looked at it to a

large degree so I don't know what the void fraction relationships are, what the distribution is or anything else. I can't answer too much. This is really ongoing work. I mean, it needs more study to make sure that everything is correct. In other words, do a sanity check to make sure that what we are seeing in terms of what the code is calculating makes sense.

MEMBER DENNING: As far as cross-flow resistance are there standard algorithms one uses to set up those cross-flow resistances?

MR. KROTIUK: That was a very important question that we asked last week when we met with Westinghouse because the original model that I had did not have good values for that cross-flow resistance. last week when we met with Westinghouse we did get their guidelines that they have developed for coming up with the cross-flow resistance, the areas and the resistances. That has to be put into the model yet.

MEMBER BONACA: Assume the number of hours into the transient, I guess, to determine the decay heat you have at that point?

MR. KROTIUK: Could you repeat the question? I'm sorry.

MEMBER BONACA: I said this happens within the recirculation phase.

MR. KROTIUK: Right. Correct.Generic Letter responses

MEMBER BONACA: Therefore, you assume some number of hours from the LOCA event?

MR. KROTIUK: Starting at 1,200 seconds.

MEMBER BONACA: 1,200 seconds.

MR. KROTIUK: The decay heat recorresponds to that time.

MEMBER BONACA: Conservative, I guess.

MR. HAFERA: In summary, we are trying to develop some detailed analysis tools and models for evaluation of downstream effects and reactor fuel. We think we are making good progress. We know we still have some ways to go but we also think we have identified plans to get the information that we need and the support that we need to make that happen in a fairly short time frame.

We will be engaged in industry activities and we have identified a formal process with the Owners Group to provide feedback on their new WCAP so we will be engaged with them there.

We are going to continue to perform confirmatory analysis for the plants that we audit. I'm sure we're going to learn lessons from that and we will apply those lessons as we develop our tools.

We stand by our original statement that evaluations by licensees should be complete by December 2007.

MEMBER KRESS: Most of their ECCS codes are like RELAP. They are not three dimensional. We ought to use those to calculate the same thing you're calculating.

MR. HAFERA: Actually, no. We have made this clear to the Owners Group. The Owners Group, as mentioned by Walt, is doing some generic analyses for downstream effects and blockage in the fuel. We made it clear to them what we would like to do is do independent analysis. We don't want them to do an analysis and then us audit their analysis. We want to do independent. We want to use our own tools. We want to make sure that we get the inputs from them so that our inputs and assumptions are used consistently. At the same time, no. We are not auditing their process. We are doing confirmatory independent.

MR. SCOTT: One clarification on that slide that I would like to add. That last bullet says, "Evaluations of licensee submittals are expected to be essentially complete by December '07." We'll expect to have them in house by December '07. Our evaluation will not be fully complete in December '07.

That is going to run into '08.

MEMBER DENNING: It would be kind of interesting to do something to see where fibers wind up within a core under low-flow rates. I don't know just how one does that or what kind of mock up one could do but it would be kind of interesting to see that. I don't have a good feeling. Certainly one would expect fibers to catch up on stuff.

I don't know how they pack and whether the adhesive forces between fibers are sufficient to make them form a fairly tight bed or not. It wouldn't be a very difficult experiment to do in some kind of a simulation. I would certainly be curious to get a better idea as to where these fibers are really winding up as they go through the system.

MEMBER BONACA: There has been such an effort in the industry to have debris catchers on the bottom of the assemblies. I would expect that you would have -- that's really where you're going to have it. At least in past experience where you have had a significant amount of debris we found the majority, all of them, at the bottom and they get caught.

MEMBER SIEBER: Those are pretty big holes in those things.

MR. HAFERA: When we discussed this with

the Owners Group and the fuel suppliers, it becomes a lot of variables. There are a lot of variables. While that is a good question, that may be a second or third order or level of concern because if you do analyses and you find out you can complete block something and your fuel can survive, well, then why continue.

But the other reality is we have had those discussions and it becomes a question of do you have a hot leg break or a cold leg break. What type of internals package do you have. Do you have a two-loop plant or four-loop plant. Do you have a Westinghouse plant or BMW plant. Do you have Framatome fuel or Westinghouse Fuel.

The number of variables gets to be very large. It is one of those things that, yeah, you're right it would be nice to do but from our standpoint we have to tie it back to 10 CFR 50.46 and what we're saying is we are telling the Owners Group, "Prove that you can meet 50.46 long-term cooling criteria." If they are, then it becomes difficult.

DR. LU: Tom, let me add a little bit. I think the strainer vendors and the fuel vendors are actually conducting tests to address specifically the question you asked. That is exactly the question we

are trying to identify, what is the type of distribution, how that is being formed inside of the fuel channel.

If you have a given amount of debris source or debris bypass, fibers come into the vessel and into the core. The details are very commercially sensitive to the design of the fuel filter and the spacer grid itself. I don't think we can comment too much on that but an effort has been made by the industry to address specifically this question, too.

MEMBER BONACA: This debris will come in and then get out again through the break. You will flush it through the core and then accumulation in preferred locations and the accumulation will take a number of passes maybe you could imagine. It will be different locations for --

DR. LU: You are absolutely right. Actually it may take several circulations for the fiber or particular to settle at a certain spot of the entire loop if we consider the containment to pool, sump screen, heat exchanger and reactor vessel core itself so many circulations to settle.

MR. HAFERA: There are differences in modeling removal from the system, i.e., the system being the containment floor, the strainer, the RHR,

everything outside the vessel. Then also modeling debris settlement within the vessel. Again, there becomes a number of variables involved. It becomes complex. It is being considered. The current thinking is take a conservative approach and don't assume any settlement. You assume removal from the strainer as the only mechanism that can remove debris from the recirculating fluid. Then if you can survive that, that is conservative.

MEMBER DENNING: Well --

MR. HAFERA: The other question gets to be anything that's infinitely -- all other debris is considered to be suspended infinitely for time. Then you say take that volume of debris. Now that volume that is infinitely suspended, since in a cold leg break I have to assume that my reactor is a boiling pot and it's 100 percent efficient.

Won't I take all my infinitesimally fine debris and I dump it in the bottom of the reactor vessel. Can I survive or not? If I can survive, I can survive. Those are the kind of -- I guess that is the other thing that we have to stress. This is the kind of discussions we've had with the Owners Group in terms of them developing their WCAP.

Their thought processes right now is can

we do some up front work, evaluate some bounding conditions, evaluate the bounding conditions in terms of debris filtration both not only from the system standpoint but also from the reactor vessel standpoint evaluated from what is the most bounding condition from the reactor internals and the fuel supplier's standpoint and run some cases and see how that turns out. If it turns out that the sensitivity is very low, then you've kind of done a bounding analysis and it becomes difficult to justify doing more sensitive analyses.

MEMBER DENNING: Have you looked to see relative to the 99.9 percent blockage that you were talking about early on how big of a debris bed does it take a fiber to give you that if all you have for your height is the downcomer height? Do you know what the answer is to that?

MR. JENSEN: It would take a lot. We looked at some of the blockage debris pressure drop data that industry did. This case that we're talking about with the 99 percent blockage, it worked out to be equivalent inlet loss factor into the bottom of the core over 160,000 which is a very large loss factor and then we can compare that with some of the industries, unfortunately very proprietary data, and

it will look like there is a lot of capability for a fairly large debris bed down there.

MEMBER DENNING: A pretty large debris saying you're saying to give you --

MEMBER SIEBER: Tolerated.

MEMBER DENNING: That could be tolerated.

DR. LU: I'll add just one more thing. Actually with that debris bed and realistically bed formation so sparse and with ECCS flow goes through the core. We really don't think that's possible to have a complete 99.9 percent blockage for even bed like that. The bed will be porus and the water will go through so 99.9 percent is really a bounding calculation.

MR. JENSEN: Well, Dr. Shanlai, you work them both out to an equivalent loss factor so whether the core is all the way blocked with a porus bed or whether it's completely blocked by a little hole, as far as RELAP is concerned RELAP doesn't care.

MEMBER DENNING: Any other comments? I don't think we do. Okay. Then I think we will adjourn now.

MEMBER SIEBER: Recess.

MEMBER DENNING: We'll recess now. The question is do we want to make it until 1:00 or until

10 of 1:00?

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

MEMBER DENNING: Until 1:00.

(Whereupon, at 11:53 a.m. off the record for lunch to reconvene at 1:00 p.m.)

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

1:02 p.m.

MEMBER DENNING: We are now going to come back into session. Graham will be back at some time but it's not clear exactly when he'll be able to make it back.

DR. LU: Okay. I'm going to start. Shanlai Lu from the staff, the Safety Issue Resolution Branch, NRR. I'm going to talk about prototypical head loss testing. That is industry prototypical head loss testing as part of the new strainer design effort.

Ever since we issued the SE, I think two months later we had a public meeting with NEI and all the licensees. We told them either they have to develop their plant specific correlation or they have to come up with prototypical head loss testing to justify the head loss across the new strainers. Ever since then they have already started -- the industry has started to have an extensive testing program. What I am going to do is give the Subcommittee's overall status of this program.

Since this started I think one half year ago we start to have the observation trips to different vendors. I am going to give you the overall staff review activities. I think in May we had a public meeting with all the strainer vendors and many licensees. We spent almost one and a half days to go through their testing program and identify issues. What I plan to do is give you a snapshot of what we heard from them for one and a half days.

MR. SCOTT: Clarification. We spent a half a day with each vendor. The whole thing with vendors ran over a full day.

DR. LU: What I plan to do is just give you one slide per vendor and actually each vendor during that meeting gave probably 70 to 80 pages of slides talking about their testing program. With that I also will talk about common technical issues we identified with vendors through our audit and our pilot audits and also the vendors observation trips. At the end I'm going to discuss the path forward.

The background. I think this question was asked this morning regarding how they come up with this debris generation and transport term as the input for their strainer testing. I think most of the licensees we interacted with followed the NEI guidance

report and the staff SE and used conservative debris generation and transport methodology to predict the total amount of the debris deposited on the surface of the strainer.

That is the analysis part of the design. With that input to the strainer testing they assume all the debris arrives out of the strainer or nearby region as the onset of recirculation.

MEMBER SHACK: How do they precondition the debris? Shredder, blended?

DR. LU: Oh, yes. That is a lot of -- yeah, we will talk about that. That is one of the technical issues I'm going to touch on. At a very high level with the assumption of the onset of recirculation, they assume all the debris arrives at the strainer. It is very conservative because all the ocean terms, all the history of the debris generation is considered as -- is not considered as part of analysis so it is very conservative to be assumed it's all here. They are all at the strainer at the beginning of recirculation.

MEMBER DENNING: Does it mean in the vicinity of the strainer rather than on the strainer or do different vendors make different assumptions?

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

After the strainer or nearby region, that means they have a different testing methodology. Either they put the debris right on the strainer surface or they want to integrate at a nearby or near field transport with the head loss into one test.

The next step, the overall approach of the industry is they perform the prototypical head loss tests to validate the strainer sizing and net positive suction head. So far we have observed three types of head loss testing. The first one is prototypical head loss testing combined with near field transport. That is the nearby region as they assume the debris arrives at the nearby region.

Second, which can be considered as very conservative, is prototypical head loss test without debris settlement upstream. They use some kind of turbulence agitator to try to force the debris flow towards the surface of the strainer. At the end of the testing all the fibers, or most of the fibers end up on the surface of the strainer.

The third type of head loss testing we observed was they developed head loss correlations, too, but using plant specific material like mineral oil or BK. They assume very conservative debris distribution across the strainer. Our responses

towards this testing effort was conduct the pilot audits and observation trips.

With that I'm going to give you a snapshot of what we learned from --

MEMBER SHACK: How many tests are in a test program for a given plant?

DR. LU: Say it again?

MEMBER SHACK: How many tests are in a test program for a given plant?

DR. LU: It can be very plant specific depending on their test matrix.

MEMBER SHACK: Obviously they have to consider different radios of particulates and fiber. Say it's a cal-sil plant with a fiberglass, is it five tests, 20 tests, 50 tests?

DR. LU: In terms of magnitude, the number of magnitude is about five to eight or around 10 or less than 10 because it is very expensive to conduct for the prototypical head loss testing to generate so much debris and then dump into the flume or testing facility.

Normally they prefer to use a NUREG CR 6224 correlation or their own proprietary correlation to perform the initial scoping analysis to determine the size of the strainer and to use very conservative

sizing of methodology and to put that strainer into the test loop and test for the given debris loading. To reduce the number of tests they have to come up with a test matrix to justify why they can reduce the number of tests because that is a lot of money.

With that, I will just give one slide about Framatome PCI and Applied Research Lab vendor group. Okay. They are using the PCI sure-flow strainer which is stacked disk of strainer with a perforated plate on the surface and there are gaps in between. This is a reduced scale strainer itself and then the average size is about this large.

This vendor group right now is supporting 14 units at this point. They only have one test loop that is the rectangular shape of the flume and they use reduced scale of the strainer or surface area to a very small testing section under that middle head loss.

MEMBER DENNING: Of course, the hole sizes are not scaled. They are full scale.

DR. LU: Yes.

MEMBER DENNING: And that one unit is what they are going to use for all 14 of the PWR -- that model is what they are going to use for all 14?

DR. LU: No.

MEMBER DENNING: No?

DR. LU: The shape of the strainer itself because that is a PCI sure-flow strainer is about the same. But the surface area and the gap in between and orientation can be different for different plants. For this one it is horizontally marked. It can be vertically marked. It's very small holes.

I think this morning Dr. Wallis mentioned the devil is in the details. I want to point out the approach velocity range is about this much. It is a maximized 0.027 which is about four times less than the testing we have been doing with the vertical test holder and the PNNL. What really matters for the head loss testing what we observed when we went to the ARL and looked at the testing, we observed the testing, the accumulation of the fiber debris becomes very interesting.

They never had a condensed bed with this approach. What we saw is very high fraction and sparse. Even see before they dump the particular into the flume we can see the fibers are tangling around and floating on the surface of the strainer surface. It does not condense and does not form a very condensed bed.

MR. CARUSO: Is that approached velocity

the value in the stream away from the strainer or is that the value that you use when you average the flow over the whole area of the strainer?

DR. LU: That is the average flow across the surface of the strainer.

MR. CARUSO: So what would the flow be like far away from that thing? What sort of velocity range would be a foot away from it?

DR. LU: That can be much higher. That is the reason we raise the issue about a near-field effect. It's just for this vendor. I'm going to touch on that issue here.

MR. CARUSO: Okay.

DR. LU: I want to talk about this approached velocity. Once you have low approached velocity very sparse and high-water fraction debris bed and after the end of the particulate we saw the particulate was not being captured by that very course debris bed at all and running through all the time. Most of the time it just runs through that strainer and comes back.

MEMBER SHACK: So they do a consecutive debris bed construction. They put the fibers in first and then add the --

DR. LU: They have this kind of sequencing

of the testing as part of the text matrix. I don't want to talk too much because somehow this relates to their testing approach of proprietary. I just want to give you a sense of what is going on.

Going back to the question of the time sequence of the debris, if you have very sparse debris bed which has a very low filtration efficiency, the time sequence or time history of the arrival of different debris may or may not be that important for normal debris. It goes back to the chemical effect. You can have precipitates with nanometers in the range of the size of the precipitate coming in. It is very hard for this kind of a sparse debris bed to capture the particulate or the precipitates there.

There might be one way out for them if you say I have such a sparse debris bed and I may not have to address the question of how long I need to run the test, for three days or four days or one week. It may not even reach that point. The debris by itself has such high filtration it can capture very small particles.

MEMBER DENNING: In this particular test series do they have the chemical debris?

DR. LU: They do.

MEMBER DENNING: Generated according to

the WCAP?

DR. LU: Yes. In the Watts Bar audit we observed that they added chemical precipitates into the test loop.

MS. LANE: Excuse me. Ann Lane from Westinghouse. I don't believe that this particular vendor is using the method presented in the WCAP for generating the chemical precipitate.

DR. LU: Paul may have something to say.

MR. KLEIN: I was just going to add a similar note. Paul Klein. The one particular test that you referred to showed why they attempted to simulate chemical effects before any of the WCAP information was available. They just tried to simulate a product based on conversations with various people.

MEMBER SHACK: Was it a calcium phosphate type product, an aluminum product?

MR. KLEIN: No, it was an aluminum hydroxide and calcium carbonate they added for the one licensee. They tried to simulate chlorine levels that they observed in an ICET 5 environment.

MEMBER SIEBER: With these low approach velocities, I would presume that the typical strainer installation would be very large.

DR. LU: It is. That is in the range of the screen areas but up to 7,500 square feet.

MEMBER SIEBER: Even that seems small to me for that kind of an approach velocity. I mean, there's hardly any velocity at all there.

MR. MARTIN: That's actually a face velocity. Isn't it, Shanlai?

DR. LU: Yes, surface approach velocity.

MR. MARTIN: Face velocity. If you divided the volumetric flow rate by the surface area, I think that is probably what you would get.

DR. LU: That's true.

MR. MARTIN: Actually, like you said, that velocity is a little higher as you go a little further away from the screen.

DR. LU: That is the near-field effect. We are going to talk about that.

MEMBER BONACA: Tell me the configuration of that strainer, the size of it.

DR. LU: The perforated plate has an average rate of .045 and .095. Here is the disk surface area. In between you have several disks laid out.

MEMBER BONACA: You say in between. What is that?

DR. LU: Okay. Between the perforated plate has the star shape of the bones.

MEMBER BONACA: It seems to have vertical sides to the strainer. They are also hole diameter range? I can't see it there visually.

DR. LU: For this particular testing the water is flowing from here towards this strainer. Then the water is being sent into the pump downwards. At the center there is the pipe taking all the water and going downwards.

MR. ACHITZL: Is the question just whether there is a series, a set of probably or six stacked on the other side of the disk. The difference -- Achitzl from NRR. Excuse me. There is a set of stacked disks. The thing about the PCI strainer is their claim to fame is that they flow average it so if you are near or further they try and get the flow. Some of the vendors don't but these guys try and distribute the flow evenly across the complete set of disks.

MEMBER BONACA: So there is a series of similar --

MR. ACHITZL: They have hydraulic complexity inside the suction pipe to get --

MEMBER BONACA: From here it seems as if you have these large spaces on the sides. There are

layer of filters.

MR. ACHITZL: Yes.

DR. LU: For the actual strainer it may have much more number of stacked disks there. They can be horizontal and vertically, too. It depends on the plant's configuration there. The gap size between those two disks can be changed, too. It depends on the loading of the debris.

So what we have done for this particular vendor we conducted Watts Bar audit and then we had three staff visits and we plan to have future audits, too, on this particular vendor group.

MEMBER DENNING: When they take their prototypic source term, do they just divide by the number of proportional areas and assume that everyone --

DR. LU: Yes. It depends on the area ratio.

MEMBER DENNING: So they use area ratio to determine what their source term ought to be.

DR. LU: Yes. This is test section and they calculate how much the total surface area of the test section and then divide it by the total surface area of the entire strainer area. For the given amount of debris just divide that ratio that dump into

the flume. We have some issues related to the near-field effect. That is something that I am going to talk about that. At this point I am going to move to the next vendor group, Alion/Enercon.

We have a different shape of the strainer, what is called the top-hat strainer. It is a cylindrical shape of strainer. Then they can have two rings or one ring only. What is shown here is the vertically oriented. It can be horizontal or vertical. It depends on the plant configuration.

For the deep sump pit they can put a vertical one. For the very shallow water they can use horizontal orientation.

This particular group is supporting 15 PWR units at this point. They have very extensive testing program. They have vertical test loop like in Los Alamos and the PNNL test loop. They have vertical chemical loop which can heat water to certain degrees and the temperature can be controlled. They also have a large flume to perform the prototypical head loss testing and large water tank loop. This vendor group has extensive testing facility as part of the program and also the analysis too.

MR. CARUSO: Do all the test facilities just recirc the water?

DR. LU: Yes.

MR. CARUSO: Do any of the test facilities have a setup like what exist in a plant where you have a strainer to catch some of the debris and then a core to catch the rest of the debris so you can see how it gets proportionally distributed between the two sets of strainers?

DR. LU: At this point we have not seen that type of configuration to model the entire containment system including the vessel, the --

MR. CARUSO: I'm not saying so much the model, the vessel itself, but the core acts like another strainer downstream of the screens. If you put a screen downstream and you put a screen, two serial screens, you are going to see a distribution of the debris which is what's going to occur in the plant.

DR. LU: What we did see actually to capture the debris downstream they have some kind of screen.

MR. CARUSO: They do?

DR. LU: Yeah, for the downstream effect evaluation. It is not intended to model the debris transport or the position inside of the vessel or the heat exchanger. The approach velocity range is also

very small. The maximum is four times less than the research test and loop velocity there.

The screen size is very similar and the entry range is almost the same. The entire industry is trying to use very small hose with a perforated plate to reduce the downstream source term. NRR visited this particular vendor four times and we plan to have a future audit.

MEMBER SIEBER: That particular strainer, again, must be huge in size if you --

DR. LU: This one?

MEMBER SIEBER: Yeah. If you look at 7,500 square feet --

DR. LU: They have many of them.

MEMBER SIEBER: Okay.

DR. LU: They have like 20 or 30 of them each one being three feet or five feet. It depends on the configuration.

MEMBER SIEBER: What do you do, put a plate over the top of it to block?

DR. LU: Actually they have the manifold to connect all the small modules into a large one.

MEMBER SIEBER: Okay.

DR. LU: Either horizontally or vertically.

MEMBER SHACK: When they do this, when you run the test, you are dumping your debris in, you are filtering it through this, you're capturing the pass-throughs so you have your downstream source. How many times do they recycle this? How long does the test go on? How many recycles do you go through?

DR. LU: That is related to -- I think that is a question related to termination criteria and also related to the downstream effect. All the vendors actually right now have the grand central line so downstream all the vendors can grab the samples and measure the concentration of the particulate and the fiber. They all have that one.

MEMBER SHACK: So they do a grab sample where they are going to filter downstream.

DR. LU: Yes. That's right. Or they just take the sample out and send it to a lab and measure the concentration of the fiber or particulate. That's where they started the downstream effect in source term.

MEMBER SHACK: Do you get a characterization of what this looks like, the fibers of such and such a length of distribution?

DR. LU: With this approach velocity and with such small holes there, they found that fibers

passing through the strainer is very short. It is dependent on the specific plant and dependent on the specific vendor. It is very short.

MEMBER SHACK: That is a characterization they do for each plant as part of the test program then?

DR. LU: Yes. Some plants can afford to use the very conservative WCAP debris source term for the pass-through as a debris source term. If some plant wants to take the advantage, they can use this data. But how they would use this data whether we buying that one is a question. That is one issue I am going to discuss there.

I'll move onto the next vendor, CCI. We have the test facility located in Switzerland close to Zurich. They are supporting about 60 units. They have a very interesting shape of strainer. I took shot once when I went to that test facility. It is what they call the pocket.

They have this surface area and this surface all covered with perforated plate. Even at the end there is the complex shape of the surface of the perforated plate. What is happening is the debris accumulation on the surface of the pocket strainer becomes very nonuniform so head loss can be very small

if you compare the test results with the correlation calculated based on the uniform debris bed.

MR. CARUSO: Then the debris just collapses at the end of the --

DR. LU: This is after they drain the water. For very high head loss case they actually have this debris accumulated on all four surfaces. For very low approach velocity case they may not. It can be very nonuniform and the head loss can be small.

MR. CARUSO: If you compared the velocity into the pocket to the approach velocity of the surface of the perforated plate, what sort of ratio do you see for something like this?

DR. LU: Of course that is just continued. It can be higher.

MR. CARUSO: Is it a factor of 10? Is it a factor of 100?

DR. LU: Four or five. I don't know the exact number.

MR. CARUSO: Four or five.

DR. LU: I don't know the exact number.

MEMBER DENNING: I don't quite understand on these little kind of mail slots is it really composed of two plates so it can flow into either side?

DR. LU: Yes. This wall itself has two surfaces. This surface has a perforated plate. On the other side it has a perforated plate. In the middle is about a quarter inch gap. After the water flows through the perforated plate it goes into the gap in the center of this unit. That is the CCI strainer and actually this strainer is being installed probably for half of the French plants.

MR. WHITNEY: This is Leon Whitney, SSIV. If I could be permitted to describe the actual shape of the pocket, it is kind of like if you had a shoe bag and you had a shoe in it. It necks down towards the back there and then there is a plenum and then the plenum allows the water to go down and out that way. Or a nose cone that is not sharp so the gap closes to the edge here is very small and it grows as you go deeper into the pocket.

When there is nonuniform a lot of times with very low flow velocities you will see almost no fiber at the top quarter of the pocket. Then these other pieces here would fall down naturally like they do but you might during the test have no fiber or whatever at the very top because it just can't lift because the velocity is just so low.

DR. LU: This vendor has three test loops.

The vertical test loop is very small scale but they put the pocket vertically and tested the pocket strainer, the hydraulic characteristics there. They have performed almost 2,000 rounds of tests with this small scale test loop.

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

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

The test facility they have is a pool, a swimming pool type of testing for loop. Water tank loop, gravity drain testing and downstream effect loop for the fuel. You asked for that particular issue related to where the debris are being deposited, how

it is going to form in the bed and actually they had this kind of loop.

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

DR. LU: I cannot talk too much about that. The next time, I think in August, I heard that ACRS is planning to meet with each individual vendor and you can talk with them. I don't think I can comment on that at this point.

We have already got two observation trips and we performed one pilot audit and we plan to have future audits, too.

One thing I want to mention they have both passive and active strainer design which is unique.

MEMBER MAYNARD: Are you talking about for the same plant or they have two options whether you want passive or active?

DR. LU: Okay. I think even for the plants using the active strainer, they want to -- well, they may want to have a sacrificial passive section of the strainer, too.

MR. SCOTT: Shanlai, I think what they told us at the vendor meeting was that they have to have a passive section to catch what the active side choose up so to speak.

DR. LU: That's right. The sacrificial section has to be there. Okay. That's all I can say right now. It's all proprietary information. I cannot talk too much about it.

AECL. They came in a little bit late in the game but already got the audits from four PWR units. It's passive strainer. They have small tank loop and large water tank loop to perform the prototypical modular head loss testing.

We went there last year and we plan to have more staff this year to visit them and future audits there, too.

Over all the industry has five vendor groups to perform prototypical head loss testing for the entire PWR fleet. It is extensive effort for them and the total budget we don't know exactly but when we visited each vendor there were dozens of people working on each test to perform one prototypical head loss testing modular testing. It cost a lot of money and needed a lot of manpower there to perform the test.

I think last time the ACRS raised the question can the scaled strainer module/section test results be extrapolated to plant conditions? How they scale this module test and extrapolate the head loss

data to the plant condition. The vendors' approach is they assume uniform debris loading on the entire array. For each array they assume it is uniform debris loading. Then they scale the debris loading based on the test section area ratio. It is a very simple approach.

We have the issues related to their near field transport. For the head loss tests without near field transport, that means they introduce the debris either right on top of the strainer or they dump the debris directly on the surface of the strainer, or use some kind of turbulent activator to force the debris to settle on the surface of the strainer. In that type of test we consider the uniform debris settlement assumption is conservative.

MEMBER DENNING: And the reason for that is that you think then those parts that get the lowest amount are going to be free and have little pressure drop? That's why you think that?

DR. LU: That is exactly the reason.

For the combined head loss and near field transport test, that is something we talked about last time. We consider this particular approach or request more attention from the staff. We estimated that about 20 PWR units plan to take the credit for the

near-field effect. The question here is what kind of scaling and testing procedure have been developed to scale the near field transport.

At the same time you have the head loss measurement there. For both transport and head loss when you combine those two phenomena together with a simple test loop like a flume, it can be very difficult to justify whether that head loss data measured from that test facility is conservative.

Our position is the proper scaling and testing procedures are needed to ensure adequate strainer size and/or sufficient removal of the problem debris.

MR. CARUSO: Is the staff going to document this position in some written document at some point?

DR. LU: That is part of the plan of the staff review guidance. We are developing this review guidance as part of this effort. We are documenting that.

Okay. I am going to hit the common issues. Instead of talking about specific vendors, what are comments to specific vendors, we want to cover the issues identified can be applied to all the vendors. First, of course, the debris surrogate

material preparation. I think one of the tests demonstrated that the debris preparation, you talked about it.

You asked me this question right at the beginning of my presentation. It affects the pressure drop across the debris bed significantly. What is the proper way to prepare the debris and the fibers becomes very important. You can get effect of two different head loss across the debris bed with different procedures for shredding the NUKON fibers. We communicate with the vendors in the May meeting and I told them this is something that they need to look into that.

The scaling of the debris circumferential accumulation. For the strainer design if it has significant amount of debris loading and if the amount of debris is sufficient to jam the disks so the circumferential accumulation becomes significant and dominant in terms of head loss, that needs to be scaled properly.

We talked about the debris addition timing sequence. The formation of the debris bed is sensitive to the debris introduction sequence. When did you add the fiber, when did you add the particulate, when did you add the chemical

precipitants is very important. The question here is it might be sensitive if you have a very sparse fiber bed.

Temperature dependency. All five vendors are conducting head loss testing at room temperature so they scaled back or extrapolated the head loss data to the onset of recirculation contained at room temperature to simply use the proportional viscosity equation.

In terms of this particular equation and approach, I think over all we have already asked Research to conduct some test over either Argonne or PNNL. At this point the preliminary test results show that this may not be an issue. We may be able to use this proportional viscosity equation to extrapolate the head loss data and measure at room temperature back to onset of recirculation 180 degree fahrenheit or 200 degree fahrenheit.

However, there is a possible temperature dependence. Debris bed structure morphology may subject to change in which maybe you have fibers which are sensitive to the temperature and the elasticity of the fibers are sensitive to the temperature and that can change the compression characteristic. This may be something to cause uncertainty there.

For the constant flow the debris bed compression is subject to change if you have a different temperature because of the pressure gradient across the debris bed is going to change for even the same debris bed with the same approach velocity but different temperature because of the delta P changes and the pressure gradient changes across the debris bed.

CHAIRMAN WALLIS: The elasticity of the fibers change.

DR. LU: Yes. That is the exact reason we raised this issue and why they need to look into this.

Another is the bore hole phenomenon or the channeling effect. If they have different pressure gradient and a different temperature and approach velocity, at room temperature if they observe the bore hole phenomenon, that may not be proportionately related to the viscosity if you have the higher temperature. The bore hole phenomenon itself may introduce nominal effect although bore hole phenomenon is good for the strainer because it does reduce the head loss, but how does the vendor to extrapolate the data at room temperature back to higher temperature?

CHAIRMAN WALLIS: The bore hole presumably lets through material.

DR. LU: Yes.

CHAIRMAN WALLIS: A hole.

DR. LU: Yes. The entire debris bed actually.

Okay. The last common issues I want to touch on is the integrated head loss and downstream bypass testing or the downstream pass-through test. As I mentioned, all five vendors right now have the graph sample downstream of the strainer so they can measure the fiber content or the particular contents. Once they start the pump through the prototypical head loss testing.

The question here is what we had to the vendors is what exactly can be done to use the prototypical head loss testing and provide the screen bypass debris concentration data. Can it be done at all? We understand that the head loss test is normally designed to maximize the head loss, maximize the filtration efficiency of the debris bed. The testing objective of the downstream pass-through test or bypass test is to maximize the debris bypass or the pass-through, through the screen. Can these two testing objectives meet?

CHAIRMAN WALLIS: If you want to maximize you want to minimize head loss presumably.

DR. LU: That's right. That's right.

CHAIRMAN WALLIS: The minimum value is zero but you have an infinitely big screen so minimum isn't a very good term. Making it adequate and producing it to the point where it satisfies the suction head may introduce some other effects.

DR. LU: That is exactly true.

CHAIRMAN WALLIS: But don't use the term maximizing or minimizing.

DR. LU: That's right. So that are the issues we raised to the strainer vendors during the May meeting. We told them these are our concerns and they told us they understood and they have not answered how they are going to respond to this.

MEMBER MAYNARD: When do they take the graph sample and how often? Is it a continuous graph sample?

DR. LU: They cannot take it as continuous. They have to take it as a time interval, every three minutes or every five minutes do the test.

MEMBER SHACK: On this one he must do his testing for a range of loads.

DR. LU: They did.

MEMBER SHACK: His maximum load is a conservative estimate of the total fiber loading but

he may well get his maximum pass-through with a much smaller fiber loading which, in fact, may be representative of some of his breaks. I mean, he has to be prepared to handle all breaks.

DR. LU: That is exactly true.

MEMBER SHACK: He should be sampling that downstream bypass for that whole range of beds and hopefully --

CHAIRMAN WALLIS: You might want to risk inform. If you are going to design this thing for the worse possible large break LOCA, it may not be very good for the most likely LOCA. I don't know.

DR. LU: On the debris bed filtration, yes. Filtration efficiency, yes. It can be difficult for the industry to come up with answers to address this.

CHAIRMAN WALLIS: You may need to make some determinations of acceptance criteria. Look at the spectrum of LOCAs and how much are you going to weigh these various ones in terms of the way in which the screen performs. Go on to give weight too much to the large break LOCA to the detriment of the small break or the other way around perhaps. You've got to have some kind of way of balancing these things. Unless you are assuming it is always going to work

perfectly for everything. Maybe that's what you require, it is going to work perfectly for everything.

MEMBER SIEBER: I think for a very small break LOCA it's not going to generate that much debris.

CHAIRMAN WALLIS: It's less of a problem keeping the core cool.

MR. SCOTT: Of course, it doesn't have to work perfectly for everything. It has to work adequately for everything.

CHAIRMAN WALLIS: That's what I meant. Adequate is perfect. In NRC parlance adequate is perfect. There is no perfection in NRC, only adequacy.

MEMBER MAYNARD: I do think that more thought needs to be put into what is the worse case condition. Is it when the screens are fully loaded or when the screens are very, very lightly loaded? Which one creates the worst effect?

CHAIRMAN WALLIS: Biggest problem.

MEMBER MAYNARD: Biggest problem. Right.

DR. LU: But also with such a low approach velocity for the fibers to pass through the strainer surface, the chance is very low.

All right. The path forward. Regarding

all those issues that were raised to the industry we have developed RAIs as part of General Letter response to RAIs. We sent to them and we asked for request justifications for taking the credit for near field debris settlement. That is one of the issues.

We are developing review guidance to document our positions regarding near-field effect transport and all those common issues, the positions I just talked about. We plan to issue this sometime in the summer. We plan to have more staff observation trips to different vendors.

We also plan to conduct plant audits so that we can understand more in detail of the vendor testing program. As part of this General Letter response review we are going to evaluate the supplemental response from the licensee regarding the testing program and according to the SE and any additional review guidance.

CHAIRMAN WALLIS: I wasn't here earlier. You are going to develop plant specific head loss correlation? That's what it says on slide 3.

DR. LU: Okay.

CHAIRMAN WALLIS: Is that true? There is going to be something that is different for every one in terms of correlation?

DR. LU: The third type of head loss testing was very unique and we only observed for one plant at this point. No other plant has been relying on the plant specific correlation at all. Most of them will rely on the prototypical head loss testing.

CHAIRMAN WALLIS: They are going to do tests and then prototypically develop a correlation which they are going to use for the plant. Is that what their approach is?

DR. LU: They are not going to develop correlation. They are going to --

CHAIRMAN WALLIS: Plant specific.

DR. LU: For this particular plant, yes. You are right. They actually did develop a head loss correlation based on the CRs before.

CHAIRMAN WALLIS: Is it just an alternative or is that --

MR. ACHITZL: Shanlai, could I just make a comment there? That is GE. There is an approved topical report for that correlation so that vendor was GE. Correct, Shanlai, in the correlation?

DR. LU: No, Alion.

CHAIRMAN WALLIS: But the other vendors are not developing correlations?

MR. ACHITZL: At least GE has the

correlation.

DR. LU: Let me just comment on this one more time. The head loss correlation approach itself requires extensive testing for a specific plant with a specific material. At this point it is a very small subset of the plants are relying on this head loss correlation to come up with a justification.

CHAIRMAN WALLIS: What are the other ones relying one?

DR. LU: They are relying on the first two type of tests.

CHAIRMAN WALLIS: Do you just take the numbers from the tests without any equations at all?

DR. LU: For the prototypical head loss testing that is the way they are doing it.

CHAIRMAN WALLIS: So you simply make a plot. You say flow versus --

DR. LU: Debris loading.

CHAIRMAN WALLIS: Three dimensional thing for different kinds of LOCAs, flow versus pressure drop and here's what you get. Use it in the plant. Don't even ask what it means.

DR. LU: Well, okay.

CHAIRMAN WALLIS: Is that the approach?

DR. LU: I think I actually discussed the

overall approach. The vendors are taking it at this point. They just performed conservative analysis and determined the debris loading and the transport to the strainer. They assume it's all right. At the same time at the onset of recirculation and perform the bounding --

CHAIRMAN WALLIS: They measure the pressure drop?

DR. LU: Yes. They measure the pressure drop.

CHAIRMAN WALLIS: That's what they use in the plant, the pressure drop that they measured.

DR. LU: That's right.

CHAIRMAN WALLIS: Okay.

MR. CARUSO: One last question. When I add up the number of plants I come up with 65. Does that mean four plants are not using these vendors?

DR. LU: I think there are some plants that are still deciding to use which vendor yet.

MR. SCOTT: But there are also the ones that are already done. For example, Davis-Besse who has already installed and Diablo Canyon had already installed enlarged strainers so that gets you to three and there's one more. Not sure.

MR. CARUSO: Just wondered.

DR. LU: I think that concludes my presentation.

MR. SCOTT: Okay. We now have Dave Cullison who is going to come and talk to you about audits.

MR. CULLISON: Good afternoon. Dave Cullison. I'm in the Safety Issue Resolution Branch. I am here today to talk to you about our plant audit program where we are going to go to a selected number of plants and review their resolution of GSI-191.

Shanlai is up here with me because at the end of the presentation about our program, we'll have a discussion about some of the things we have been seeing in the Watts Bar audit. Shanlai is the team leader for that audit so he can answer any questions you may have.

The purpose of our audit program is to perform in depth assessments of licensee's actions taken in response to Generic Letter 2004-02. I want to point out the last two bullets on the slide where we identify where additional evaluation of licensee resolutions through the NRC inspection program is necessary.

What that means is that when we go through the audits if we determine that we may need a change

to the inspection program to look at this issue, we will recommend that. There is a temporary instruction that has been issued where the regions will go out and look at every plant and verify the licensees installed what they said they were going to install. Because the auditors were only going to do a certain number of plants, we wanted to make sure that everybody does what they are supposed to do and that is why we have the TI.

Also another function of these audits are to determine whether additional audits are needed. If we find out there are some generic issues that go beyond the few plants we are looking at, we can enlarge the scope of the audits..

MEMBER SHACK: Do you have a number for few?

MR. CULLISON: On the very next slide.

CHAIRMAN WALLIS: Do you have any idea of the size of the submittals? Are they going to be 500 pages of technical information or are they going to be one paragraph or what are they going to look like?

MR. CULLISON: The supplements?

CHAIRMAN WALLIS: All the stuff. RAIs and there's going to be a description of their screens and why they work and all that. It's going to be a fairly

substantial document. Isn't it?

MR. CULLISON: The honest answer is I don't have any idea.

MR. SCOTT: I think it's safe to assume that it's not going to be a paragraph. They got a number of RAIs and their responses need to address the RAIs at a minimum and also address all the generic letter criteria. I think they are going to be substantive. I don't think we have a number to attach to that.

MEMBER MAYNARD: I would also expect they would probably be referencing parts of a number of other larger documents to take credit for, too.

MR. CULLISON: Yes.

CHAIRMAN WALLIS: It's going to be substantial. A substantial amount of material to review.

MR. CULLISON: Yes. We expect -- one of the benefits of not having them all come in at the same time is to kind of spread that workload out for the staff, although there will still be a big bulge in the workload, if you will, right at the end of 2007.

MR. SCOTT: It's 13 as of right now.

CHAIRMAN WALLIS: That's more than we heard before, isn't it?

MR. CULLISON: We have included some additional ones. That includes the two pilot audits which we have already done and this is the break down for the calendar years. It includes Watts Bar. We are still identifying the plants that we are going to audit.

MEMBER MAYNARD: Are you going to tell us a little bit about your selection criteria?

MR. CULLISON: The very next slide. Plant selection criteria.

MEMBER SIEBER: You guys are cheating. You're looking ahead.

CHAIRMAN WALLIS: We always ask the right questions.

MEMBER SIEBER: Let's see what's on the next one.

MR. CULLISON: We are selecting plants based on the analysis vendor, the screen vendor, any unique analyses, and also trying to spread it out throughout the regions and also looking at the screen installation schedule. The idea is that we are trying to look at at least one or two plants from every analysis vendor and every screen vendor so we get a selection from each.

That way we can determine if there is

possibly an issue with that vendor where we have to expand scope. The region part is we want to make sure -- since we encourage region participation in the audits, we want to make sure all the regions get the same opportunities.

How are we going to conduct the audits? This is from now on. This doesn't discuss how we conducted the Watts Bar audit but based on some lessons learned from that we are changing the way we conduct the audits.

The audits will have eight to 10 team members, staff and contractors. Like I said, we are going to encourage regional participation. They can send anybody they want. They are going to be focused. We will try to keep them about two months from start to finish. Have an in-house review of licensee documents and one or two weeks onsite.

The idea is loosely based on my experience at the region where you have inhouse review, a week onsite, go back to the office for a week, and then if we need to go back to the site for another week. After the second onsite period the all the auditors should be submitting their reports to the team leader.

MEMBER BONACA: Slide 2 you said that you assess the adequacy of licensee responses of the

Generic Letter the adequacy of licensee corrective actions. You do expect to have a full detailed plan. I'm not saying SRP but some plan on what is adequate and what is appropriate, what is acceptable, what is not.

MR. CULLISON: Well, we have an audit plan which I am currently revising and in that we will have some review elements in which we are going to have to update because when they were written six or eight months ago we have learned a lot since then. That is going to be guides for the auditors when they go out what to look for. Hopefully if we get it in there, with acceptance criteria. The auditors are usually the subject area matter expert from our office or DCI in that area so they would know what is okay and what's not.

MR. SCOTT: Let me add something to that, please. One issue that we have is that we can't do all the audits at the end of 2007 or the first month or two in 2008. We are starting the audits now and if you think about the timeline we described to you, particularly in the chemical effects area, there are still a number of open items. When we do an audit in calendar year 2006, we will basically be doing a partial audit.

We'll audit what they finished and what they have not finished we will carry as an open item that will be addressed in Generic Letter responses. It's an unfortunate situation that we simply can't wait until the very end and do them all at the same time.

That is somewhat mitigated by the fact that we are doing in 2006 and early 2007 audits on plants that will have installed their strainers in 2006 and, therefore, they are committed to provide us the Generic Letter information by the end of this year so that will mitigate it somewhat.

MR. CULLISON: As Mike said, any open items coming from the audits will be resolved during our review of the supplemental responses to the Generic Letter.

Onto the Watts Bar audit. Watts Bar is our first real audit, if you want to call it that. It really started when the licensee came in on March 2nd of this year a large group of them came in. We had an off-site meeting where they gave presentations on their analyses, what actions they are taking, the whole gambit.

That was after they had sent us all the documents and there had been some in-house review.

During this audit staff was covering all the baseline analyses and strainer testing. We issued RAIs which we will get something probably the end of this month, knock on wood.

We are performing confirmatory calculations on FLOW-3D. We expect to have the report out by the end of July. You will notice that there is a large time gap between March 2nd and the end of July and that is one reason why we are changing the way we are doing business so we can get these completed and the reports out a little faster.

Some of the key observations from audit -- of course, this is all preliminary. The report is not issued and has not been reviewed by management.

MEMBER MAYNARD: Briefly, when the report is issued would that mean that Watts Bar is done or you still would have --

DR. LU: We anticipate open items through this audit so the audit open items will be addressed as part of a Generic Letter response review at the end of December '07.

MEMBER MAYNARD: All right.

MR. CARUSO: Has Watts Bar sent in their Generic Letter 2004 response then?

MR. CULLISON: The supplement? Everybody

sent in their September '05 --

MR. CARUSO: Their supplement. Have they sent in their supplement?

MR. CULLISON: No, but --

DR. LU: They did as part of that one. It's part of the draft RAI response to us that addressed all the RAIs we asked them as part of the September response review.

MR. CARUSO: That was draft?

DR. LU: That was draft. The official one will be sent to us at the end of this month.

CHAIRMAN WALLIS: Let me go back to the previous slide. You said staff confirmatory calculations are being performed. What does Watts Bar do? Does TVA run some sort of a code to predict these things or how did they justify that --

DR. LU: TVA, I think, contracted a line to perform the transport calculation.

CHAIRMAN WALLIS: Did they use CFD?

DR. LU: Yes, they used CFD.

CHAIRMAN WALLIS: Did they use some sort of a code for downstream core evaluation too?

DR. LU: They actually decided to use conservative approach to determine the source term and then perform the analysis. Their position was there

was no issue related to the downstream core.

CHAIRMAN WALLIS: Didn't do any analysis of the downstream core?

DR. LU: They did and they have that analysis there but they performed a very conservative analysis instead of performing a code calculation.

MR. CULLISON: Some of the key observations. They are a low fiber plant, mostly RMI. They are assuming that all containment coatings fail. They are not taking any credit for qualified coatings.

Transport. Everything but the RMI transporting to the strainer. They used CFD to calculate the RMI debris.

CHAIRMAN WALLIS: Did they know how to calculate the effects of coatings on a strainer?

DR. LU: They assume entire containment coating failed and 100 percent transportable to the strainer.

CHAIRMAN WALLIS: But in what form? Was it in chips or particles or what?

DR. LU: In chips.

CHAIRMAN WALLIS: In chips? Did they know how to calculate the pressure drop across the strainer with chips?

DR. LU: Hold on. Matt is going to talk

about that.

MR. YODER: Watts Bar actually used chips and particulate debris. Because they are a low-fiber, almost no-fiber plant, the thought is a chip if it makes it to the strainer surface is going to plug that hole so they took chips roughly the size of the strainer hole or slightly larger under the thought that -- this is in the staff guidance as well. For a plant without fiber we told them to assume chip debris. Then they took particulate debris for the zone of influence and the other --

CHAIRMAN WALLIS: But the area of the containment covered with coating is much bigger than the area of the screen so if you take all that coating and put it on all the holes, you've blocked them all.

MR. YODER: They actually put the coating debris into their flume test and at the end of that test actually shoved all of these coatings onto the strainer itself and they were still able to maintain flow.

CHAIRMAN WALLIS: It was based on a test?

MR. YODER: Correct.

CHAIRMAN WALLIS: It wasn't based on some kind of semi-theoretical let's say.

MR. YODER: They actually put the debris

in and used the test to prove that.

MEMBER SIEBER: That was confirmed by another test also that stacked up paint chips will pass flow.

MR. YODER: I think in some of the PNL work that we heard about yesterday even when they put all the chips on there was enough of a tortuous path that the flow could get through.

MEMBER SIEBER: Right. So this is not inconsistent with all the other tests.

MR. CULLISON: And for head loss the --

CHAIRMAN WALLIS: I'm just wondering what ACRS should do. You have done all this. At some point would it be appropriate for us to audit your audit or something? I don't really want to do that. I would just like to say that you have done a good job but do we get involved at all in checking the quality of what industry does and your evaluation?

MEMBER BONACA: I have the same question. I mean, I guess I misunderstand the word audit. To me audit means you are looking at the compliance with certain specific requirements.

DR. LU: That is exactly true.

MEMBER BONACA: Now, it would seem to me that you have four or five different kind of

approaches to the resolution of this problem. A number of clients have used one type or the other one and so on. There will be a phase where you are reviewing the approaches taken on a generic basis but you are not doing that.

DR. LU: I think based on what we observed so far most of the licensees are following the guidance report to perform debris generation and transport calculations. The only difference there comes from vendor testing, the head loss data or the choice of the strainer itself.

MEMBER BONACA: So you decided that the NEI process is appropriate?

MR. SCOTT: Well, it's not a simple answer to that. There is the staff's SE from two years ago which provides review guidance in some but not all areas. The other areas, chemical effects, you heard we are going to develop review guidance for that.

You heard Shanlai mention that we are going to develop review guidance for the head loss testing in the near-field effect and review guidance in a couple of other areas, too. I think you also heard that we are expecting that some of that review guidance will be iterative. The review guidance will be applied to the audits and those will be the

criteria we will use.

As for the question of ACRS review of the audits --

MEMBER SIEBER: Give us the report.

MR. SCOTT: Well --

CHAIRMAN WALLIS: Review of something. Shouldn't we be reviewing something to sort of play a role of checking that things are going okay or should we just leave it all up to you and then you come back at some later date with something for us to see? How do we get involved with this stuff?

MR. SCOTT: One suggestion, if I might. You might want to look at the review guidance that we've told you we are going to develop and weigh in on that.

CHAIRMAN WALLIS: While it's being developed?

MR. SCOTT: At some point during its development.

CHAIRMAN WALLIS: When we can be most useful. Okay. Review guidance.

MEMBER MAYNARD: I really don't think the ACRS should get in the role of independent audit of the NRC's audit.

CHAIRMAN WALLIS: That's not really our

job.

MEMBER MAYNARD: Right.

CHAIRMAN WALLIS: That's not our job.

MEMBER SHACK: But the scaling arguments, for example, to support the near field transport sounds like something that --

DR. LU: Be part of the review guidance. That will be part of review guidance.

CHAIRMAN WALLIS: Technical guidance.

MEMBER BONACA: I think we should make a judgement of whether or not we think this is all technically adequate. Otherwise we are spinning our wheels and wasting our time.

MEMBER SIEBER: Before you leave this slide, I have a question about the transport bullet. Maybe you can tell me what RMI debris looks like. My picture of it is a bunch of ripped up sheet metal. I would not think even if you transported all this stuff to a strainer some place that it would impede the flow very much. It would just provide surface for other debris to accumulate on. Do I have that right or wrong?

DR. LU: You're right. I think based on our observation of the test most of the RMI just settles at the bottom of the flume and becomes like

porous medium for the water to go through. It really does not add additional head loss on the surface of the strainer so you are right. In terms of the transport we are trying to figure out how much RMI would be transported based on the safety of analysis.

MEMBER SIEBER: It really doesn't make any difference how much is transported since it has no effect on head loss.

DR. LU: That's correct. For this particular plant, yes.

MR. SCOTT: So being an RMI plant is arguably a good thing.

CHAIRMAN WALLIS: Well, now, you're saying all containment coatings fail and then you're saying they are all transported to the strainer?

DR. LU: That's right.

CHAIRMAN WALLIS: The strainer area is 4,600 feet square. The typical containment coatings area is several hundred thousand square feet and so I have to do some math here but it looks as if you've got something like whatever it is. It is probably 70 square feet of container coating per square foot of strainer. You are going to put 70 layers of coating and put it on the strainer and it's not going to have trouble?

DR. LU: Actually that's what we observed.

CHAIRMAN WALLIS: That's what you observed?

DR. LU: Yes. First we dumped all the coating chips, RMI, and the fibers upstream of the strainer so we questioned whether this was because of the artificial near field transport. They did not take enough credit from the near field transport and then later say, "Okay, let's just shovel everything upstream in the flume and bury the entire strainer and see what is the head loss." The head loss was higher than the previous condition but it was still significantly lower than the --

CHAIRMAN WALLIS: Something like an inch of debris on the strainer? Is that right?

DR. LU: Actually it's the entire strainer.

CHAIRMAN WALLIS: What is the thickness of stuff you get on the strainer?

MR. YODER: Matt Yoder from NRR. One thing that we observed is it's physically impossible to get all of this debris onto the strainer. There is just so much debris it cannot be done.

CHAIRMAN WALLIS: Where does it go?

MR. YODER: In a mound around the base of

the strainer and piled --

CHAIRMAN WALLIS: One reason the strainer works is that it's not uniformly coated.

DR. LU: That's right.

CHAIRMAN WALLIS: That helps a lot. So the stuff piles on the bottom of the strainer and the top part of the strainer is relatively clear then.

DR. LU: I don't have a picture but visually you can consider because of very low approach velocity the chip itself becomes very -- there's a huge mountain but it was such a high void fraction that --

CHAIRMAN WALLIS: That's what bothered me when you said all debris is assumed to be transported to the strainer. You don't really mean that it gets to the holes. You mean it gets to the vicinity of the strainer.

DR. LU: That's right.

CHAIRMAN WALLIS: Then use CFD to figure out where it goes, whether it goes up into the strainer or falls on the floor.

DR. LU: They calculate the fraction of the debris, RMI debris, from the containment pool.

CHAIRMAN WALLIS: So it doesn't all go onto the strainer. It does not all go onto the

strainer.

DR. LU: No.

MEMBER DENNING: So would you say this is credit for a near-field effect?

DR. LU: Yes. Right at the very beginning of the test.

MEMBER DENNING: I thought you were telling us the opposite here.

DR. LU: Right at the beginning. They calculated the total amount of debris close to the nearby region of the strainer. Then they dumped all the debris in the testing flume and the testing flume demonstrated that most of the debris actually did not end up on the surface of the strainer. We questioned that testing approach and they decided to shovel in as much of the debris as they can to bury the entire testing section.

CHAIRMAN WALLIS: If you know what the size of the debris is but these are coatings. Do you know how to predict the size of the coating flakes or particles or whatever they are?

MR. YODER: The justification for the size of the coatings that were used, as I said, these were all ruffled, the size of the holes or larger, and the distribution --

CHAIRMAN WALLIS: Then they would fall out.

MR. YODER: That's correct, but since this is a no fiber plant, that's the only way the coating is going to impact the head loss. If you have particulate coating they are going to pass straight through and not impact the head loss at all.

CHAIRMAN WALLIS: If the containment coatings are small enough they would all pass through?

MR. YODER: If you don't have a fiber bed to filter them out on, yes.

CHAIRMAN WALLIS: You get 300,000 square feet of coatings in the reactor?

MR. YODER: Some portion of it would pass into the reactor, yes.

MEMBER DENNING: You mean particulate.

CHAIRMAN WALLIS: Whatever the coatings became. The coatings are going to become very tiny particles now and they are all going to go through the strainer because they are assumed to be all transported.

MEMBER SIEBER: That's a nice color.

CHAIRMAN WALLIS: Then presumably then end up going through the reactor, too, and coming back around again.

MEMBER DENNING: Now, wait a second. They are not double treating the -- I mean, in their tests I gather what happened was they took all the coatings and pretended they were chips. Right? Okay. Then they fell out. A lot of them fell out so they did something to maximize how much of it they could get onto the strainer. It's not totally clear to me how they did that but even in that process of trying to maximize it, a fair amount of it still did not go onto the surface of the strainer. Is that correct?

MR. YODER: They actually buried. I mean, they physically shoved this stuff onto the strainer and on top of it and all around it as much as you possibly could to get this stuff on it and around it and still were able to have a flow.

MEMBER DENNING: You piled it up.

MR. YODER: Right. To address Dr. Wallis' comment, remember they are running five to 10 tests so they ran another case where they introduced all the coating debris as particulate and they did sample the downstream so they have that data.

CHAIRMAN WALLIS: Did a lot of it go through?

MR. YODER: Yes.

CHAIRMAN WALLIS: A lot of it did go

through so then we have to think about downstream effects maybe.

MEMBER SIEBER: You know, there is one very conservative assumption piled onto another all the way through this. I can't imagine, for example, in any space other than regulatory space where you would assume that all the coating failed and ended up at the sump. Secondly, the transport models in the tests and experiments that were performed showed the stuff really doesn't transport.

Those two things combined say that the amount of deposits that actually end up on the strainer is going to be relatively small. Even if they end up there, they will pass water. I think it is fair to use all these conservative assumptions, particularly if you come out looking good anyway. On the other hand, I think it is fair to recognize how conservative a position this really is. I think it's extremely conservative.

MEMBER BONACA: I imagine it will be piling up with debris all over the area.

MR. ACHITZL: I would just like to make one comment about Watts Bar. Going way back when this thing started there were a set of plants that we felt nobody had to do anything for any accident. I would

like to reflect with an RMI plant like you mentioned with the coatings and stuff like that with a fairly big strainer before they spent the $5 million here, that was one of the plants that we decided didn't have to do anything for any accidents. I mean, yes, they are making changes but I'm not sure those are necessarily dollars well spent I guess is my thought.

DR. LU: Bottom line I think the head loss is very conservative in terms of the margins they have. The new trainer they are going to put it in.

CHAIRMAN WALLIS: The only kind of reason you have a little bit of reticence perhaps in that is that people that thought before that everything was fine. Before the thin bed effect was discovered everyone thought things were fine. Then something happened in the BWRs and it was discovered that a rather small amount of debris just left there because they hadn't cleaned the suppression pools enough to block the strainer so there were surprises.

When people come in with a lot of these things like, "I think it's okay because we are very conservative and this isn't going to happen," and so on, it sounds good but there have been surprises before. I can't tell you that you're going to have surprises again and maybe the ACRS isn't going to be

involved in trying to guess but you might find there are surprises.

MR. WHITNEY: This is Leon Whitney from --

CHAIRMAN WALLIS: I think I am reluctant to say everything you are doing is fine. I am reluctant to say its lousy. I may be reluctant to say anything about it. Just wait and see.

MR. WHITNEY: This is Leon Whitney from SSIB. Indeed, the licensees' strategies are no surprises 10 years from now and that's why they go to these large strainers in part even when you could argue that maybe they don't need such massive strainers in a particular plant. They use all the conservatism in the analysis and then they can back off those conservatisms if there is a surprise. There is a lot to do with in the psychology of licensees.

CHAIRMAN WALLIS: What was the size of that strainer before?

DR. LU: I cannot remember the exact number.

CHAIRMAN WALLIS: Was it smaller?

DR. LU: It's much, much smaller. It's about 40 or less square feet. I cannot remember the exact number.

CHAIRMAN WALLIS: I thought Ralph implied

it was not a very big change.

MR. YODER: The change was significant but I think what Ralph was saying is that because they are a low fiber plant and all these other factors, they didn't have the kind of problems that a plant with a lot of fiber that creates a bed has.

CHAIRMAN WALLIS: Are they changing the whole size and the strategy now?

DR. LU: Yes, they did.

CHAIRMAN WALLIS: What kind of strainer is it?

DR. LU: It's a PCI strainer. I think we can go back to slide --

CHAIRMAN WALLIS: Is it the pigeon hole one?

DR. LU: It's the stacked disk, flat, square shaped.

CHAIRMAN WALLIS: Okay. That's the one where you have to worry about whether or not the stuff can get into the area because it might jam on the outside.

MEMBER SIEBER: Right.

DR. LU: That's right.

CHAIRMAN WALLIS: Okay. Thank you.

MR. CULLISON: Moving on to chemical

effects, Watts Bar uses sodium tectraborate as their buffer agent which means ICET test 5 is most applicable for their plant specific environment. There is insufficient fiber to form a debris bed. That's what we have been discussing.

The licensee added a significant amount of margin to the screen area to accommodate chemical effects.

MEMBER SIEBER: What about aluminum content in containment? Do you know anything about that?

MR. CULLISON: I think Paul is going to answer your question.

MR. KLEIN: Paul Klein. The aluminum content, I believe, is less than 1 percent of the ICET 5 value that was tested.

CHAIRMAN WALLIS: Well, the 5 percent it would seem to be gratuitous, not something that really is necessary, the 50 percent margin.

MR. KLEIN: I think Leon had discussed earlier that they wanted to add plenty of margin to account for surprises down the road.

CHAIRMAN WALLIS: Well, we know that chemical effects in the wrong social senses can have an effect which is larger than 50 percent on pressure

drop.

MR. SCOTT: The other consideration I think for the licensees is that the marginal cost of adding another module of strainers is not that great once you've made the investment in the design for the whole set.

DR. LU: This particular plant has sufficient space to put the strainer so that is the reason they made it as conservative as they can.

MEMBER SIEBER: So this is not a good plant to test your prototype audit plan.

MEMBER DENNING: Exactly.

MR. SCOTT: Actually, we wanted to start with a relatively less challenging one. We are working our way up to the more challenging ones.

MEMBER SHACK: I was going to ask you how Ford Calhoun came out because that's not so trivial.

DR. LU: I think we issued a pilot audit about Ford Calhoun. I don't think this particular presentation was intended to address that particular issue. However --

MEMBER SIEBER: We'll just read about that.

DR. LU: Yes.

MEMBER DENNING: Now, definitely tell us

how you do an in-vessel evaluation that was performed conservatively. I want to know.

DR. LU: I don't know whether Tom is here. My understanding is -- before Tom starts maybe I can make a few comments. My understanding is they applied that very conservative debris source term to the downstream evaluation for the core.

MR. HAFERA: As I mentioned during my presentation, this is a plant that doesn't even have enough fiber to make a bed in their reactor so it becomes very difficult to say you are going to have some kind of a thin bed or any kind of bed on the lower core plate or on the fuel nozzle inlet or at the grid straps because they just don't have enough fiber.

MEMBER DENNING: What analysis did they actually do?

MR. HAFERA: They did a hand calculation. Now, one of the other things that they are doing, though, is they are deferring --

CHAIRMAN WALLIS: How many calculations did they do? They used their hand but what was the calculation? Can you sketch out what it was?

MR. HAFERA: Let me finish. They did a hand calculation that basically said they didn't have enough fiber to create a bed and, therefore, it's not

a problem. What they also did was they deferred essentially. We asked them a number of RAIs and at that point they deferred to the new Owners Group WCAP that's being developed so they are not considering that to be final.

CHAIRMAN WALLIS: What was the hand calculation then? What was it based on? It must have been based on some sort of principle or balance of mass or something. Can you sketch out the logic of the calculation?

MR. HAFERA: 2 is equal to M delta H. That's how you move heat. You don't effect the --

CHAIRMAN WALLIS: How much product for the matter came through the screen and where it went. What did they do about that?

MR. HAFERA: Again, the particulate matter becomes an analysis of whole size in your reactor because what you find is they had enough adequate bypass paths that would not capture small particulates because the bypass paths are on the order of an inch to an inch and a half.

CHAIRMAN WALLIS: What goes through the screen would not block the flow to the reactor.

MR. HAFERA: Correct because the bypass paths are on the order of an inch to an inch and a

half and their strainer size hole was 1/12th of an inch I believe, the final strainer hole.

CHAIRMAN WALLIS: Don't they have debris catchers at the bottom of the core that catch debris?

MR. HAFERA: Well, again, your lower fuel nozzle has -- your core plate has debris holes and your lower fuel nozzle, depending on your fuel design, has debris catchers and that can catch certain debris but it wouldn't catch small particulates because actually those holes are typically larger than the ECCS strainer because by design the ECCS strainer is supposed to be smaller.

CHAIRMAN WALLIS: Do you know the size of the holes in these strainers?

MR. HAFERA: Not off the top of my head. They were larger than the holes in the ECCS strainer.

CHAIRMAN WALLIS: The people who sell these strainers emphasis how effective they are at catching stuff.

MR. HAFERA: Right.

CHAIRMAN WALLIS: And you're telling me how ineffective they are.

MR. HAFERA: Well --

MEMBER MAYNARD: I think it's for a different purpose.

MR. HAFERA: It's for a different purpose. That's right. Unfortunately you missed the presentation, Dr. Wallis --

CHAIRMAN WALLIS: Very sorry.

MR. HAFERA: -- where we basically showed that you can block 99.9 percent and still okay.

CHAIRMAN WALLIS: All right.

MEMBER MAYNARD: The strainer size should be smaller than what your nozzles are for your fuel. The debris catchers in the fuel design in case you have some sort of lose part that gets into the RCS or something else in there, it is sized so that --

PARTICIPANT: They are not for particles.

MEMBER KRESS: In the aerosol business, which may not be an exact analogy, if you continue to flow aerosols out a leakage path that is a pipe of six inches in diameter. It will eventually plug the entrance to that pipe if you just continue flowing it through. These aerosol particles are 10 microns down. I don't know if the same thing would happen if you continued to recirculate particles through a bigger opening. Would it eventually plug up that anyway even though they are much smaller than the opening? I know it happens with aerosols.

MEMBER BONACA: That's right. That is

what we were discussing this morning about the core, about recirculation and having certain areas where you begin to have accumulation and then you have blockages.

MEMBER KRESS: I don't know if we run these tests long enough and recirculate enough to decide whether or not eventually you are going to plug a pipe situation.

CHAIRMAN WALLIS: If you pour all your salad dressing down the drain in your kitchen it would probably block it up, too.

MR. HAFERA: To address that issue, you have to recognize also (a) how the LOCA event progresses.

MEMBER KRESS: That's true.

MR. HAFERA: (b) how is the plant constructed; (c) what are the emergency procedures and how is the plant operated post LOCA. One of the key factors to recall is every pressurized water reactor in the country after a period of time goes on to simultaneous or hot leg recirculation to flush braun precipitation out of the reactor vessel. We would not expect that these precipitants would behave significantly different than that.

MR. CULLISON: To finish up, over all our

preliminary finding is the design of the Watts Bar strainer appears to be robust with sufficient margin.

CHAIRMAN WALLIS: That's preliminary. That's why it appears to be.

MR. CULLISON: Right.

CHAIRMAN WALLIS: When you reach a final conclusion you will state it is adequate.

MR. CULLISON: When it gets signed off by management, then it is instead of appears.

CHAIRMAN WALLIS: So now you are going to do some difficult ones later on.

MR. CULLISON: Yes.

CHAIRMAN WALLIS: Good. Thank you very much.

MR. SCOTT: Okay. Our final presentation of the day is Leon Whitney is going to talk to you about the process that we are planning to use to ultimately close out the Generic Safety Issues. You all had some process oriented questions so please bear with us when we give you a process oriented discussion here.

MR. WHITNEY: Good day. Leon Whitney from Safety Issues Resolution Branch. I'm going to talk about the end game in the Generic Safety Issue 191. We are going to talk about the top level activities.

We are going to resolve all the technical issues that we've talked about both yesterday and today. Chemical effects, downstream effects including in-vessel, retransport and near-field effect, qualified and unqualified coating adhesion, coating debris characteristics and transport, and debris head loss.

CHAIRMAN WALLIS: What do you mean by resolve technical issues?

MR. WHITNEY: Well, at least get to the point of review guidance where we can --

CHAIRMAN WALLIS: That means review guidance.

MR. WHITNEY: Implication thereof.

MR. SCOTT: But there is a proceduralized NRC process for resolving and closing generic safety issues and that is what we are ultimately talking about.

CHAIRMAN WALLIS: It depends upon the context. If you want to publish in a journal something about chemical effects, that is something but if you want to say that you are satisfied that the design is adequate or assure public safety for certain plants, you may be able to make a very crude assessment of chemical effects and, therefore, there

is no chemical effect. Resolving depends very much on the context.

MR. WHITNEY: We need to declare the adequacy in accordance with 5046.

CHAIRMAN WALLIS: That's what you mean by it.

MR. WHITNEY: That's the over-arching goal.

CHAIRMAN WALLIS: So you don't mean that you have to get a debris head loss correlation which is accurate to one part in a thousand or something. You mean that because of the experiments that are being performed you have adequate assurance that the strainer will meet its specifications.

MR. WHITNEY: And that the entire plant during the LOCA operates as required by design --

CHAIRMAN WALLIS: Oh, that's what you mean by resolving technical issues. It really means assurance that the core will be adequately cooled.

MR. WHITNEY: Long-term cooling is assured.

CHAIRMAN WALLIS: Okay.

MR. WHITNEY: Well, the steps are to observe the 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, obviously in conjunction with the Office of Research.

CHAIRMAN WALLIS: NRC confirmatory testing. That's the ones which have been done so far really.

MR. WHITNEY: Research has taken the lead in most --

MR. SCOTT: And in the future if the need is determined to do more, than that would go in here as well.

MR. WHITNEY: Revise the Generic Letter audit plan as needed based on evolving technical knowledge. We have talked about individual sets of review guidance for various technical issues. Process license amendment requests to support licensee Generic Letter schedules. Those are in process. There's a small number of those, five to eight as I remember.

Conduct Generic Letter plant audits for a sample of 12 selected PWRs. We are going to have to reach closure on the open items. As we talked about that, it may be during the supplemental response time period and not necessarily during the plant audit. We will consider based on the audit results whether to

increase the audit sample size to ensure adequate PWR fleet response to Generic Letter.

Also we will verify the adequacy of the 2006 and 2007 Generic Letter supplemental responses and/or responses to February 2006 requests for additional information for each PWR. As you remember, the RAI response --

CHAIRMAN WALLIS: I guess 12 is equal to 13?

MR. WHITNEY: Well, you would have 12 more and I guess Watts Bar --

CHAIRMAN WALLIS: Oh, you counted 12 more. Okay. That's why you get 13.

MR. WHITNEY: As you'll remember, the RAI responses may be folded into the Generic Letter supplemental responses. The regions will be conducting inspections under the TI-2515/166 to verify implementation of the Generic Letter plant modifications and procedural changes as described in the Generic Letter supplemental responses and RAI responses.

MEMBER BONACA: How different are these inspections from the audits?

MR. WHITNEY: They are looking at implementation not technical adequacy. What did you

promise and did you do what you promised as opposed to is that strainer big enough, is this --

MR. SCOTT: What did you say you going to install versus what you actually installed.

MR. WHITNEY: And/or procedural changes. Evaluate extension requests for Generic Letter modifications and procedural changes based on SECY-06-0078 extension criteria. There have been five of those, six actually on our plate.

One denied, four approved, and one in progress and there are other ones coming, two or three that we know about. None of them have gone past spring 2008 in their request. And develop Generic Letter closure letters for each PWR based on supplemental responses, RAI responses, pilot results, if any, because we're not doing audits of every plant at this point, and/or the TI-2515/166 implementation inspections.

MEMBER DENNING: What does the closure letter actually say? Does it say we accept? It just says we agree that you have submitted the information or does it say more than that?

MR. WHITNEY: When it's submitted we are going to have to assess the adequacy as it appears in the documentation. Remember we are writing RAIs so

that whatever holes we can fill the holes.

MEMBER DENNING: But you only look into TIL at 13 but you basically tell everybody else the results.

MR. WHITNEY: The sample size of which we can increase if we had indication that there was a generic failure out there or something significant that drove us to audit more.

MEMBER DENNING: What is your schedule for when those closure letters would be written?

MR. WHITNEY: They are subject to these supplemental responses so there are two tiers, 2006 and the 2007, tiers of responses based on when the strainers are installed. They all can't be written soon.

MEMBER DENNING: But for 2006 would you write them as soon as you could after?

MR. WHITNEY: I would expect in late 2006 and early 2007 we would be writing the 2006 ones. Depending, again, if there was an audit at one of those plants we would not issue the letter until the audit. When we actually issue the letters there would be a management decision.

MR. SCOTT: As soon as for a particular plant all the pieces are in place that we have talked

to you about and we've gotten sufficient information to verify that they are in compliance, then we can go ahead and write that letter.

That at the earliest, I assume none of the responses will come in until right at the end of this calendar year so then we'll start looking at them. If there are no remaining open issues, RAIs, etc., then we can write the letter. Now, whether that is going to be the case for the early plants that come in, that's questionable.

MEMBER MAYNARD: Also, for the audits, 13 audits probably covers close to 18 or 20 plants. Some multi-unit sites would be covered in that.

CHAIRMAN WALLIS: Then there are some plants which are quite similar to other plants.

MR. WHITNEY: And in 2008 we will be briefing ACRS. We'll be updated the standard review plan based on the knowledge gained and the information that we understand about the Generic Safety Issue closure. We will ensure that 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. Maybe we'll still be auditing and writing letters.

CHAIRMAN WALLIS: Might still be doing

research.

MR. WHITNEY: There are only so many people in the section and then DCI.

CHAIRMAN WALLIS: It would be nice to move on from this issue and do other things which might actually be more important for reactor safety.

MR. WHITNEY: It would be very nice to move on.

CHAIRMAN WALLIS: Are you going to finish up, Mike? Are you going to have a few final remarks for us?

MR. SCOTT: Yes. A very few, yes. In closing, I would just like to say that, again, we appreciate the opportunity to come in and brief you again and we are looking forward to a number of additional opportunities. I believe we are going to be talking to you again in August along with the vendors.

I think the vendor presentations will hopefully answer a number of your detailed questions if we didn't fully fill the bill on those today. Of course, we only had one slide per vendor so you didn't get much detail.

Ralph, I assume you're looking at several hours with each vendor in August?

CHAIRMAN WALLIS: Something with Westinghouse or the PWROG.

MR. SCOTT: The OG, whatever the OG is. We'll work that acronym out. Anyhow, so you are going to get some of that information in August. You are going to hear a lot more from us, I think, right around the new year when we start getting these packages in and we start getting a look at them and finding out how much they are filling the bill for us and whether we need to adjust the plan to deal with what comes in.

Between now and then we'll start having the guidance documents drafted and we'll keep in touch with Ralph and let you know when we think they are right for a look from the Committee.

We do appreciate the fact, as you all noted in your March letter, and as several of the members talked about today, we appreciate your agreement that we basically put an appropriate emphasis on making near-term enhancements to the sump designs as our top priority. We will, as I mentioned, integrate information from many sources to determine when the generic safety issue is resolved.

We are certainly not in a position to resolve it and close it today. It is a very so to

speak fluid situation because the solutions are not always clear. The industry, as we've noted, is doing significant work and possibly going to alternate buffers so for us to say we have the solution for a particular configuration is at this point premature. We don't know what the configuration is that the plants are going to be using.

All of this will become more and more clear to us towards the end of this year and particularly into next year. We look forward to continuing to work with you all in that time and to benefit from your feedback. Thank you.

CHAIRMAN WALLIS: We wrote a letter in March which was fairly substantial and direct. Now you have gone to work. You told us what's going on. We haven't really had substantial technical issues we can help with at this time. Are you expecting us to write some sort of letter this time or just more an informative thing to go along with and then when we have something more substantial down the road, we can write another letter which is more substantial?

MR. SCOTT: Well, I guess our perspective is that there is not much new that has occurred since your last letter. If there is some particular subject area on this that you believe having heard where we're

going today that you all --

CHAIRMAN WALLIS: Change direction we would do something.

MR. SCOTT: If that's where you want to go, yes. It really hasn't from our perspective changed that much. You still hear the same story which is that we got the research. It's coming in now. We are just starting to use it. We are just starting to develop review guidance. We are just starting to do audits. It's a lot of stuff that's kicking off now or has kicked off in the last couple of months. It's pretty early in the process.

CHAIRMAN WALLIS: Your team has thought about many of the things that they have to do. That's evident. Lots of plans. As you said before, how it works out will depend upon what sort of detail is in the details. We'll find out from the plans in industry and so on.

MR. SCOTT: If you believe having heard the questions that we're asking that there are questions that we should be asking, then that would be obviously something we would want to hear about.

CHAIRMAN WALLIS: So you are not asking for another letter unless we have something substantial to say.

MR. SCOTT: Right.

CHAIRMAN WALLIS: I think before you leave we might give an indication as to whether or not we want to write a letter? Can we do that? Are they going to sway the Committee's view? What do you think, John?

MEMBER SIEBER: Well, I think that particularly the plans that evolved from today's session is something the full committee should hear. We have time scheduled for the next meeting and I think there is progress being made here. On the other hand, everything is arriving at the goal line at the same time but I think the Committee would benefit from the fact that there is resolution coming.

I think the idea that the research is sort of just catching up to NRR, NRR is moving ahead and the industry is moving ahead and the research is maybe a little later than just in time. I think that requires some kind of explanation and some progress as to where the research is right now because I think there is enough done that you can reach some conclusions.

On the other hand, I think that it's important for the Committee to recognize that the schedules that are out there and the emphasis on

answering the Generic Letter and the goal to actually improving the plants is what drives this process.

CHAIRMAN WALLIS: If we have a presentation on research, what I would like to see would be a very short one where we don't see the individual actors but we see someone who knows what's going on saying, "These are the research programs. This is what we've learned from them." Maybe NRR are the appropriate people and we are showing awareness of what is being done and what has been useful and what you're going to do with it.

MEMBER SIEBER: That is my sentiment exactly.

CHAIRMAN WALLIS: Have a presentation by each researcher.

MR. SCOTT: The only thing I would caution on that is that in July we still won't have a lot of the reports.

CHAIRMAN WALLIS: That's right, so it would be a progress report saying we think we are learning this from this one and it's going to appear in the report and we have learned this from this one. We have learned about aluminum. We have learned something about whatever. Are you ready to do that or are you going to want to wait?

MR. SCOTT: If you want a progress report we can give you one. No problem. If you are looking for --

CHAIRMAN WALLIS: For the benefit of the whole Committee.

MR. SCOTT: I understand. If the whole Committee would like to hear about where we stand with looking at research, then we can do that.

CHAIRMAN WALLIS: We're not in a position to hear any kind of evaluation of it until we see the final thing.

MR. SCOTT: Not a detailed evaluation.

MEMBER SIEBER: The question is whether we write a letter or not. Probably in my opinion I don't think a letter is necessary at this time to comment on the plans or progress. On the other hand, we have a letter that is outstanding that the EDO has sent us.

CHAIRMAN WALLIS: Response to the EDO you mean?

MEMBER SIEBER: Yeah. As I look at that and listen to the last two days of presentation, I have a better appreciation from where the staff is coming from. We may want to in our deliberations on whether we write a letter or not to take that into consideration and --

CHAIRMAN WALLIS: It should be a meaningful one which contains a message of importance.

MEMBER SIEBER: Right.

CHAIRMAN WALLIS: I'm not sure at this stage there is such an importance.

MEMBER SIEBER: Right now other than just keeping informed I don't think --

CHAIRMAN WALLIS: We do have meetings with the full Committee where we don't write letters so that's a possibility.

MEMBER SIEBER: Anyway, that's my opinion.

MEMBER MAYNARD: First of all, I would like to say that between yesterday and today I've heard a lot of good information and I think it gave me a better feeling for what has been done and what is being done than the perspective that I had before the meeting so I think the meeting was very helpful and I thought the presenters all did a good job.

As far as a full Committee meeting, I think it would probably be worthwhile to have a progress report. I'm kind of neutral on whether it is actually them giving a progress report or whether it's a Subcommittee report. I think that the full Committee needs to be apprized. I'm neutral on how that's done.

As far as a letter, I don't believe there is a need for a letter specifically from this meeting as far as a response to what's on the table. I think we can talk about that. I think there are still some areas. I tend to agree with what Tom said yesterday. I think there are a few specific areas that we might be able to provide some input that recognize they made a lot of progress and there is some good information available now.

There may be a couple of key areas that maybe some additional focus could be on. Perhaps we could help in providing input on guiding those activities. That is where we would probably be best suited in identifying that.

MEMBER KRESS: I personally think you could handle this with a Subcommittee report. I don't think a letter is needed at this time.

CHAIRMAN WALLIS: Only two members are not here.

MEMBER KRESS: I don't think a letter is needed at this time because I can't think of anything that I would put in it to either complain about or make a substantial change in direction. I do think that our other letter is still appropriate because I think there's need for additional experimental work

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

CHAIRMAN WALLIS: It could be a brief one.

MEMBER KRESS: Yeah. I think one area that I haven't thought much about but if the fix to the chemical effects problem is to change the buffer, I think there would be a need to test the new buffers to see if they have chemical effects that we aren't aware of. I think for the --

CHAIRMAN WALLIS: Excuse me. Will there need to tests about their affect on iodine and so on as well or is that something understood so well that you wouldn't need it?

MEMBER KRESS: I think maybe it's just the pH to worry about and I think I buy what Rich said about don't really need to enhance the sprays. They are good enough so I think maybe not. There may be chemical effects that we're not thinking about on the debris.

CHAIRMAN WALLIS: They are looking at those. They are looking at buffers from the point of view of chemical effects.

MEMBER KRESS: I think also that for the calcium nucon that there should be a criteria on the maximum amount of dissolved aluminum that would be allowed to prevent the chemical effect all together.

I mean, prevent a significant chemical effect. I don't see that being pulled out of the data yet and I think it could be.

On the coatings, at this point they don't look like a problem to me. Can we just dispose of them and say they are not a problem? I don't know. It looks like that's the way we're going.

CHAIRMAN WALLIS: They are a problem in regulatory space.

MEMBER KRESS: Yeah. I think there is still going to be a need to complete the multi-layer head loss criteria as a tool to assess whether or not you believe the integral test that the vendors are doing. I think I would like to see that carried on and completed up to some level of fruition.

CHAIRMAN WALLIS: These messages are getting through to them.

MEMBER KRESS: Yeah, I think so. I'm just repeating mostly what I said yesterday. I'm still convinced that we have put the downstream effects to bed. In particular I'm worried about long-term recirculation of debris over and over and over through the core and through the various regions. I don't know what the fate of that debris is going to be or where it's going to go. Maybe it blocks up parts of

the core and gives you enough release to violate 10 CFR 100 as opposed to being a real risk. It may be a compliance problem.

CHAIRMAN WALLIS: You have a 30-day mission?

MEMBER KRESS: Yeah, for 30 days.

CHAIRMAN WALLIS: If it's plugged up with stuff, you've still got to call them so it's not as if things are over in 30 days.

MEMBER KRESS: I think there may be a need for some long-term recirculation tests. I don't know what the nature of them would be. I don't know if there is a facility out there to do that or not.

MR. SCOTT: If I might interject something. A point that the industry made with us at a recent meeting we had with the Owners Group, and Ralph Caruso was there, too, they raised the question about what the long-term objective is here post LOCA. They were concerned that the staff might be too focused on, for example, localized effects on the fuel.

They have asked us informally and we told them they need to ask us formally for an interpretation on what the applicable requirements are long-time post LOCA. That is a subject that is still

under discussion.

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

MEMBER SIEBER: You have that and Appendix K. I think you have to meet Appendix K.

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

MEMBER SIEBER: Or some version of it.

MR. HAFERA: The discussion at the Owners Group came down to 10 CFR 5046 long-term cooling. Post LOCA you are going to have cladding perforation from over pressurization and cladding perforation so 10 CFR 100 as a release issue is not necessarily the problem. The real problem gets to be long-term cooling.

If you look at 10 CFR 5046 long-term cooling says it has success criteria that is pretty vague and nebulous. It maintained temperature and acceptably low value long-term cooling. We had a number of discussions on that. You have to recognize that means you have to maintain your core geometry. Core geometry, the structural integrity of a fuel assembly is from the control guide tubes and the grid straps.

The fuel itself does not add structural integrity to the fuel assembly. As Mike said, we are

in the process of discussing that, coming up with a position, and we are going to discuss that with the Owners Group so there are discussions going on in that area.

CHAIRMAN WALLIS: Thank you. That was very helpful, Tom. That is going to be in the transcript and everyone, I'm sure, heard it.

MEMBER DENNING: I'm in total agreement with Tom. I think you did a great summary job and I kind of agree also with where you are standing on whether we really need a presentation. I don't think we truly do. I think we have a pretty thorough summary of this but I don't think we really need the presentation.

CHAIRMAN WALLIS: You're not allowed to say anything.

MEMBER BONACA: He can't say anything. I don't think we need a letter at this stage. In fact, we shouldn't write a letter. I also think we should have only a Subcommittee report.

CHAIRMAN WALLIS: The Subcommittee report I think will be longer perhaps than some of them we've had and I would hope other members could jump in besides myself. Tom might be more articulate on some matters I'm sure than I would be. People who have

opinions could express them.

MEMBER BONACA: We need to see what the vendors are doing and I think we'll see that at the Subcommittee meeting at the end of August and probably that will give us the opportunity for a presentation of the full Committee after that.

I think I'm pleased to see there is progress going on so far as implementing certain solutions. They will really give us the opportunity to test the solutions to questions in a specific way. We may see some dramatic solutions actually that they are implementing by doing certain things. I thought the presentations were very good from yesterday to today.

I think we got a lot of good information. I think the downstream effects are pretty optimistic as far as the calculations. You may not agree but I believe they may be. But I also agree that a certain level of localized clad damage is within the regulation for this particular kind of event so I don't have a problem with that.

I'm interested also in seeing what some of the audits will do. I still have the question in my mind about how much do we know already what is acceptable, what is adequate and what is not adequate.

There are certainties there and we recognize some additional research may be required to clear some issues. All in all I think it was a very useful meeting. I think it was very constructive.

CHAIRMAN WALLIS: So it looks as if we are headed for a Subcommittee report. I'm not going to ask you folks to come to the full Committee meeting in July.

MEMBER DENNING: Of course they are invited to visit.

CHAIRMAN WALLIS: I'm not going to ask you to make a presentation. I am more reassured than I was. I think the staff is serious about this, that you are aware of how difficult parts of it are, that you guys have thought about some of the things you have to do.

As I said before, I think the devil is going to be in the details. We know what industry is doing and what some of these vendors conclude and how well they conclude from experiments, how comprehensive the experiments are, how much they really dig into what might happen and how much they investigate that and so on.

The general quality of their work is going to be crucial. Let's hope that works out well. Very

much of this is in the hands of the vendors of these strainers and industry. We will hear about that somewhere down the road.

MR. SCOTT: You can rest assured we are serious about it. We've got a whole branch that is nothing but GSI-191 and we use resources from outside, too. We are very much focused on getting this issue resolved.

CHAIRMAN WALLIS: Still you are at the point of having made plans of how you are going to conduct this campaign and now you have to conduct it. It is a bit like a battle that things happen along the way that you have to face.

MR. SCOTT: And we have to be flexible enough to deal with those. That is correct.

MEMBER SIEBER: Roadside bombs.

CHAIRMAN WALLIS: I think our previous letters have emphasized these things. I don't think we need to say it again so thank you very much. Now being 3:00 it's time to knock the gavel and we finish again ahead of time because of the nobel efforts of my colleagues and the staff. Thank you very much.

(Whereupon, at 3:04 p.m. the meeting was adjourned.)