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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

February 14, 2006

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

THERMAL HYDRAULICS SUBCOMMITTEE

MEETING

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ROCKVILLE, MARYLAND

TUESDAY,

FEBRUARY 14, 2006

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The Subcommittee met in Room 2TB3 at Two White Flint North, 14555 Rockville Pike, Rockville, Maryland, at 8:30 a.m., Graham B. Wallis, Subcommittee Chair, presiding.

<u>PRESENT</u>:

GRAHAM B. WALLIS	Subcommittee Chair
RICHARD S. DENNING	Subcommittee Member
THOMAS S. KRESS	Subcommittee Member
WILLIAM J. SHACK	Subcommittee Member
SANJOY BANERJEE	ACRS Consultant

<u>NRC STAFF</u>:

RALPH CARUSO	Designated Fed. Official
RALPH ARCHITZEL	NRR
DAVID CULLISON	NRR
MICHELLE HART	NRR
JON HOPKINS	NRR/DPR
WALT JENSEN	NRR
PAUL KLEIN	NRR
JOHN LEHNING	NRR
SHANLAI LU	NRR/DSS/SSIB
TOM MARTIN	NRR
ROBERT TREGONING	RES
STEVEN UNIKEWICZ	NRR/DCI/CPTB
LEON WHITNEY	NRR
MATTHEW YODER	NRR/DCI/CSGB

<u>OTHER PRESENT</u>:

JOHN BUTLER	NEI
MAURICE DINGLER	WOG

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

8:30 a.m.

CHAIR WALLIS: Good morning. The meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards Subcommittee on Thermal Hydraulic Phenomena. I am Graham Wallis, Chairman of the Subcommittee. Subcommittee Members in attendance are: Tom Kress, Will Shack and Rich Denning. The consultant to the Committee is Dr. Sanjoy Banerjee.

The purpose of this meeting is to discuss the progress being made by the NRC staff in the resolution of Generic Safety Issue 191, PWR Sump Performance. Today we will hear a report from the staff on the industry response to Generic Letter 2004-02, as well as a report from NEI and the Westinghouse Owners Group about their activities.

Tomorrow and Thursday, the staff will present the results of its ongoing staff research program associated with chemical interactions of coolant and debris within the containment during the loss of coolant accident.

The Subcommittee will hear presentations by and hold discussions with representatives of the NRC staff and other interested persons regarding these

issues. The Subcommittee will gather information, analyze relevant issues and facts and formulate proposed positions and actions as appropriate for deliberation by the full Committee.

We understand that Dr. Shack has a conflict of interest and will not be participating in Committee deliberations on this matter. Ralph Caruso is the designated federal official for this meeting.

The rules for participating in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on February 7, 2006. A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice. It is requested that speakers first identify themselves and speak with sufficient clarity and volume, so that they can be readily heard.

Who is going to speak first? I thought it was -- it's not -- Mike Scott has had a remarkable metamorphosis and is now on the NRC staff and is appearing before us. I understand that he is not going to speak first. So, please, go ahead and introduce yourselves.

MR. HOPKINS: Yes, hi, I'm Jon Hopkins, NRC/NRR Project Manager. I work with GSI-191. I

would like to introduce some of the staff first that will be presenting today. You've acknowledged Mike Scott over there at the table. In the first row there is Dave Cullison on the end, Ralph Architzel, Shanlai Lu, Matt Yoder and Paul Klein. Right here to my left is Tom Martin, Division Director, and Tom has some opening statements.

MR. MARTIN: Good morning. I'm relatively new to this project. On one hand, I've been doing other things in the Agency, as you may be aware of. I came back to NRR about six months ago. However, I did point out to my staff that I was Chief of the Generic Safety Issue Branch in 1995 when this issue first surfaced and I guess --

CHAIR WALLIS: Well, wait a minute. It's surface grant, first?

MR. MARTIN: Well, as a Generic Safety Issue.

CHAIR WALLIS: Oh, but it's been around?

MR. MARTIN: It's been around a little bit longer than that, but as a GSI-191.

CHAIR WALLIS: As a GSI-191.

MR. MARTIN: It resurfaced.

CHAIR WALLIS: Okay.

MR. MARTIN: Around 1995.

CHAIR WALLIS: Thank you.

MR. MARTIN: We do appreciate the opportunity to share our activities with you on this important topic over the next several days. I would also like to report that we have made some significant progress since we last met with the Committee, but there are still some areas where the NRC and industry are lacking knowledge of the phenomena involved.

We took your comments and questions to heart and are continuing to make progress. We aren't at the end of the road on this issue, however, we do have a plan to get there and we're going to share that with you today.

There is a question here that frequently exists for the staff and that is at what point do we have enough information to make a decision requiring the industry to move forward with modifying their systems? Sometimes we might not have all the answers, but we do know enough to apply appropriate conservatisms and make a decision with the best information at hand. This is such a case. Sometimes we refer to this as engineering judgment.

The PWR plants are now on track to substantially enlarge their sump screens by the end of 2007 using an NRC-approved methodology. We believe

this is the right thing to do, we do now, because one thing that is becoming more apparent is that the PWR sumps are undersized. In many cases licensees are increasing the size of their screens by about two orders of magnitude.

Today, we will start by showing you the staff's plan and the NRR perspective for addressing the issues. The Office of Research will discuss details of research in these areas tomorrow and the next day, so we may ask you to defer questions in some areas regarding research to those presentations.

We have carefully considered your previous comments, particularly your letters of October and December 2004. Many of your comments are addressed in our presentations. We will also have staff present to answer questions you may have if our presentations do not specifically address your comments or questions. We plan to update the Committee two additional times this year and welcome your feedback.

I'm also sorry I'm not going to be able to spend much time at these meetings, because I made a commitment some time ago to attend a training class this week. At thing point, I would like to turn the floor back over to Mr. Hopkins.

CHAIR WALLIS: I have written comment on

your presentation. You and your introductory remarks indicated that you were closer to resolution because of the work that is being done. I'll be very interested to find out from the presentations in the next couple of days whether you are closer to resolution or further away. And then some of the new information seems to indicate that some of the optimistic ideas of being able to predict things may have been overly optimistic.

MR. MARTIN: How close we are to resolving this is a relative term. I would say that we have made significant progress and we continue to make significant progress. The industry has moved forward with some substantial amount of testing as we have and we're anxious to share the results of that testing with you.

However, at this point, I believe we do need to make a decision and move on with this issue to improve the overall operation of these plants.

CHAIR WALLIS: See more information may make it more difficult to make that decision and I think that's what we're going to try to find out in the next few days whether more information is helping or whether it's not. I hate to say muddying the waters or clouding.

MR. MARTIN: Well, we'll be interesting in hearing your thoughts about it.

CHAIR WALLIS: That's what seems to be happening in some of these experiments. Okay. We'll move on. Thank you.

MR. MARTIN: Thank you.

MR. HOPKINS: Okay. Thank you. I'm going to start off the presentation with a short recap of history and summary of where we are. You know, in 2003, the NRC issued a bulletin. In 2004, we issued Generic Letter on this. We issued a safety evaluation on the NEI methodology in December of 2004. In September of 2005, we got detailed licensee responses to the Generic Letter and SE methodology.

And in September 2005 and January 2006, we issued an Information Notice in Supplement 1 on chemical effects specifically, trisodium phosphate and Cal-Sil insulation. There will be more presentations on these topics following.

These are the specific topics we will be addressing today in our presentation. I would like to mention that last week Thursday and Friday we had public meetings with industry and vendors. There are five strainer vendors here in the United States. At the meeting it was presented that all plants plan to

install or have installed new strainers. The smallest new strainer planned right now is 650 square feet screen area. Again, there will be more in following presentations.

CHAIR WALLIS: Now, I think, again, this is a question we're going to be after getting an answer to in the next few days is yes, it's nice to plan to install these strainers, but if new information is coming in, which might change the kind of strainer you want to put in, you don't want to put a new one in and then have to put another one in after that because you've now found out that you've got new information and your previous design wasn't quite what you wanted.

MR. HOPKINS: Yes, I understand. I think that's what Tom was addressing in his response.

CHAIR WALLIS: Yes.

MR. HOPKINS: There are industry -- you're referring also to some test programs going on now and status of those will be specifically addressed.

MR. SCOTT: Can I add something to that, Graham?

CHAIR WALLIS: Yes.

MR. SCOTT: As Tom Arden said, the staff's perspective on that is that it is important that we

make significant improvements to the plant in the near-term recognizing that those improvements will be made in parallel with the attainment of additional knowledge and that it is possible that the result of that knowledge will be the need to make additional modifications. And we recognize that it's not an ideal situation, but the staff believes it is important to move forward, at this point.

CHAIR WALLIS: But having a very big strainer may not turn out to be a very good idea.

MR. SCOTT: And this --

CHAIR WALLIS: Previously, we thought the bigger, the better, but that may not be true.

MR. HOPKINS: Okay. Well, and that's where the engineering judgment comes in that Tom also referred to.

CHAIR WALLIS: Right.

MR. HOPKINS: But again, we'll work through that in these presentations.

CHAIR WALLIS: Yes, thank you.

DR. BANERJEE: Is there going to be any discussion of modeling efforts or it will be just talking of experiments at this meeting?

MR. HOPKINS: Yes, there will be some discussion of modeling.

DR. BANERJEE: Where will that be?

MR. HOPKINS: I believe Shanlai Lu under near-field effects. Will you be discussing that or can I have some help here?

MR. LU: Yes, at a very fine level.

DR. BANERJEE: At what level?

MR. LU: At a very fine level and we're going to summarize the vendors past --

PARTICIPANT: We can't hear you.

DR. BANERJEE: Can't hear you.

COURT REPORTER: Talk to the microphone, please.

MR. LU: Okay. How do you do this? Shanlai Lu from NRR/SSIB. Yes, I'm going to cover -- give a summary of vendors testing and the modeling approach, but at a very high level. The details of the modeling and the correlation development will be presented by Office of Research tomorrow and so you will hear the details there.

DR. BANERJEE: So tomorrow?

MR. LU: Yes.

CHAIR WALLIS: Yes, I think tomorrow is when we're going to do that one, yes. Maybe the question is whether you can model something of the experiments non-repeatable. That's one of my

questions anyway.

DR. BANERJEE: Maybe it will shed some light as to why they are non-repeatable.

CHAIR WALLIS: That's right. Okay. These look like very interesting topics.

MR. HOPKINS: Thank you. And again, those are just NRR's topics this morning. As Shanlai said, Research will be presenting more.

This is a rather busy flow chart, but it's to -- the shaded green area is essentially where we are today. But it's to show you the path we have lead out and how the Bulletin and Generic Letter reviews lead ultimately to closure of GSI-191. As you can see by the, roughly, green shaded block that says industry/NRC testing, the results of that do lead into our review of the Generic Letter responses and, if necessary, additional NRC communication.

With that, I would like to go to the first presenter or next presenter.

MEMBER DENNING: May I interrupt just a second?

MR. HOPKINS: Yes.

MEMBER DENNING: One thing I don't see here is an assessment of what the risk is. As I see it, we're now in a position where there is a lot of

uncertainty out here and the testing that has occurred over the last year has verified that there are some issues that we don't have a good handle on. And NRR has to decide can I continue to leave the situation the way it is? I mean, there are certain actions that have taken place at the plants already.

MR. HOPKINS: Yes.

MEMBER DENNING: And we have to ask the question are those adequate in the short-term? Do we have to go ahead even with our lack of full understanding and, for example, put in the biggest screens you can and move forward recognizing that in the future you might have to come back and ask for more or do you wait to see where the root research leads and have a lot of confidence that the change that is made is the proper one?

And in order to make those decisions, I see risk assessment being a critical element. I don't see anything in here that says that we're refining now our understanding of what the risk truly is here and whether it's imperative that we move quickly, even though that with the associated uncertainties we might find out we have to go back and ask for more later.

Any comment on that? Is there a risk element in NRR's decision process or do you think

you're going to resolve the issues to a level that we wait just another few months and we're ready to put everything to bed?

MR. HOPKINS: Donny, do you want to?

MR. HARRISON: Yes, this is Donny Harrison from the PRA Branch. In a way, the answer is yes to both your questions. The resolution for GSI-191 is a deterministic resolution, but at the same time we're right now in the process of refining some of the earlier risks, perspectives I'll call them, on this issue that date back to 1999. We're refining them with some of the more recent information we have got since and some studies that were done and published in NUREG CRs over the last three years to give a perspective of what the risk is related to some clogging.

So that is something that we are doing right now, but it's more of an informative process as opposed to actually driving resolution. So the resolution will actually be a deterministic resolution.

MR. HOPKINS: I would say just to recap some history, again, in the Bulletin and Generic Letter, essentially, there is justification for continued operation in there. And, you know, the

staff considered risk when we established that amongst that and if licensees want to go beyond the designated end date of December '07, they also need to consider risk.

Lastly, I think I need to say even though we sort of focus on modifying the strainers and making them larger, there are also aspects of other modifications, such as debris catchers or removal of insulation or buffering agent changes or something that can improve the situation that is just not strainer specific. Okay.

CHAIR WALLIS: In a way, we're doing this backwards. We're having research come in tomorrow and tell us what the set of knowledge is and you're going to tell us today how you're going to make decisions? It seems a bit backwards, but it will be interesting to do it this way around.

MR. HOPKINS: We're going to do the best we can.

CHAIR WALLIS: Okay.

MR. HOPKINS: Okay. I believe the next presenter is Dave Cullison.

MR. CULLISON: No.

MR. HOPKINS: No?

CHAIR WALLIS: No, we're talking about the

screen.

MR. HOPKINS: Oh, my mistake. Okay. How do we get to minimize?

CHAIR WALLIS: So while you're struggling with this, are you going to, when you present your work, refer to the research results or are they going to be -- are you going to refer these research results today or are you still struggling with the computer that you can't answer my question? Is anybody prepared to answer my question?

MR. HOPKINS: I'll answer your question. I'm sorry, I will just --

CHAIR WALLIS: Are you through --

MR. HOPKINS: Yes.

CHAIR WALLIS: -- with the computer? I was just wondering if your presentation today is going to take account of the research results we're going to hear about tomorrow? Are you going to refer to them in some way or are you going to not?

MR. HOPKINS: For the most part, we're going to try not to and just rely on tomorrow. But in one area, chemical effects, Paul Klein, go ahead and address the question.

CHAIR WALLIS: So he will talk about the-- what you people --

MR. KLEIN: Yes, we'll try to. Paul Klein from NRR. We will discuss the high level of the research results and how they affect our decisions.

CHAIR WALLIS: Good. Thank you very much.

MR. CULLISON: Good morning. I'm Dave Cullison from the Safety Issues Resolution Branch at NRR. I'll be presenting the Bulletin 2003-01 and Generic Letter 2004-02 status. The purpose of this presentation is to update the Subcommittee on the status of the Bulletin and the Generic Letter.

On the Bulletin status, we have requested that the Generic Communication Branch "globally" close the Bulletin, which is we have done our reviews. All but one plant has been issued a closure letter.

CHAIR WALLIS: Globally close means being on the same planet?

MR. CULLISON: That's the phrase used to close all of them.

CHAIR WALLIS: That's a phrase.

MR. CULLISON: They're all inclusive phrase.

CHAIR WALLIS: Pretty big volume there.

MR. WHITNEY: It means to close the issue broadly, based on individual closures --

CHAIR WALLIS: Use the microphone.

MR. WHITNEY: -- of the individual plants.

MR. CULLISON: Leon, use the mike.

MR. WHITNEY: I'm sorry. Leon Whitney, Safety Issue Resolutions. It simply means that the issue is to be closed based on closure at each individual plant.

CHAIR WALLIS: Okay. So you -- it's very plant-specific?

MR. WHITNEY: Yes, yes. There are plant-specific closures that support the global closure.

CHAIR WALLIS: But until everyone has approved, you haven't got a global closure then?

MR. WHITNEY: Excuse me?

CHAIR WALLIS: Until every plant has got some approved way forward, you haven't got global closure then?

MR. WHITNEY: Right. The branch issued the global closure recommendation based on individual closures at each plant.

MR. CULLISON: And just to refresh the Subcommittee's memory, the Bulletin requested that the licensees do one of two things. One is to confirm compliance with 50.46 or to implement some compensatory measures to reduce the risk while they are resolving the issue. Davis Besse is the only

plant that took the first option and they confirmed compliance with 50.46.

DR. BANERJEE: What does 50.46 mean?

MR. CULLISON: Long-term cooling requirements, B5. The Safety Issues Resolution Branch developed criteria used to evaluate the plant responses and these are the criteria we use. We at least have one ICM at each of the six categories. I won't read these, but maybe in a minute.

CHAIR WALLIS: Now, you have all these things here, but there must be a measure of how effective they are. And there must be a measure of how much they reduce risk or something, otherwise, they're just going through a ritual.

MR. WHITNEY: Sir, Leon Whitney, Safety Issue Resolution Branch, no, there was no prescribed effectiveness measure. It was based on the judgment of the reviewer.

DR. BANERJEE: You circulated to us some audits of various plants, if I recall. The documentation you have got.

MR. WHITNEY: The pilot audits?

DR. BANERJEE: Yes.

MR. WHITNEY: Okay.

DR. BANERJEE: Pilot audits, right. And

in those pilot audits there were many issues which were closed or whatever it was.

MR. WHITNEY: Right.

DR. BANERJEE: Not resolved. Now, is that -- some of those were fairly recent, I remember.

MR. WHITNEY: Right.

DR. BANERJEE: Those were coming in January 2006. So how does that relate to what you're telling us now?

MR. CULLISON: Because those are related to the Generic Letter not the Bulletin. The Bulletin had a separate set of actions and we were --

DR. BANERJEE: Can you tell us what the Bulletin had?

MR. CULLISON: Yes.

MR. WHITNEY: Let me explain, the purpose of the Bulletin was to perform -- to establish a risk bridge, if you will, to reduce risk in the interim while the Generic Letter and SER fixes were being established over about a three year period. So the Bulletin went out. Licensees were to do interim compensatory measures to reduce risk to form that "risk bridge" for the time period until December 2007.

CHAIR WALLIS: Then there must have been a measure by how much the risk was reduced surely?

MR. WHITNEY: No, there was not.

CHAIR WALLIS: So how can you increase it?

MR. WHITNEY: The criteria that was established by NRR was to ensure that licensees did one interim compensatory measure in each of these six areas that were called out in the Bulletin.

CHAIR WALLIS: Well, the NRR must have satisfied itself somehow that risk was being reduced and had some idea of the order of magnitude of the reduction.

MR. ARCHITZEL: Dr. Wallis, this is Ralph Architzel --

CHAIR WALLIS: Yes.

MR. ARCHITZEL: -- from the staff. I would like to remind the Committee that we did have a layoff.

CHAIR WALLIS: Yes, you did.

MR. ARCHITZEL: Yes, we did. It was -- when the study was including operator recovery actions when the Bulletin Interim Compensatory Measures tend to enforce the existence of the recovery actions, there was an order of magnitude reduction of the risk.

CHAIR WALLIS: Right.

MR. ARCHITZEL: When those factors were considered.

CHAIR WALLIS: Yes, I think you ought to say that, because, well, to help to reassure the public that you actually did achieve a big change in risk.

DR. BANERJEE: Which measure gave the most reduction in risk?

MR. WHITNEY: Again, as the reviewer of the Bulletin, it would be difficult for me to say, since we did not have a risk measure during these reviews. We had to ensure that there was at least one interim compensatory measure in each area and we weren't measuring them by risk reduction explicitly and individually.

DR. BANERJEE: But you had -- you said you used engineering judgment. Which in your engineering judgment reduced the risk most?

MR. WHITNEY: Well, obviously, if you can delay switchover and/or avoid switchover, that would be important. The next slide discusses the fact that we established that each licensee had, and I'm getting ahead of the slide, but to answer your question, for small and some medium LOCAs, the ability to conduct an aggressive cool down that puts them directly in shutdown cooling without going -- switching over to the recirculation mode.

For those small and medium LOCAs, that's a 100 percent reduction in any risk, because you do not enter the recirculation mode and you do not use your sump.

DR. BANERJEE: And is there a risk then of tunnel stresses in this cool down increase?

MR. WHITNEY: These are conducted within the PCT limits of each individual reactor plant. They are not outside of their design-basis.

CHAIR WALLIS: Now, you have responses to sump clogging, the first item there, but some of these plants have pretty porous screens and what might well happen is what clogs and the debris catches in the bottom of the vessel. Did they train how to respond to that?

MR. WHITNEY: No, the operator actions were on the order of identifying and coping within the normal operation. For example, the containment spray pumps, not all of them were necessarily needed in all scenarios and the licensees would train their operators to not operate one of two, for example, to reduce the draw down on the RWST and to reduce the wash down of debris towards the sump.

The downstream effects were not -- an ICM to address downstream effects, I did not see in my

reviews.

CHAIR WALLIS: Well, that seems to me is an omission, because if you did clog the inside the direct vessel, this would make it difficult to cool it by any means.

MR. WHITNEY: And, sir, I guess I would appeal to the JCO, the Justification for Continued Operation, in the Generic Letter. This was beyond the scope of this risk bridge to get plants to reduce risk as possible until December 2007.

DR. BANERJEE: This was to consider debris going into the vessel or downstream effects? Was that beyond the risk bridge?

MR. WHITNEY: Yes, I did not recognize any interim compensatory measure identified by licensees that would address clogging of the, let's say, core plates once it had been established that there is clogging in the core plates. There was no measure for that.

MR. LEHNING: This is John Lehning of the NRC staff. Although the specific issue -- the items in the Bulletin weren't specific to downstream effects, there were several things like aggressive cool downs that would avoid recirculation and that would reduce risk of downstream effects as well as

cleaning out the containment and other items like that to reduce the amount of debris that could get through the screens. So although it wasn't an explicit focus on that, a number of those interim measures would also have reduced that risk, too, yes.

MR. WHITNEY: Look at number 4 and number 5 on the current slide. Both of those would -- excuse me, number 4. More aggressive containment cleaning and increased foreign material control would ultimately reduce to some degree any effect that would happen at a specific reactor plant in that regard.

CHAIR WALLIS: Well, if you can avoid recirculation all together, then you avoid the problem. But I was looking at the first bullet.

MR. WHITNEY: But also you reduce the amount of debris --

CHAIR WALLIS: Yes.

MR. WHITNEY: -- in theory, to some degree, and again this was not measured, this was not quantified.

MR. CULLISON: Moving on to the next slide. We have already mentioned some of these, but these are some of the notable ICMs that were implemented by all or some of the utilities. I'll just give you a second to read those.

CHAIR WALLIS: RWST refill is refill from where?

MR. WHITNEY: It could be a boric acid tank. Usually a normal refill, however, we had the licensees identify all possible sources, such as spent fuel pool, borated and non-borated sources, so that they could either refill the RWST or bypass the RWST in a direct injection mode. These weren't necessarily high enough volumes at any given time relative to decay heat.

However, as a conservatism to refill the RWST as soon as you go into recirculation meant that you would have a volume of water later in an event that may have high value relative to the decay heat level that you could inject. And I'm repeating myself, but we did identify multiple sources for this refill and/or bypass of the RWST for direct injection.

CHAIR WALLIS: So you would be finding ways to use other sources of water which exist on the site now?

MR. WHITNEY: Absolutely.

CHAIR WALLIS: You wouldn't be putting in another tank?

MR. WHITNEY: No, we did not. I don't remember any licensee installing extra tanks. They

did identify all possible sources and the line ups that would be necessary to either inject into the reactor coolant system or into the RWST for later use.

DR. BANERJEE: Eventually, they would have to recirculate this water, right?

CHAIR WALLIS: Um-hum.

MR. WHITNEY: Yes and no. In number 1, if it's a small enough LOCA, they may end up and shutdown cooling mode and never enter recirculation. However, for a large LOCA, yes, there would be no option. You would have to attempt to use your sump and yes.

DR. BANERJEE: Why didn't people do the first item before? Was there a reason?

MR. WHITNEY: No, they all -- what we did was identify that -- this is in the standard PWR procedures. We identified that the licensees had trained their people properly, that they were -- there was no site-specific hold on doing this, that, okay, it is an accepted practice within PCT limits. And some licensees may not have been as willing as others and we talked to them at some length to ensure that they understood, you know, okay, let's be frank. Protect the core first, okay, and let's do this in this interim.

We know we have a problem with sumps.

Let's emphasize to the operators that this does exist and is an option and should be pursued. So it isn't that it was an invention resulting from the issuance of the Bulletin. It's more a matter of emphasis and clarity and training to ensure that it will be conducted.

MEMBER DENNING: Is there a limit on how much flooding you would allow of the containment? I mean, in principle or in theory, rather, one could fill the containment over the break location. Is that -- are there limits as to why you wouldn't do that?

MR. WHITNEY: These efforts are conducted in extremists.

MEMBER DENNING: Yes.

MR. WHITNEY: And there is -- this will be something that will have to be decided by the TSC organization and the plant management in a severe accident situation.

MEMBER DENNING: So well, at least that you knew that the core was in distress that you might then go to --

MR. WHITNEY: Would not normally do such a thing. However, if you had a clogged sump and if you knew that your core needed cooling, you would have to make a judgment relative to the containment

equipment, the containment structure, etcetera. Now, that is we're talking we're way out there at the end of all options when these decisions would be made.

MEMBER DENNING: But you have gone through accident management strategy or have the plants gone through accident management strategies to determine whether they would, indeed, attempt to fill above the break?

MR. WHITNEY: Well, the question is whether they would fill beyond the single volume of an RWST and the answer is yes. Yes, they have considered the ramifications as part of this Bulletin process.

CHAIR WALLIS: It is hard to fill above the break if you don't know where the break is.

MEMBER DENNING: Keep filling.

MEMBER SHACK: Keep filling.

MEMBER DENNING: Yes, well, I don't know what the implications are of that whether, you know, what systems you ruin and so but hopefully we would have examined these things before you get into the situation in assessing what options are available to you if you do get into the situation. So certainly there ought to be thinking today not thinking when suddenly you are in distress.

MR. CULLISON: Moving on. Now, we're

going to discuss the Generic Letter. The purpose of the Generic Letter was to request licensees performing an evaluation of the ECCS and CSS recirculation functions and take appropriate actions and provide information to the NRC.

In the Generic Letter we had requested actions, that was to perform a mechanistic evaluation using an NRC-approved methodology and implement any modifications resulting from their analysis.

CHAIR WALLIS: Yes, now, this approved methodology, does that include methods for calculating what happens on the screen? And if so, isn't it likely to be changed as a result of results of research?

MR. CULLISON: Could very well be but --

CHAIR WALLIS: So these guys are going to do all their calculations and get it approved and then Research is going to come along and say sorry, you couldn't do it that way or what?

MR. CULLISON: Shanlai?

CHAIR WALLIS: Shanlai can answer that.

MR. LU: Shanlai Lu from NRR. And in terms of head loss evaluation, I'm going to cover that. I talk about that specifically in my presentation, so I will address your comment at that

time.

CHAIR WALLIS: Thank you.

MR. CULLISON: I have a couple of slides here that just goes through the information requested in the Generic Letter. I'm not going to read these. This has been presented to the Committee before. One thing I want to point out --

CHAIR WALLIS: But it's interesting here. I'm sorry. This is such an important problem. I think we're going to ask you a lot of questions.

MR. CULLISON: Okay.

CHAIR WALLIS: You're saying here's the letter that goes out to all the plants. Each individual plant somehow has to figure out what to do and come back with an answer. It's conceivable that the problem could be global enough that the NRC, as a result of its research or whatever information it has, might have to itself define some of the characteristics of the solution rather than rely on all of these plants to come up with one.

And the NRC might legislate that certain materials be removed, certain changes be made in all plants or something. It's not always responding to industry which is the appropriate answer.

MR. CULLISON: Well, that's true. We

haven't reached that point, I don't think, on any research of our reviews or anything that we're going to start mandating the use or removal of any specific material from containment. We are closely following what industry is doing and what our own confirmatory testing is finding and if we see that need to be necessary, you know, such an action would be necessary, I believe we will take it.

But moving on, I just wanted to point out on this slide that the staff expects all actions to be completed by December 31, 2007. The next slide just has some of the specific information requirements in the Generic Letter. The third sub-bullet, I just want to mention, is the one that includes chemical effects. It's where the Generic Letter addresses chemical effects in the information request.

DR. BANERJEE: You can't go so fast.

MR. CULLISON: Okay.

MEMBER DENNING: But, of course, Sanjoy, this is just history.

MR. CULLISON: Right.

MEMBER DENNING: I mean, this is what the request was.

MR. CULLISON: Right.

MEMBER DENNING: Now we're going to see

what really the key --

CHAIR WALLIS: We're building up to this. It's an interesting part.

MEMBER SHACK: So this is what we asked for.

MR. CULLISON: This is what we asked for. All right. Another slide with the information requests.

CHAIR WALLIS: So you didn't ask for anything about bypass of debris in the screen?

MR. CULLISON: Excuse me? I didn't hear the first part of the question.

CHAIR WALLIS: You didn't ask for anything about what proportion of the debris is predicted to go through the screen, bypass, downstream effects, whatever you want to call that?

MR. CULLISON: Yes.

CHAIR WALLIS: I mean, you're asking for them to predict the maximum head loss.

MR. CULLISON: Right.

CHAIR WALLIS: That they could calculate, but maybe --

MEMBER DENNING: But do they address anything on downstream effects?

MR. CULLISON: Yes.

CHAIR WALLIS: It goes through the --

MEMBER DENNING: Did you request downstream?

MR. UNIKEWICZ: This is Steve Unikewicz, Mechanical Branch for NRR. Yes, we did. We did ask that question. We asked them to address how much debris would bypass the screen, through their openings, and also to address --

CHAIR WALLIS: And you got responses to that?

MR. UNIKEWICZ: Pardon me?

CHAIR WALLIS: Did you get responses to the bypass question?

MR. UNIKEWICZ: We expected responses to the bypass question, yes.

DR. BANERJEE: Which item was that here in this list that you asked for downstream effects?

MR. CULLISON: On this slide it would be-- one of them is the third sub-bullet, verification that close tolerance sub-components are not susceptible to plugging or excessive wear due to extended post accident operation with debris laden fluid and the second sub-bullet, the basis for concluding that inadequate core or containment cooling would not result due to downstream blockage.

CHAIR WALLIS: Well, if you don't have any other information and you're being conservative, one conservative assumption is all the debris forms on the screen in the worst possible way. The other conservative assumption is none of it forms on the screen or it gets so chopped up that it goes through it.

Now, those are such extreme limits, but they are possible physical limits and somehow or other, these plants have to steer away between these Scylla and Charybdis.

MR. CULLISON: The last slide of the information is we asked for information on any changes they made to their licensing bases and any programmatic controls instituted to give the assumption that their analysis is valid.

Here are some of the -- what we found during our review of the responses, that all PWRs are upgrading or have recently upgraded their sump strainers. As the sub-bullets say, 66 of the 69 are replacing their existing sump screens and the other three have done so in the recent past. However, much of the information we requested in the Generic Letter was not provided.

DR. BANERJEE: Before you move on --

MR. CULLISON: Yes.

DR. BANERJEE: Now, these, I noticed that in your pilot audits, these sump screens are very different, right?

MR. CULLISON: Right.

DR. BANERJEE: I mean, some are Top Hats, some are other things.

MR. CULLISON: Yes.

DR. BANERJEE: So these designs of these sump screens which are used for replacement, they are completely up to the plant.

MR. CULLISON: Right.

DR. BANERJEE: So are there any approved designs or are they just whatever they want?

MR. CULLISON: Well, I guess the answer is whatever they want. We are not mandating any specific design or any specific material or any -- we have left it up to the plants to resolve it and, also, taking into account that each plant is different and one design may not fit in another plant.

DR. BANERJEE: Right, right.

MR. CULLISON: So I think, as Jon mentioned earlier, there's five vendors and each of those vendors have their specific designs, but we have allowed plants to put in the design of their choosing.

DR. BANERJEE: So are there a finite number of designs or are there 66 designs for 66 plants?

MR. CULLISON: Well, there's probably similarities between the design, but there may be 66 individual screens. I don't know that. We haven't seen the final designs.

DR. BANERJEE: So all you have been told is that they replaced the screens?

MR. CULLISON: Right, and they are going to put in a screen of roughly some size. And that is all we know right now.

DR. BANERJEE: So they didn't have to come and say like we have to go to the Architectural Review Board and say I'm making this change, can you approve it before they did it?

MR. CULLISON: No.

DR. BANERJEE: They just did it?

MR. CULLISON: No, we're not specifically approving the modifications.

DR. BANERJEE: I see.

MR. CULLISON: Prior to them being installed.

DR. BANERJEE: And then you have to look at it.

MR. CULLISON: Right.

DR. BANERJEE: And see if it was adequate or not?

MR. CULLISON: Right. The assumption is they are going to do the -- if they use their analysis, that they are going to do that right thing. And that's why we're doing audits to go back to see if they properly used the methodology, you know, did their analyses correctly and that their design is fine.

CHAIR WALLIS: Well, I think you have got to be very careful because some of the guidance they have been given is to use certain assumptions, which are supposedly conservative and it may well be that that is not the case, that they are not conservative when you look at recent information. You have got to be very careful on evaluating this and this rushing to put in some screens on the basis of partial information.

MR. CULLISON: I understand.

MEMBER DENNING: You said NRR's current position is that there is an approved methodology?

MR. CULLISON: Yes.

MEMBER DENNING: So that methodology is an approved methodology and you comply with that and, in

your review, if they comply with that methodology, then they pass the test.

MR. CULLISON: Yes.

MEMBER DENNING: That's true?

MR. CULLISON: That's why we approved a methodology.

MEMBER DENNING: Yes. So now, there is more data?

MR. CULLISON: Right.

MEMBER DENNING: What is NRR going to do with that, review that and decide whether the approved methodology really does provide an adequate basis or at the moment is the presumption that this experimental work that is going on now and theoretical work is confirmatory?

MR. CULLISON: Well, our work is supposed to be -- what is being done by Research is mainly confirmatory, but we evaluate all the new information that comes out and we will, if necessary, supplement the safety evaluation to reflect any of this new information if it changes what is an acceptable approach for an analysis. If we need to change our approved methodology, we will.

CHAIR WALLIS: But these guys are replacing their screens. That means they are actually

building things now. Is that right?

MR. CULLISON: That's correct.

CHAIR WALLIS: And you are still worrying about whether or not you're going to change the methodology?

MEMBER DENNING: Well, he wasn't. I was asking.

MR. CULLISON: Yes.

MEMBER DENNING: I was worried about it and I raised the question, right?

DR. BANERJEE: Well, he should be worrying about it.

MEMBER DENNING: I think so.

MR. HOPKINS: Jon Hopkins here. I would just mention that you are correct, essentially, and that was -- what Dave said is true. That was on my sort of busy flow chart slide.

There was this green-shaded block that said industry NRC testing and it had a couple of outputs, and one was to Generic Letter closeout which Dave was going to try to get to, and the other was to possibly supplement the safety evaluation or issue new generic communications if necessary. At this time, we don't see the need to supplement the SE or issue new generic communications.

DR. BANERJEE: What sort of information was provided?

MR. CULLISON: Oh, this slide will --

DR. BANERJEE: Okay.

MR. CULLISON: -- provide some of the -- would, I think, answer your question here. No plant was able to completely answer the questions requesting specific results of their evaluations. That's Section D of the information request. Davis Besse came very close. They were the most complete of the responses.

I just want to point out that the staff does not feel that they didn't answer the questions because they didn't want to or were withholding information from the staff. They gave us the information they had and this shows that the progress wasn't what we had expected at the time they submitted the responses.

CHAIR WALLIS: Well, how can you possibly resolve an issue without addressing downstream effects?

MR. CULLISON: I want to point out -- okay, go ahead.

MR. UNIKEWICZ: I will answer that. The reason -- I'm going to address this later on in my presentation, but one of the reasons a few plants

addressed downstream effects is because it's an iterative process. Until you complete the design of your sump screen, it's difficult to predict what is going to come downstream. Now, once you predict what is coming downstream, you then do an assessment and you iterate back and decide what the optimal approach is going to be.

Another issue with that is there are only so many bodies doing this work, so it does take time. The choice right now has been for many of the licensees to try to address the screens at the moment and then they will address the downstream equipment, pumps, valves, things of that nature, after they assess NPSH and as they assess their screen size and screen openings and things of that nature.

That is what I suspect, that at least in the initial submittals they didn't completely address the answers because, quite frankly, back in September they weren't ready.

CHAIR WALLIS: But, you see, you have been focusing on NPSH and screen blockage. If you put in very big screens, a question of screen bypass may become paramount.

MR. UNIKEWICZ: Well, I will disagree that that's been the only focus, because we have been

talking about downstream for two years. So while you may have been hearing a lot in many different forums about NPSH, I respectfully disagree that we haven't been talking in a lot of detail about all the downstream equipment, including pump operation, including vibration analysis, including the wear of internal and wetted components. It just hasn't been brought up, I will say, in that sort of depth because it is truly, I will call it, a solid engineering part.

CHAIR WALLIS: Well, you have been talking about it, but until you have a methodology for prediction, you haven't really got anywhere.

MR. UNIKEWICZ: Our methodology is standard engineering design practices. We have been looking at wear of wetted components for many, many, many years. It's a standard part of a good design engineer's tool.

CHAIR WALLIS: Well, I guess we'll get to this tomorrow, will we, where experiments have been done about bypass material through the screen? We're not going to address it today?

MR. UNIKEWICZ: I have a downstream presentation. There is a presentation tomorrow on some experiments that were done, yes.

CHAIR WALLIS: So what I'm trying to avoid

is the ACRS writing a letter which says you guys have done all this stuff and recent research shows that you have got to go back to square one. That is what I'm trying to avoid having to do.

MR. CULLISON: I think these presentations over the next few days will show that we don't want to reset and start again.

CHAIR WALLIS: Okay.

MR. CULLISON: That we're progressing toward the resolution.

CHAIR WALLIS: Well, you keep saying that optimistically.

MR. CULLISON: We just want to make sure you get the message, okay?

CHAIR WALLIS: You're going to convince us, right?

MR. CULLISON: To convince you.

CHAIR WALLIS: Okay.

MR. CULLISON: Here are some of the schedule challenges that we see. One is something we have been alluding to or have been discussing already this morning.

Due to the late start by industry for doing their testing, licensees are still waiting for the results. And also a process issue is license

amendments. Due to schedule slippage and late submittals, we're concerned that our ability to review and approve the amendments to meet the licensee's schedules may be challenged.

And also, already five plants have requested additional time to complete their corrective actions with at least one additional request expected. So far all these requests have been additional time to complete their actions. They only go into the spring '08 outage and, right now, we are considering criteria for evaluating these requests.

MEMBER KRESS: Does the criteria involve risk analysis?

MR. CULLISON: I am not developing -- yes, we can include that. We'll take a look at whatever criteria we're developing with the risk reflected.

CHAIR WALLIS: So you are -- after we have heard from Research tomorrow, we don't hear from you folks again, do we, until the full Committee meeting, so we don't have a response to you from what we hear from Research?

MR. UNIKEWICZ: Jon?

MR. CULLISON: Yes, that's correct. And future staff actions --

CHAIR WALLIS: I think that's a pity. Is

there some way you guys can be here tomorrow so you can answer questions?

MR. HANNON: Yes. This is John Hannon. NRR staff, yes, we can be in attendance tomorrow. No problem.

CHAIR WALLIS: Thank you.

MR. CULLISON: Future staff actions. Right now, we're developing a Commission Paper to inform the Commission of the status of 191 and also developing a Regulatory Issue Summary to update the JCO. That's in the Generic Letter. This month we're going to issue RAIs based on our review of the September responses and we're meeting with you today and the full Committee in March.

CHAIR WALLIS: So this is the last time we meet with you before the full Committee meeting?

MR. CULLISON: That's correct.

CHAIR WALLIS: So anything that you need to do to improve matters, you won't be able to do or you will need to be able to fix some things up by March, but we're not going to have another go with this Subcommittee. And if, for some reason, we are not happy, we just have to wait and see how you resolve it by March? And, usually, if there is a big issue --

MR. CULLISON: Right.

CHAIR WALLIS: -- we like to have several Subcommittee meetings until everyone feels that things are in really good shape.

MR. CULLISON: Okay.

CHAIR WALLIS: Then we go to the full Committee, which is a very public meeting and a letter comes from it and we like to get the staff -- have everything in good order before we have to write a letter, because we don't like to write letters which say things are not in good order. So I'm a little concerned about the speed with which things go. Maybe you'll do such a good job I won't have any concerns.

MR. CULLISON: You won't. We'll completely convince you, buddy.

MR. SCOTT: Graham, Mike Scott, NRC staff. If you all would like to have another Subcommittee meeting, then we will certainly come and present to you.

MR. CULLISON: Continuing on with the slide. Ongoing chemical effects and coatings confirmatory testing and we will be conducting audits of selected plants. You have the reports from the pilot audits and Ralph Architzel is going to discuss those in his presentation.

CHAIR WALLIS: These coatings confirmatory tests are going to test, what do they call them, approved coatings or the ones which --

MR. CULLISON: Qualified?

CHAIR WALLIS: -- qualified coating. Are you going to test the reality of the qualified coatings in the plant?

MR. YODER: Matt Yoder, NRR. The confirmatory coatings testing is testing qualified and unqualified coatings, chips and the fluid velocities of which they transport.

CHAIR WALLIS: Well, are you going to test them in the condition they really are in the plants where some plants may even have flaking qualified coatings?

MR. YODER: The testing covers a range from all the way down to like a 64^{th} of an inch size chip up through a 1 to 2 inch chip.

CHAIR WALLIS: No, I'm just wondering what will come off in the plant.

MR. YODER: Well --

CHAIR WALLIS: As coatings age in a plant.

MR. YODER: I will address that.

CHAIR WALLIS: You will address that?

MR. YODER: In my presentation later.

CHAIR WALLIS: Okay. Thank you.

MR. YODER: But the short answer is we really don't have that data now, that's why that confirmed core testing attempted to cover a range.

CHAIR WALLIS: Of size, yes.

MR. CULLISON: As I mentioned, we're performing audits of selected plants. Right now, we're looking at around eight audits and also we are writing a temporary instruction to have the original inspectors verify the installation of all the hardware changes, identify the licensee responses.

MEMBER DENNING: Okay. I don't understand. With regards to audits of selected plants, is there -- in the long-term, will every plant be audited --

MR. CULLISON: No.

MEMBER DENNING: -- to determine whether they have complied with the regulatory methodology? That their solution is consistent with the approved regulatory methodology? No? Just you just audit to determine whether some of them have or am I missing something? Have I misspoken?

MR. CULLISON: No. Mike?

MR. SCOTT: Mike Scott, NRC staff. Although not every plant will be audited by NRR, there

is an instruction that we're developing now for use by the regions and the resident inspectors to inspect that the licensees have accomplished what their submittals have stated that they were going to do.

MEMBER DENNING: But that's only a matter of that their hardware is consistent with the hardware. It's not an assessment of whether they really have satisfied the pressure drop, the pressure drops and this kind of stuff.

MR. CULLISON: No, it's not. Those are in depth reviews of their -- how they exercise methodology or did their analyses. We are -- one of the things of the audit program is if we find significant problems across the board, we will broaden the audit program as necessary to give us the comfort feeling that industry does know what they are doing and they are using the methodology appropriately.

MR. HOPKINS: Yes, Jon Hopkins. I'll just mention, of course, that we are reviewing each plants Generic Letter response. One aspect of the audits is we get the different designs. And as we mentioned there is five strainer vendors and if we do roughly eight audits, we can go more intense into each strainer vendor. And so that was sort of getting to the question of do we have a qualified strainer, which

the answer is no, the staff hasn't tried to qualify any strainer. But through the audits, we can get into more detail of the vendors.

MR. CULLISON: And that concludes my presentation. I think Ralph Architzel is next.

DR. BANERJEE: This is a general question. These audits you did were very interesting, in fact. So there were certain open issues and so on in these audits. Did this feedback into the process of the changes they made or how was that made? Somebody, are you going to answer that?

MR. ARCHITZEL: Well, I can during my presentation.

DR. BANERJEE: Yes.

MR. ARCHITZEL: Ralph Architzel with the staff. I can do that during the presentation.

DR. BANERJEE: All right.

MR. ARCHITZEL: If I don't answer it -- I guess, up front trying to say did the issues and findings in the -- well, let me go through the presentation.

DR. BANERJEE: All right.

MR. ARCHITZEL: You have --

CHAIR WALLIS: You're going to talk about these pilot audits, I take it, at some point?

MR. ARCHITZEL: Yes. This is this presentation. How do you make it bold?

CHAIR WALLIS: Use the buttons, I understand.

MR. ARCHITZEL: What's that?

PARTICIPANT: We're not going to view it?

CHAIR WALLIS: F5.

MR. ARCHITZEL: As I mentioned, my name is Ralph Architzel and I was the team leader for the two pilot audits that were distributed today by staff, ACRS, excuse me. Leon Whitney was the team leader for the or is the team leader for the Oconee audit and Dr. Shanlai Lu is the team leader for the Watts Bar audit. Those are the audits that have been to date.

I guess getting a little bit of history on the audits and this was modeled somewhat to follow the BWR closure. If you look at the BWR closure letter, a similar path and they have just a Bulletin, but we have a Generic Letter and a Bulletin. And fundamentally, it was to examine, as Dave said, all the Generic Letter responses, that's part of the closure. They did all of the Bulletins and they did about five audits.

So this was modeled and then there was a memo addressing how all the plants fell into different

categories. In addition to the audits, there were quite a few additional trips to strainer vendors. So the model we have is similar to the BWR closure. And it is a compliment to the Generic Letter response reviews and, as mentioned also, there are inspections that are going on, the actual physical modifications.

All right. The next slide. I'll go over the pilot, some of our perceived benefits learned and what we want to get benefits out of is to determine the resource needs for future reviews, audits or inspections. It was to feedback into the research and testing programs what we learned, what are the areas that we want feedback and try and focus those areas, so that was an objective.

And then also to try and get better responses. The pilots were intended to try and enhance the responses by licensees by giving them information of what we learned in the audits.

CHAIR WALLIS: Now, when they respond, does someone check their analysis and what they do?

MR. ARCHITZEL: On the pilot, it's different than the audits.

CHAIR WALLIS: Well, on the --

MR. ARCHITZEL: The response, you mean the Generic Letter responses, Dr. Wallis?

CHAIR WALLIS: Well, if you take one little question certainly, what do they do about say this thin bed effect? All right. Does someone go into the response, either in the audits or in the responses, and say how is this plant treating this effect?

MR. ARCHITZEL: We do that in depth in the audits.

CHAIR WALLIS: You do that.

MR. ARCHITZEL: And I think you could say that --

CHAIR WALLIS: You know how to do that? What exactly is the embed effect?

MR. ARCHITZEL: Well, Dr. Lu is going to talk about the --

DR. BANERJEE: To the best of their ability, at that time.

CHAIR WALLIS: Okay.

DR. BANERJEE: Yes.

MR. ARCHITZEL: There is a presentation on how we handle that.

CHAIR WALLIS: Okay. There's going to be a presentation on the technical questions like that that someone has to make a decision about when they audit or, you know, reevaluate a response?

MR. ARCHITZEL: Well, there is a specific one on the head loss aspect of it. On the other areas, I'm not saying we're going into that right now. If you wanted it, it would be different. I'm not going into each and every one and how we do it. We use basically the Guidance Report and the methodology.

CHAIR WALLIS: Well, I'm puzzled, because the Guidance Report, as I remember it, was inconsistent. It said that you should assume the bed is homogeneous, that's conservative, and then on another page it said you should assume you have a thin bed effect, that's the worst case. Now, I'm not sure how you apply two widths of the --

MR. ARCHITZEL: Well, in the actual testing, when we started testing, we make sure that they are --

CHAIR WALLIS: So it's based on testing?

MR. ARCHITZEL: Fundamentally, Dr. Wallis.

CHAIR WALLIS: Yes. Someone else is going to respond to that?

MR. ARCHITZEL: Yes.

MR. LU: Yes, I'm going to. In the next presentation, I'm going to cover this part.

DR. BANERJEE: I have a more general question. We got the staff responses to these audits,

but we didn't get -- oh, at least your SE or whatever, but we never saw the -- any submission that came from the plant to you.

MR. ARCHITZEL: The reason you wouldn't get that is because what goes into the Generic Letter response is when you ask for information, there was ways you got to do it and you get it docketed and that's what the Generic Letter response is. It did limited amounts of information. We're not allowed to just broadly ask for information. The detailed information, we did get their calculations, their test reports, things like that that were all considered along the lines of audit records or inspection records and they are not. They are supposed to be destroyed after the audits, they are likely at your side and you're looking at their records, so you did not get that, that's correct.

DR. BANERJEE: So we only got your response in some sense. So we don't know what you were responding to.

MR. ARCHITZEL: You don't have the actual calculations.

DR. BANERJEE: So it's very difficult to see what was actually done.

MR. ARCHITZEL: Yes.

DR. BANERJEE: I mean, there's just a description here. We got this and then it was okay, it's not okay. We think it's good. We think it's bad, something like that.

MR. ARCHITZEL: It's only what was reflected in the audit report.

DR. BANERJEE: Yes.

MR. ARCHITZEL: Which is a typical situation for an audit report or inspection. The base documents are not provided for review at a public ACRS. That's a standard approach.

DR. BANERJEE: Right. But you do have -- I mean, if we want to actually evaluate in detail how you did the sort of -- why you made a response saying this is fine and this is not, so we can look into that?

MR. ARCHITZEL: The truth is we're supposed to destroy those records after the completion of the audit, because they are not NRC records, so I can't tell you. I'll turn around. There may be some still in existence right now, but they are not supposed to be. I guess the answer would be --

CHAIR WALLIS: You can't destroy records. Suppose there is an accident and the screen gets clogged. Someone is going to want --

MR. ARCHITZEL: Well, no, no. The licensee --

CHAIR WALLIS: They will want to know how it's designed. You want to know the results of all these calculations.

MR. ARCHITZEL: Yes, the records are available at the licensee's facility. Go back there and look at those records.

CHAIR WALLIS: They are in a drawer somewhere, but we can't see them?

MR. ARCHITZEL: You can see them just like we can see them.

CHAIR WALLIS: Oh, we can see them? We can see them?

MR. ARCHITZEL: Yes.

CHAIR WALLIS: So they are not destroyed?

MR. ARCHITZEL: If the licensee --

PARTICIPANT: You can go to the plant.

MR. ARCHITZEL: You have to go to the plant, because they don't make them public. They don't submit them, so if you submit them, they can be requested.

CHAIR WALLIS: So how can we --

MR. ARCHITZEL: The information.

CHAIR WALLIS: How can ACRS review what

you have done without documents coming to us? I'm not picking you apart.

MR. ARCHITZEL: Well, I've got two pilots. What I could do is I'll check with the licensees and if it's agreeable to them, we can give -- if it is agreeable, but that would be -- is it something for us to do or Ralph to do, maybe I'll take that as an action.

DR. BANERJEE: Well, I think the real problem here is if you want us to take a look at these audits, presumably you want us to, otherwise why would you send us these documents, you know, if you want some feedback, we need to know what to give feedback to. At the moment, all we have is the SEs which say this is okay, this is not okay, this is okay. We have no idea why it's okay, why it's not okay.

MR. ARCHITZEL: Okay.

DR. BANERJEE: I mean, we don't see the methodology. We see maybe a consultant's report, which says it's okay or it's not okay. So at the moment, there's nothing we can say, other than say we read them, but there's nothing substantive that we can respond to.

MR. ARCHITZEL: Well, maybe -- I don't know. I guess, that's maybe a question for us. Do we

want you to actually look at and do the audit along side of us or something like that and then say --

DR. BANERJEE: Otherwise, we want a cart load of paper, which has been sent to us, luckily in a compact disk, and we have been going through this, but a lot of the stuff which actually leads to the stuff that you have sent us is not there. So there's no way we can evaluate what has happened.

MR. ARCHITZEL: I don't have a good answer at this meeting for that question, I guess.

CHAIR WALLIS: Well, the same is true --

MR. LU: Maybe we can of pop to the vendors or the licensee if you're comfortable with disclosing that proprietary information, we can find a way to deliver out to you.

CHAIR WALLIS: Well, I --

MR. LU: If that's something we can follow the process.

MR. ARCHITZEL: I guess I'm not even sure that's appropriate. I guess I would say maybe an ACRS Member wants to come along on one of the audits for part of it, if that's how you normally do business. Maybe that's a better way to do it.

CHAIR WALLIS: We don't want to have to do any of those things. We want to get evidence from you

that satisfies us that the right thing is being done. We don't want to do your job. It's absurd.

Now, there's another problem with the WOG Report. The WOG Report, for example, has a whole other description of the things that need to be done. But until you see how those are done, again we don't know how good the work is.

MR. ARCHITZEL: That report, that's going to be discussed later by Steve.

CHAIR WALLIS: So we're going to discuss that, too. But I'm just bringing it up, too, as we get these things to review, but they don't really tell us the essence of the calculation techniques and so on. So we don't know whether it's any good or not.

DR. BANERJEE: I'll give you an example, a concrete example. You have in one of these plants these Top Hat strainers, okay. Just take that as an example. These are stacked in a huge area of stacks. I don't know how many of these.

MR. ARCHITZEL: I've got some pictures of that.

DR. BANERJEE: Yes. In any case, there's some testing done on a little piece of one or whatever. How is that actually applicable to this huge stack where you can have shielding effects,

you've got all sorts of complex deposition doing on in there and you're going to use a little experiment to say something about what happens in this big --

MR. ARCHITZEL: There are also more module experiments where it's not just the flat plate type experiment. There is more than one type of testing that's done by these vendors, including prototypical testing of arrays and things like that or as best they can do it.

DR. BANERJEE: Well, that would be interesting to know, because that's not evident. All we have seen there is a little piece of it and we have encountered this problem before where we have noticed that people have tested say one little strainer and then they have stacked them all up and then they have taken the single strainer data, use it for the stack as it's piling up and giving the wrong approach along with these --

MR. ARCHITZEL: That specific one, Dr. Lu will do. That one we do have a presentation today on, that particular topic.

DR. BANERJEE: All right.

MR. ARCHITZEL: If I could move on, one of the perceived benefits the program was to get staff clarifications early on regarding the Generic Letter.

The pilot plants did get fee waivers for a license amendment request, although hadn't necessarily made any. If we could move on to the next slide.

CHAIR WALLIS: There's a fee waiver, too?

MR. ARCHITZEL: If they had a license amendment. This was an incentive to the pilot plants. There was only two pilot plants.

CHAIR WALLIS: Oh, it's for the pilot. Okay.

MR. ARCHITZEL: So it wasn't generic. This was if they had a license amendment to pilot plants to get a fee waiver. There were only two volunteers. We did discuss the Pilot Plant Program at the industry workshop and it was completed before the Generic Letter response. It's kind of important, because we don't have the same criteria for filing for pilots that we do for the audits. So it was a little bit of a free-ride in a sense. Okay. And as mentioned before, the audit plan is in place for the remainder of the sample audits to be made.

This is redundant here. Go to the next one.

MEMBER KRESS: How many total audits do you plan?

MR. ARCHITZEL: There were eight. Well,

not counting the pilots, there's eight at the moment. It would be expanded. In addition to that, there is very likely to be many more visits to actual strainer testing of the particular designs, somewhat resource limited there as to how many we can go to.

But that's a flexible number, because if you begin to see problems, then you would expand the sample scope. Whether it was with a particular vendor design or in a particular area, there was a problem, the intent was to expand the sample size.

CHAIR WALLIS: I am on page 6. You're on page 7. When it says they have a chance to exercise the approved methodology, they also do tests to see if it works?

MR. ARCHITZEL: Well, in the sense of the strainer tests.

CHAIR WALLIS: They do, so there was some kind of comparison between the methodology and data then?

MR. ARCHITZEL: They generally try and prove in the testing --

CHAIR WALLIS: They do?

MR. ARCHITZEL: -- that they predicted head loss using the correlations typically comes out much less than the -- excuse me, I mean the other way.

They tested the loss.

CHAIR WALLIS: Okay. So that's some useful information to see, yes.

DR. BANERJEE: And it's all done in a research lab called Alden Lab?

MR. ARCHITZEL: No, there's different labs. It depends on the vendors, strainers.

DR. BANERJEE: Who orders an audit?

MR. ARCHITZEL: One audit was printed and I've got some --

DR. BANERJEE: Oh.

MR. ARCHITZEL: One was Fort Calhoun. Excuse me, Crystal River audit was done with lab testing at Areva, I mean, Alion in Chicago and some others there. The Fort Calhoun strainer design is by General Electric and they are using Fluid Dynamics.

DR. BANERJEE: Continuing with that.

MR. ARCHITZEL: In New Jersey, Continuing Dynamics in New Jersey, Union, New Jersey, so we want to observe that testing. The Watts Bar audit, I mean, that was testing observed up in Alden Research Lab. I've got some photos of some of that flume testing that was done. We went to CCI in Switzerland. They are a vendor for quite a fraction of the plants and we observed the strainer testing done there. And then we

also went to Canada and observed the strainer.

ACL has a number of designs and we observed strainer testing being done for, I think it was, the Darlington Plant. But we know the facilities and what they use for that testing, so we have gone and observed the strainer testing facilities as part of these audit reviews.

DR. BANERJEE: Now, when they involve materials like mineral, wool and things for which you don't have data as to how much debris should be generated or how they actually would behave in the environment, what do they do? They take the closest analog?

MR. ARCHITZEL: What you see in the report, you read about that.

DR. BANERJEE: Yes.

MR. ARCHITZEL: Sometimes they try and say it's very similar to fiberglass.

DR. BANERJEE: Right.

MR. ARCHITZEL: New fiberglass and the last question, but how can you make that determination to these differences and then the vendor will go off to justify the comment and do additional testing to try and defend the similitude. I mean, they have done things like looked at is how's your Cal-Sil? The same

as other Cal-Sils? They have done SCM photography of the Cal-Sil to try and justify why their particular Cal-Sil is the same as what was being tested.

DR. BANERJEE: Yes, that, it would be useful to have that sort of information before we can say it looks like you've done a good job or not. I mean, or do something else.

MR. ARCHITZEL: Well, I'm struggling with this comment about we document report what we have, yet there's a lot behind that, because we've looked at a lot more. I'm struggling with can we get that information to you or is it even -- I'll take that back.

DR. BANERJEE: Well, maybe it's selected information. We have put in --

MR. ARCHITZEL: Well, if you ask for it, we'll get it.

DR. BANERJEE: Yes.

MR. ARCHITZEL: We'll try and get it if the licensee -- it's up to the licensee, but we'll try and get it for you for sure, if you would tell us what you would like.

DR. BANERJEE: Yes.

MR. ARCHITZEL: Related to that.

DR. BANERJEE: Yes, if we get through your

references here.

MR. ARCHITZEL: What I can't do is guarantee you that we have it in hand at the moment. We'll go out and get it if the licensee wants to give it to us, I'm sure they will. But we have this problem of it's their records. It's not our records. And they have to voluntarily provide it and then the understanding is you look at it and then you destroy it as well. Okay.

Again, there were areas, obviously, that-- the unknowns that were incomplete, so we didn't reach conclusions, definitive conclusions in those areas and you can see them listed here somewhere.

MEMBER DENNING: Which key plant-specific issues were complete?

MR. ARCHITZEL: Thanks. There were selected areas you could look at, debris characterization or things like the mineral wall, areas where you use Nukon and they tested Nukon. Those areas were complete and they did head loss test or an actual strainer where you've got the flat, you know. There was a lot of areas where we did get value on it doing these pilots. Okay?

DR. BANERJEE: I think it identified areas you need more information.

MR. ARCHITZEL: Well, CFD, I mean.

DR. BANERJEE: Those audits, I would say.

MR. ARCHITZEL: Yes, I guess. I'm not trying to say it was. There were some areas where the characteristics and we could look at what they did and reach agreement that that was a reasonable approach.

CHAIR WALLIS: Well, I don't know what you mean by incomplete. I mean, does that mean that there were huge gaps or just minor incompletions? I mean, were there commas missing in the report or was the whole basis of head loss in question? I don't know what you mean by incomplete.

DR. BANERJEE: Well, if you read their response, I think, in detail, you get a sense of it. I mean, here you're just summarizing it.

MR. ARCHITZEL: Right.

DR. BANERJEE: But actually, the response when they do say incomplete, there are several paragraphs which gives you more of a feel for what incompleteness.

CHAIR WALLIS: But you don't know what the original document is.

DR. BANERJEE: Some of them are more -- that's basically the problem.

CHAIR WALLIS: Right.

DR. BANERJEE: That we don't have the original documents. But on the other hand, I mean, we already got one cart load, so this will really be another five cart load or something, so that we'll try to select what we want, I think. Well, back to you with that.

MR. ARCHITZEL: Yes, and I don't know what the timing is. If you're looking at the pilots, it's one thing. If you look at the audit, it's another and it takes a while to produce them and get them to you.

CHAIR WALLIS: Well, do they look at lots of different LOCAs in different places?

MR. ARCHITZEL: Yes.

CHAIR WALLIS: Because there's --

MR. ARCHITZEL: We agreed --

CHAIR WALLIS: -- debris transporters are very specific, isn't it the one actually the size of the hole is and where it is and --

MR. ARCHITZEL: And the assumption is in which methodology. Did they use the refined methodology or based on methodology and we're looking at that. So where the LOCAs are or what areas they took for LOCAs. What pregenerated --

DR. BANERJEE: Even the LOCA influence --

MR. ARCHITZEL: Right.

DR. BANERJEE: -- is different for these plats. They have asked for --

CHAIR WALLIS: And it's a very global assumption and they may be that they're focused --

DR. BANERJEE: Only damages.

MR. ARCHITZEL: Well, it's very plant-specific, too. I mean, on the one hand it's global, but there's very plant-specific guidance, where to take the breaks and what the size of the ZOI is. It's very complicated.

CHAIR WALLIS: But the ZOI simply says that insulation gets damaged or something. It doesn't tell you the particle size as it doesn't --

MR. ARCHITZEL: There's distribution of particles.

CHAIR WALLIS: It does? It tells you how much the fiberglass gets shattered and so on?

MR. ARCHITZEL: How much and which type size and how much then erodes further in the pool.

CHAIR WALLIS: Okay. Okay.

MR. ARCHITZEL: All of those type numbers.

CHAIR WALLIS: So there's a lot of stuff there then.

MR. ARCHITZEL: And then specific licensees can go out there and are going out there.

And for the fraction, it's like the small and they are doing testing to verify whether or not they need to take the --

CHAIR WALLIS: Yes, to be a transporter is much more difficult. No one is going to release to bring in the upper story of a reactor building and see where it goes. But the realistic --

DR. BANERJEE: But they have some CFD calculations to actually see this drywall.

MR. ARCHITZEL: Well, that's for pool transport. But for the containment transport, there's assumptions that go with the fractionalization of it. And they live with those assumptions or they try and justify a different one, I guess. And the debris -- the initial debris transport, which is logictry, the Drywall Debris Transport Study -- well, actually we have an appendix to the safety evaluation that went into that fractionalization.

DR. BANERJEE: For example, for the first, not Fort Calhoun, the other plant, I've forgotten the name now, they have a ZOI which is 4D rather than 10 or something. And you guys said it's fine. But what is the reason that you said that? That doesn't come through clearly.

MR. ARCHITZEL: Are you talking about the

first one, the coating ZOI data needed?

DR. BANERJEE: Yes.

MR. ARCHITZEL: With 4 versus the 10?

DR. BANERJEE: Yes.

MR. ARCHITZEL: What it is there, there was no basis for the 10D ZOI.

DR. BANERJEE: Right.

MR. ARCHITZEL: In the Guidance Report.

DR. BANERJEE: But it was in guidance. I mean, every --

MR. ARCHITZEL: It was the default position that you would take, so these licensees are, one, analyzing the 10D for the coatings and, two, saying also simultaneously analyzing the 4D or a 5D ZOI for coatings and betting on the cone that that's going to be demonstrated. You'll have a presentation later by Matt talking about testing that's going on right now to demonstrate a different ZOI.

So, yes, we identified that, because they didn't have the basis in place yet, but we anticipate it won't be a problem for them getting that basis on that particular issue. If it is, they will use the bigger one. They will use the bigger ZOI.

DR. BANERJEE: But it generates a lot more debris, right?

MR. ARCHITZEL: At 10D ZOI?

DR. BANERJEE: Yes, 10 versus 4.

MR. ARCHITZEL: To give you a feel, the BWR is treated 80 pounds of coatings debris in the ZOI using a different methodology. The type number you're talking about is 6,000 pounds of -- or 1,000 pounds, you know, quite a bit more coatings debris as a finite particulate. For the PWR, it will come down quite a bit when they get a smaller ZOI. So that particulate load goes down significantly with a smaller ZOI.

DR. BANERJEE: Right. But so they have to really justify using it.

MR. ARCHITZEL: And are presently doing it. You're going to hear that aspect in a little bit if I move -- later on there is discussion on the -- that's an industry burden that was placed out there. If they want to use a smaller ZOI, they can do it. There's at least two. We heard that last week about the ongoing testing that's being done by the industry to demonstrate smaller ZOIs for coatings, for qualified coatings.

DR. BANERJEE: Okay.

MR. ARCHITZEL: So we have been talking this slide. Let me go on to some of the particular findings.

DR. BANERJEE: Now, you use the margin for chemical effects or factor of fuel or something. That was a fairly sort of pulled out of a hat or was there some basis for it?

MR. ARCHITZEL: Well, going to the licensee whether they just said this is the largest strainer they can put in and the resulting margin is a factor, too, or did they actually engineer a margin in there? In the case at Crystal River, you can see they fully encompassed their sump, so that is what you could put in the sump with the stacked, those Top Hat strainers and the margin is what's left. And they had a significant margin still available for the chemical effects.

We haven't passed judgment on that margin yet. That's what they are documenting is the margin. And at Fort Calhoun, they've got problems because they are Cal-Sil and trisodium phosphate and that margin may not be enough for them. And so they have actually delayed the implementation of their sub-installation, because of the uncertainties associated with both the near-field effect and the chemical effects at the moment.

So we don't know that the margin is enough. We can't criticize it in the report, because

they don't have the information at this time in the pilot form. This is just giving you some of the things we did do on some of the audits. We did evaluate computational fluid dynamics of the pool transport.

The Crystal River use of that with Alion. We actually ran the CFD with the licensee's input for Fort Calhoun. That was in the appendix of one of the reports. It is proprietary. I'm not going to go into it now. We have purchased hardware and software for future audits, so we can do CFD calculations.

CHAIR WALLIS: Now, CFD, this is for debris transport. Is that what it is?

MR. ARCHITZEL: In the pool.

PARTICIPANT: In the pool.

CHAIR WALLIS: I don't understand CFD working with particulates where this is a basis for, you know, you calculate the flow field and you figure out what the particles do in it. That's been fairly well-established, but I can't imagine CFD dealing with whatever you said was bundles of fiberglass.

MR. ARCHITZEL: Well, you treat --

DR. BANERJEE: Well, there is sump technical --

CHAIR WALLIS: But it's so easily caught

up on staircases and all kinds of things. I mean, it's not --

MR. ARCHITZEL: There are thing you can do like intermediate interceptors and things like that, but for fines by and large, you're not going to -- I guess I could ask John. Do you want to ask that question?

CHAIR WALLIS: Well, if you look at a house that the fire department has just hosed down, because there was a fire in it, the fiberglass insulation is all over the place and stuck onto the --

MR. ARCHITZEL: But there is different --

CHAIR WALLIS: -- furniture and everything. I mean, it's --

MR. ARCHITZEL: Distribution is not all the same size. There is a four side distribution, three side. The fines are all going to go, but not all of the smaller ones.

CHAIR WALLIS: Fines probably will go with the water, right?

MR. ARCHITZEL: Right. But you model all that and then you say what can settle, at what rates can it settle and what areas can it settle with low-flows and then you have the nice pretty pictures, but it reduces your debris.

CHAIR WALLIS: It's the worst scenario for the core as the fines go with the water and nothing else does.

MR. ARCHITZEL: Well, then you hope in the core that there's enough bypass flow to flush it on out and keep it going. So that's another issue though.

DR. BANERJEE: I guess the real problem you are facing here is that one assumption would be that all the debris generated gets to the screen. If that's not acceptable, then you have to do some CFD and sharpen your pencils and hope that some of it drops out, right? The problem, of course, is that settling in a turbulent fluid is an extremely difficult problem to handle, especially in the sort of CFD that I have seen you guys are doing.

The explanation for the hindered settling and turbulence of these fines or fibers is very poorly treated. Now, we will take a look at this, but this is one area that we really need to examine in some detail to be sure that enough is getting to the screens, you know, and not an artifact of the CFD that they are happily settling it out.

MR. ARCHITZEL: Yes. And in that case, that is our work, not the licensee's work. So you

actually have --

DR. BANERJEE: Right.

MR. ARCHITZEL: -- modeled off the work NRC did to do that.

DR. BANERJEE: Yes. Now, Los Alamos did some work for you guys.

MR. ARCHITZEL: Yes, they did.

DR. BANERJEE: Right.

MR. ARCHITZEL: That was what was attached.

DR. BANERJEE: Which I have looked at the little turbulence model there briefly. It's in one of your audit reports, I think. It looks very primitive. So we need to look at that.

MR. ARCHITZEL: Okay. As this is the discussion of the Flow-3D that was done. A couple of issues were identified such as the nonuniform spray addition and the way to refuel cavity drainage was actually modeled and the run-off coming down the sides. Just some of the typical things, some of the things that we're addressing in the report, you know, imagine that.

Getting to somewhat particular designs right now, I want to say Crystal River 3 was the first pilot. You can see they are increasing significantly

in size, their screen, their strainers.

CHAIR WALLIS: Well, what are we looking at in the picture?

MR. ARCHITZEL: The picture on the left is the new sump at Crystal River 3.

CHAIR WALLIS: You mean what?

MR. ARCHITZEL: It's a sump pit. There are Top Hat strainers on the left, okay?

CHAIR WALLIS: Those are all strainers?

MR. ARCHITZEL: As the existing sump. You know it's an existing sump which is -- and this was a box-type sump. What they have done is replaced, inserted inside that sump with a trash rack on the top a significant, you know, 1,100 or 1,200 square feet of surface area strainers, that's what they have gone to and it's installed at Crystal River.

That's not the only change they made. They also -- if you look at the picture on the right, what you see --

CHAIR WALLIS: So they have actually decreased the size of the pits, so the debris could fill it up more readily.

MR. ARCHITZEL: Well, the --

CHAIR WALLIS: There isn't much place for it to settle out then.

MR. ARCHITZEL: The debris would not have been considered coming into the pit before, because it would have been considered on the surface of that box strainer. Yes, there would have been bypass, but it's an open area inside that box, so the debris would not have been inside that pit. It would have been on the surface of the previous strainer, so they've significantly increase the surface area.

And for Crystal River, their analysis shows, a key part of their analysis was that you wouldn't get with all the debris they have got, you wouldn't fill up that interstitial volume in that pit. So they have got -- they did an analysis. The quantity, form of the quantity is the debris still had a margin to not completely filling up the area within the interstitial area within that pit right there.

DR. BANERJEE: You mean off these Top Hat strainers, you're talking about?

MR. ARCHITZEL: Surrounding the Top Hat strainers within that sump.

DR. BANERJEE: Right.

MR. ARCHITZEL: They are an RMI, mostly an RMI plant, so it's not as difficult. I mean, this is all somewhat plant-specific.

DR. BANERJEE: Right.

MR. ARCHITZEL: They have mineral wall and they're replacing the generators and their pressurizers year after the date, but the mineral wall is going to be gone, but right now they have analyzed the mineral wall. They are taking that out, too.

DR. BANERJEE: You mean all RMI or what?

MR. ARCHITZEL: Well, essentially, they are getting rid of the -- when they get rid of it, there might be a little bit of fiberglass insulation here or there. Some plants have an easier problem than others when you have this type of situation. You don't have a lot of Nukon fiber insulation that they can handle that type of surface area and then, you know, so it's not all -- they are not all the same out there. Their plants aren't similar.

MEMBER DENNING: Yes, let me make sure I understand this design here. Basically, the vertical areas that we're seeing there is the primary flow area that we're talking about, right? In other words, each of these strainers.

MR. ARCHITZEL: These are concentric. There's an inner and an -- they are annular type of cylinders. The outer surface of each cylinder and the inner surface are all perforated steel plate built. So your flow area is everything around and inside.

MEMBER DENNING: And inside.

MR. ARCHITZEL: Those Top Hat strainers. In this case, that's the flow area and that's where you get the 1,140 square feet.

MEMBER DENNING: Yes. And what you were saying was that you won't fill up all the areas internal and surrounding that?

MR. ARCHITZEL: All the debris gets calculated to arrive at the sump screen. That's not true of all strainers. It's true of this strainer design at this plant.

CHAIR WALLIS: This is where you need to know something about where the debris goes. Maybe the coarse debris goes in one place and the fine debris goes somewhere else.

MR. ARCHITZEL: Well, the fine debris is going to pass through it until you get a filter bed. If you get a filter bed, it's going to be on the filter bed, you know.

CHAIR WALLIS: But you might not get a filter bed over all the area.

MR. ARCHITZEL: It depends on the accident.

CHAIR WALLIS: You may get it in parts of the screens.

MR. ARCHITZEL: Certainly, yes, we have seen they are not uniformly covering and depending on the breaks.

DR. BANERJEE: Yes, that's why I was talking about the stack, do the calculation on the stack. It could be that you take out the coarse stuff and the fine stuff would go further downstream.

MR. ARCHITZEL: I've got some other slides that show that you can get uniform coverage and other testing shows you don't get. It's still nonuniform. So you can have it both ways. For head loss perception, a fine coverage in a thin bed type coverage it is the more challenging head loss situation. When you have massive amounts of debris, you can still have open areas that reduce the head loss.

CHAIR WALLIS: But can they bypass the fines -- the screen?

MR. ARCHITZEL: There is an ability to bypass. They have to look at it both ways. Yes, there is a bypass area.

DR. BANERJEE: Screen effect, as you called it.

MR. ARCHITZEL: The picture on the right is just showing us some additional changes. It wasn't

limited. One way to handle their debris, they did install, which is, a perforated debris interceptor on the right. You can see that. So they had a unique containment design where all of the debris is channeled in a certain direction. And you can get, it's like not topped, the interceptor is not topped during the actual --

MEMBER DENNING: I don't really understand that right hand. Could you kind of point out to us?

MR. ARCHITZEL: Well, if you look on the, say the, left hand side, forget the right.

MEMBER DENNING: Yes.

MR. ARCHITZEL: You see all the LOCA. The way they are contained, there are only certain exits from the D-ring, they call it.

MEMBER DENNING: Yes.

MR. ARCHITZEL: And basically, they have cut off an ability to go to the right, so the flow, basically, if you look at the CFD, has to come around one direction. It hits this flow interceptor and that flow interceptor is going to take a lot of the heavy debris and settle it and filter it out right there.

MEMBER DENNING: And the flow is going from left to right?

MR. ARCHITZEL: Left to right. I don't

know what the right --

MEMBER DENNING: And this flow interceptor is just a step?

MR. ARCHITZEL: No, it's actually perforated plate and it's got a trash rec on the top and the perforations are bigger and then the perforations when you get to the strainer, so it's all an engineered thing that goes into the CFD.

MEMBER SHACK: Well, what is the dimension?

MR. ARCHITZEL: I think it's like, you know, the flow might be 2 feet, so it's a 1.5 or something like that. All right. So it is -- so not to be a blockage point for flow, there is a clearance on the top.

DR. BANERJEE: Here is a single Top Hat strainer.

MEMBER SHACK: Yes.

MR. ARCHITZEL: So the idea here is just it's not the only thing to do to change the strainer. You can do other things to sequester debris and that's how the CFD was used somewhat to sequester debris remotely from the strainer.

CHAIR WALLIS: That might not be good. You might catch all of the big flocs and then the

fines go over the top.

MR. ARCHITZEL: That would be considered.

CHAIR WALLIS: And they would go right through the screen. I mean, there's so many variables in this.

MR. ARCHITZEL: In the worst case, you would want the debris to be caught, that's the idea. I don't understand what --

CHAIR WALLIS: Well, I see. You want it and you don't want it.

MR. ARCHITZEL: Well, you don't want -- what we don't allow is credit for filtration by the accident building of a filter for the downstream. If you look at these Top Hat strainers on the left, we heard a presentation last Friday and that vendor, and I'm not for these strainers, they could back it, they've got a fine intermesh screen available. It's not an option to take debris out on the inside. So you can actually dress that thing with a strainer design as well for some of the downstream effects.

DR. BANERJEE: What is the screen size on these? I have forgotten.

MR. ARCHITZEL: It's up there, 1,140.

DR. BANERJEE: 1,140.

MR. ARCHITZEL: Oh, you mean the hole

size? They are like 1/8th of an inch.

DR. BANERJEE: Yes.

MR. ARCHITZEL: Or somewhere in there.

PARTICIPANT: An eighth or a quarter.

MR. ARCHITZEL: Or a little smaller. Not a quarter.

DR. BANERJEE: The point is --

MR. ARCHITZEL: Eighth or smaller typically.

DR. BANERJEE: -- correct that you could take out the fiber or whatever which would form a map to take out the particles in the early part and then the particles would go through and go downstream.

CHAIR WALLIS: On the small fibers.

DR. BANERJEE: Yes, the small fibers.

MR. ARCHITZEL: As I mentioned, some of the -- we did go to Alion before Crystal River and we observed some of the head loss testing at the vertical loop. One thing we did do was look at thin bed testing in the upper left corner. You can see where it was thin bed and Nukon and then they did put in the simulated sink. You see some of the beds on the right where yes, it's on the surface, some of the particulate was on the surface and it would be more yellow underneath.

One thing we did do Dr. Wallis, we actually considered your sandwich comment and we did a test where we -- it was similar to the one on the left where you first put the Nukon down there and then you put in the zinc and then they ran another and they had a certain head loss, about 2 feet or something like that. Then they stirred it all up and ran the test again instead of doing it sequentially and ended up with head loss of one-half of the --

CHAIR WALLIS: One-half.

MR. ARCHITZEL: So it was definitely -- it makes a difference the sequence of arrival.

CHAIR WALLIS: And I think you'll find when we hear from PNL --

MR. ARCHITZEL: The same kind of stuff.

CHAIR WALLIS: -- whatever they are called now, PNL, NNL, that they can get a much bigger factor than one-half depending on how they --

MR. ARCHITZEL: Well, this was just the one test situation.

CHAIR WALLIS: Yes.

MR. ARCHITZEL: I'm just trying to tell you that the arrival on that particular test was a factor or two different, depending on how you timed the arrival.

CHAIR WALLIS: Right.

MR. ARCHITZEL: So we understand that exists and yes, you'll hear more about that tomorrow. There's another thing we observed, we did find some things on some of these audits. The strainer on left is an installed strainer. But one thing we noted is when you take these flat bed assumptions and then you actually see what really happens in a real strainer, you see it's not uniform. It's not homogenous. You do get these pass through holes and things like that. And it complicates the use of a correlation.

Typically, your head loss would be less, because of factors like this, but the head loss in most of these strainers though is really pretty low. Another thing we noted, I'll go to a little slide, and if you'll look at the picture on the right that flume, look at that type, the quantity of water that might be in that pipe, we had some interesting observations associated with backflush for the Crystal River testing.

CHAIR WALLIS: What's the thing on the left? It looks like a parking garage in D.C.

MR. ARCHITZEL: You're looking down from the top at a strainer that is such a large flat plate replacement strainer.

CHAIR WALLIS: And the groups in the bottom?

MR. ARCHITZEL: The channel on either side is a bunch of series of these and then you'll have water on either side. At this point, it might be 24 inches down from the water level, so there is a drop occurring right now. Because of head loss there is a very fine thin bed on this strainer at the moment that you're looking at with a 24 inch. It's almost a limiting drop, a 24 inch drop for that strainer.

DR. BANERJEE: I guess the problem is to take a purely correlation approach to this sort of phenomena is going to be impossible.

MR. ARCHITZEL: We're not taking it for a purely --

DR. BANERJEE: And I guess that correlation is -- yes, it's use correlation.

MR. ARCHITZEL: We've got an IRB. I'll pass to comment for now, okay, and we can discuss in a moment.

CHAIR WALLIS: Well, it's an approved engineering calculation or nothing. If it happens to be a correlation, it's --

DR. BANERJEE: Well, yes, but the problem with the correlation is it's a static thing. Whereas

what's happening is a dynamic thing. It depends on when things occur and so on, so what is transported in what order. So it's not going to be a correlation. It has to be a dynamic thing.

MR. ARCHITZEL: Well, we -- yes.

DR. BANERJEE: Yes, I think there is a --

MR. ARCHITZEL: You say the licensees have their own correlation because they do testing and they verify their head loss through the testing. You may be able to hear that this afternoon. Industry can talk about what they perceive as the vendor-specific correlation for the different strainer designs.

DR. BANERJEE: Right.

MR. ARCHITZEL: But the complex strainers, basically, have lower head loss than correlation would indicate the correlation.

CHAIR WALLIS: Have any of you guys thought of pumping the stuff out of the sump and cleaning it outside in another building and then bringing it back in again? Does this have to be inside the containment?

MR. ARCHITZEL: Nobody has a strainer outside.

CHAIR WALLIS: No, they don't, but I mean no one has ever tried to submit anything like that to

you?

MR. ARCHITZEL: There are active designs, but that's all handled inside. There's three or four plants with an active strainer design.

CHAIR WALLIS: And if you are stuck with a very small sump, you know, if it weren't for radiation and so on, you would simply fill the building beside and pump the stuff out, clean it and bring it back again.

MR. ARCHITZEL: I don't think you would pump it outside and leave it outside.

CHAIR WALLIS: It's the radiation, some radiation that's the problem.

MR. ARCHITZEL: Right. Nobody volunteered that.

CHAIR WALLIS: Radiation, yes.

MR. ARCHITZEL: But it certainly is an option that somebody could have done. They could have had the filtration. If they had room, they could have done an outside.

CHAIR WALLIS: Would you have to make that another piece of it, an addition to the containment? It would have to be contained.

MR. ARCHITZEL: Well, outside of the containment.

CHAIR WALLIS: Right. But outside the existing containment, but another little containment, yes.

MR. ARCHITZEL: Well, just like the ECCS as you go outside, it's not the containment anymore, but it's all contained.

DR. BANERJEE: Yes.

MR. ARCHITZEL: So it is. Similar to that, you could do that.

CHAIR WALLIS: For the secondary.

MR. ARCHITZEL: There's no restriction against doing it. Nobody has volunteered that.

CHAIR WALLIS: Okay.

MR. ARCHITZEL: It would take space and things like that. Outside versus inside containment. I think they think they can solve it inside, so they don't look at that.

Let me go on. One thing I will mention with the strainer on the left we did notice, we had a previous criteria, but you could only -- because it's a not fully submerged screen, you can only take half the screen height and beyond that you get instability where you can't get sufficient flow-through that screen, so that was a criteria.

REI, as we did note, you have a situation

where you have downstream, even when you have a fully submerged screen, there can be the downstream portion or channel flow portion that can be vented. And if that's vented, you have a situation that you could have the same effect, because that can then drop this waterhead here and you can basically have air on the inside surface.

So we have asked that REI question to all the plants that may have that situation. We are also examining to make sure they don't have sumps that are vented downstream, even if they are fully submerged. To develop the full differential pressure, we want to make sure to have a full submerged sump and not a vented inside type sump where it can fail due to just flow.

One thing I want to do here is -- I think if I can get off this slide, and I'll try and do this really quick, I mean, I just need a second.

CHAIR WALLIS: Are you going to --

MR. ARCHITZEL: Yes, just real quick. I'll go through these movies real quick. But what I want to do is show you, I'll try and go in order here, these clips. And what we are seeing is some testing we did observe. They have -- that's that strainer that we just looked at from above with a thin bed on

it. And that was just -- you didn't hear the audio, but that little clip right there was turning off the pump. So they had the limiting head loss on that thin bed. Now, it's mostly fiber and a little bit of particulate.

CHAIR WALLIS: I have no idea I'm looking at here.

MR. ARCHITZEL: Well, you're looking at the side. There might be eight of those strainers. You're looking at one side of the strainer. This strainer is more like a flat plate strainer. It's covered with debris at the limiting amount right now, with thin bed debris on that. This is just a demonstration of a backflush situation we observed, is all this is. So you, basically, got a uniform coverage of debris.

MEMBER DENNING: Well, it looks like it's heavier at the bottom. Is that an optical illusion?

MR. ARCHITZEL: No, that's not. There is mostly uniform on this.

MEMBER DENNING: Yes.

MR. ARCHITZEL: There might be a little bit more at the bottom.

CHAIR WALLIS: So where is this thin debris?

MR. ARCHITZEL: All over the surface of that and then every one of these plates as you go trough with the clean side being on the inside of the different plates.

CHAIR WALLIS: So it's on the surface? It's behind the surface I'm looking at?

MR. ARCHITZEL: It's all on this surface you're looking at.

CHAIR WALLIS: All that stuff is thin bed?

MR. ARCHITZEL: It's all covered. It's uniformly covered. It's a perforated plate that's not a complex shape. And what you just saw there was stopping the pump.

CHAIR WALLIS: But this was put in that flume that you showed us all?

MR. ARCHITZEL: Yes, it was in that flume.

PARTICIPANT: Could you run that again?

DR. BANERJEE: Well, we see backflushing occurring?

MR. ARCHITZEL: Not yet. Not yet. This is limiting debris loss case right there.

CHAIR WALLIS: Right.

MR. ARCHITZEL: And that was -- and this video here, the next one, this is turn the pump off and close the valve, so there's no backflush, right?

And I showed you the pipe earlier. That screen turned the pump off, closed the valve and came right back and turned the pump on again, came right back to limiting head loss. No change in the screen. No help at all. Totally limiting head loss once again. All right.

DR. BANERJEE: But nothing fell off?

PARTICIPANT: Yes.

MR. ARCHITZEL: Nothing fell off when the screen was gone. Now, the next one here is, I call it lead, but basically now, at this time, they didn't close the valve, so that length of pipe you saw that had a -- or just a run-off pipe, not pump backflush, but just the --

DR. BANERJEE: Just to head back through?

MR. ARCHITZEL: A little bit of back and a little bit -- when it caught a little bit, the whole thing just came down.

DR. BANERJEE: It peeled off a piece?

MR. ARCHITZEL: Peeled off a piece. So basically --

CHAIR WALLIS: So you were lucky. Now, you predict that.

MR. ARCHITZEL: We --

CHAIR WALLIS: Pick out a piece that is going to peel off.

MR. ARCHITZEL: Well, hold on. Let me just get the next one and then I'll --

CHAIR WALLIS: No, but you see, that was the point, you know.

MR. ARCHITZEL: What's that?

CHAIR WALLIS: You see the point I'm making?

MR. ARCHITZEL: Well, let me make my point first and then I'll talk about your's.

CHAIR WALLIS: True.

MR. ARCHITZEL: Okay. Now, you start the pump off and what happened? That was just stopping flow. Now, they started the pump up again and strip clean the entire strainer.

CHAIR WALLIS: After you knocked off a little piece?

MR. ARCHITZEL: A little piece. The whole thing came off, never again to have a head loss. So going from a limited head loss to no head loss at all was very --

CHAIR WALLIS: Well, that's it. You see, whimsical things can change from one extreme to the other.

MEMBER DENNING: Now this is exactly what happened. Basically, you had flow going through that

kind of filter on top there. You turned off the flow.

MR. ARCHITZEL: When they got to the limit, they kept on adding more and more. They were trying to say their design is okay.

MEMBER DENNING: Yes, and they got the limit.

MR. ARCHITZEL: They got to the limit. At that point, when they are going to terminate the test, they said let's try some backflow demonstrations.

MEMBER DENNING: Yes.

MR. ARCHITZEL: Is what the point was.

MEMBER DENNING: Now, the flow did turn around somehow in this thing?

MR. ARCHITZEL: The first one, they closed the valve when they turned the pump off, so there was no backflow at all.

MEMBER DENNING: So there was no way to --

MR. ARCHITZEL: It just stopped.

MEMBER DENNING: Right. Excellent.

DR. BANERJEE: It just stayed on the wall then?

MR. ARCHITZEL: It just came to nothing, the flow.

MEMBER DENNING: Right. Okay. Now, tell me how.

MR. ARCHITZEL: And then they started the pump up again and it came right back to the same head loss.

MEMBER DENNING: Right. I understand that. Okay. Now, what happens with this other case where you're --

MR. ARCHITZEL: They didn't close the valve, so the volume of water that was in that pipe, very small volume of water, was allowed to diffuse back through the other side where gravity is weighing down and that small amount of flow.

MEMBER DENNING: So there's a little bit of flow going the other way through the screen now?

DR. BANERJEE: Reverse flow.

MR. ARCHITZEL: Right. Reverse flow.

MEMBER DENNING: Reverse flow.

MR. ARCHITZEL: Small, very small.

MEMBER DENNING: Small.

MR. ARCHITZEL: Reverse flow.

MEMBER DENNING: And we saw some of it peel off as a result of that?

MR. ARCHITZEL: Right.

MEMBER DENNING: Right. But you're saying then when they -- but there was a large sheet of it that didn't peel off?

MR. ARCHITZEL: A lot.

MEMBER DENNING: Perhaps it was --

DR. BANERJEE: It was teetering, ready to peel off.

MEMBER DENNING: It was teetering?

MR. ARCHITZEL: Yes, it wasn't help up.

MEMBER DENNING: And then they turned the pump on again giving the positive flow.

MR. ARCHITZEL: In the normal direction.

MEMBER DENNING: In the normal direction. But when they did that, whatever delamination occurred was such that it didn't just go poof back up against the thing, it --

MR. ARCHITZEL: It all fell off.

MEMBER DENNING: -- fell off?

MR. ARCHITZEL: Right, yes.

DR. BANERJEE: Well, it was almost like a mat, I guess, which is slightly detached.

MEMBER DENNING: Yes, but the mat didn't then just go back up again, which you could think it might or it would have impacted the screen.

MR. ARCHITZEL: Well --

CHAIR WALLIS: This is an important thing.

MEMBER DENNING: Yes.

CHAIR WALLIS: I mean, it shows slight

differences in the experimental technique and can make a big difference to the result.

MEMBER DENNING: But I think that what the point you're trying to make is that there might be actions that one could take if you determine that you're --

MR. ARCHITZEL: Fall off.

MEMBER DENNING: -- if you haven't --

MR. ARCHITZEL: Well, I guess the point I was trying to make in the pilot audit, there were significant actions taken by Crystal River. We discussed this result with them. This isn't their strainer, by the way.

CHAIR WALLIS: Well, you said there's a problem with this. And if you have a little bit of just -- if you have a little bit of chemical effects gluing this stuff onto the screen, then it makes all the difference in the world to this experiment.

MR. ARCHITZEL: Well, if you have any flow at all.

CHAIR WALLIS: And all of these plants are different.

DR. BANERJEE: Yes.

CHAIR WALLIS: And it's a very old mystery.

DR. BANERJEE: And the strainers are also different.

CHAIR WALLIS: And all the strainers are different. It's a very messy field to predict anything in.

MR. ARCHITZEL: What I was trying to do is demonstrate that there is some value to the backflush.

CHAIR WALLIS: Yes.

MR. ARCHITZEL: In Crystal River's case, they have a backflush. Most plants don't. They have a backflush, a gravity feed backflush. They changed their procedures after we discussed this to make it permanent. They were going with their existing procedures backflush with flow in the forward direction. They changed their procedures to when they do have or have to use it in their instant access management strategies. When they're going to do that backflush, they're going to make sure all flow is off, so they get the head of water from the reactor actually to allow them to backflush and get some flow in the reverse direction because of that.

And they are also making permanent -- they are actually getting some -- they designed a differential pressure capability in the reverse direction for their strainers. So they heard the

comment and they actually are addressing backflush in a way that's positive towards this.

CHAIR WALLIS: Now, maybe this is a way that -- yes. Maybe this is a very positive thing, if it can be understood. It means that even if you clog the strainers, there may be a very quick way to unclog them.

MR. ARCHITZEL: If you have backflush. Not all plants have it. And it wasn't required.

CHAIR WALLIS: Well, maybe you guys should require it?

MR. ARCHITZEL: Well, it was your comment years ago.

DR. BANERJEE: That is the chemical effects tests, right, because this backflush might be fine without, the chemical effects may not work.

MR. ARCHITZEL: Well, chemical effects may be put to bed by backflush, depending on the timing, that's maybe one thing you could do. I don't know. I'm not at the end of that yet. We're not.

Anyway, I'll move on to Fort Calhoun real quick. I'll try and move a little closer. The difference for Fort Calhoun now they are going for -- they actually were not as far along in their analysis and things like that as Crystal River was.

CHAIR WALLIS: They had 56 square feet?

MR. ARCHITZEL: You can see the existing strainers at Fort Calhoun.

CHAIR WALLIS: They only have 56 square feet?

MR. ARCHITZEL: That's what this is.

CHAIR WALLIS: And how much of that --

DR. BANERJEE: And did they have fiberglass debris?

MR. ARCHITZEL: Yes, yes.

CHAIR WALLIS: They had these truckloads of debris that we heard about in the presentation?

MR. ARCHITZEL: They have 50 percent clean screens.

CHAIR WALLIS: That's by --

MR. ARCHITZEL: That's our Reg Guide.

CHAIR WALLIS: I know. But I mean, I'm just telling you that if you take a truck load of debris and put it on 56 square feet, you've got it pretty thick right now.

MR. ARCHITZEL: You put it right next to that guy. That's the size of their strainers.

CHAIR WALLIS: Yes.

MR. ARCHITZEL: What they --

DR. BANERJEE: How many of these did they

have?

MR. ARCHITZEL: Two. One on the left and one on the right.

DR. BANERJEE: Okay.

MR. ARCHITZEL: You see them both there.

DR. BANERJEE: These square feet?

MR. ARCHITZEL: No, no, no. It's a half each and they could be 28 square feet on one and 20 on the other.

CHAIR WALLIS: In total. We're allowed to assume that half of them were blocked, so that's how they met the regulations.

MR. ARCHITZEL: Yes. The head loss would be -- and then there would be accidents today where that would be sufficient. You know, how do you know?

CHAIR WALLIS: Yes.

MR. ARCHITZEL: GE. Fort Calhoun was going with GE Passive Stacked-Disk Strainer design. I'm going to pass something out for the members and I'll just ask, these are proprietary, I don't want to comment on them, but I just want you to look at them and we can comment if you want.

MEMBER DENNING: Are you going to take those back?

CHAIR WALLIS: Well, we can see.

MR. ARCHITZEL: No, you can keep these.

CHAIR WALLIS: We can see proprietary stuff.

MEMBER DENNING: Yes.

MR. ARCHITZEL: Yes, you can see it, but I don't want to comment in this meeting. We're not closing the meeting?

CHAIR WALLIS: No, okay.

MEMBER DENNING: Yes.

MR. ARCHITZEL: And if you want to close the meeting.

PARTICIPANT: Go ahead.

MR. ARCHITZEL: I just wanted to give you a feel, but not get into these.

CHAIR WALLIS: Well, you won't get a feel for the real.

MR. ARCHITZEL: This is the testing we observe. Yes, you can -- these are all legitimately submitted and stuff like that. They are all --

MEMBER DENNING: We can keep these?

MR. ARCHITZEL: You can keep those.

MEMBER DENNING: But be controlled as proprietary.

CHAIR WALLIS: Um-hum.

MR. ARCHITZEL: And I would rather not

discuss them during this meeting.

CHAIR WALLIS: So we can't say anything about what we see?

MR. ARCHITZEL: Unless you close the meeting, you certainly could.

CHAIR WALLIS: Okay.

DR. BANERJEE: So in some senses this is a little bit like the Vermont Yankee stack, this right here.

MR. ARCHITZEL: The stacked-disks are --

DR. BANERJEE: It's a little different.

MR. ARCHITZEL: They were installed. Those are PCI stacked-disks.

DR. BANERJEE: Yes.

MR. ARCHITZEL: I think, I'm not really positive. We have PCI. I have some PCI displays. GE did put stacked-disks in. They are similar in that sense. These are rectangular versus --

DR. BANERJEE: Yes, rectangular not circular.

CHAIR WALLIS: Well, whatever the design, if you're going to put a lot of area in a small space, you've got to stack your strainers somehow.

DR. BANERJEE: Yes, then you have to be very careful about the approach velocity you use.

MR. ARCHITZEL: Yes.

CHAIR WALLIS: Well, I think you also got to worry about big hunks of fiberglass clogging the outside so nothing can get through between and get to the plates.

MR. ARCHITZEL: Yes, you have bridging concerns and things like that.

CHAIR WALLIS: Yes.

MR. ARCHITZEL: Bridging is observed during this testing, all these tests. You do have that going on also.

DR. BANERJEE: Yes. The concern here would be that you wouldn't be able to use the approach philosophy for the whole open area here, because as you sort of fill up the interstitial spaces, the limiting assumption is the approach philosophy to the periphery of this, rather than to the faces themselves.

MR. ARCHITZEL: Right. If you were really doing a correlation and things like that.

DR. BANERJEE: Yes.

MR. ARCHITZEL: But if you see what they are doing is using, you know, air from channel A or actually doing prototypical testing with design loads, so you're having the actual --

DR. BANERJEE: Right.

MR. ARCHITZEL: -- again line.

DR. BANERJEE: We will wait, too.

MR. ARCHITZEL: But you do get some of these, not like Crystal River where interstitial is not, some of them would overwhelm or be in that situation of having more debris that can go inside the area of the strainers.

DR. BANERJEE: Yes. You can visualize the situation where you fill up these interstitial spaces if there is enough debris.

MR. ARCHITZEL: Right. Oh, there are situations like that, yes.

DR. BANERJEE: All right.

MR. ARCHITZEL: Let me move on to, unless the Committee wants more time, the Oconee audit for a second. This is another plant which has -- Leon Whitney was the team leader for this. And it's just started where it's an RMI plant. They have large quantities of -- not that much fiber and they are putting in a fairly large 5,000 square foot pocket-type strainer. It's installed at one of the units right now, so they already have installed this.

But their analysis wasn't totally complete. So the team is -- that audit has sort of

been suspended right now. But just to tell you the current status of it.

DR. BANERJEE: So if they had so much RMI --

MR. ARCHITZEL: This is an in-process audit, by the way, so we're in first audit and not a pilot any more.

DR. BANERJEE: Why do they need 5,000 square feet of screen?

MR. ARCHITZEL: They had it available.

DR. BANERJEE: I see.

MR. ARCHITZEL: They had the area available. They could put it in and put questions to rest. There's significant margins associated with that design. But we don't have the analysis in place to go over that one yet. We're going to look at that. Well, I say significant margins might be challenged by that comment with the unknowns I guess. But they are not a Cal-Sil plant or anything like that, so the chemical effects might not be that challenging.

CHAIR WALLIS: Well, let's look at the first statement here. You've put a lot of RMI there and maybe it's bigger size and it's more porous and so it doesn't catch the fibers and particulate debris.

MR. WHITNEY: Actually, this is Leon

Whitney, the phenomenon appears to be if RMI encompasses a strainer, then the fiber that approaches, and for that matter stickers and tags and whatever, get trapped on the outer parts of this rough metal pile --

CHAIR WALLIS: Yes.

MR. WHITNEY: -- and you end up with porous metal passages to the strainer and you actually do not allow the formation of a bed to -- and, therefore, you end up reducing the potential for head loss.

CHAIR WALLIS: Yes, I --

MR. ARCHITZEL: It's sort of like we said you could make a complex surface part of the design for some of these strainers, and the RMI basically provides that complex surface. You can't take credit for that, but it does --

MR. WHITNEY: If it transports and there's a lot of ifs, but if it transports and encompasses a strainer, you could see this phenomenon, hence the bed.

CHAIR WALLIS: That's what I was going to say, but it might be that then you get channels through the bed which are relatively high velocity because there is nothing. You know, the rest of the

bed has got fibers on it and this would be a real sort of particle transporting pipeline.

DR. BANERJEE: Into the core.

CHAIR WALLIS: Right.

MR. WHITNEY: There is nothing about an RMI encompassing a strainer that would stop particulate.

CHAIR WALLIS: You see, once you get --

MR. WHITNEY: Debris, yes.

CHAIR WALLIS: This is a generic problem with strainers, is you get bypass or blow-through or whatever you want to call it and it happens in the experiments and we'll hear about it tomorrow. You build up a bed or an RMI, whatever it is, and then there are places where the fibers don't get caught or something and the flow goes through.

So now, you haven't got all the area effected. You have just got these little holes in the bed through which stuff is going and you have to be able to analyze that, presumably, if you're worried about downstream effects.

MR. WHITNEY: We're not --

CHAIR WALLIS: If you're only worried about head loss, a hole is great, but a hole if you're worried about downstream effects --

MR. ARCHITZEL: Well, you still have the same size openings that you have already analyzed.

CHAIR WALLIS: Well, you do on the screen, but the screen is a quarter inch and this stuff is -- you know, the fines are -- there are fines that are smaller than that.

DR. BANERJEE: 10 microns.

MR. ARCHITZEL: Well, they have already analyzed that pass-through. They have to analyze that pass-through.

CHAIR WALLIS: But you see how difficult it is? When you have an RMI bed and it has got fibers on it and the fibers are covering it, but they are only covering 95 percent of it, then you have got these holes, what are you going to do?

MR. ARCHITZEL: But that's the analyzed condition for the downstream situation. You do it with clean and you handle that downstream aspect and that is what you --

CHAIR WALLIS: Well, look at your one where you backflushed and some of the stuff fell off. Now, you have got effectively some area which is clean. The rest of it is all covered with stuff, presumably, if it doesn't all fall off.

MR. ARCHITZEL: But it has to flow-through

that also, that opening.

CHAIR WALLIS: So now you have got your effective areas is decreased by a factor of 10 or something. Are you going to analyze that situation?

MR. ARCHITZEL: I guess so.

MR. LU: But, Dr. Wallis, you are right there and, actually, the vendor conducted two tests where another test is just no RMI and, you know, as a blockage or a filter and they put the fiber and the debris and the particulate right on the screen of the surface, so that they have two cases.

But the specific statement there just to state the phenomena, when you have combined RMI and fiber debris together, it may reduce the total head loss.

CHAIR WALLIS: No, I understand that.

MR. LU: They did have a bounding case to evaluate the head loss due to the fiber and the particulates, assuming it's 100 percent transportable to the surface of the strainer.

CHAIR WALLIS: Well, I guess what I'm saying is that not catching all the fibrous and particulate debris may not be such a good thing if there are certain areas of the screen which are bypassing it. That's the only point I'm making. It's

really downstream effects I'm getting at and not head loss.

MR. WHITNEY: Okay. Ralph, if you would go back to the slide, please.

MR. ARCHITZEL: Oh, I'm onto the next one, yes. Okay.

MR. WHITNEY: I would like to answer that question in the sense that this is a 5,000 square foot strainer. And, Ralph, please, go back to the slide. By design, if fully engaged, the licensee requires the vendor to have a 0.1 foot design head loss. Okay?

CHAIR WALLIS: Yes.

MR. WHITNEY: And if you can visualize a pocket strainer, it basically is shaped like, say, a shoe bag in each pocket. If the flows are very low, the fibrous debris will tend not to lift to the top of each pocket. And, yes, this 5,000 square foot strainer design, regardless of RMI, will tend to have pass-through by design because the upper part of each pocket will evolve flow. And I'm agreeing with you. I'm saying that this design has significant pass-through of particulate.

MR. ARCHITZEL: I guess Dr. Wallis' comment was basically maybe you got to take half the strainer design and see what increase flows, does that

affect the downstream, and that's not an issue at the moment in front of us.

CHAIR WALLIS: At the moment.

DR. BANERJEE: I guess the --

MR. ARCHITZEL: We did it with clean strainers. That was the issue.

DR. BANERJEE: Yes, it's like the Devil in the Deep Blue Sea here. If you have everything caught on the strainer, then your head loss goes up. If you don't and the fines go through, you have got downstream effects to worry about.

CHAIR WALLIS: But that's Scylla and Charybdis.

DR. BANERJEE: Yes.

MR. ARCHITZEL: But the point, as I understand the point, it was that when you're doing a downstream evaluation, do you assess the increase flow off the totally clean strainer because some of the strainer may be blocked and preferentially flow through the open area, and that's one -- I guess we'll have to take that back. It hadn't been really -- that hadn't been the focus of the way we have been looking at downstream.

CHAIR WALLIS: So there are two questions here or at least two. One is your ability to

visualize or predict all the different kinds of things that can happen in terms of inhomogeneities and so on, and the other thing is if you can visualize enough of these possibilities, the next question is how deeply do you have to go in order to predict what happens with all these different possibilities? That seems to me to be something that --

MR. ARCHITZEL: And typically what we do is take a bounding type of an approach, not always bounding, there are cases where it's not bounding, try and address. You heard in the VY presentation where you try and take individual bounding assumptions on the different parts of the question. And in the end you make an assumption that generally it's okay.

A lot of these strainers still have open area with massive amounts of -- so they have low flow issues, right. When they actually do their real test, the vertical surface is likely the same in the pocket strainers. The VY strainers at the bottom were clean, so the head loss is very low. The next one up, going up to this Watts Bar, it's currently ongoing.

DR. BANERJEE: What is a Sure-Flow Stacked-Disk Strainer?

MR. ARCHITZEL: I will show you a picture of it. Well, actually, Shanlai has one in his presentation.

MR. LU: Yes.

MR. ARCHITZEL: So you will see that, a picture of that coming up. We did go and observe testing. This audit is starting out. Watts Bar is using again, they said, Performance Contracting Strainers, another one of the vendors. And then here we're going to get those modification packages, etcetera, coming in in the next week.

Perhaps Dr. Lu wants -- that might be a good one, but you won't have our audit report for awhile, so which one do you want to get if you wanted to look at that? We are getting that information in and we're getting a -- well, maybe even -- well, you don't want to participate, so --

CHAIR WALLIS: Well, you observed the testing, didn't you?

MR. ARCHITZEL: We observed the testing and we're starting the audit.

CHAIR WALLIS: Did you critique the testing?

MR. ARCHITZEL: They will be in the -- I guess there are some comments on the testing coming up. Yes, there are critiques of the testing but --

CHAIR WALLIS: So it looks like a pretty large facility over there.

MR. ARCHITZEL: That's a big flume. Now, this is not, Watts Bar. This is open domain pictures. We went in March of last year to watch testing at all the research labs. This is the facility we looked at for Watts Bar testing. They don't have a high fiber case. This is a high fiber case plant, but it is -- we got the slideshow on the public website and used a couple of photos out of that slideshow.

DR. BANERJEE: Are these all the research labs?

MR. ARCHITZEL: Alden is in Massachusetts, Worcester, Mass., near Worcester. And you can see they have a flow path that generates turbulence within the flume, simulate turbulence of is there is a direct path for that LOCA fluid to get into the sump area to keep the stuff stirred up. You can see the flume on the left, the actual -- page down here for a second.

This is a lead-in, my last slide here, to Dr. Lu. If you see on the left the return flow path, the strainer itself is coming out the end. It's in the upper left area. You can't see the strainer too well, but you can see the types and quantities of debris. Now, this is --

DR. BANERJEE: Maybe you can point to it because on the --

MR. ARCHITZEL: Where do you want me to point?

DR. BANERJEE: There.

MR. ARCHITZEL: Here.

DR. BANERJEE: Yes, yes.

MR. ARCHITZEL: Since this is public domain, I have got some videos I could give to you that show what this looks like during a test, but this would all be quantities of -- you got a small -- over here at this end, this loop here is just the loop that is associated with the turbulence level.

CHAIR WALLIS: Well, isn't that concentration of debris?

MR. ARCHITZEL: Well, that's what I wanted to talk about. That's what we're going to talk about. The actual strainer here is a part module, a scaled module down at this end. All this debris that you see in this flume is the debris you would calculate to be on that strainer scaled in this case, this plant, and it's not all there.

DR. BANERJEE: Is it fiberglass or --

MR. ARCHITZEL: It's a mix. It's whatever they had, fiber. The reason you can't see through it, there's also coatings debris and stuff like that, too. In a lot of these tests you won't even be able to see

through the test at all because of the coating surrogate.

CHAIR WALLIS: And this stuff is just sitting there?

MR. ARCHITZEL: A lot of it, but you can-- and I would almost like to show you the video, but I would have to close the meeting. These are, like I say, public domain. There is actually some fiber that is keeping on transporting down to the left end. The strainer, you will see a photo of the strainer. The strainer is now encompassed with the fiber and this is the question of the near-field that we're going to talk about next.

CHAIR WALLIS: Well, as long as there is no big bubbles or something forming to stir it up, it's going to just lie there?

MR. ARCHITZEL: Right. There's some stuff at the bottom that just lies there and doesn't move along and there's others that does move along in this particular test.

DR. BANERJEE: So you have characterized the turbulence and everything, so you know how much is being transported?

MR. ARCHITZEL: In a plant that had turbulence, they would use the turbulence.

DR. BANERJEE: Okay.

MR. ARCHITZEL: In others they wouldn't use the turbulence part of it. They try and keep it all mixed up in the beginning. This is showing you the introduction of the coatings surrogate into that test that we observed. And then this is the massing on top of the strainer here, the mass of fiber that didn't get on there.

Actually, we did have some foam. That was interesting. They had foam. They thought foam floating won't be any issue, but since it was close we did find it. The foam actually caused a dam and got air right through the strainer when we watched that test.

So you do have to be a little careful about the floating debris if you're very close to the surface and you have this phenomena. It wasn't like vortexing or anything like that.

CHAIR WALLIS: When you say foam, you mean foam insulation not foam --

MR. ARCHITZEL: Foam insulation was thrown into the mix and it was to demonstrate there is no issue, and the issue was that you actually could form a dam from the water.

CHAIR WALLIS: We raised that question

with another plant and they said that the foam wouldn't go to the strainer because the strainer was submerged when, in fact, there is flow to the strainer. The foam can sort of wander around until it gets near the strainer.

MR. ARCHITZEL: And if you --

CHAIR WALLIS: Then it gets in the near-field and it might do things.

MR. ARCHITZEL: If you don't have sufficient submergence --

CHAIR WALLIS: Right.

MR. ARCHITZEL: -- you can have a problem with something like that.

CHAIR WALLIS: Right.

MR. ARCHITZEL: You can prevent the -- so we learned things during the audit. We observed things.

CHAIR WALLIS: So you are still learning things.

MR. ARCHITZEL: Yes.

CHAIR WALLIS: That's good.

MR. ARCHITZEL: Anyway.

DR. BANERJEE: These are very interesting.

MR. ARCHITZEL: That completes my presentation. At this point, Dr. Shanlai Lu is going

to talk about --

CHAIR WALLIS: Well, you went through all these tests and all that. Did you learn enough to make decisions from observing these tests?

MR. ARCHITZEL: We made some. Well, we didn't have that type of criteria in these pilot audit reports. We had more criteria that it looks like it's generally okay or not enough information to make a decision was the last category. The middle categories are sort of might be okay type thing. The first one was a pretty more robust answer that we think it will be okay.

And there were areas in the back of each report that characterized how we felt about the different areas and some came out that we were very comfortable with upstream effects in some of the plants. I mean, in some we did make, as best we could in a pilot, some type of conclusions.

DR. BANERJEE: The one thing you did show, I think, is that if you consolidate this material on a strainer or something and provided the chemical effects and you even backflush it off, then it's consolidated. It was out of the loop of consideration in some way.

MR. ARCHITZEL: Right.

DR. BANERJEE: So it doesn't re-entrain. It's all sort of --

MR. ARCHITZEL: And these loops will clean up eventually. They will clean up and have crystal clear water.

DR. BANERJEE: Yes, right.

MR. ARCHITZEL: And the head losses are very low for the types of testing that has been observed. I mean, the industry can tell you they have very low head losses even with these large quantities of debris.

DR. BANERJEE: Okay. So that backflushing experiment was very interesting.

MR. ARCHITZEL: Well, that's a separate issue. That's for the thin bed, which is another controlling situation.

DR. BANERJEE: Yes. Once you have captured everything in that thin bed and if you backflush it off, it doesn't re-entrain very easily and sort of capture stuff.

MR. ARCHITZEL: Yes, whether the ACRS believes the thin bed or not, if it's isolated thin bed and that's all of you have got and you get rid of it, the head loss is low.

DR. BANERJEE: You have taken out the

particulates, too, in that thin bed.

MR. ARCHITZEL: And that's the controlling case. Normally, it would be -- the controlling case would be that thin bed. If you get a bigger debris bed, it can handle a lot more and you don't have nearly the head loss when you have much more quantities of debris in a loop.

CHAIR WALLIS: I'm wondering where we are, thank you, Ralph, where we are in time. Shanlai, are you going to take a long time? We haven't done a break yet and we have been going since 8:30.

MR. LU: Maybe we can do that after the break because I have at least 40 minutes. It depends on the questions, if you have a lot of questions.

CHAIR WALLIS: Well, we should probably have a break now.

MR. LU: Yes, great.

CHAIR WALLIS: How long a break? Can we have a break until 10:50? Is that something we can handle?

PARTICIPANT: Yes.

CHAIR WALLIS: And then we'll try to catch up. Well, we may have to go over this afternoon.

PARTICIPANT: Okay.

CHAIR WALLIS: It's quite anticipated,

this being so interesting.

PARTICIPANT: All right.

CHAIR WALLIS: So we'll see you. We'll take a break now until 10:50.

PARTICIPANT: All right. Okay.

PARTICIPANT: Is that the only remaining one out of this?

CHAIR WALLIS: Are you the only remaining one?

PARTICIPANT: Yes, then we start chemical effects.

(Whereupon, at 10:37 a.m. a recess until 10:50 a.m.)

DR. BANERJEE: Do we have this?

MR. LU: All right. Should we wait for the other Members to come here or you want me to start now or --

CHAIR WALLIS: Yes. Please, start, yes.

MR. LU: Okay. All right. Shanlai Lu from staff, NRR/SSIB, and the title of my presentation is the Near-Field Effect and the Prototypical Head Loss Test.

CHAIR WALLIS: Just a moment. John?

PARTICIPANT: Yes?

CHAIR WALLIS: Well, I guess you're the

federal --

PARTICIPANT: I'm the DFO until relieved.

CHAIR WALLIS: Yes, okay. Excuse me. This is just one of those. Okay. Okay. All right.

DR. BANERJEE: I'm a DFO.

CHAIR WALLIS: You can't leave, John.

MR. LU: So the focus of my presentation will be related to the head loss and I guess during our last meeting with ACRS, we spent a lot of time discussing correlations in head loss and the evaluation methodology.

So this time we're -- I'm going to go over that a little bit, just with one slide, because during the past 15 months a lot of things have happened and, actually, the current focus of staff's inspection or the audit and the evaluation is a focus on the vendor's prototypical head loss test. But I will go over a little bit of history of what we did in terms of SE.

CHAIR WALLIS: Thank you.

MR. LU: How we address the ACRS comments here. Okay.

During our meeting with ACRS last time we spent quite a lot of time discussing the validity of NUREG-CR/6224 head loss correlation and we got a lot

of comments back and from the full Committee and the Subcommittee.

And before we release the final version of the safety evaluation, and we had about three to four weeks before that after the full Committee meeting, and we evaluated the ACRS comments and worked on this correlation, and then we revisited a lot of issues and thinking about this correlation and why we want to choose this or the NEI Guidance Report, what is their positions. And we decided to revise the safety evaluation and the final version to incorporate the ACRS comments.

This is just a summary of the position there and we believe that NUREG-CR/6224 correlation is not appropriate for many PWR LOCA debris types, particularly for Cal-Sil. However, it's a useful tool for scoping analysis. The reason is very obvious. That's probably the only tool available on the street for licensees or vendors or whoever are interested to at least perform a scoping analysis before they come back to full scale modular head loss testing.

So that is the position we took. We took the comments from the ACRS and we revised the staff's position and that was December '04. Okay.

In January '05, we met with the industry

the second time after we -- the first time after we released the final version of -- issued the final version of the staff's evaluation, safety evaluation. And we provided a path forward for the industry, which is they can perform plant-specific tests to address the head loss issue.

CHAIR WALLIS: While all this was going on there was an NEI guidance document that came out.

MR. LU: Right.

CHAIR WALLIS: Which I think cited 6224.

MR. LU: Right.

CHAIR WALLIS: As the basic reference, and I think you approved that guidance.

MR. LU: Well, this particular position regarding that NEI Guidance Report and I think it's very clear that we took a different position on that.

CHAIR WALLIS: So you have changed your position on the Guidance Report, too?

MR. LU: That's right.

CHAIR WALLIS: Okay. Thank you.

MR. LU: That's correct. Okay. So right after the January meeting with the industry last year and we observed a trend from the industry, and licensees and vendors are gearing up to perform plant-specific prototypical head loss tests to address the

head loss evaluation issue.

And at this point, based on the NEI survey, all 69 PWR units plan to perform plant-specific prototypical head loss tests. Okay. And they are right now ongoing and there are five vendor teams producing the test results and designing the strainers for the 69 PWR units. And each vendor has its own testing facility and testing program.

CHAIR WALLIS: This is very interesting because NUREG-CR/6224 was based on an extensive test program.

MR. LU: Right.

CHAIR WALLIS: And I think a lot of work was done, a lot of careful consideration of various things, and the result turns out not to be appropriate. Now, you're going to have 69 plants trying to develop their own equivalent of NUREG-CR/6224?

MR. LU: Okay. I think I will address the first part of the comment. The NUREG-CR/6224, yes, it's was developed under the -- with quite a lot of effort there, but the intention, original intention from NRC, is to develop a confirmatory tool for staff to evaluate the head loss, so to push a confirmatory tool to the point that it can be used to broadly

evaluate head loss, taking into account the consideration of all type of PWR debris, all kinds of geometry of strainers.

I want to emphasize the shape of the strainer is so complicated, it becomes a difficult process, as Dr. Banerjee just pointed out during the last presentation. And even one picture shows that you have channeling effect going through the strainer debris bed, which if you go -- if you decided to go for an analytical approach, it will be very hard to -- you may be able to bound and actually you can bound that, but to go for that analytically, it will become extremely difficult and harder to evaluate the uncertainty.

The second part of your comment is I think that's true, too, and I think -- and a lot of efforts were put into that correlation development and Office of Research has done a lot of work there and so that is Los Alamos. That is the reason it can become a useful tool for the industry and licensees to use that tool as a scoping analysis tool and do a first shot of scoping.

Okay. And, as Ralph mentioned, that we conducted two pilot audits and we have two audits ongoing. And, in addition to that, we also -- the

SSIB team and plus other staff, we visited all five vendors' test facilities to evaluate their testing procedures, their testing facilities setup and their evaluation methodology, too.

DR. BANERJEE: Let me ask you one question. Are there five test facilities now, each of the vendors has one?

MR. LU: That's right.

DR. BANERJEE: And are there differences between these test facilities?

MR. LU: Okay. That's exactly what my first bullet is going to talk about that. There are significant differences among the five vendors. I really don't want to address that in much detail because that is proprietary information. That's the reason a lot of issues I want to talk about today is really generic issues. But the key vendor testing approach is very similar.

At a very high level, if you stay, you know, 10,000 feet above the ground, you can see it's all green there. But the way they are doing the testing is they use a reduced section of the replacement strainer design and put in a test facility, a tank, a pool or a flume and they run the water through that one and then through a

recirculation loop, and they put this debris, all kinds of debris, RMI, coatings, fiber and particulates, everything at the strainer or upstream of the strainer and measure the head loss.

Normally, they use the debris type identified by the plant, so it becomes plant-specific, and also they use the plant-specific approach, velocity and the ECCS plus the containment spray pump flow rate, specifically for that plant, to measure the head loss. That is the common way they are conducting the head loss there. Okay.

DR. BANERJEE: But let me ask you one question. If they are taking a piece of a strainer --

MR. LU: Right.

DR. BANERJEE: If there are effects due to multiple pieces --

MR. LU: Right.

DR. BANERJEE: -- how do they handle that, because we have come across that in a previous situation where there were stacked-disks.

MR. LU: Right.

DR. BANERJEE: Where they used the wrong approach velocity.

MR. LU: Right. That is a valid question. Actually, I think on the fifth or sixth slide of my

presentation that is exactly the question we're asking the licensees to address. That's in terms of the scaling.

DR. BANERJEE: Okay.

MR. LU: So okay.

DR. BANERJEE: We'll wait for that.

MR. LU: Right. Okay.

CHAIR WALLIS: I think there is also the question of the applicability of the test, and we're going to hear tomorrow that Los Alamos did some tests which we have seen before and talked about. And then specific labs did some other tests, the same tests.

MR. LU: Right.

CHAIR WALLIS: The same tests.

MR. LU: Right.

CHAIR WALLIS: And it's the same test, right?

MR. LU: Yes.

CHAIR WALLIS: And in some cases the results were quite different. So are you going to say that you're going to take the results from which lab or are you going to say you're going to take the results from Alion and say they were predictions of what would happen further north? Do you see the problem? You're going to say a test in a lab in

Massachusetts now applies to a facility in Texas or something.

MR. LU: It's a valid question.

MR. ARCHITZEL: Dr. Wallis, Ralph Architzel. I just want to point out one thing. What Shanlai has been talking about is the full article, full scale type test.

CHAIR WALLIS: Right.

MR. ARCHITZEL: There is another set of tests, the vertical loop test and things, and that is more what you're talking about. Some of these test facilities also have vertical loop tests, so you got to be a little careful mixing and matching as per the correlation.

CHAIR WALLIS: Well, I understand that.

MR. ARCHITZEL: So what you're talking about now is more the vertical loop test.

CHAIR WALLIS: I understand that, but these tests were very simple and, presumably, very well-defined tests, whereas these plant tests --

MR. ARCHITZEL: Yes, you would expect those to be.

CHAIR WALLIS: -- are much less well-defined.

MR. ARCHITZEL: Right.

CHAIR WALLIS: You would expect more uncertainty in the plant than in these. You wouldn't expect two national labs -- in fact we have even got another one involved now that also does the same test and getting different results.

MR. LU: Okay. Yes, that's one of the issues actually I was planning to cover at the end of my last slide, how we are going to use research results.

CHAIR WALLIS: Yes.

MR. LU: And that is what you're looking for, too.

CHAIR WALLIS: So you're relying on one test to then be applied to the plant.

MR. LU: Right.

CHAIR WALLIS: And you have to then somehow handle this business of, well, how predictable are these phenomena if different labs get different results? Are you going to put a huge range of uncertainty on the results or something or how are you going to handle that?

MR. LU: Okay.

MEMBER KRESS: Has there been a formal scaling analysis of this phenomenon, scaling analysis in the test compared to the actual prototypic size?

MR. LU: That is exactly -- actually, since last March when the staff was introduced to this near-field effect and the vendors decided and licensees decided to take the credit of near-field sediment, and our immediate response was what is the scaling?

MEMBER KRESS: Yes.

MR. LU: How do you justify your scaling is properly done, so that you can address this settlement issue and can you conservatively predict the debris transported to the strainer surface. That is exactly -- you are asking exactly the question we asked them last March, and I think that's the reason I want to put this item here for discussion with you guys. Okay.

DR. BANERJEE: I have a comment maybe. You may cover this. It's that the variability that Dr. Wallis is referring to always sort of would indicate that there is some parameter in the problem which is not being properly met. I mean, if you believe in science and causality.

MR. LU: Right.

DR. BANERJEE: In this case a candidate is the sequence in which things arrive at the strainer.

MR. LU: Right.

DR. BANERJEE: So the whole thing is sort of a dynamical process.

MR. LU: Right.

DR. BANERJEE: Which I was, in fact, mentioning to you before.

MR. LU: Okay.

DR. BANERJEE: So just a static sort of correlation probably doesn't work in this case.

MR. LU: Yes.

DR. BANERJEE: I mean, it depends on whether the fibers get there and then take out the particles afterwards.

MR. LU: Right.

DR. BANERJEE: Will the particles go through and then the fibers come? You know, all this sort of stuff starts to matter.

CHAIR WALLIS: Or how well the fibers are washed before they are used.

DR. BANERJEE: Right, and how they are cooked, that the organic comes off or not.

CHAIR WALLIS: Which blender you use to chop them up.

DR. BANERJEE: Right.

MR. LU: Yes.

DR. BANERJEE: How fine they are, in fact,

yes.

MR. LU: Well, I can respond to this particular comment. Actually, that is exactly the reason. Once we identified that the PNL test loop and the liner loop produced different head loss data, and then one of the issue we identified is the debris, the introduction method and the limited preparation method which can cause effectively two differences that is observed by the PNL and the nano test comparison.

And we also observed from our Watts Bar audit two, so we had established that. So that is one of the issues I want to cover today. That is what exactly we needed to have the licensee to respond. Right now, we deal with each individual vendor team and testing.

Some issues can be surfaced as, you know, the common ground can be talked about publicly, but some issues we deal with at the, you know, vendor to NRC level in the proprietary information meetings, the closed meeting there. And so going back to this particular question, we are applying research results to guide us and establish positions to require licensees' reactions.

CHAIR WALLIS: So these two labs are getting very different results. They are trying to

get the same results by trying to do it the same way and, yet, there's difference in preparation or arrival of the debris or something. In a plant, depending on the plant and where the LOCA is and how big the -- what the shape of the hole is in the pipe, you get different -- all kinds of uncontrolled --

MR. LU: That's right.

CHAIR WALLIS: -- things about how the debris is broken up and when it arrived and all that.

MR. LU: You're absolutely right, right.

CHAIR WALLIS: So that is even more difficult to predict than to predict that Atel will get the same results as Los Alamos.

MR. LU: You are absolutely right.

CHAIR WALLIS: Okay.

MR. LU: I think that was one of the issues.

CHAIR WALLIS: So you'll figure that out somehow. You will figure that out somehow.

MR. LU: Okay. Yes. But I want to hit a major issue we identified, commonly referred to as a near-field effect. Not all the licensees or vendors decided to take the credit, because some of the licensees have an ample margin and they have very clean containment and they can just dump all the

debris, RMI, everything, right on top of the strainer. They measure the head loss and then they have a factor of 10 margin. So for those plants it's not an issue.

MEMBER KRESS: But do they dump it all?

MR. LU: What?

MEMBER KRESS: Is it homogeneous stuff?

MR. LU: No. Some of the plants were doing like a bounding case. Instead of doing the -- for example, the Oconee case. They measured that fiber and the particulate first and then they dump the -- and in another case they just dump the RMI first and then that cause the filtration effect. But they bounded both cases with different tests.

MEMBER KRESS: And you have enough data to know that's a real bound?

MR. LU: Well, actually, I think the vendors were doing that data to bound that one, doing that type of test to bound that, to make sure that they are not take credit of some odd effect introduced by the testing procedures.

DR. BANERJEE: But what about the preparation of the debris? How sensitive are the results to that?

MR. LU: Okay. I think that's a valid question. I'm going to address it on the sixth slide.

The real issue I want to point out, this is a very significant issue here, is I want to focus on the phenomena observed as a near-field effect. I'm going to touch that part, too.

And the phenomena we observed or the vendors observed is a large quantity of transportable debris does not reach the strainer surface and settled upstream from the testing module due to debris agglomeration.

CHAIR WALLIS: Yes.

MR. LU: Okay. And that is what Ralph just showed in the picture of the large flume and all those debris, based on the current SE, staff's SE and the NEI Guidance Report were supposed to be calculated based on transport calculation. All those debris are supposed to be on the strainer surface.

But instead of measuring the head loss of all those debris on the strainer surface, vendors consider the reality here and not all the debris will reach the surface of the strainer because very high concentration of the debris, even the transport of the debris, tend to agglomerate.

Once it starts to agglomerate, it will settle at the bottom of the tank and the head loss can be a factor for 20 to 40 times lower than the

prediction by the NUREG-CR/6224 correlation. So that is a credible physical phenomenon I think the vendor is trying to take the credit from. Some plants cannot live without this. Some plants can live without this, but some plants cannot.

So the application of this near-field effect and the testing procedure will give some plants much smaller strainer size or lower head loss than a design following the NRC SE and the NEI Guidance Report. So that is the major issue I want to point out here and discuss with the Subcommittee here.

CHAIR WALLIS: Are we going to look at the next picture? Yes.

MR. LU: Yes. Okay. If you remember, Ralph just showed that last flume. It's about 30 feet or 40 feet. I forgot what the length. And this particular case was last March when we first introduced the near-field effect, and you can see that this is a PZI stacked-disk strainer. You were asking what is the shape of the strainer that's -- or the PZI.

DR. BANERJEE: The central pipe in the middle there?

MR. LU: Yes, okay.

CHAIR WALLIS: Can you see? They are

going to bridge it right across the gap there in some places.

MR. LU: Right. These is -- we have the issue related to this being that observation, test observation trait, that's one of the issue we raised.

CHAIR WALLIS: So you have some areas where there is no goop at all. Does it actually clean?

MR. LU: Exactly.

CHAIR WALLIS: And in my figure I have got here, the bottom right hand corner.

MR. LU: Okay. Here?

CHAIR WALLIS: There is a whole lot of bubbles.

PARTICIPANT: Bubbles.

CHAIR WALLIS: What are those bubbles from?

MR. LU: Okay.

CHAIR WALLIS: Where do they come from?

MR. LU: This test after they started draining the tank, you will see the bubbles after doing the test, the entire whole thing.

CHAIR WALLIS: Where do they come from? Where do they come from?

MR. LU: It's submerged, entire -- the

strainer was submerged during the test. This is after they start to drain at least half the water and you can see the part of the strainer was --

CHAIR WALLIS: But where do the bubbles come from? Presumably, they are in the pool somewhere, then they rise to the surface?

DR. BANERJEE: There bubbles, Graham?

MR. LU: Well, you mean the bubble here?

CHAIR WALLIS: On your figure.

MEMBER KRESS: Look on your --

CHAIR WALLIS: Look on your figure.

MR. LU: Okay.

MR. ARCHITZEL: Dr. Wallis? Dr. Wallis, one thing I would like to point out, some of the tests we observed, and this may be one of them, they used that recirculation of the energy. You call it the stirring mechanism with all the --

MR. LU: To introduce turbulence.

MR. ARCHITZEL: Yes. You saw those. It's a simulation of turbulence scenario, so they had a lot of flow in some of these tests that would have aerated a lot of that article.

CHAIR WALLIS: But is that realistic then to have bubbles like that?

MR. ARCHITZEL: Well, this -- not all the

tests were done there, but at least -- I'm not positive, but there's a lot of air inside a lot of that debris.

CHAIR WALLIS: You see, bubbles have a potential for rendering stuff which would sink buoyant.

MR. LU: Right.

CHAIR WALLIS: And so it then floats to the surface and drifts over to the strainer.

MR. LU: Right.

CHAIR WALLIS: And that is something that you don't want to happen.

MR. LU: Right.

CHAIR WALLIS: You want it to settle and stay settled.

DR. BANERJEE: Well, bubbles could be formed if there was something raining on a surface, right?

CHAIR WALLIS: Or there was chemical effects.

MR. LU: That is exactly right. That is exactly what they did and, as part of the demonstration, they demonstrated to the NRC staff that they can use the nozzles to inject water upstream of the testing flume to introduce a turbulence to

simulate the plant break flow a condition, and so that might be the bubbles coming out from there.

CHAIR WALLIS: Some of the chemical effects tests, they actually product hydrogen.

PARTICIPANT: Right.

MR. LU: Yes, we have trash cavity insulator.

CHAIR WALLIS: I'm talking about the chemical effects tests on the New Mexico.

MR. LU: Okay. Okay.

CHAIR WALLIS: Not the ones done near Chicago.

MR. LU: Right. It will be covered by a separate presentation. That's right.

CHAIR WALLIS: There was hydrogen produced, I think, from the aluminum, was it?

MR. LU: Yes, the ICET 1 I think.

CHAIR WALLIS: Right.

MR. LU: Okay.

DR. BANERJEE: Can you just guide us --

MR. LU: Okay.

DR. BANERJEE: -- through this picture a little bit more?

MR. LU: All right. That's exactly what I'm intending to do and stop talking about chemical

effects. Here is the strainer and during the test, the entire strainer is submerged, was submerged, inside the water and then there is a pump suction here, the suction line from here underneath the water.

MEMBER KRESS: Do you put that at the end of the strainer?

MR. LU: Yes, the end of the strainer, yes. The strainer surface has perforated holes and then you can see the amount of debris settled on the surface of the strainer is this much and that is the purpose I want to show this picture.

DR. BANERJEE: I still don't completely understand.

MR. LU: Okay.

DR. BANERJEE: Is this a stack of strainers like three strainers stacked?

MR. LU: Yes, it's a stacked strainer of PZI strainer, stacked-disk strainer, and the real size is much --

DR. BANERJEE: Looking at it sideways?

MR. LU: Yes.

DR. BANERJEE: Looking at it sideways?

MR. LU: You are looking at it from the top, I'm sorry, from top of -- here is the flume.

DR. BANERJEE: Okay. Looking at it from

the top.

MR. LU: You are looking at it from the top.

DR. BANERJEE: Yes.

MR. LU: And then the tank is half submerged, you know, drained, partially drained.

DR. BANERJEE: So now, the PZI strainer, is there a central tube through the --

MR. LU: Yes, it does, it does.

DR. BANERJEE: Where is that central tube?

MR. LU: And the central tube is -- you cannot see here.

DR. BANERJEE: Okay.

MR. LU: It's underneath, inside of the water, you know, here. So they take the water from here and then run through that recirculation loop, but pump back to upstream of the testing flume and it comes back here.

MEMBER DENNING: Now, was that not submerged?

MR. LU: Right.

MEMBER DENNING: We're looking at the top. Was that never submerged?

MR. LU: No, no, no. For this particular case it's submerged, and the reason I want to show

this one is that after it's -- part of the water is drained, was drained, and then we were looking at the debris loading, the purpose of showing this picture is I want to show you how much debris you are going to get actually through the testing on this strainer surface. That is that little.

CHAIR WALLIS: But then the other stuff is floating debris? There is kind of a scum all around it?

MR. LU: Yes.

CHAIR WALLIS: The other stuff you see there is --

MR. LU: Yes, there is quite a lot of buoyant debris which is exactly what Ralph mentioned about, that we had a concern if the large strainer submergence depth is too shallow, like you see some of the licensees are part of their response they mentioned only 3 inches, so we had a concern about that. Buoyant debris may build up a higher dam and cause the flow path for airflow, for the air to flow directly into the strainer, but that is a separate issue.

And the major issue I want to talk about is the near-field effect, the debris loading on the strainer. That is what this picture is about.

DR. BANERJEE: And what is this debris?

MR. LU: Okay. This particular one, they have -- you can see here a little bit, yes, yellow stuff and that's the fiber, Nukon fiber. And they also dumped zinc powder, my understanding, zinc powder as a surrogate material to model the coating chips. Okay.

MEMBER DENNING: Now, we believe that during the test, that that coverage was probably uniform or relatively uniform? I mean, we see clear parts of the screen here. Do you think that during the test there were clear parts of the screen?

MR. LU: For --

MEMBER DENNING: Are we merely looking at this after the fact and the stuff has kind of washed off of it?

MR. LU: This picture was taken after the fact.

MEMBER DENNING: Yes.

MR. LU: Okay. And I personally don't believe that you have a clean screen there during the test.

MEMBER DENNING: Yes, I mean, during the test.

MR. LU: But it may inside the -- if you

have bridging issue, then you may have the clean screen at the center.

MR. ARCHITZEL: Yes. This is Ralph Architzel. I wanted to make a comment on that. We did observe a number of tests. It was certainly -- when there was massive amounts, it was clearly bridging where this thing -- that particular clear opening is obviously sort of draining it open, but others, and we could show you some photos offline here, not now, because they might be proprietary photos, after this meeting or separately.

There was massive amounts of clean areas inside some of those strainers where it was bridged and nothing came down. So there were significant quantities of areas in some of this testing that were absolutely clean on the inside.

MEMBER KRESS: Now, the flow is supposed to go between those stacks and down and then through?

MR. LU: Okay. This is the top of the flume, so the flume actually is in this direction. So the water is flowing towards here.

MEMBER KRESS: Um-hum.

MR. LU: And then this strainer was submerged and the flow can go through all directions to approach this surface. Okay.

DR. BANERJEE: We are not seeing the main surface area, which is into the board.

PARTICIPANT: Into the board.

MR. LU: Right, that's into the board. Yes.

DR. BANERJEE: Right.

MR. LU: Okay. All right. The next picture, that's about 10 feet away, upstream of this strainer, the inside of the testing flume, that is how much debris you can see at the bottom once they reach steady state of the head loss. And we had a look and they said if they dump all this debris on top of a strainer and perform a head loss calculation using NUREG-CR/6224, although we will still consider that maybe or may have a significant uncertainty, the measure of the head loss is about a factor of 120s to 140s.

CHAIR WALLIS: So you had zinc powder in here?

MR. LU: Yes, we did.

CHAIR WALLIS: But your pH was around 7, so there was probably no chemical effects on the zinc powder.

MR. LU: You are absolutely right. This is another head loss test.

CHAIR WALLIS: Chemical effects of --

MR. LU: No, it's not for chemical testing.

CHAIR WALLIS: Duplicate the pH that is actually in the pool itself.

MR. LU: Yes, no. This particular head loss test was done to evaluate the head loss due to normal debris. Okay.

DR. BANERJEE: Was all this debris dumped in at one time or was it added gradually?

MR. LU: It was dumped at one time right at the beginning of the test, and then they started to stir and using that water jet above the testing flume to stir the water, so that make it suspend. And then after that, they turned off the spray on top of the flume and then start to run the pump.

Visually, we could see that actually settlement right at the spot. And so the question here is this part of settlement and the debris settlement due to the agglomeration, what is the physical phenomena there and what is the driving force? Is there any skinny issue related to that? That is right now our focus at this point.

DR. BANERJEE: What was the preparation for this? Did they shred it or how did they make the

debris?

MR. LU: My understanding is they shredded it with the garbage disposal, right, and then make the -- as a slurry and then they dump into -- make it wet first, then dump into the flume. That is part of the testing procedure's protocol and we have some questions related to specifically that vendor.

MEMBER SHACK: And then in the flume they start out with a well-mixed solution. They stir it with their jets until they get what they think is a uniform suspension of this stuff?

MR. LU: You are absolutely right. That's they way they did that. But actually --

MEMBER SHACK: And they --

MR. LU: Sorry, go ahead.

MEMBER SHACK: What is the pump? What is the velocity now it's being transported at?

MR. LU: That's exactly the question. When we ask them how they designed this test regarding the transport velocity inside the flume, and they said, okay, we scaled strainer inside of this flume to take into account the full ECCS flow, comparing this scale based on surface of the strainer.

But in terms of velocity in the flume, there was no answer there. So right away my question

to them was did you do any scaling analysis to justify your approach velocity upstream of the strainer as representative of the containment in real plant conditions at all. And if no scaling was done, how can I attest to this? You can take the credit off the near-field settlement. And there was no answer there.

This was one case and then right after that we performed another pilot audit, and we found another one that was doing the similar thing, although they did not use the near-field effect as a term, but they were doing the same thing. So we asked the same question and that's the reason we have some ongoing interaction with the vendors and the licensees regarding this particular issue.

MEMBER KRESS: But if you're going to take credit for something like this, you have to have a way to calculate agglomeration and settling in a turbulent flowing field.

MR. LU: That's right.

MEMBER KRESS: And those things are extremely difficult and it depends on --

MR. LU: It becomes very difficult.

MEMBER KRESS: Yes, yes, and I don't --

MR. LU: And it becomes very difficult. However, I think, at this point, we have already posed

the questions. It's always easier to ask questions in GSI-191. You can always ask a lot of questions.

MEMBER KRESS: Yes, we found that out on this.

MR. LU: Right, yes. But I think they are making -- I think every vendor team we visited, they have -- they put their best player there and they are doing the best they can do to the best of their knowledge to try to address all of the issues.

And whether they can fully resolve this issue to the certain degree to we were buying that results and we are wait and see, but I think they are actually -- we had the meeting last week and then they are coming in to ask us our expectations. And so that's the reason we are working with them and identify the issues and see whether they can come up with a good solution there.

MEMBER SHACK: Just off the top of my head, I mean, your head loss would be controlled by your mass per unit area of the strainer and that is, presumably, they are scaling the debris in the strainer size that way. The agglomeration is somehow a density per unit volume.

MEMBER KRESS: Number density.

MEMBER SHACK: Number, and I'm sure that

those two numbers, both of them don't scale from the facility to the real world.

MEMBER DENNING: I think that you're giving it more credit than it really deserves. I think that basically what we're seeing is a concept that is fatally flawed where the industry thinks that they can do integral tests where they take into account all of these processes and they do them specifically for the amount of particulate, the amount of fibrous material, they dump it in, they take a fractional size of the screen and they think that they are taking into account all of these effects.

They don't think like modelers, you know, I mean, and so, I mean, I think the concept is just fatally flawed. I mean, we talk about, well, have they really given concept to scale and this kind of stuff.

I don't think they are anywhere near that. And then if you start to compound it with things like pH and additives and what are the different rates -- but, again, I think from what I'm hearing that the vendors and the industry are thinking we can do these proof tests, these integral proof tests, that are applicable to my plant, because I'm going to take all the debris and stuff like that from my plant. We're

going to stir it all up, mix it up. You don't have to worry about, you know, these details about how turbulent and stuff like that. I'm simulating my plant.

And I just think that the concept of integral tests without the development of models -- you see, early on we criticized their use of the correlation for the debris bed, because we realized it wasn't really a static thing, but I think it's worse now where they are headed. I think they are not thinking models at all, is my impression, and I have seen things like this from the industry before.

MEMBER KRESS: If they are, indeed, relying on plant-specific prototypic tests to determine the head loss, I think you're absolutely right. How you run those test is going to be extremely important.

MEMBER DENNING: Well, you'll notice when they are talking about head loss there, they are saying we're going to take care of this near-field effect. Well, that's not part of understanding what the head loss is for the debris on there. That is an integral concept and I just think it's hopeless if you really scientifically try to do it.

DR. BANERJEE: They have to have a

framework to interpret these results. Otherwise, you repeat them, change the conditions slightly, they are completely different results.

MR. LU: Okay.

MEMBER KRESS: And that framework --

DR. BANERJEE: Chop it differently.

MEMBER KRESS: The framework has to be a model or something.

DR. BANERJEE: Yes, it has to be a framework.

MR. LU: Okay.

CHAIR WALLIS: So what you're saying perhaps is that the NRC needs to do more tests.

MR. LU: Okay.

CHAIR WALLIS: In order to get enough knowledge to interpret this.

MR. LU: First, I don't think it's hopeless. I think there is hope there. And the second, the -- not all the licensees took the credit of this near-field settlement, not all of them. And some of the vendors are doing the testing.

They directly dump all the debris on the strainer surface and they use a debris type reflecting the plant-specific conditions. So for those plants and licensees, I think that's my -- this issue may not

be that significant. However, recognize that I agree with your comments related to how -- what kind of testing procedure needs to be established, and then they need to come up with a good story to demonstrate their upstream flow velocity and that the testing procedure is bounding or at least conservatively developed.

I think there is a way to do that. Right now, we are engaging with them and discussing specifically on a vendor-specific basis at this point.

CHAIR WALLIS: I think they do some chemical effects. They start of with boric acid. There is a low pH. And then they dump in this, what is it, it's a type of phosphate or something.

PARTICIPANT: TSP, TSP.

MR. LU: Trisodium phosphate.

CHAIR WALLIS: TSP. Now, shouldn't that be duplicated in this test? Isn't that what's really happening in a plant?

MR. LU: Okay.

CHAIR WALLIS: Trisodium phosphate. Is that it?

MR. LU: Yes. Well, I think it will be in the next presentation. We will address that and Paul Klein will address this particular issue.

CHAIR WALLIS: Are they going do that in these kind of facilities?

MR. LU: Right. Okay.

MR. KLEIN: We can get to that question in the next presentation.

CHAIR WALLIS: Okay.

MR. KLEIN: But that is one of the major questions we have for industry because, for the most part, in a flume type test the approach that has been offered thus far has been to test with tap water.

MR. LU: Okay. All right. So I think I may want to skip this part very quickly, and we all had a similar concern now, and multiple vendors and licensees --

CHAIR WALLIS: I mean, you told me they are putting in new screens already.

MR. LU: Right.

CHAIR WALLIS: Based on these kinds of tests and that it may be that you folks or we will encourage you or something, and you actually decide, no, you're going to go and do some chemical tests in these facilities to confirm what you have already done.

MR. LU: Right.

CHAIR WALLIS: And it may turn out there's

something that is quite different that happens and they guys are stuck there with a half built modified screen in their plant and it may not be appropriate.

MR. LU: That's --

CHAIR WALLIS: New information.

MR. LU: No, that's the reason I think Tom Martin right at the beginning, there is -- he mentioned there is some challenges there and that we are evaluating the licensees' progress and, at the same time, we realize there is information, new information coming in, but you have a valid point there.

CHAIR WALLIS: But they all have chlorated water to start with, don't they, isn't that true? All plants have boron in the water.

MR. LU: That's right. You are right. You are absolutely right.

CHAIR WALLIS: So they all have a somewhat low pH to start with and they all have some kind of buffering, do they?

MR. LU: Yes, but TSP, Cal-Sil plants, we only identified six plants. The rest of other plants -- I will leave the topic to Paul Klein.

CHAIR WALLIS: Yes, but they all have some sort of buffering.

MR. LU: Yes. Okay. So what is the regulatory actions we are taking at this point to address this particular issue? We identified during our pilot audit and we issued RAIs across the board to almost all the PWR licensees, because we don't know exactly how many number of plants are taking credit or not. That is one issue. So we issue this RAI. At the same time vendors is engaging with us to discuss how they are supposed to address this issue. Okay. All right.

Then you mentioned what exactly the staff's expectations are, and then we were also asked by the vendors what exactly you expect us to do to address your questions about scaling. So right now, we are in the process to develop our own knowledge and the positions are based on the observations we had and then pilot audits results.

So this is the several key, five, bullets here for us to engage with industry and the vendors to evaluate the testing procedures to ensure proper head loss data obtained from this type of test.

CHAIR WALLIS: It seems to me that you need a Reg Guide or something that specifies some sort of properties of these tests that say you must do this, this, this and this. You must have a scaling

analysis or you must have whatever it is you need to make a decision.

MR. LU: I think that is a valid point and I think we are in the process to identify what we really need and require, and what the realistic time frame for the vendors to take action based on our requirement. And that's the reason we decided to engage these vendors as early as we can. We don't want to get into the end of December '07 and tell some of the licensees they need to repeat their test. That is the purpose for me to talk about this today here, too.

All right. Let me go through the other five bullets here. First is proper testing debris material. If the hydraulic characteristic of the debris should be very similar to the plant insulation material, but if the licensee decides to take the credit of the near-field effect, the surrogate material needs to be more transportable than the planned debris type. That is something they need to evaluate.

If the density is much higher than the coating debris they evaluated from their containment, and then it's readily to settle at the bottom of the test facility before reaching the strainer, of course,

that surrogate material may not be right.

CHAIR WALLIS: I think if you have chemical effects, you have got to be very careful about using surrogate material.

MEMBER KRESS: Well, yes. I was going to say it would be very important to have the proper particle size distribution and shape factors, because you're going to mix debris with particles.

MR. LU: Right.

MEMBER KRESS: And this is going to involve the agglomeration by velocities that differ between particles.

MR. LU: That's right.

MEMBER KRESS: And that's going to be due to the turbulence and the settling and those are two different phenomena.

MR. LU: Right.

MEMBER KRESS: So you got to have the right shape factors, the right size distribution. You got to have the right densities. You got to have the right turbulence and you got to have something about how that turbulence is distributed near the wall as they settle out. And whether there are eddys that reenter in, it looks like a very difficult thing to model, I mean, or to even scale for a prototypic test.

MEMBER DENNING: Well, I have got to ask the consultants and you guys. Do you really think that you can? I mean, this test is not oriented towards modeling. It's not oriented towards the development of a model or understanding the physical processes that occur. As I see it, these are integral tests. Do you really think that that's a feasible approach to go here?

As I see it, the only outcome of these is that you do this prototypic kind of test, and that's what they mean by prototypic here. You come out with a head loss and it's acceptable or it's not acceptable or some value. There is no model. It's not that we're putting debris on in a certain way and we're coming up with a model.

Is that a feasible way to go about a problem that is complex like this? Can we really determine the initial conditions and stuff like that that are characteristic of Plant A and just dump it in and stir it up and think that with a couple of tests looking at different things, that that's the way or do you have to go about it and develop a model that tries to describe these processes in the near-field and in the area --

MEMBER KRESS: I think if you look at all

of his bullets, to me that's what they're asking for. You know, they don't say it in so many words.

MR. LU: That's exactly it.

MEMBER KRESS: But if you look at those, that's what --

MEMBER DENNING: But if you look at the character of the tests that are being performed, that's why it seems to me somewhat hopeless. If you think the NRC -- I think there is a basic approach that is being taken here, a very integral kind of approach, and now the NRC is coming in and saying, well, now have you considered these scaling factors and stuff like that?

MEMBER KRESS: The answer is going to be no and they can't.

MEMBER DENNING: And you can't. That's my concern.

MEMBER KRESS: I think you're right.

MR. LU: Okay.

DR. BANERJEE: I guess there are two or three things that could be done. First of all, I think the results may be insensitive to certain things.

MR. LU: You are right.

DR. BANERJEE: So in a problem like that

you want to get rid of the parameters which don't affect the answer too much. Okay. So let's say as an example you change very much the timing of the debris introduction and nothing much changes in the results, then that's interesting to know, okay, or maybe something changes.

So what needs to be found is what are the results if they are going to do these integral tests more sensitive to? I suspect they are going to be more sensitive to the preparation of the debris material itself because -- and probably the chemical effects, you know?

MEMBER KRESS: Well, if chemical effects are important --

DR. BANERJEE: Yes.

MEMBER KRESS: -- then that may make the timing important.

MEMBER DENNING: Introduction is important.

MEMBER KRESS: Because it takes time for chemistry to take place.

MEMBER DENNING: We know that introduction is important. If you put in the fibrous and the particulate all together, you get quite a different answer than if you put in a little bit of fiber and

you load it up with particulate.

DR. BANERJEE: Yes. I don't know what is important here, but what I see sort of missing is the simplest possible model, which is even used in the chemical industry for a suspension which is filtered. I can give you papers where people have written this, you know, with fibers and particles. They have a simple model which comes onto a wall, so everything is taken care of in the proper sequence leaving aside chemistry, so this looks like chemical reaction.

PARTICIPANT: Just the dynamic, just the mechanical part.

DR. BANERJEE: Just the mechanical part. We are even lacking that right now. I mean, they do this for a filter plant and this is a reactor. You aren't doing anything for that. I can give you a reference.

MR. LU: That would be great.

DR. BANERJEE: Yes, you know?

MR. LU: We would like to get information.

DR. BANERJEE: The standard practice for filtration.

MR. LU: Okay.

DR. BANERJEE: You know?

MR. LU: Okay. But I will address, Mr.

Denning, the comments about the hope of whether we can resolve this issue. I think that can be resolved, because you're really looking at the scaling of this phenomena. It's a single phase, some debris. It's multi-phase flow condition. It's no complicated than AP-1000 head loss --

DR. BANERJEE: First you will write the equations.

MR. LU: Right.

DR. BANERJEE: Before you scale it.

MR. LU: And you are not really getting into that. You round -- they around the GE, around the PWR and plant facilities. They could do the scaling properly to the degree we are satisfied. And then for to address this transport, very low velocity transport of debris, multi-phase, too, towards a strainer, I don't think that's a dramatically difficult problem, but it can be handled properly as Dr. Banerjee just mentioned.

Some of the parameters may not be sensitive, so it's up to the licensee or the vendors to identify and simplify their test matrix, so that they can address this. But there are certain issues they cannot escape, is what is the velocity inside the flume or upstream of the strainer. If it's a factor

of 10 away from that real pool condition, I don't see -- is there any reason for us to take the position that that is perfectly acceptable? Okay. All right.

So I think we have already discussed all this and that is the -- the last bullet is about a sufficient test matrix. That is exactly to address, Dr. Banerjee, your questions, your comments about it. Not all the variables are sensitive. Okay.

CHAIR WALLIS: But, you see, having a very low velocity may be counterproductive, because it may lead you to a thin bed effect, because it's only going to be the very fine particles which, if you have already got a thin bed, are going to clog up that thin bed as they arrive. They are the only ones which are going to arrive if you have very low velocities. So you are going to be building up this stuff which we know can clog a thin bed.

DR. BANERJEE: Unless they flocculate and agglomerate.

CHAIR WALLIS: Well, flocculation is very sensitive to chemistry, so anyway.

MR. LU: Okay.

CHAIR WALLIS: It's fascinating.

MR. LU: All right. Conclusions. And I think overall we should appreciate that the industry,

to applaud the effort to conduct so many prototypical head loss tests other than relying on a correlation across the board, everybody punching their calculators to calculate the strainer size. I think they are moving towards the right direction and each vendor's team are trying to address staff's comments as much as they can to the maximum of their knowledge. And I think we have hope. It's not hopeless condition or situation.

But to resolve those issues, and we plan to follow-up with more vendors' head loss tests, I mean, maybe out of the scope of the audit we may just take a one day trip to another lab or whatever to just have a look at their current ongoing testing procedures and ensure that the testing procedures will produce conservative head loss results.

And then we are going to perform licensee new strainer design audits, which will give us more confidence. That will give us more in-depth review of vendors' methodology and also licensees' calculation of upstream, of the debris location, the selections.

And very important as, Dr. Wallis, you made comments about how we are going to apply research test results. It's the one example. We identified the difference between the nano and the UM head loss

test and the PNL test, and one of the issues was related to the debris preparation, and also the timing of the sequence of the debris arrival which was factored into our questions to the licensees there.

And as part of the confirmatory head loss testing, we don't expect that NRC is going to resolve all the issues. We are asking the Research to conduct a test to identify the issues for us to ask valid questions instead of asking questions across the board, and then we have a focus there. So that's primarily the conclusion of my presentation.

CHAIR WALLIS: So you have been saying, and I think your colleagues have said, that by doing more and more of these tests you will get more confidence in the way forward. It's quite conceivable that the more tests you do, the less confidence you will get, because you will learn how difficult the problem is and how susceptible to all these variables we have been talking about.

MR. LU: Okay.

CHAIR WALLIS: In which case you might need to take some alternate path to success.

MR. LU: Okay. I think, at this point, research has done quite a lot of test for us, but a lot of responsibility and the experience came from

industry. We learned a lot. I will just pick up one particular vendor. I don't want to name the vendor. They have -- at the test facility, they have run the test facility to run 2,000 for small scale head loss test, 200 integral modular head loss test.

CHAIR WALLIS: Head loss on that?

MR. LU: Yes. Okay. So a lot of experience is covered there and then if we rely on our own limited project to conduct the research and that would mean not have a -- we may not be able to cover every single area we want to cover. I think the most from -- valuable experience came from the industry and the vendors and is a very key important part of our decision making. We have to rely on researchers results to support staff's decision making process.

DR. BANERJEE: Let me ask you a question here. I looked through the material that Research has sent us.

MR. LU: Okay.

DR. BANERJEE: I don't see there any systematic approach at modeling, other than another correlation being produced. What is that? I mean, do you feel that this type of correlation is going to serve your needs? There is only one thing on modeling which we have from RES. Do you need something a

little bit more sort of to address some of the issues like we were discussing, a model which is a bit more dynamic than just another correlation?

MR. LU: Okay.

DR. BANERJEE: That's all I have seen in what was presented to us.

MR. LU: That's a good question and that's a question we were asking us right at the beginning what exactly we needed from Office of Research from the PNL test loop. And the reason I'm focusing on near-field effect and the prototypical head loss test is because I think that's a significant issue. But there are other part of approach, too, from the vendors.

And some vendors they also decided to take the correlation modeling perspective from that approach to design the strainer. And they are developing plant-specific debris-specific and the velocity-specific range of the correlations to design their strainer. Okay. Following the path of assuming certain debris distribution on the surface of the strainer and then calculate how much of the strainer surface is above and conduct or correlate, you know, the test, plant-specific test to come up with their own proprietary correlation to address that design.

And that's the part, I think, that will play a role for us to make the decision and the new correlation will help us. I don't think it will resolve all the issues, because resolution relies on the licensee to resolve that. But we can use that tool as leverage to ask questions.

CHAIR WALLIS: And some of these tests even with very simple constituents, they put in a loop, the test is done, it's run for days.

MR. LU: Right.

CHAIR WALLIS: The pressure drop continues to go up, never settles down.

MR. LU: Right.

CHAIR WALLIS: So what about time? Are you going to apply your correlation? I mean, something is going on there.

MR. LU: Right.

CHAIR WALLIS: Which is not in the correlation time.

MR. LU: Right.

CHAIR WALLIS: And how are you going to handle that kind of a situation, because it's there. You know, it's --

DR. BANERJEE: I guess we have been saying this repeatedly that the correlation by itself is not

sufficient. There's more to this than just applying a correlation.

MR. LU: But --

CHAIR WALLIS: So there are more things in that and they are dropped off in your correlation.

MR. LU: You are right.

CHAIR WALLIS: So there comes a point where the engineering solution is to make a change. Say no Cal-Sil or no TSP or no something or another, because that at least makes the decision, you know, we can go forward from there, you know, without having to do endless and endless experiments which are liable to interpretation.

Are you considering that kind of a recommendation or are you just looking at more and more tests and more and more trying to get out of it by looking at data or correlations?

MR. LU: I think from the industry we learn a lot. They actually have more practical challenges than we do in terms of the removing of the debris. Some of the plants decided okay, we're going to do it. That's exactly what they said. And some plants may not be able to afford to do that, because of the, you know, radiation and other constraints.

So if they decide not to do that, it's

more expensive for them and then they may opt to take the direction of conducting prototypical head loss test. That's the part and we may face the challenge there. But I think that's the way it is.

CHAIR WALLIS: Well, but the PWRs are going to probably go to higher power. They love to go to extended power upgrade, right?

MR. LU: Right.

CHAIR WALLIS: Which might in some cases involve putting in a bigger steam generator, a different steam generator.

MR. LU: Right.

CHAIR WALLIS: In that case, you've got a wonderful opportunity to take off the insulation that's on the old one.

MR. LU: That's exactly -- a lot of plants are doing that. I think Ralph mentioned that Crystal River was planning to remove or replace their steam generator. As part of process, they are going to get rid of all the, you know, Cal-Sil or fiber debris and then a mineral wall, I think that was mineral wall, and I think that approach is exactly the industry is considering and a lot of licensees are doing that.

CHAIR WALLIS: Now, does the fire barrier material come off too in some way or is that not

involved in this part of a LOCA? Its in other rooms and so on. There is various fire barrier stuff which is put on cables and so on, which is of a fibrous or of a plastery kind of nature. Does that come into this?

MR. LU: Yes.

CHAIR WALLIS: The debris picture?

MR. LU: Well, if it's in the zone of influence of the particular breaks analyzed in a lot of these, Fort Calhoun was, and some material, if it's included in the debris mix.

CHAIR WALLIS: Okay.

DR. BANERJEE: I have a question about unqualified coatings. Now, these are taken into account as well, right?

MR. LU: Yes, I think the coat, regulated coating we have is a specific presentation prepared for you. Okay. I don't know whether you have any other questions.

CHAIR WALLIS: Well, I think we have to thank you very much for your presentation.

MR. LU: Thanks.

CHAIR WALLIS: Now, we are behind. We knew we were going to be behind, because this is such a fascinating subject.

MR. LU: Okay.

CHAIR WALLIS: What I'm suggesting is that we take a break now for lunch and then do the best we can in the afternoon. And we may actually make progress, because we may have already asked a lot of the questions, which we would have asked in the afternoon.

MEMBER DENNING: Just ask them over again.

CHAIR WALLIS: Well, no, no, we won't, we've got the answers. See, we won't have to ask them, because the staff knows all of the questions by now.

DR. BANERJEE: What time do you want to pick up then?

CHAIR WALLIS: Well, I just want to take a break from 12:00 to 1:00 for lunch.

PARTICIPANT: That sounds good.

CHAIR WALLIS: I wondered if any, you know, of the Committee Members had anything they wanted to say, at this point? I think we have already tried to summarize where we think things are and we have asked the questions about whether this is a feasible approach and so on. I'm sure we will come back to that. Is there any more to raise that sort of an issue, at this time?

DR. BANERJEE: We have raised that.

CHAIR WALLIS: We have raised all of that.

DR. BANERJEE: Already.

CHAIR WALLIS: Okay. So we're ready to take a break then?

DR. BANERJEE: Um-hum.

CHAIR WALLIS: No one from the staff wants to say anything in five minutes? We'll take a break until 1:00.

DR. BANERJEE: Well, we get five minutes more for lunch.

CHAIR WALLIS: Yes.

(Whereupon, the meeting was recessed at 11:54 a.m. to reconvene at 1:00 p.m. this same day.)

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

1:00 p.m.

CHAIR WALLIS: Please, come back into formal session. We're going to hear about chemical effects now. I would invite Paul Klein to tell us.

MR. KLEIN: Thank you. Good afternoon. I'm Paul Klein from Division of Component Integrity at NRR. I would like to give you an update this afternoon on the status and plans of chemical effects. By way of outline today, I would like to very briefly provide a description of chemical effects issue, talk about the current status of where things are and we'll try to highlight some of the more recent interactions that the staff has had with both our own research people and industry. We will discuss some of the challenges associated with chemical effects and we will describe our path forward.

We gave a presentation to the Subcommittee in July of '05, at that time we provided a brief history of chemical effects, so we won't repeat that here, but it's clear that chemical effects is a more recent issue than most that are involved with GSI-191. In a broad sense, you can define chemical effects as interaction between plant materials in the post-LOCA containment environment that could produce chemical

products that contribute to head loss across the sump screen or it could also affect components downstream of the screen.

Next slide, please. By way of a broad overview, we think testing this date has produced some basic technical knowledge concerning chemical effects and it may seem that it's not much progress, but if you go back 15 months to December of '04, at that time when ICET 1 was in progress, it was unknown that chemical products would form in representative plant environments.

So over the subsequent 15 months, we have found that chemical products do form in those type of environments. We have learned about some of the important parameters that effect product formation and we started to characterize the head loss for some of these environments, in particular, trisodium phosphate containing environments.

It is clear that additional testing is needed to support licensee plant-specific chemical effects evaluations and we're really, I think, at a transition point in this whole process. Up to this time, the NRC has been out in front of industry with respect to head loss testing. We did a joint screening test, the ICET test. The NRC has done some

head loss testing. Industry is now moving towards doing head loss testing.

But overall, it is the licensee's responsibility to evaluate and account for head loss from plant-specific chemical effects. And it's our responsibility to perform an independent review of their evaluations and ensure that their actions sufficiently account for chemical effects.

Next slide. On the next few slides, I would like to discuss some of the more recent activity with respect to Research and then industry. If you look at some of the research that's going on, and I should mention up front that Research has scheduled, I believe, for the next day and a quarter with the Subcommittee, so that the intent here will just touch on highlights of the research and maybe the implications. But they will certainly be in a better position to provide details regarding some of the more technical details of the tests and the results in the following day and a quarter.

I've grouped the testing that has been performed thus far into three different subsets. The first bullet ICET and Bench Top Tests. These are more things that were intended to provide knowledge about formation of chemical products, where the products

were formed, some of the key parameters that might affect their formation.

CHAIR WALLIS: If you read the summary or the beginning of the ICET Report, the conclusion seems to be we have found that some things happen, but now everything is plant-specific, nothing we have done sort of is a predictive tool. We just found some things happen. Now, it's up to the plants to each do their own tests. That seems to be that conclusion.

MR. KLEIN: I think headed into the ICET tests it was a joint effort between the NRC and industry. It was viewed as a screening test, so it was designed to look at whether chemical products would form in representative environments. It was recognized prior to those tests that we weren't going to try to characterize the head loss associated with any of those products. And that if products were observed to form during those tests, that industry would or licensees would be responsible for characterizing the head loss consequences associated with those.

CHAIR WALLIS: That's right. So the fact that something happened is the significant result.

MR. KLEIN: Yes.

CHAIR WALLIS: But they didn't end up with

any kind of correlation or an equation or a predictive method. They ended up with questions now to be answered by individual plants.

MR. KLEIN: I think that's an accurate characterization. In addition, following on the ICET test --

CHAIR WALLIS: Well, that's very different from what we did with the LOCA question in the '70s or something. The Government actually did a lot of work which could then be used and this is a very different approach. You're not trying to do this definitive basic work at all.

MR. KLEIN: I think it would be very difficult for us to do that, given the number of combinations that exist out in industry, combinations and materials and environments.

DR. BANERJEE: Are these at all predictable on the basis of total dynamics?

MR. KLEIN: I plan to get to that at the bottom part of this slide. The first two bullets here, the ICET test and then the head loss tests, we viewed as more things that were needed to be done. At the same time, we recognized that it would not be possible to run 69 ICET tests or however many you needed to try and characterize the number of

combinations that are possible.

So we asked Research to investigate whether any commercially available programs could predict what might form outside of the ICET test, such that we could -- it would be more of swinging for the homerun, where you could input your individual plant parameters and containment pool chemistry, so you could actually predict what might occur. And I believe you will hear more about this from them tomorrow. But I think at this point, there are enough limitations in the current programs that it would be very difficult to use one of these programs as a stand-alone toll to predict what might happen in your containment pool.

DR. BANERJEE: Can they help? Because, I mean, the chemical industry has been going around for a long time. And they seem to be able to predict things. What is unique about this that you can't do what say some people do, chemical engineers do, for chemical plants.

MR. KLEIN: I think they can provide insight in response to your question. I don't know that the database and the borated systems may be as developed for some of these programs as some of the other process environments for which are used, but I

think we ran into, and I'll discuss this in a few slides and you'll hear more about it tomorrow, but I think we also saw that there are limitations with these programs.

DR. BANERJEE: Are these kinetic codes or are they chemical equilibrium?

MR. KLEIN: Most of them are equilibrium and understand some may have a kinetic option, but I don't believe they are very well developed.

DR. BANERJEE: You mean that some of them are.

MR. KLEIN: Finishing up on this slide. The head loss tests were more confirmatory to support our review of licensee responses and then the chemical speciation we will touch on again in a couple of slides.

Next slide, please. By way of status, implications from the research results and this is a little backwards in providing implications and then you'll hear results tomorrow. But I think ICET taught us a number of things. We did see from running these five tests that variations in either insulation materials or buffering agents can produce significantly different chemical effects, can effect the product that forms, the relative timing of product

formation. And it became apparent after observing some of these ICET tests that following testing would be needed to determine head loss consequences.

The middle pool, the chemical products form at different times. We saw, for example, in ICET 3 almost instantaneous formation of calcium phosphate when we introduced TSP into the ICET tank. And that's important since plants gain significant NPSH margins with time. So a chemical product that shows up immediately is in a much different category than one that evolves over 15 or 30 days.

And we also noticed that in some of the tests we saw results that raised questions about downstream effects. We saw in ICET 1 and 5, for instance, that it would not be visible product at the ICET thermal test temperature, but as we cooled the fluid to room temperature, the product would form.

Next slide, please.

CHAIR WALLIS: Now, these deposits, the calcium phosphate deposits that affected the flow meter, this was a white powder or something, wasn't it?

MR. KLEIN: Yes, it had a white color and it had a consistency.

CHAIR WALLIS: It was very fine powder.

MR. KLEIN: Yes, so it was initially observed in the tank. It was described as a white floc that they could visually see the eddys in the tank through the window, based on tracing the flow of the floc material.

MEMBER KRESS: So these were turbine flow meters?

MR. KLEIN: Yes.

MEMBER KRESS: So it deposited on the turbine blade?

MR. KLEIN: Yes. Are we ready to move to slide 7?

DR. BANERJEE: What are the concentrations of trisodium phosphate, if you could tell me?

MR. KLEIN: All right.

DR. BANERJEE: The range.

MR. KLEIN: I don't recall off the top of my head what range we used in ICET, but I know it was based on plant input.

MR. TREGONING: This is Rob Tregoning from Research. And Leon is here, so correct me if I'm wrong. But it's 4 grams per liter, I believe, is the TSP concentration at the end of the dissolution phase. It's metered in over a certain time period, so you don't have that amount initially, but at the end of

the metering period, it's 4 grams per liter.

CHAIR WALLIS: What's it's form when it comes in? Does it come in as a liquid or as a powder? It comes out of a sack, doesn't it?

MR. TREGONING: The form, did we use it in these tests?

CHAIR WALLIS: It comes out as a powder? No in the plant.

MR. TREGONING: When used in the plant.

CHAIR WALLIS: It comes in as a powder out of a sack?

MR. TREGONING: In the plants it's in baskets.

MR. KLEIN: It's in baskets.

CHAIR WALLIS: It's a powder, isn't it?

MR. TREGONING: Yes.

CHAIR WALLIS: So it is some time before it's dissolved to it's full --

MR. KLEIN: Over time as it dehydrates. So you typically get a block, I believe.

DR. BANERJEE: What are the dissolution kinetics like then? How long?

MR. KLEIN: For TSP? We asked that question of some of some of the plants with TSP and Cal-Sil to describe how long it would take to dissolve

the TSP baskets and it varies depending on the break and the number of trains in service, but we ran tests in the range of one to four hours just to have representative rates for TSP addition within the head loss testing. And we were trying to understand how that would affect calcium dissolution from calcium silicate insulation.

Within the ICET test, I believe, and Rob, correct me if I'm wrong, I think we metered it in over a four hour period.

MR. CARUSO: As the TSP dissolves out of the box, you have a gradient of concentrations, very concentrated right next to the baskets and much more dilute. As it travels around, it interacts differently depending on the concentration.

CHAIR WALLIS: Well, unless it's actually in particulate form and it gets caught in the screen, in which case you would have a very strong concentration on the screen.

MR. CARUSO: Yes.

CHAIR WALLIS: I'm not quite sure. In the basket, it's what in granular form or something in the basket? It's inside a screen. The basket is sort of inside the screen.

MR. CARUSO: Yes.

CHAIR WALLIS: Isn't it?

MR. CARUSO: Yes.

CHAIR WALLIS: And then it's just left hanging there to dissolve by itself like a tea bag?

MR. CARUSO: Yes.

CHAIR WALLIS: Or is it shaken or anything? It's just left there?

MR. KLEIN: I think typically they sit on the container.

CHAIR WALLIS: Or a flume that comes out of this thing, a concentrated TSP.

PARTICIPANT: It's stirred.

CHAIR WALLIS: Or is it a slurry? If it's a slurry, it could get caught on the screen then you would have a real reaction going on on the screen itself. I don't know. It's just these kind of questions that I think are so real.

DR. BANERJEE: Like how far are these baskets from the screen?

MR. KLEIN: I think that's a plant-dependent answer. It can vary.

DR. BANERJEE: But I mean, are we talking real close or real far? I mean rough.

MR. KLEIN: Oh, I believe some plants have TSP actually in their sump and some have baskets that

are located well away from the sump screen.

DR. BANERJEE: And when these dissolve, do they actually dissolve or do they come out of the slurry as Graham was asking? What happens to them?

MR. KLEIN: I think I have to be careful, because I'm not an expert in TSP dissolution. My understanding is that it is very readily dissolvable.

DR. BANERJEE: I see.

CHAIR WALLIS: Yes, but that's only if it's mixed. And if you try and dissolve something very readily, like sugar is very readily dissolved in water, but if you take a bag of sugar and put it in a sink at home, it will take a long time before it dissolves. But if you stir it, well, even when you put in your coffee, it goes to the bottom. It doesn't dissolve until you stir it.

DR. BANERJEE: Does that flow through it, in other words? I guess that's what is being asked. Is it just sitting in stagnant?

CHAIR WALLIS: You're hoping it will dissolve.

DR. BANERJEE: Or is it actually in --

MR. KLEIN: I think --

DR. BANERJEE: -- is it put into a flowing stream?

MR. KLEIN: You know, in a post-LOCA environment, you're going to have significant turbulence and the basket itself is sitting still, but the flow around it is going to be significant.

DR. BANERJEE: Okay.

MR. KLEIN: I mean, that's what you count on to get the dissolution of the TSP.

DR. BANERJEE: So that is how it's engineered, right?

MR. KLEIN: Correct.

DR. BANERJEE: So that you do get flow.

MR. KLEIN: Yes. And I think the number of baskets is also plant-specific, so that you may have dissolution more readily in some plants than others.

DR. BANERJEE: So you get a plume downstream of this basket as the flow goes through it?

MR. KLEIN: I would expect you would get some by gradient from the basket outward as it dissolves. Again, I'm not an expert in TSP dissolution, so --

DR. BANERJEE: So who is? Is there somebody here that can speak to that? I mean, how quickly it dissolves?

MR. KLEIN: You know, based on the

responses we have from industry, I would expect the material to dissolve in most cases in an hour or less depending on the size of the break again, but certainly by four hours if it's a large break LOCA.

CHAIR WALLIS: When it dissolves it makes sodium ions and phosphate ions? Is that what it does? It gets ionized right away? There's a whole lot of questions.

DR. BANERJEE: Well, it probably ionizes right away.

CHAIR WALLIS: Yes. And interacts with the boric acid? Is that its primary function?

MR. KLEIN: The primary function is to buffer the pH or the solution above settling.

CHAIR WALLIS: So it probably interacts with the boric acid then.

MR. KLEIN: Let me ask.

DR. BANERJEE: So what is the concern here, if you don't have it, then you have a very corrosive environment or is that the problem?

MEMBER KRESS: Well, if you don't have it, you worry about iodine getting back into the container. This sequesters the iodine.

CHAIR WALLIS: So it's designed to catch the boron, but actually catches the calcium?

MEMBER SHACK: Yes, I mean, it's a pH control that controls the iodine.

MEMBER KRESS: It keep the iodine.

MEMBER SHACK: The boric acid is kind of incidental. It just makes it slightly acidic and you're just changing the pH.

CHAIR WALLIS: Okay. This is pretty acidic.

MR. KLEIN: It's the iodine chemistry you're really worried about.

CHAIR WALLIS: That's what you're worried about in the long run.

MR. KLEIN: Yes.

DR. BANERJEE: So you can't get rid of it?

MEMBER KRESS: Well, you could maybe. I believe there's some questions about whether, you know, this is needed for the pH control. There are other basis things.

MR. SCOTT: We do have a presentation coming up to talk to you about one plant that is proposing to remove TSP. That will be this afternoon.

MR. KLEIN: Moving on, the reason we selected the --

CHAIR WALLIS: Well, I think this is important, as we said this morning. You can't just

throw TSP into a tank and hope that you are duplicating what happens in a sump or in a containment. Because near the basket different things happen than far away from the basket and so on. So I think we're cautioning against just assuming that any old experiment is going to duplicate what happens in the plant. No one has shown us any details of how the stuff hangs in baskets.

MR. LU: Dr. Wallis, this is Shanlai Lu. I just need to add one comment here. Related to the transport and the localized dissolution of TSP, the current approach, in my understanding actually, is assuming it's all dissolved, so it generates the maximum amount of TSP count, the calcium phosphate. So that question actually is resolved as being an engineering approach as a bounding case.

So the detail transport may not be an issue at this point, but, you know, Paul has more detailed relation regarding that, I guess.

MR. KLEIN: I was just going to disagree with the characterization through TSP and the tank technique. I think we tried to meter it in in a manner that was representative with the best information we had from industry over the amount of time it might take for TSP to dissolve in the plant.

And as part of the follow-on tests that were done at ANL, we tried to understand the effective of TSP dissolution rate on how that might effect how much and how fast calcium would dissolve from Cal-Sil and looked at dissolution rates of an hour or four hours or without any TSP at all.

MEMBER SHACK: Or instantaneously, all the TSP was instantaneously there.

DR. BANERJEE: And did that make a difference the rate of dissolution?

MR. KLEIN: For the range of what we thought to be representative of one to four hours, it did not make much difference. If we assumed instantaneous dissolution of TSP, it did seem to actually less calcium dissolved in that case.

DR. BANERJEE: And why would that be? Your conjecture?

MR. KLEIN: I think some of the conjecture was that the -- as you dissolve TSP, the calcium that dissolved would react with the TSP, so you could more effectively dissolve the calcium from the Cal-Sil if you had a constant TSP dissolution at the same time. By adding all the TSP immediately, it seemed to inhibit some of the dissolution of calcium.

DR. BANERJEE: What would be the

mechanism? I mean, does it build up a protective layer or what happens? Why wouldn't it? So you expose the Cal-Sil to a high concentration of TSP that inhibits dissolution or the reaction, rather than if you slowly meter in the TSP. So is there a sort of barrier, physical barrier, to diffusion and the reaction or what?

MEMBER SHACK: Well, actually, that will be discussed tomorrow to a greater extent, but you get two things. One, you're just changing the pH. The dissolution of the Cal-Sil is more rapid in a slightly acidic solution. As you add the TSP, you're driving the pH up, so typically you're slowing the dissolution down.

You also do seem to get a much longer term effect that we have interpreted as, essentially, a coating of the Cal-Sil particles and that seems to give you a long-term inhibition over and above what you would expect simply from a pH effect.

DR. BANERJEE: Okay.

MR. KLEIN: Next slide. With respect to some of the chemical speciation modeling --

CHAIR WALLIS: Excuse me. It seems to me the best way to make calcium phosphate would be to catch the Cal-Sil on the screen and then force the TSP

to go through it, have a wonderful reactor right there.

DR. BANERJEE: A fixed bed reactor.

CHAIR WALLIS: The reactor and you might even get particulate TSP coming in to make particulate Cal-Sil inside the bed.

MR. KLEIN: I think one of the lessons learned from the ANL test is that calcium phosphate seemed to be effective whether it was formed in the pool and transported to the screen or whether Cal-Sil arrived at the screen and then was transformed into calcium phosphate while on the screen.

With respect to the modeling I think, and I will provide a very high level overview, they did some initial work with various programs, tried some blind comparisons just using the pure thermodynamic approach and they did not have very good agreement with the ICET results in those circumstances.

When they went back with one of the programs and refined the inputs used in some of the data and observations from ICET, there was a broad agreement with the results and better agreement for the first days of the test. As you developed passivation of some materials or you saw an influence of one material on another, the modeling wasn't as

effective in those cases.

DR. BANERJEE: What package was this? What were you using?

MR. KLEIN: Which package?

DR. BANERJEE: Yes, for the model.

MR. KLEIN: You will hear more details about this tomorrow, but I think they looked at four different programs, OLI.

DR. BANERJEE: Sorry?

MR. KLEIN: OLI, Stream Analyzer, Freak, EQ3/EQ6 and the fourth name escapes me. Maybe someone in Research can help me, but, again, you will hear more details tomorrow.

In general, although these programs may provide some insights for environments outside ICET, we don't think they are sufficient by themselves to predict interactions, because they have limitations, such as inability to deal with kinetics, in most cases, need to suppress certain precipitation in order to make the results more agreeable with ICET and effects of one material on another model.

All right. The next slide, that sort of moves us from some of the research results into more interactions with the industry in the chemical effects area starting with the Generic Letter 2004-02

responses. Overall, the responses provided limited information concerning their chemical effects evaluation strategy and plans for evaluating chemical effects.

I think prior to September, the staff knew that licensees were not going to be in a position to provide many answers in relation to chemical effects. We expected some more details, however, concerning their particular plant environments and their plans for moving forward.

One of the things that they did provide in the responses you see in the second bullet. They identified the environment that was most similar from the ICET tests of their plant. And if you look at this table on the right side, you will see that, a distribution of the five ICET tests and then the number of plants that would fall into that category. And again, some of these plants you could move around since no plant really fits in one category. They have a variety of insulation materials and other materials.

DR. BANERJEE: When you say the ICET, the environment most similar to the plant, it's ICET -- oh, I see. You mean the whole lot. One was close to NaOH, Nukon as well.

MR. KLEIN: Yes.

DR. BANERJEE: Okay.

MR. KLEIN: But you would read across. For example, for the ICET 3, which was a trisodium phosphate with a blend of insulation containing 80 percent Cal-Sil and 20 percent Nukon, there is six units that would be closest to that particular environment.

CHAIR WALLIS: But all Cal-Sils aren't all the same, are they?

MR. KLEIN: We have heard that there's a number of Cal-Sils that have gone into the plants over time.

CHAIR WALLIS: Well, I understand there is some variability in the chemical composition of those Cal-Sils. Are we going to hear about that?

MR. KLEIN: You weren't going to hear about that in this presentation.

CHAIR WALLIS: Well, it's something I have heard about. Is it a concern for NRR that all Cal-Sils are not quite the same?

MR. KLEIN: I'm not sure how to address some of the unknowns like that that may exist, because you have different heats of insulation materials that are put into plants over time and I think what we tried to do in the research test was to take material

that was representative from a given plant and put it in the test, and that it does go back to the plant-specific part of this issue.

It's important for each plant to understand their particular mix of materials and how they may differ from the ICET materials. We have sent out RAIs in response to the Generic Letters that were sent out this month. Next slide, please.

MEMBER DENNING: Is there any variability in the Nukon?

MR. KLEIN: I would expect there to be variability in just about every insulation material. I mean, I don't know for sure, but are we ready to move on?

CHAIR WALLIS: Yes.

MR. KLEIN: Okay. Just a status on some of the other interactions that we have had with industry. We continue to engage industry routinely with public meetings to try and share information both ways and to discuss ongoing plans. We had a public meeting with industry last week to discuss a number of topics.

Since the last time we have talked to you in July, we also issued Information Notices 2005-26 and Supplement 1 related to some of the ANL test

results with head loss of materials containing Cal-Sil and TSP. We provided some feedback to industry on their own WOG Test Plan and WOG in this case is representative of all the industry. Staff has visited to observe the ongoing tests. We expect to receive a report from the WOG and we're --

CHAIR WALLIS: Are these test tube type tests or are they large scale tests like the ones we saw this morning?

MR. KLEIN: These are smaller scale tests, I believe, on the order of 120 to 150 milliliters.

CHAIR WALLIS: So they wouldn't address the question such as what happens near a basket of TSP?

MR. KLEIN: I think those tests are more designed to look at dissolution and precipitation using different industry materials. We're having ongoing discussions with screen vendors who will be responsible for performing head loss testing and we're conducting audits. Next slide, please.

CHAIR WALLIS: Now, if TSP clogs up the screen, why doesn't it clog up the basket? I mean, if calcium phosphate clogs up the screen, why doesn't it clog up the basket that has got the TSP in it? Isn't there some sort of formation in there, too?

MR. KLEIN: I would expect you would have dissolution of the TSP before you form sufficient calcium phosphate to clog the basket.

CHAIR WALLIS: Well, conceivably, you could get some goop formed in the basket, too?

PARTICIPANT: I think, you know, a TSP basket is designed to allow things to pass out of it as easily as possible.

CHAIR WALLIS: That's before, yes.

PARTICIPANT: So that you can get things into solution. So even if you were to form some kind of a calcium phosphate within that basket, I think it would be easier for it to pass.

CHAIR WALLIS: Well, I want to know what the basket is like. Is it a woven basket with holes or something? What is it? It looks like a screen, doesn't it?

PARTICIPANT: I can't speak to that.

CHAIR WALLIS: I don't have a good vision of what you mean by basket. Does anyone have an idea what a basket is in this context?

MR. UNIKEWICZ: Sure. I have seen maybe 60 or 70 of them. Generally, they look just kind of what they sound like. They are typically square baskets, 2 to 3 feet deep, sometimes holes on the

order of 3/4 inch to an inch around them. They are open-topped. One of the operator actions normally is to go around and to scrape the top with rakes to make sure that everything --

CHAIR WALLIS: So they must have fairly large granules in there if it has such big holes in the bottom.

MR. UNIKEWICZ: There are big holes in the bottom. There's big holes in the top. There are screens there meant just as we said, for water to go through and pass through as quickly as possible.

CHAIR WALLIS: So once this stuff dissolves, it falls out, presumably, as it gets smaller?

MR. UNIKEWICZ: It will fall out onto the floor, it will fall out into the solution. They are typically very low to the floor, on the order of an inch or two up off the floor as you walk around the bottom level of the containment.

They are spaced three to four places around depending on your plant, depending on a few other configurations, so that they are in the major flow paths as water comes down through. I mean, they are open baskets with big wire strainers and, structurally, they are held together with some plate

steel.

CHAIR WALLIS: Thank you.

MR. KLEIN: Moving on. I think that the biggest overriding challenge is developing a sufficient understanding to ensure that licensee actions sufficiently account for chemical effects.

Thus far, the NRC and industry tests have been more general to date and they have provided basic knowledge. There's many uncertainties that need to be evaluated on a plant-specific basis. We have seen that thermodynamic models, though they may provide some insight, they do have inherent limitations in their ability to model and predict species in these environments.

And another challenge is, at this point, there is no industry lead organization for assessing plant-specific chemical effects head loss, so that there will be -- each licensee will be pursuing plant-specific testing with their own vendor.

CHAIR WALLIS: It seems to be very difficult. It's like what we had this morning. Everything is so plant-specific. Are you really going to be able to evaluate what they submit to you and their different arrangements of baskets and things? Are you just going to accept that it makes no

difference or how much detail are you going to have them work out before they submit something to you since the plants are so different?

MR. KLEIN: I think that that is one of the challenges, making sure we have enough information to evaluate them. But we seem to be focusing just on plants with TSP. There are a number of other buffers as well. If we go back to the slide that showed the table, there is, approximately, 26 units with TSP and more that do not have TSP. So I can't --

CHAIR WALLIS: So what are these other things that they have instead of TSP?

MR. KLEIN: Well, they have sodium hydroxide or sodium tetraborate.

CHAIR WALLIS: That's in a solution, NaOH?

MR. KLEIN: That would be sodium hydroxide would be added as --

CHAIR WALLIS: The solution.

MR. KLEIN: -- part of the spray to buffer the pH and sodium tetraborates in the ice condenser plants frozen within the ice.

CHAIR WALLIS: Frozen in the ice. Is that the $Na_2B_4O_7$?

MR. KLEIN: Yes.

CHAIR WALLIS: Okay.

MR. CARUSO: Can all the vendors test with TSP, because we have heard some stories that some places are not allowed to test with it because they can't get rid of it.

MR. KLEIN: I think one of the questions the staff has for industry moving forward is that a lot of the flume and larger scale testing to be -- intended to be performed with tap water rather than a representative plant environment, and that raises a lot of questions in the chemical effects area on how you can extrapolate those results from that environment back to your plant environment.

MR. CARUSO: So how many of the vendors can actually test with TSP?

MR. KLEIN: I don't know that TSP by itself is very aggressive, but the question that you might have is how many plan to do tests with representative plant environments and we don't know the answer at that point. That's one of the questions that we're trying to have answered through the RAI process.

CHAIR WALLIS: But you could state. You could make it part of the specification for a test, that it must reasonably reproduce the plant environment. You could make that statement right up

front, that you're not going to accept anything that doesn't do that. You don't have to wait for them to submit stuff.

MR. KLEIN: Well, we, in our plan, are waiting for them to submit the -- we would intend to engage them up front of these tests. We expressed a number of reservations at the public meeting last week and we intend to follow-up on those with industry to make sure when they do get to head loss testing, that we're able to dialogue on some of these issues up front rather than after the tests have been performed.

MR. SCOTT: Paul, now correct me if I'm wrong here, but don't the RAIs also convey that expectation?

MR. KLEIN: The RAIs are intended to try and get at some of the detailed plans for performing chemical effects testing, yes.

MR. SCOTT: Okay. Including an expectation that the testing they do be scaleable, if you will, to plant conditions?

MR. KLEIN: Well, the RAIs are questions.

MR. SCOTT: I understand.

MR. KLEIN: So we're not really laying out expectations within that process.

MR. CARUSO: Is an expectation a

requirement?

MR. KLEIN: We are laying out expectations, I guess, in the RAI process. We're asking questions.

PARTICIPANT: For instance, an RAI might ask how does whatever material you're using, whether you created it by using TSP and Cal-Sil or you made it dumping in calcium chloride and, you know, whatever mix of chemicals, how does that surrogate, if you will, match what was created in the ICET or what you would expect to see in the real plant.

How can you justify that and how can you show that the size of the particle, the hydration, the filterability, all those characteristics, are going to perform the same way when you put them into a flume with tap water or whatever the testing medium is?

MR. SCOTT: Which although it is a question, it also conveys, in my opinion at least, an expectation that they will show that that correlation or scaling exists or is visible.

CHAIR WALLIS: Well, Ralph Architzel showed us this morning these fairly large experiments in Alden Research Labs and that's all with tap water.

MR. KLEIN: Yes.

CHAIR WALLIS: Is this removed to try to

duplicate the real chemistry of the plant in those tests?

MR. KLEIN: Most of the tests that I understand that have been run thus far have not addressed chemical effects. The few tests that I'm aware of where they tried to add a chemical surrogate, we are discussing with the licensee and, in those cases, we have raised a lot of questions about whether they are accurately assessing chemical effects when they are adding a material to a completely different environment. So I think the staff has serious questions about the approach that some licensees have taken to --

CHAIR WALLIS: It seems to me you shouldn't just be reactive and I think we have said this already. You wait for them to do something and then they do something and then you scratch your head and say, well, maybe that wasn't good enough because you didn't do something else.

Why don't you lay out some clear expectations ahead of time?

MR. KLEIN: I understand it's --

CHAIR WALLIS: This is the way a fair engineering course is. You tell the students, you know, you are going to be tested on your knowledge of

A, B, C, D and E and that's there and they expected to be tested on those things, and you don't sort of say, well, I'm sorry, but the exam is going to consist of other things. And sorry but, you know --

DR. BANERJEE: Maybe it's too early days yet to lay those expectations out.

CHAIR WALLIS: To be specific.

DR. BANERJEE: Yes.

CHAIR WALLIS: You're just trying to find out what happens?

DR. BANERJEE: Yes.

MR. KLEIN: If I can maybe answer in terms of the whole process. You know, initially, we had a joint program. We were trying to understand if products would form. We went through that process. We did observe that products are formed. Now, we're trying to understand the head loss consequences associated with that.

We have run some initial tests on our own to try and get confirmatory information. Licensees are also starting down a path to do their own testing. We have been trying to engage industry along the way to let them know what our expectations are, to discuss some of the things.

We did comment on the WOG tests ahead of

time to try and raise some questions about what might be done, but we agree. At some point it might be better to lay out certain expectations. It's a very dynamic process and we are working it.

Next slide, please. I think it's easy to get pessimistic also when you start thinking about chemical effects, but the purpose of this slide was to point out that there are a number of options available for addressing chemical effects. It isn't always a matter of just trying to characterize what might be a very bad chemical effect, that you might be able to avoid it by changing plant materials or changing the pH buffering chemical.

Industry has an initiative looking at those options, we understand. There are things that they could perhaps do to over-design the screen or to use a screen backflush. We saw earlier this morning that that appeared to be effective.

CHAIR WALLIS: But it might not be if the chemical effects glue the material to the screen.

DR. BANERJEE: The problem with changing chemicals and things is that you have all sorts of effects, corrosion problems, this, that. I mean, it's hard to put your finger on what happens when you change something in that environment.

You know, it's not -- you might think, well, get rid of the TSP or something and do something else, but you would have to then follow through and see that it doesn't affect something else completely, corrosion. It's not obvious that you can do those things so easily.

MR. KLEIN: I agree. Early on in ICET, the first tests with TSP looked very favorable compared to the sodium hydroxide tests and, at that time, a lot of people thought switching to TSP might be the answer.

DR. BANERJEE: Okay.

MR. KLEIN: So you can fool yourself.

DR. BANERJEE: Yes.

MR. KLEIN: But, you know, there are -- there is also testing that can be done to evaluate switches and we would expect that that would be done.

Another thing to keep in mind is that plants tend to gain a lot of margin with time and, thus far, we have talked a lot about calcium phosphate because it does form very early, but most of the ICET environments, the chemical products formed, they evolved over time. And so they are -- from a margin standpoint, that's a good thing.

Next slide. At this point, we're not

planning to issue a design guidance to address chemical effects or the associated head loss consequences. I think it would be very difficult for us to go out to all these potential mixtures of materials, some of which we have tested, some of which we haven't, and provide design guidance on how to handle that.

So the licensees are responsible for determining the plant-specific chemical effects and accounting for that in their design. And our intent is to rely on information from our own confirmatory research work to evaluate these submittals.

CHAIR WALLIS: Are these submittals going to be open to the public?

MR. KLEIN: Yes.

CHAIR WALLIS: They will have to. Otherwise --

MR. KLEIN: Generic Letter responses are open to the public.

CHAIR WALLIS: With all the different methods coming from all these different plants? Some research student at a university could take 69 different plants and do some studies of it, what was found there? It's all going to be open?

MR. KLEIN: Yes, the Generic Letter

responses are open to the public.

CHAIR WALLIS: Yes, but the solution, too, the eventual submittal in terms of -- well, I guess that's what it is. It's a submittal. I guess there will be further submittals in the future, won't there, about how they solved the problem? I guess all that is going to be open, too. It's going to be very interesting. They are going to mine for --

MR. DINGLER: This is Mo Dingler from Wolf Creek. While the Generic Letter responses will be open to public, but it's like an audit plan. Most of that data calculation is available at our plants and really not submitted for public disclosures.

CHAIR WALLIS: So that won't be available? It will be expurgated in some way?

MR. HOPKINS: Yes. Jon Hopkins here. It won't be on the docket, that test data, if that's what you're referring to. No, that is part of the staff's audit.

CHAIR WALLIS: Well, that may be the crux of the whole matter, isn't it? The evidence which is behind the submittal may be the key thing. Okay.

MR. KLEIN: That is my final slide unless there's additional questions.

CHAIR WALLIS: So you are going to be here

sticking with this problem when we see you again? We don't want to have too many changes in personnel here. We want to hold you guys accountable.

MR. KLEIN: This is just too much fun to leave it.

CHAIR WALLIS: Okay. Thank you very much. Very interesting. I think we even gained some time. Let's move on. Who is next? Thank you. Go ahead when you're ready.

MS. HART: Okay. Hi. My name is Michelle Hart. I am from the NRR staff and I will be talking about the impact on the design basis access dose analysis of a proposal to remove TSP from the containment.

As was noted before, there are six plants that have both TSP and Cal-Sil in their containments. One of those plants has proposed to temporarily take TSP out of their containment for one operating cycle in the meantime until a new buffering agent is chosen and installed. This can cause some impacts on their design basis dose analysis to show that they meet the siting criteria and control room habitability, because if you remove TSP without adding another buffering agent, you lose pH control and potentially your sump pH could drop below 7.

And in the alternative source term, both NUREG-1465 and the Reg Guide for that imply that if the pH is less than 7, iodine can re-evolve from the sump water. Also, the iodine species assumption that it's mostly particulate is predicated on the pH remaining above 7. And any gaseous iodine removal by sprays during the recirculation phase is dependent on sump pH, as well, and that is in the Standard Review Plan.

CHAIR WALLIS: So how rapidly does it change when the pH is, say, 6? Is it a tremendous effect or a little effect?

MS. HART: It's not a tremendous effect. It is certainly less than what is currently done, so that you would have to consider that there would be extra iodine in that containment or less iodine is actually removed by the sprays. And for the AST you would have to assume that there is more gaseous iodine, which could make a difference in your control room habitability depending on your filter efficiencies.

I did do a preliminary look. I use very simplistic assumptions. I used the reference plant, the plant that had come in for this change. I did a LOCA dose calculation, only looked at the containment

release, and I did both the old source term TID-14844 or the AST source term.

I assumed, much as the plant is planning to assume, that 100 percent of the iodine that would have been removed is not removed, so it's 100 percent iodine re-evolution just to not worry about what the actual equilibrium that would be set up is since you don't want to do too much research outside of this, and that there would be no plate out in the containment either.

For my purposes, that's what I assumed. And for the AST, for lack of further information, I just assumed that the old source term values of 91 percent elemental and 4 percent organic applied.

And the results showed that for this plant it would be likely to meet the off-site dose, Part 100 or Part 50.67 for the new source term, but it was not likely that it would meet the control room dose in GDC-19. However, temporary compensatory measures, such as KI and SCBA, would give enough credit, but they would still meet the criteria.

DR. BANERJEE: What is KI and SCBA?

MS. HART: KI is potassium iodide, which is a prophylactic to bring down your thyroid dose and SCBA is self-contained breathing apparatus.

MEMBER DENNING: Let me make sure I understand. So you took, effectively, 100 percent or 91 percent evolution for those two?

MS. HART: What I did is for both source terms I assumed that there was no removal. So whatever was released from the core is in the containment atmosphere and ready to be released.

In the old source term, for example, it's all released immediately and 50 percent of the iodines that are in the core inventory are released to the containment and 50 percent of that 50 percent plates out, so it's effectively 25 percent. I assumed instead that the 50 percent that was released from the core is available in the containment atmosphere to be leaked.

MEMBER DENNING: Now, for the AST you didn't apply, so wouldn't the more logical assumption have been that 5 percent is applicable to be released for the AST?

MS. HART: For the AST, the iodine species that are in the source term are now 95 percent particulate.

MEMBER DENNING: Yes.

MS. HART: So I just assumed, because I didn't know how much would actually re-evolve and turn

into iodine, I said, well, the old source term, because there was no pH predication for that source term, I just used that speciation.

MEMBER KRESS: That certainly ought to be conservative.

MS. HART: Yes.

MEMBER DENNING: Oh, hugely conservative.

MS. HART: It would be very conservative, yes. It didn't make a difference in the results for this particular plant and for most plants it probably wouldn't because the filters have the same filter efficiency.

MEMBER KRESS: That's because most plants were designed for this sole source.

MS. HART: Right, and the filter efficiency is the same for most. In this particular case, the filter efficiencies for the particulate and the gaseous forms of iodine were the same, and it would only apply to the control room dose, this change in iodine species, considering that there would be no other iodine removal in containment, natural or otherwise.

MEMBER KRESS: I think this would make a significant difference in your LERF value then, be a surrogate for your death QHO, because you're going to

get a lot more iodine released.

MS. HART: Right, right.

MEMBER KRESS: At least.

MEMBER DENNING: You will get more release, but it's not clear how much of the iodine that's in the form of iodine is going to be evolved.

MEMBER KRESS: Well, but assuming it's gaseous, you're not going to have the --

MS. HART: It's not as easy to remove.

MEMBER KRESS: -- issue processes to remove it and so it's going to get released and I don't know how fast, but it's released.

MEMBER DENNING: You mean through these assumptions. Is that what you're saying?

MEMBER KRESS: What's going to happen is you're still going to get that aerosol and the iodine probably coming out as an aerosol, yes. I mean, this is going to go into their sumps and then it's going to get released at some rate as an iodine. It's going to be continued to be released from their containment.

MEMBER DENNING: If it's converted to the full extent that it's converted from iodide to iodine.

MEMBER KRESS: Yes, it's going to be if it's acidic.

MEMBER DENNING: Well, I don't think --

MEMBER KRESS: I mean, if there is no silver there to -- if there's not other things there to -- it will come out if you don't have a pH control. But it's a question of the rate coming out and how fast it leaked from the containment and where it goes from there, because the energy level is a lot lower now and it's a late release, maybe a later release.

MEMBER DENNING: Yes. Of course, our real problem here is we're in artificial DBA space.

MEMBER KRESS: Yes.

MEMBER DENNING: Is where we are.

MEMBER KRESS: Well, that's the regulations. Does it meet the regulations?

MS. HART: Right, right. That's the issue, is you --

MEMBER KRESS: But if you look at it from a risk standpoint, why, it still could increase the risk.

MS. HART: It's something different. Right. Yes, that's the issue here, is that through all this looking at the chemical effects, if it's determined that taking TSP out of the containment is something you need to do, you still need to meet Part 100, and so we have these deterministic design basis accidents set up.

And so how does that impact that and that is what I'm speaking to here. And I know that these assumptions are overly conservative probably for what is actually happening in the containment even without TSP there, without pH control.

MEMBER KRESS: But it's a good place to start, I think.

MS. HART: Right. It's just a preliminary look and it's really -- the results that I came up with are sort of borne out by the licensees' preliminary results that they were talking about, that they would still meet their off-site dose, but they would need to do something to still meet their control room dose.

And so my conclusion, short presentation, loss of pH control negates some of the assumptions in current design basis accident dose analyses that show compliance with the siting criteria or control room habitability, and plant-specific analyses are needed for any plant that would like to remove TSP without installing an appropriate buffering agent in its place, and that temporary use of KI may be required to meet GDC-19.

DR. BANERJEE: Are there any other effects of the low pH, the acidic?

MS. HART: There are other effects. I can't speak to those. Of course, there is the corrosion issues and things like that and that is not something that I was tasked to look at. I was just purely looking at the impact on the dose analysis.

DR. BANERJEE: So are other people looking at the corrosion issues and things?

MS. HART: That is my understanding, yes.

MEMBER DENNING: Is there any other example of where we have allowed KI usage for something like this?

MS. HART: We have used, allowed, temporary use of KI in the control room if there is something in the plant that can be fixed in a reasonable time frame or there is an analysis that they are reevaluating. It has to be on a temporary basis with all the attendant procedures that go with that. So if it's in a temporary time frame, because KI is obviously -- it's not ideal. You should have your plant designed correctly.

MEMBER DENNING: Well, the nice thing is you don't have to take it if it's --

MS. HART: Right.

MEMBER DENNING: If you don't get --

MS. HART: You know, there are obviously

issues with taking KI, you know.

MEMBER KRESS: You know, if this were to be brought before the ACRS, the first thing we're going to ask is what is the effect on risk?

MS. HART: Right.

MEMBER KRESS: And this is not risk.

MS. HART: This is not risk and it's not even a good, you know, proxy for risk.

MEMBER KRESS: My suspicion is that probably if you met the QHO and early fatalities, you probably still would.

MS. HART: Right.

MEMBER KRESS: You almost always meet the QHO and late fatalities. This might put that part of it in question.

MS. HART: Right, right. You know, these overly conservative assumptions, even with those applied to the design basis accident, it was still below the Part 100 criteria.

MEMBER KRESS: Yes, which --

MS. HART: So that's well below that.

MEMBER KRESS: But, you know, that's not severe.

MS. HART: Yes. That's not a severe accident.

MEMBER KRESS: But it might not even -- you know, I don't -- it might not even affect laden answers.

MS. HART: It might not.

MEMBER KRESS: Because the iodine decays away so fast.

MS. HART: It may not.

MEMBER KRESS: And it may not even affect that but, you know, it would be nice to see a risk analysis.

MS. HART: I --

MEMBER KRESS: If you'll allow this.

MS. HART: Okay. Are there any further questions?

DR. BANERJEE: Is TSP the main bad actor?

MS. HART: I don't know which one is the limiting reactant in the reaction. I don't have that information. The licensee decided that they would try this tactic to by-step that whole issue. If you take one of the reactants out, you're not worrying about the chemical effects. And it doesn't necessarily have an impact on the probability of the sump clogging up in the first place.

DR. BANERJEE: Well, I guess this is a broader question. Taking TSP out, does it actually

solve the problem or not?

MS. HART: I don't believe that it necessarily does. It avoids the chemical effects issue, because then you do not have the interaction between the Cal-Sil and the TSP. There may be interactions between other chemicals that are already there, but that is something that, you know, I understand that they are still looking into.

DR. BANERJEE: Okay. Thanks.

MEMBER KRESS: When you did the Part 100 analysis with the old source term, did you allow any credit for spray removal of the iodine?

MS. HART: I allowed no credit for any removal of any kind.

MEMBER KRESS: None at all.

MS. HART: Right. So it was very conservative.

MEMBER KRESS: Okay. Thank you.

MS. HART: Thank you.

CHAIR WALLIS: Thank you.

PARTICIPANT: Who is next?

PARTICIPANT: Downstream.

CHAIR WALLIS: Downstream effects. We're catching up.

PARTICIPANT: Steve, do you have your

handouts?

MR. UNIKEWICZ: I gave my two earlier today. I put one on everybody's desk.

MEMBER DENNING: Yes.

DR. BANERJEE: What is this?

CHAIR WALLIS: It looks like this.

DR. BANERJEE: Downstream effects, downstream effects. Ah, there it is.

PARTICIPANT: It's two sided. It makes it difficult.

MR. UNIKEWICZ: That's what you asked for, right? Let me see. We got five here. Gotcha. Okay.

MEMBER DENNING: Whenever you're ready.

PARTICIPANT: Do you have extra copies?

MR. UNIKEWICZ: I gave you a whole bunch.

MEMBER DENNING: You can go ahead.

MR. UNIKEWICZ: Okay.

MEMBER DENNING: Ready.

MR. UNIKEWICZ: Okay. All right. Good afternoon. My name is Steven Unikewicz. I am with the Division of Component Integrity and today I'm going to at least give you an update of where we are with the evaluation of downstream effects.

Now, a little bit of background. If you recall, downstream effects really is an evaluation of

all the emergency core cooling and containment spray components downstream of the containment sump strainer and for operation with the proposed LOCA fluids.

So really what we're looking at is an evaluation of things just on the backside of the strainer. It includes all the ECCS and CSS pumps, valves, instruments, piping, heat exchangers, as well as reactor vessel, fuel assemblies and all the internals therein.

Now, understand this is part of an integrated solution. You can't have a strainer without looking at downstream and you can't look at downstreams without looking at the strainer. So they are really designed in conjunction with each other and they need to be evaluated together.

Where are we today? Well, back from the September responses, very few of them completed their downstream effects evaluations. Part of that had to do with people were in the midst of designing sump screens. They were in the midst of looking at what I will call the upstream piece of it.

Once you're done with that, it really becomes an iterative process in order to evaluate the downstream piece. And once you have decided what is going downstream, you look at what's happening

downstream, reevaluate what's happening on the upstream and, again, you sort of iterate through it.

We have indications that, approximately, 50 percent of the licensees are planning modifications to address at least their preliminary evaluations. Now, these modifications are along the lines of hard facing of wetted components, possibly replacing valves, possibly installing orifice plates, a lot of different things people are talking about. We have heard of one or two people who are actually getting ready to make those modifications. The expectation would be those modifications will probably be done at the same time as your sump screen modifications.

Another, approximately, 50 percent are planning to do some sort of confirmatory testing to validate their design assumptions. Now, this testing is along the lines of looking at the coatings that they are using and looking at the hardness of those coatings with respect to, say, Stellite-6, Stellite-12, 439 stainless, other different shaft materials. There are some investigations going on to in-vessel work, but primarily that confirmatory testing is looking at hard faced components and how the material that makes it past the screens interacts with those.

MEMBER KRESS: Those are almost all

Stellite, aren't they?

MR. UNIKEWICZ: Pardon me?

MEMBER KRESS: Are those almost all Stellite?

MR. UNIKEWICZ: No, actually there are a few people that are considering putting in, say, Stellite-6 and Stellite-12 on some of it. Some of them still have some stainless steel components internal. So when you look at, you know, the materials you have, say, from a latent debris standpoint, you look at it and say, gosh, depending on the concentration, how will it affect those components?

Again, you hear that other parts are very plant-specific. Well, this is very plant-specific also. The other part that we have asked a lot of questions is this is a very time-dependent type of evaluation. Very early on in the scenario, you need lots of water at a very high pressure. Later on in the scenario, that may not necessarily be true.

So when you look at your evaluation, okay, while you need to look at it spread over time, okay, you're looking at it going on to research, maybe 10 hours into it on a small break LOCA, sometimes sooner than that on a large break LOCA, but heat rates drop

sort of dramatically over time and you need to look at what the ECCS system and the containment spray system needs over time and that is variable. It is variable.

Now, most all, not all of them, refer to a Westinghouse report, it's WCAP-16406, in their September responses. In that the responses were all say, in general, incomplete and in more terms they were vague. And, again, part of that was they were not far enough along in their evaluation of the sump screens to be able to make a very good assessment of downstream.

Now, some people did do that. Some people made some conservative assumptions. They looked at what they had and did make some statements that they are going to hard face some components. They are looking at replacing some valves, but by and large that was few rather and not that many.

The recent RAIs we have issued go to those points. We asked them very specifically how are you using this WCAP? What portions are you using? What portions are you taking exception to? The WCAP is a rather large report. It does, for the most part, address all the issues we called out in the Generic Letter and all the issues we called out in our safety evaluation.

CHAIR WALLIS: But it's very discursive. It seems to be all words. I mean, it says they have been considering what happens to the debris while they consider its density and its shape and so on. Okay. But then there is no real analysis or it's all words, isn't it? It says you have got to consider this, these things.

MR. UNIKEWICZ: That's correct.

CHAIR WALLIS: But there is no indication that we know how to do it.

MR. UNIKEWICZ: Well, that's part of the normal design engineers toolbox and how do I evaluate fluids going through my pumps, how they go through the valves, how they affect the wear and operation of my components. I'm not quite sure I fully understand your question.

CHAIR WALLIS: Well, it sort of says what you have got to do. You got to evaluate. I'm just reading from it, evaluate potential for blockage due to transfer of particulates into the core, blah, blah, blah, blah, blah, blah, blah, compare with the limiting flow velocity and low -- but, you know, it doesn't really say that that works. I mean, you have got to make some calculation of the velocities in the lower plenum and figure out whether particulates go into the core.

This isn't a trivial thing to do.

MR. UNIKEWICZ: Never said that it was.

CHAIR WALLIS: Well, it just says do it and it doesn't tell you how difficult it is or --

MR. UNIKEWICZ: Well, engineering work can be difficult.

CHAIR WALLIS: I know.

MR. UNIKEWICZ: And these evaluations --

CHAIR WALLIS: But I was wondering what it contributes if all it says is you have to somehow analyze all these things without giving indication of how possible it is to do it.

DR. BANERJEE: Well, it does give some sample calculations, right?

CHAIR WALLIS: It does give some sample calculations.

DR. BANERJEE: Yes.

CHAIR WALLIS: But most of it is just text, isn't it?

DR. BANERJEE: Yes. Most of it is text and it's just very -- it's not very quantitative in any possible way. So you don't have real guidance. That's what you're saying. There are very few sample calculations in it which give you --

MR. UNIKEWICZ: Well, again, I would refer

to a site's design control manual that does give examples on how you address fluid through pumps, how you address fluid through valves, how you address brackish water, how you address salt water, how you address waters of different densities and of different constituents.

DR. BANERJEE: Well, let's talk about reactant internals and fuel, Section 10 in WCAP.

MR. UNIKEWICZ: Okay.

DR. BANERJEE: Right? In this case what you are worried about is how, say, particulate matter might be held up in various parts of the core due to maybe it passes through the screens. The guidance is not quantitative as far as I can see as to how to do that evaluation. I don't know how to do it. Maybe the engineers in the plants do, but I would be very surprised if they do. I can't see how they would.

MR. UNIKEWICZ: Do we have somebody from the Reactor Branch here that would like to speak to the vessel piece?

DR. BANERJEE: The fuel is a complex thing. How do things get held up there?

MR. JENSEN: Hi. I'm Walt Jensen of the Core Performance and Codes Branch, formerly Reactor Systems. And, yes, I would -- well, we were asked not

to review the WCAP, but we looked through it and gave comments and some of our comments were really like yours. The guidance, we thought, were very general and there wasn't really any specific means that one would use to calculate what would happen in the core.

There was some discussion that some of the material could be re-entrained in the lower plenum or it could be swept into the core. I guess for a hot leg break there would be a high velocity through the core perhaps. But if a cold leg breaks, the coolant will allow to style the break.

The core velocities would be much less and the off-material would be entrained in the lower plenum and then less would be swept into the core or what happens into the core if material does get in the core, especially material that is understandably neutral and would be swept with the water. I'm not really sure what would happen myself, but I can declare it's boring.

Material that is entrained will be left behind and areas, I guess, where it's boring may be that's with lower flow around the grid supports. Maybe more material would be deposited there. But so far I haven't seen any detailed evaluation of what would be in the core.

DR. BANERJEE: Do you know how to calculate what happens if you knew that? I mean, it's even worse. I mean, even if we could estimate what got into the core, and I agree with your statements where they wave their hands about hot leg breaks and cold leg breaks and all that stuff, but even let's say you could estimate it, what the hell do you do with it after that? Where does it go? Does it block stuff? Does it not? All I see are these diagrams which to me mean nothing.

MR. JENSEN: Those are all good points, Dr. Banerjee. If there is very low materials that are swept into the core, I think our task would be much easier than if it's a lot of material.

DR. BANERJEE: Sure.

MR. JENSEN: When we try to determine what is going to happen to it.

DR. BANERJEE: Yes. I agree that if there was very little, perhaps it's not such a big problem. So as a first order issue as to how much gets in, even if that could be estimated, it would be helpful. But once you estimate that, all I see are these little diagrams with decision trees and things, and there is no concrete guidance as to what to do.

MR. JENSEN: It's complicated further with

the boric acid that we know will be concentrated within the core from boiling for cold leg breaks, and operators are going to have to take or train to take specific actions to keep the boric acid from being concentrated and how will that affect what's going on in the core with the material that is being transported in? So, yes, it's quite a difficult analytical problem.

CHAIR WALLIS: But also, they seem to make some very simple statements, so I think they say that if a particle is smaller than the hole, it won't go through -- it will go through.

MR. UNIKEWICZ: Right.

CHAIR WALLIS: But I don't think that's always true. I think, I'm trying to remember experiments I did fluidizing marbles and things and trying to get them to flow. You get them bridging a hole, which is bigger than themselves.

MR. UNIKEWICZ: Um-hum.

CHAIR WALLIS: They don't necessarily go through a hole just because they are smaller than the hole. A group of marbles can bridge a hole, which is bigger than each one individually and then once it builds up, gets some pressure behind it, it becomes a structure, rather than, you know, something in a

fluid. So it's not necessarily true that if you have say a quarter inch screen size that everything smaller will go through.

MR. UNIKEWICZ: That's something --

CHAIR WALLIS: Just try taking a riddle, a servant serving some dirt or something, there's all kinds of examples you can take from your own experience. Particles can bridge holes bigger than themselves.

DR. BANERJEE: Well, I have a direct comment. 10.7 reactor internals and fuel here. It says the immediate flow parts --

CHAIR WALLIS: We're allow to quote from it, by the way? I'm not sure we're allowed to quote from it.

MR. UNIKEWICZ: No, you're not allowed to quote from the WCAP.

CHAIR WALLIS: No matter what it says.

DR. BANERJEE: Okay.

CHAIR WALLIS: So even if it's a simple statement.

DR. BANERJEE: There is a statement which I find incredible. The first line is 10.12, 10.7 and I don't see how anybody can find that credible.

MR. UNIKEWICZ: That's 10.7, Dr. Banerjee?

DR. BANERJEE: Yes. The first line in Section 10.7.

MR. UNIKEWICZ: Well, let me give you an idea of where we're going with this particular WCAP, so you have a better idea. Originally, the staff received a copy of the WCAP in August 2005. It was a copy for information.

CHAIR WALLIS: 10.7, this is incredible, but if you read the rest of the paragraph, it refers you back to Section 9.2, which is more -- it gives you more detail. But anyway, we can't do it, because we're not allowed to talk about this portion.

MR. UNIKEWICZ: Not yet anyways.

DR. BANERJEE: This is not a closed session?

MR. UNIKEWICZ: I believe we will have opportunity at a later time this year. Going forward, what we see is we did provide comments to the Westinghouse Owners Group in October. We have had conference calls with them last month in January. We expect to have some more this month and also next month.

Skipping this slide, I'll come back. Some other issues is earlier this week or the last week, I should say, we were notified that the WOG is intending

to submit it as a Top 4 Report, hopefully some time this month. At that point in time, it will be put on the docket and we will be able to talk about it in more open terms.

We expect at least their comments or their responses back to our initial comments some time in February or early March. Now, we're going to continue to work with the WOG and we have been working with the WOG over the last couple of months with our questions to firm up some of the same questions that you also have.

In very general terms, our questions and our concerns with the WCAP is that it didn't fully address wetted surface wear for pumps. It didn't necessarily address post-LOCA pump performance, at least in full detail to our satisfaction. Valve and orifice wear needs some more work. The effects of fuel and reactor internals of those things you just mentioned.

CHAIR WALLIS: That is a major issue it seems to me. Forget about everything else, that's really worth consideration.

MR. UNIKEWICZ: Agreed. The settling of debris in low flow areas. We had some discussions with them about the bypass flow and by bypass flow, I

mean, what falls out of the break versus what's being recirculated within the vessel. The changes in the post-LOCA fluid characteristics over time, again due to either settling within the vessel, due to filtering effects of the screens, a couple of things. Those areas still need to be addressed.

The effect of system operating line ups, whether somebody, a plant decides to throttle back on system flow, whether they decide to change system line ups over time due to changing characteristics over the course of an accident, these are the types of questions that we have posed back to the Owners Group.

CHAIR WALLIS: Now, during this recirculation phase, is the flow through the core steady or is it subject to oscillations?

MR. UNIKEWICZ: It depends where the break is. It depends on if there's bypass LOCA coming out of the break.

CHAIR WALLIS: Well, if it's subject to oscillations, then debris can be stirred up in a way in which it wouldn't be stirred up if it were just a steady flow.

MR. UNIKEWICZ: That's why we asked the questions that we need to understand the line ups. We need to understand how things are operating on that

side of the fence, if you will.

CHAIR WALLIS: Well, how do they do this settling of debris in low flow areas? Do they run their code and predict the velocities? And they use those to predict settling?

MR. UNIKEWICZ: One of the questions we always ask is what are your flow velocities in your piping systems. And typically, those run from 7 to 10 feet per second in most areas. In some areas it may be more, some areas may be less. They need to -- we have asked them to do plant walk-downs and they have done plant walk-downs where there are bends, low flow areas, dead legs, things of that nature to see what things would settle out. And again, we're back to the fundamental question of what does it take for sand and dirt and dust to settle out of a moving stream.

CHAIR WALLIS: Well, what I'm getting at is when they run their code to predict this even, very often codes show fluctuations. And the velocity which is said to be 1 foot a second may be on the average, but it may actually have some peaks predicted by the code of say 3 feet per second. These codes often produce oscillations. Are you going to take the 3 feet a second or the 1?

MR. UNIKEWICZ: We would expect them to

take the conservative number.

CHAIR WALLIS: Which is the highest flow the code predicts.

MR. UNIKEWICZ: Unless they can show otherwise.

CHAIR WALLIS: Even though it could be just a numerical oscillation.

MR. UNIKEWICZ: Okay. I understand that the highest number is not always conservative nor is the lowest number always conservative. One needs to consider both ranges of operation. Just as using a pump analogy, running a pump run-out is not necessarily conservative flow condition. Running at shut-off head very well may be.

The expectation is if you're going to run it, operate the pump at run-out, you need to evaluate it out there. If you're going to operate that particular component under throttle flow, it needs to be evaluated there. And passing one does not necessarily mean it's going to pass the other range.

DR. BANERJEE: I guess one thing in response to your question, Graham, they refer to NEI 04-07, whatever that is.

MR. UNIKEWICZ: That is the NEI.

DR. BANERJEE: Right division one.

MR. UNIKEWICZ: Um-hum.

DR. BANERJEE: To evaluate how to study debris settling and laid out or whatever, so hold on. I would like to discuss any ideas.

CHAIR WALLIS: Yes, isolate the --

DR. BANERJEE: Are we not?

MR. UNIKEWICZ: Yes, of course.

DR. BANERJEE: Okay. So somebody is going to tell us about this methodology on how to set this?

CHAIR WALLIS: Isn't that the one that we reviewed a couple of days ago?

MR. UNIKEWICZ: The one you have reviewed in a lot of detail.

PARTICIPANT: Yes, enthusiastically.

MR. CARUSO: Dr. Banerjee?

DR. BANERJEE: Yes?

MR. CARUSO: If you don't have a copy of that, I can get you a copy.

DR. BANERJEE: All right. That would be great.

MEMBER DENNING: Now, with regards to your own review criteria, I can't remember what's in the Regulatory Guide related to this, if anything. Is it your intent to develop for this particular aspect review criteria?

MR. UNIKEWICZ: The acceptance criteria is the ECCS must remain operable and must be able to perform design basis functions. If over time those design basis functions change, and I'll say for instance, if early on in the scenario I'm required to inject 900 GPM through my HPI pumps, then my acceptance criteria is the pumps shall be capable of providing that for such a period of time as it needs to remain operable from the standpoint of providing pump flow that the head is supposed to do and not self-destruct.

Now, there have been instances where over time due to wear and abrasion of internal components where the pump will go into, I'll say, an unfavorable vibration mode, okay, because it unbalances the forces within the pump, under those long-term conditions that would be an unacceptable condition. It must be able to perform to its mission time.

One of the difficult parts that many of the licensees have are truly defining their mission times. That seems to be one of the challenges that we struggle with all the time. Once you define your mission time and once you define your operating line up to get you there and what you are required to produce from an ECCS and a CSS standpoint, that

defines your acceptance criteria.

As long as my pump can continue to operate and produce the amount of water or amount of fluid at a particular flowing pressure, that constitute acceptable operation.

MEMBER DENNING: But there are a number of issue here, Mike, the clogging up of the lower plenum and perhaps carrying into the core for certain LOCAs coolability questions for the core that are non-trivial issues. And what I'm hearing you say is that the industry is going to have to look at those. Then you will just review their analyses and determine without any particular criteria beforehand whether you believe that these various functions that have to be performed will be performed. Is that what you're saying?

MR. UNIKEWICZ: Well, the criteria is that the core remains cooled --

MEMBER DENNING: Yes.

MR. UNIKEWICZ: -- in a cool -- yes.

MEMBER DENNING: But that's such a difficult issue to address without the staff that are going to be in review mode having some criterias to how they determine that.

MR. UNIKEWICZ: You are correct. It is

not a simple answer. The component piece of stream of a vessel, to me, is fairly well-defined. In fact, to me, it's very defined. I will agree that the challenge ahead of us, yes, is how we deal with the in-vessel clogging, how we deal with the in-vessel flow characteristics, because that will also play a part in what do mechanical components have to produce and have to deliver? Yes, that is the challenge ahead of us.

CHAIR WALLIS: Well, this long-term cooling, the vessel is just sitting there. It's a pot that's boiling, isn't it? And the steam goes off and you put water in.

MR. UNIKEWICZ: Hopefully it's not boiling at this point in time, but possibly, yes.

CHAIR WALLIS: But it's evaporating. The cool water is cooled by evaporation or by circulation?

MR. UNIKEWICZ: It's cooled by circulation.

CHAIR WALLIS: It's not --

MR. UNIKEWICZ: There's heat exchangers in some of these loops.

CHAIR WALLIS: Aren't there some accidents where it's actually boiling? It's actually sitting there?

MR. UNIKEWICZ: Yes, there are some scenarios, yes, sir.

CHAIR WALLIS: So the particles that get in, they don't get out. They just accumulate?

MR. UNIKEWICZ: Yes, and that's one of the -- in that report, they have some algorithms on what they believe settling rate to be. We have some questions along those lines.

CHAIR WALLIS: But if it's in the core already, whether it settles or not, doesn't seem to matter. It's just being stirred up in the core by the boiling and everything.

MR. LU: Where heat --

MR. UNIKEWICZ: Well, where it does matter is it matters from an erosion standpoint of the other throttle valves. It matters if the particles and the constituents are in the bottom of the vessel, then I'm not running them through my pump and I'm not running them through my valves and I'm not running them through my orifices, orifice, I'm not running them through those other components.

So it's almost a law diminishing your terms where there's a finite amount of material that either ends up in the vessel or it ends up recirculating through the system. If it recirculates

through the system, my evaluation goes one way. If it stays in vessel, my evaluation may potentially go another way.

And again, a lot of this is time-based. Because once the reactor is shut down, my heat loads drop dramatically and they drop rather quickly. So my cooling loads drop rather quickly. But you are correct, the in-vessel question is the key question with respect to these evaluations. The rest of this is, I'll just say, solid mechanical engineering evaluation.

CHAIR WALLIS: Well, if we have these 56 pickup truck loads of debris we were told about once, and one of them got to the core, that would be an enormous effect, wouldn't it? I mean, if 2 percent of the debris that we were told about in one of these presentations was fine enough to get to the core, that's a pickup truck load of debris in the core. Can you imagine that?

MR. UNIKEWICZ: And therein lies the balance between sizing containment screens and looking at the evaluations of the vessel and the other components.

MR. LU: Steve, this is Shanlai Lu. I want to add a little bit.

MR. UNIKEWICZ: Sure.

MR. LU: In terms of the criteria from the staff and relating to cooling, I think CFR 50.46 and Appendix K relates to LOCA and also the cooling has already been established and we have the criteria there and I think that Walt can comment on that. We had a lot of expectation what exactly needs to be the meaning of the coolable geometry, that part.

And then in terms of the licensee's side that the branch is to perform the core dumpster evaluation and some of licensees is planning to take the dumpster and sample from the integral head loss test, which identifies concentration of the debris. And the fuel is going to use up data to perform the tests as part of their fuel pump transfer test to determine the coolable geometry or the cooling or heat transfer characteristics.

CHAIR WALLIS: Now, these spaces are very good at catching debris and that's why to prevent fretting you have some sort of debris catcher below the core.

PARTICIPANT: Don't you mean the core bottom nozzle?

CHAIR WALLIS: On the bottom nozzles. What is that? Is that a screen type thing or what is

that?

DR. BANERJEE: There's three screens or something, isn't there, Walt?

MR. JENSEN: It all depends on the vendor.

DR. BANERJEE: Yes.

MR. JENSEN: Yes, I'm not sure exactly what they look like, but I think there's some holes there, oblong holes.

CHAIR WALLIS: Well, they're very small. They catch material which would otherwise get caught in the spaces where the spaces are pretty small and the flow passages and parts of the spaces are pretty small. I imagine those holes are really quite small, aren't they in those screens at the bottom of the core?

MR. JENSEN: Yes, they are. They are fairly small.

CHAIR WALLIS: Are they much smaller than the screens in the sump? Are they the same or what?

MR. JENSEN: I don't know.

CHAIR WALLIS: You don't know?

MR. JENSEN: I can't give you that answer.

CHAIR WALLIS: But even if they are --

MR. JENSEN: I think they are.

CHAIR WALLIS: -- much finer than the

screens in the sump, one might hypothesize that fines get through the screen in the sump, but they get caught below the pump.

MR. JENSEN: They are not that fine for sure.

CHAIR WALLIS: Well, I don't know.

MR. JENSEN: No.

CHAIR WALLIS: No one seems to know.

MR. JENSEN: They are not. These are 10 micron particles you are talking about.

CHAIR WALLIS: No, I'm talking about particles that go through a quarter inch screen, which don't necessarily have to be a few microns. They could be pieces of fiberglass or something.

MR. JENSEN: All right.

MR. UNIKEWICZ: Yes, and you are correct. In older field designs, those screens were of a much smaller nature. What the new field ones, some of the new field designs are, I can't speak to that specifically. I can speak to --

CHAIR WALLIS: Well, it seems to be very important to know. Isn't it?

MR. UNIKEWICZ: That's correct. And that is part of --

CHAIR WALLIS: That's one of the first

things I would want to know.

MR. UNIKEWICZ: That is one of the investigations that the Westinghouse Owners Group is still looking at, and that is the effect of the fuel. Those fuel designs are certainly proprietary. They can speak for them better than I, at least with the newer designs. I don't have an answer to that. We'll get you an answer though.

DR. BANERJEE: But in the old designs, well, there were three levels, weren't there of screens?

MR. JENSEN: I can't remember. I can tell you later.

DR. BANERJEE: Yes.

CHAIR WALLIS: Do we have actual samples of these things?

MR. CARUSO: The staff probably has them somewhere.

CHAIR WALLIS: Probably has somewhere. Because I think the staff has samples of pieces of fuel designs and all that somewhere, because they have been submitted by vendors at various times.

MR. UNIKEWICZ: I no longer have them. I used to.

CHAIR WALLIS: But this would seem to be

a very important issue and nobody knows the hole size in these screens?

MR. UNIKEWICZ: I don't know the hole size and I am confident that staff has the answer to that. We just don't have the correct individual party here to answer your question.

CHAIR WALLIS: Well, there's a lot of study going on in Research about how downstream effects now, about whether or not particles will go through the screens. We're going to hear about that tomorrow in sump screens. It seems to me you have got to have equal effort to determine what happens to it if it does go through. I mean, how much does it take to block up the entry into the core?

MR. UNIKEWICZ: Again --

CHAIR WALLIS: What happens if it does block it up? Is the pressure enough to break through or what? I don't know.

MR. UNIKEWICZ: I just don't see the appropriate person here to answer that question.

MR. JENSEN: I think, Dr. Wallis, it's going to be plant-dependent and it's some plants --

CHAIR WALLIS: So you can't do anything until you look at each plant?

MR. JENSEN: We didn't know what's in the

plant, what's coming into it and what's coming into the core. It wasn't those -- we don't know yet.

DR. BANERJEE: And then some of these plants at the bottom have a whole lot of tubes as well, don't they? So a very complicated flow plots, instrument tubes.

MR. JENSEN: Instrument tubes, yes.

DR. BANERJEE: Yes, yes.

MEMBER DENNING: Graham, I think that we're going to want a presentation on what the fuel, real fuel designs really look like in this regard and what the potential is for clogging. And the question is I don't think we want that at our full Committee meeting.

CHAIR WALLIS: Well, are these guys going to appear before the full Committee not knowing anything about the size of these holes?

MR. JENSEN: I think they will.

MR. UNIKEWICZ: My co-presenter, obviously, is not here today. He was meant to answer these questions. I don't have an answer. We will get an answer back to you on that. There was a co-presenter on the staff. I don't have those answers. I'm confident that he does.

CHAIR WALLIS: Why don't we worry about

the thin bed effect. We have presentations, some rather small amount of material was enough to cover 100 square foot screen or something. These are a rather small amount of material. And I would think you would need a similar order of magnitude presentation about what happens in these screens at the bottom of the core, so we know the kind of thing we're dealing with.

MR. UNIKEWICZ: Okay.

CHAIR WALLIS: That's just to get an overall perspective on the problem. You need that first.

DR. BANERJEE: Well, the first order, if your screens are going to be, let's say, in the order of 1,000 square feet, what is the flow area into the core? Is that --

MR. UNIKEWICZ: It will depend on location of the break. It will depend on the particular accident and accident scenario that we're dealing with.

CHAIR WALLIS: Well, no, no, no, you mean the flow area at the bottom of the core.

DR. BANERJEE: Bottom of the core.

MR. UNIKEWICZ: Yes, but --

CHAIR WALLIS: It's a geometrical thing.

It doesn't depend on the --

MR. UNIKEWICZ: That will vary from site to site.

DR. BANERJEE: Right. Sure. But within what order of magnitude are we talking about?

MR. UNIKEWICZ: Again, I would defer to my colleague who is not present today.

PARTICIPANT: 50 square feet.

DR. BANERJEE: 50 square. Oh, that's good enough.

CHAIR WALLIS: Well, it's like saying you can't do anything about core safety, because there are different designs.

DR. BANERJEE: No, but I think that's the rock numbers, right?

CHAIR WALLIS: Surely you can make some estimate of what happens.

MR. CARUSO: Six by six maybe nine by nine.

CHAIR WALLIS: Yes, we'll find out.

MR. CARUSO: 200 bundles.

CHAIR WALLIS: You'll find out.

MR. CARUSO: I'll get you a number, yes.

CHAIR WALLIS: All right.

MR. UNIKEWICZ: Again, I'll defer to my --

DR. BANERJEE: And it's much smaller than the --

MR. UNIKEWICZ: -- colleague to answer those questions.

CHAIR WALLIS: Now, this becomes a target core report. It's still a proprietary thing?

MR. UNIKEWICZ: No, it becomes -- is placed on the docket.

CHAIR WALLIS: So it sees the light of day and then it's available for critique.

MR. UNIKEWICZ: Well, for opening critique, yes. It already has been and I'll say that over the last number of months the Owners Group representatives and the staff had a lot of conversations.

CHAIR WALLIS: But surely on this matter, which is likely to have some public interest, the more you can make open the better.

MR. BATEMAN: Steve, can I ask a question? Is this -- what's the report going to be proprietary or what a non-proprietary version?

MR. UNIKEWICZ: I would ask Mr. Andre Cic, who is sitting right behind us, if he could answer that.

MR. CIC: I would defer to Mr. Dingler, at

this time to --

MR. DINGLER: Would you go to the --

MR. UNIKEWICZ: I saw you first.

MR. DINGLER: At this plant, it's planned to submit proprietary with a Class 3 coming in, but we can discuss that.

MR. CARUSO: So you will submit a redacted version, at the same time?

MR. DINGLER: It's usually followed up later with a Class 3.

MR. UNIKEWICZ: Any further questions?

MEMBER DENNING: Again a comment. I think that the thing that seems to be so important about this particular issue is that the answer for the rest of the problem seems to be make those screens as big as you can. And this seems to be a potential downfall in that logic and that's why it seems so important --

MR. UNIKEWICZ: That is correct.

MEMBER DENNING: -- that we understand it better.

MR. UNIKEWICZ: Let's just say I think I would rather characterize it as a balance. And the balance is large screen versus can I survive and can my downstream components survive and perform the mission they are intended to? And the answer to that

is sometimes large screen works and understand there is also the active design. And the active design has its own set of unique characteristics in that that's where the downstream evaluation is becoming extraordinarily critical.

In fact, that's where the downstream evaluations dominate. The passive designs you find the screens dominate the equation, if you will. On the active designs the downstream evaluations dominate.

CHAIR WALLIS: In the passive design, we don't have much head available to flow stuff into the core. You better not have much blockage.

MR. UNIKEWICZ: Depending on the robustness of your equipment, you can always deal with a little bit of pump degradation if necessary.

CHAIR WALLIS: Now, we heard that the risk had been reduced, because there are lots of ways to cool the core besides recirculation. But if you actually go into some recirculation and your paths get blocked into the core, that affects all these alternative methods, doesn't it?

MR. UNIKEWICZ: And there are --

CHAIR WALLIS: So in trying to protect the sump screen, you may focus on the wrong end of the

problem.

MR. UNIKEWICZ: Well --

CHAIR WALLIS: The first thing is to protect the core screen no matter what. So let it block the sump and then cool the core some other way.

MR. UNIKEWICZ: The first rule is yes, protect the core. There are alternate flow paths. Even if a sump screen were to block, there are other flow paths for sump screens.

CHAIR WALLIS: But if the vessel screens block, then you don't have that flow path.

MR. UNIKEWICZ: Again, I would defer to the vessel people to answer that question more in detail.

CHAIR WALLIS: So I think you need to establish some sort of hierarchy of what needs to happen here and not just keep studying things and looking at what industry does. First of all, this has got to work. And then this has got to work and so on. And then assign, you know, some expectation.

DR. BANERJEE: Like LOCA, I guess, we need a PIRT, right, or something?

CHAIR WALLIS: Okay. I guess you were finished. Thank you very much for illuminating.

MR. UNIKEWICZ: Okay.

MEMBER DENNING: We'll take a break.

CHAIR WALLIS: Are we taking a break or what's next? Where are we?

MR. CARUSO: Well, what I would like to do is the industry representatives, Mr. Butler and Mr. Dingler, are not available tomorrow. I would like to take them next and then leave coating people for last.

MR. DINGLER: I'm available. I'm staying. John won't be, but I will be.

MR. CARUSO: Okay. Well, what I would like to do maybe is get you this afternoon and then we'll go back to the staff.

CHAIR WALLIS: So --

MR. CARUSO: We can take a break then we can start with industry.

CHAIR WALLIS: So we're going to stay beyond 5:30 probably.

MR. CARUSO: I think so.

DR. BANERJEE: So we'll take coatings last, I guess?

CHAIR WALLIS: We'll take coatings last. Is that okay with the staff?

PARTICIPANT: Yes.

PARTICIPANT: It's fine.

CHAIR WALLIS: It's okay for the staff to

stay late?

MR. SCOTT: How late did you have in mind?

CHAIR WALLIS: Midnight?

MR. SCOTT: Midnight? Sure, sure.

CHAIR WALLIS: Until it's over, until it's over. All right.

PARTICIPANT: We'll leave at 7:20. I have a train to catch.

CHAIR WALLIS: Okay. So we will take a break until 3:00 and we're doing it now.

(Whereupon, at 2:43 p.m. a recess until 3:00 p.m.)

CHAIR WALLIS: We're ready to start again. Is the transcript in order to start again?

COURT REPORTER: Yes, we're ready.

CHAIR WALLIS: Okay. Let's go. We'll come back into session and we're very much looking forward to hearing what NEI has to tell us about these problems and their solution.

MR. BUTLER: And I'm very much looking forward to telling you. Well, thanks for having me. I'm John Butler. I'm the Senior Project Manager at the Nuclear Energy Institute and I followed the GSI-191 issue. The first two slides I'll go through very quickly. You've heard some of this already in

presentations this morning. My intent with having them in here was to not forget where we have been, because it does play on where we are now and where we're going to go.

But the GSI-191 issue does apply to all PWRs and the point here that has been addressed several times this morning and we keep stressing it, at least I keep stressing it, is that each unit is unique in its design, in terms of its insulation materials, how that plays into the various debris generation factors, chemical effects and other things, the coatings, the containment design whether it is compartmentalized, open, effects transport, the strainer design, they are all generally different.

And a very key factor that shouldn't be forgotten is, of course, the NPSH requirements. You will see later on with the proposed current sizing of the strainers, there is quite a wide variation there. NPSH will play a very big part in that. A plant that has 16 feet of NPSH margin has a little bit more latitude on its strainer size than a plant that has been with something that is maybe less than a foot.

So there's a high level of design variation and that requires a plant-specific resolution approach for each plant. That makes it

difficult in trying to put together a concise set of industry guidance. It makes it difficult in performing experiments, because you're trying to cover a wide variety of conditions.

You've heard it before and you'll hear it again and you'll continue probably to make comments on it, but we have done things in many cases for lack of a better approach in a conservative fashion, what we believe to be a conservative fashion. We started developing evaluation guidance following, I guess, back in 2002, the issuance of the parametric evaluation that was developed and performed by Los Alamos for the NRC.

Our first evaluation guidance was really guidance for plants to perform walk downs of their containments to basically identify in more detail what they have inside their containment as input to the evaluation guidance. A key staff activity in 2003 was the issuance of the Bulletin. The intent there was to make sure that plants had compensatory actions in place to address the risk impact of this GSI-191 during the period of time in which plants were working to resolve the issue, developing an evaluation guidance and actually implementing any modifications that would come out of that.

CHAIR WALLIS: Could you, just for the record, explain what NEI's role is here? NEI doesn't have its own engineers that produce these reports. But you put together a team from industry or something and facilitated? How does NEI work when it produces a report like 02-01?

MR. BUTLER: In this case, it varies from issue to issue, NEI's role is primarily a coordination role and an advisory role. NEI has a Task Force of representatives from the industry, utilities and the vendors and AEs, who have worked to advise the rest of the industry on how to proceed on this.

The WOG has had a very big role in this particular issue, in that they have been the, to a high degree, technical arm of the activity. So the WOG has been developing the evaluation guidance and it was reviewed by the Task Force and issued as an NEI guidance document. Did that answer your question?

CHAIR WALLIS: You don't have reviewers from outside this industry group? You don't bring in people from outside the industry when you write these reports to get some kind of a different perspective on them?

MR. BUTLER: Well, we have quite a range of personnel on the Task Force.

CHAIR WALLIS: Yes.

MR. BUTLER: I mean, I don't know what benefit that would provide us to go outside of the industry.

CHAIR WALLIS: Well, it's okay. I think you've given a pretty good description of what happens. Okay.

DR. BANERJEE: But NEI itself, does it have -- how large is NEI in terms of permanent staff and engineers and things? They are an organization which is permanent there?

MR. BUTLER: Yes, yes, approximately, total of all of NEI is probably 150 people.

DR. BANERJEE: Okay.

MR. BUTLER: But not all of them are engineers, not all of them are project managers, like myself, so NEI does not do the technical research activities. That's either done by EPRI or Westinghouse or the WOG's contractors or a range of other contractors in the industry.

DR. BANERJEE: You subcontract our work?

MR. BUTLER: Yes.

MEMBER SHACK: How extensive was the review of the compensatory actions that people have taken? I mean, are they in the EOPs, the severe

accident management guidelines? Have those really been reviewed to see if, you know, they are really suitable to minimize the need to do the recirculation?

MR. BUTLER: There was a WOG activity that specifically looked at the range of compensatory actions that plants could consider. And as part of that, they did look at the pros and cons of the various compensatory actions. I think what you're getting at, there are some clear cons to certain actions that you might consider.

Each plant took that WOG activity and introduced their own plant-specific features that would, you know, come into play. In some cases the plants made a determination that it was not appropriate for their plant to implement a particular compensatory action, because of their features. Whereas, another plant may have introduced or may have implemented a compensatory action, because there is more favorable imbalance for them.

DR. BANERJEE: I guess what Graham's question, the way I interpreted it, was --

COURT REPORTER: Could you get closer to the microphone, please?

DR. BANERJEE: Sorry. Do you have any independent scientific evaluation of some of these

things from somebody or some group outside the industry or is it all sort of within the industry? Because I guess the concern always is do you get too introverted in looking at a problem? Are there external scientifically expert people who take a look at some of these issues sometimes or is it always pulled together from the industry, of the industry and back to industry?

MR. BUTLER: Well, first, I've got to understand what you mean by industry, I mean.

DR. BANERJEE: Well, the industry people who are working on, let's say, plant operators, the vendors, the suppliers to the vendors, all these people, is there some external group or somebody that you turn to sometimes who don't have anything to do with the stuff, but a good scientist to take a look at this?

MR. BUTLER: Well, let me answer it this way. I mean, the personnel that are brought in to review different products varies. It's not always the same group of people and the group of people within the industry is not static, so that's always dynamic. And a contractor who does work occasionally in nuclear, I don't know if you would call him within the industry or not. So it's hard to answer that

question.

It depends upon the particular review area as to who we would go to to do the activity or to review the activity.

DR. BANERJEE: So to give you an example, a sump screen blockage issue is a problem which is similar to say filtration problems, particles. There are people who are experts at this who have nothing to do with this. They may be chemical industry people or they may be academics who work on suspension flows or I mean there are many very famous people who have worked on this problem.

Is it -- I was just wondering if you ever accessed these types of people who have nothing to do with nuclear to give a view of is this the state of the art, really, what's being done.

MR. BUTLER: In general, yes, we do do that. In this particular case, I don't know that we have done that. The reasons for that probably can be attributed to the invariable constraints of time and money.

DR. BANERJEE: It may save time and money in the long-term in some ways, because there are approaches to these problems, even if it's just the modeling, which certainly is not being used here,

which are common in other parts of various industries, nothing to do with nuclear.

MR. BUTLER: Understood.

CHAIR WALLIS: There's a lot of civil engineers who deal with cleaning water --

DR. BANERJEE: Yes.

CHAIR WALLIS: -- in all kinds of ways cleaning out all sorts of debris.

MR. BUTLER: Sure.

CHAIR WALLIS: Okay.

MR. BUTLER: Shall I continue? Just very briefly, the Generic Letter was issued back in September of 2004. The schedule that that called for was to have the evaluation completed by September of 2005. The actual evaluation methodology wasn't issued until December of 2004, so plants only had, at that time, nine months to complete their evaluations. They did not, at that time, have, you know, completion of the chemical effects activities, so there really wasn't any evaluation guidance for that.

And the downstream effects didn't come out until June or July of 2005. So the only point I'm trying to make here is that it shouldn't be a surprise that the evaluations weren't complete when plants provided their September 2005 results. This is just

graphically the schedule that plants have been working on.

The evaluations, the majority of the evaluations are complete, at this time, but I don't want it to be interpreted as a static activity. This is going to continue to be an iterative activity. These designs aren't going to be finalized, well, until their input and I'm wondering then if they will actually be considered final designs. But plants will look to continue with their modifications, even though there will be some uncertainties left.

So at this point, the schedule has been pretty firm. The staff has been very firm on their expectations for closing out GSI-191, so plants have no choice but to try to meet that schedule as best they can.

CHAIR WALLIS: Well, they said they have to provide description of the evaluation methodology to be used. What seems to have happened is that they don't have a whole lot of confirmed models for all the phenomena, so what they are trying to do is do a lot of plant-specific tests which are supposed to represent more or less what happens in their plant.

Isn't that the way they are going, that this evaluation methodology could say that sort of

that the level of prediction doesn't exist and, therefore, they are doing all these plant-specific experiments. Is that what's happening?

MR. BUTLER: There will be plant-specific qualification tests for the strainer designs. They are each going to be different. In terms of the source term that is used for qualifying that strainer, the chemical soup that you would take into account, the surface area, the approach velocities, there are a lot of factors that are plant-specific that you have no choice but to look at each plant's recipe individually.

There is commonality among -- in how that is performed. There is a limited number of vendors. There's five strainer vendors that are assisting plants, 69 plants, right now, so they are similar.

CHAIR WALLIS: I guess what I was saying was if there were technical methods which were established, it wouldn't matter really that there is all this plant-specific stuff, because they simply put the numbers in for their plant and out would come the answer, but that doesn't seem to be the way it's going. They are going to all do experiments and that seems to indicate to me that they don't know enough to be able to predict what would happen in their plant.

So it's not a question of using something like a handbook and just making some calculations. They are all going to do experiments. And, as my colleagues were saying this morning, this means that a lot of attention has to be given to whether these are appropriate experiments.

MR. BUTLER: There is no correlation that can be applied to give you a good estimate of what the head loss would be.

CHAIR WALLIS: So a lot of thought has to be given to defining what is now going to be an adequate convincing experiment. You worry about scaling things and how big does this have to be, how much stuff, does it have to represent all kinds of chemical effects or only some and so on and so forth.

MR. BUTLER: Well, I don't want to give you the impression that I am knowledgeable in strainer design, but there are people who are who are involved in the strainer qualification activities. What I do know is that there are some key parameters that play into what you would see from a flume test and those are being taken into account.

I think one of the obvious realities from these activities is that when you reduce the approach velocity to a low enough point, a lot of these

uncertainties are still there, but there are a low enough magnitude where they are not impacting the final result. Shall I continue?

CHAIR WALLIS: Go ahead. Oh, yes. If we're not speaking, you should be speaking.

MR. BUTLER: All right. The evaluation guidance was issued back in December of 2004 along with the staff SER, which did modify the utilization of the evaluation methodology in some aspects. But, generally, I think it can be said that the methodology which focuses in on the debris generation and transport aspects of the issue is a conservative estimate, in some areas too conservative requiring plants to go back and do some testing of their own to try to reduce that conservatism, because they are unable to deal with the results from that evaluation.

Skipping ahead, the two areas that the evaluation guidance and NEI 04-07 did not address adequately was the downstream effects, and that was addressed in a separate guidance document that came out in June or July, it was made available to the industry in June or July of 2005, and then the chemical effects. The ICET results filtered out throughout 2005 with the Quick Look Reports and the final reports. I think all that is out now and,

subsequently, the WOG performed some Bench Top testings to provide input to the strainer vendors on how they can address chemical effects.

This slide just very briefly talks about the downstream effects WCAP, which was issued in June of 2005. And I think, as was mentioned earlier, the staff has had this, but it was provided for information. I think the Westinghouse Owners Group is reconsidering that and will be providing it to the staff for review, so that it will get some additional attention in the coming months.

CHAIR WALLIS: And I suppose we'll know if it works when we find out if the plants can use it.

MR. BUTLER: Well, they are using it right now. How they are using it in certain areas, as you had noted, it provides general guidance and it's up to the plant to perform the necessary more detailed analyses and tests to fill in the blanks.

Chemical effects testing, which you already have been briefed on, it just shows here the schedule for those tests.

CHAIR WALLIS: Now, whose tests are you referring to here? Are these the --

MR. BUTLER: This was the joint industry/NRC/LANL/University of New Mexico test.

CHAIR WALLIS: An ICET type thing?

MR. BUTLER: Yes.

CHAIR WALLIS: But ICET just sort of threw it back to you guys and said it's all plant-specific. Now, you have got to go work it out.

MR. BUTLER: Each plant is unique, I guess, as I pointed out. You got to live with that. The recently completed activity of Westinghouse and the WOG to look at chemical effects was a set of separate effects tests that was documented in a soon to be released WCAP. It's being finalized now and we'll be providing that to the staff for information, I believe.

But the output of this is sufficient information, we believe, to allow the strainer vendors to incorporate either the results, particular results, directly to attest or to support justification for a surrogate material in their testing.

CHAIR WALLIS: These are the Bench Top Tests, so there aren't testing --

MR. BUTLER: Correct.

CHAIR WALLIS: -- in test tubes or something?

MR. BUTLER: All right.

CHAIR WALLIS: It's small scale, very

small scale?

MR. BUTLER: Very small scale, yes.

CHAIR WALLIS: And then, of course, we're going to wonder how a lot of small scale separate effects tests can be put together to give a description of what happens in the real soup when all kinds of things are happening together.

MR. BUTLER: It has been compared to the ICET results which were, in effect, an integrated test. And, you know, I don't have that information in front of me, but I have been told it compared favorably with that. This graphic here just stresses the point that there was a lot of activity going on. There is still a lot of activity going on.

My next few slides are going to very quickly try to summarize some of the activities that are going on in the industry to give you kind of a snapshot in time of where the 69 PWRs are currently.

Back on January 19th we issued a survey to all PWR operators asking them to very quickly provide information to us. We got that by January 30th, so I think that was a record for collecting information from all PWRs. The result of that is that all 69 plants have completed their evaluations necessary to determine whether or not a strainer modification is

necessary. That is a key first step, as you might expect, because that turns on a lot of other activities.

Three units assessed that their current strainers, which they had previously modified prior to GSI-191, were appropriately sized and they are currently involved in confirmation activities to confirm that. So 66 units plan to replace their current strainers and, actually, that is less than 66 now because some of the plants have already begun, have already changed out their strainers. Crystal River is one plant. That is one plant that the staff performed an audit on and I believe Oconee has recently changed out one of their strainers.

CHAIR WALLIS: Now, when you say plan to replace, does that mean that someday they will do it or they actually have designs right now for replacing?

MR. BUTLER: They all have designs right now and they are planning to replace.

CHAIR WALLIS: So they have the specifications which they could give to someone who is going to make these things?

MR. BUTLER: Yes.

CHAIR WALLIS: That is all being done?

MR. BUTLER: Subject for --

CHAIR WALLIS: So they are already committed to doing what they have designed?

MR. BUTLER: They have committed to put in a new design. They have preliminary sizes subject to refinement between now and when they are actually installed, but yes.

MEMBER DENNING: And they are all relying on five vendors. Is that true? We have heard about five vendors.

MR. BUTLER: Yes.

MEMBER DENNING: And they all fit into the five vendors?

MR. BUTLER: Yes. The five vendors are shown on this slide. There is a team with the Enercon, Alion, Westinghouse and Transco where Transco is the actual company that builds the strainer with Westinghouse, Enercon and Alion providing various analytical testing services. And that is the Top Hat design that you have heard a little bit about.

Framatome in conjunction with PCI has a stacked-disk strainer. GE has both a passive stacked-disk design and an active strainer and there are plants that are utilizing both designs.

MEMBER DENNING: And there are some plants that are committed to the active design?

MR. BUTLER: There are plants with the GE passive and plants with the GE active.

MR. ARCHITZEL: Ralph Architzel. I just want to make one comment or correction. One plant did not follow those vendors in the pre-installed design, did their own design. So there is one plant with existing designs.

MEMBER DENNING: Of the ones that are already made?

MR. ARCHITZEL: Yes.

MEMBER DENNING: Okay.

CHAIR WALLIS: Well, I can see that a spec for the screen should be based on sort of NPSH requirements, that it should catch enough stuff and not have a head loss which, you know, violates the requirements for NPSH.

Is there any specification about how much they are allowed to let through? I mean, I would think that would have to be a design specification, that it should catch 99.99 percent of the debris, but at the same time it has got to meet the head loss characteristics, you know, the NPSH requirement.

MR. BUTLER: It's an aspect of the design that --

CHAIR WALLIS: Requirements about how much

stuff it has got to interdict, you know, and stop getting into the core. Is there any requirement on that yet?

MR. BUTLER: Whether or not that is part of the design spec that was given to the strainer vendor, I cannot -- can't say.

CHAIR WALLIS: Well, it seems to me that's one of the important things you have got to get there, isn't it?

MR. DINGLER: Graham, this is Mo Dingler. At Wolf Creek we have set the screen size opening to reduce the amount that is bypassed based on our downstream effects.

CHAIR WALLIS: Is there a specification that says no more than a teaspoonful or a truckload or whatever?

MR. DINGLER: We set hole open size and then we're going to test to validate how much goes through there.

CHAIR WALLIS: Well, you must have a desired result.

MR. DINGLER: We have a desired result, but it's not in the spec. It was separate from the spec.

CHAIR WALLIS: Only a barrel load gets

through or something?

MR. DINGLER: We put a percent of bypass on there.

CHAIR WALLIS: Yes, you got --

MR. DINGLER: Knowing what our total debris is.

CHAIR WALLIS: A percent of bypass. Well, if you're talking about these, I don't know how much you want to take as a baseline, a truckload, it's going to be a pretty small percent if it's truckloads.

MR. DINGLER: That's correct.

MR. BUTLER: There are -- as far as the replacement strainers that are planned, the majority of them are passive strainers of various designs. Four units intend to install active strainers.

I just want to point out that even whether it's active or passive, it's subject to change. Two units in particular noted that while they are currently going with the passive strainer, that their preliminary design and sizing requirements to accommodate their debris load was so large that they are having to reconsider going with an active strainer.

CHAIR WALLIS: Now, an active strainer was something that scrapes off the debris as it forms on

the strainer. Is that --

MR. BUTLER: It's a motorized blade.

CHAIR WALLIS: And then it takes the debris and puts it somewhere else, does it? It takes --

MR. BUTLER: It keeps it off the flow area of the screen.

CHAIR WALLIS: But it doesn't do much good.

MEMBER DENNING: Physically away.

CHAIR WALLIS: It doesn't do much good to just drop it in the vicinity, does it?

DR. BANERJEE: Well, it's consolidated so it may not --

CHAIR WALLIS: So it might help, it might help.

PARTICIPANT: If it dropped it low enough.

CHAIR WALLIS: But some of the numbers we saw would actually fill up the whole room where the screens are.

MR. ARCHITZEL: Dr. Wallis, Architzel again. The design that is in front of the staff or being used is sort of like a macerator pump and it passes through the debris.

DR. BANERJEE: Passes what?

MEMBER DENNING: Say it again. Explain.

MR. ARCHITZEL: It essentially chops up the debris and passes it through.

CHAIR WALLIS: Passes it through the screen, lets it go somewhere else?

MR. ARCHITZEL: Downstream.

CHAIR WALLIS: Does it go downstream? That's an acceptable design? Might as well have no screen at all.

MR. LU: Just adding one point. The GE active strainer actually has a section of a sacrificial passive part of this strainer, too. That part can take a lot of debris load, so only a portion of the debris is being chopped through the active strainer surface.

CHAIR WALLIS: It's like a disposal in a sink?

DR. BANERJEE: But is this chopped after the screen or before the screen?

MR. BUTLER: I guess I need to point out that the design of the active strainer is not to chop up the debris, but that is a consequence, that some portion will be chopped up and passed through, but it's --

MEMBER DENNING: It's not the intent.

DR. BANERJEE: Right, right.

MR. BUTLER: It's not.

DR. BANERJEE: The intent is still to catch most of it, right?

MR. BUTLER: The intent is to keep the debris away from the flow holes of the active strainer and it does do that, but it's a natural consequence. Some portion is caught by the blade and broken into smaller pieces.

CHAIR WALLIS: But you wouldn't want to chop it up. You would never want to chop it up and let it go through the strainer.

MR. BUTLER: It's not designed to do that, but that's a consequence of the movement of the blade across the surface. It will happen.

CHAIR WALLIS: That's the whole purpose of it. Okay. But it's just a blade, but it's not a chopper. It's a scraper.

DR. BANERJEE: Is it a scraper?

CHAIR WALLIS: That's very different.

MR. BUTLER: It actually is not even in contact with the surface. You're using --

CHAIR WALLIS: But if it's sort of lifting off blankets of stuff and depositing it, that's fine. That's not chopping it up.

MR. BUTLER: Right.

CHAIR WALLIS: I thought of it as scraping off blankets of filtrate.

DR. BANERJEE: We better look at the design. Maybe we ought to take a look.

CHAIR WALLIS: Well, I don't know. Maybe we have to look at detailed designs. I'm not sure we're the ultimate authority on what is allowed.

DR. BANERJEE: No, but we can take a skeptical view instead, because it has a bearing on what --

MEMBER SHACK: That's designs in installing backflushing systems?

MR. BUTLER: I don't know.

MEMBER SHACK: Is it a large number, a significant fraction? Don't know?

MR. BUTLER: I don't know. It wasn't a question that I included in the survey and offhand, I haven't heard a lot of discussion about backflush, so I suspect that it's a small number.

CHAIR WALLIS: You ought to make something like a paper making machine that lays down the debris and makes a sheet, takes the sheet and rolls it up and puts it off in the corner somewhere. No, seriously, that's the sort of thing that would be very good.

DR. BANERJEE: Then you would have to get people from outside the industry to help out on this.

CHAIR WALLIS: It may be a good idea. So these changes look dramatic.

MR. BUTLER: Yes, I'll just go to this next slide here. This is the spectrum of sizes for the estimated replacement strainers. Now, one point I need to make on this slide is this is the total screen area. So if you have multiple trains, if you have two trains, you know, the size and strainer for each train would be half of this size. But I just wanted to have kind of a common basis for the total amount of screen size you're installing in the plant.

DR. BANERJEE: Is it so much larger than BWR because there is more debris around? Is that the reason?

MR. BUTLER: There are multiple reasons for --

DR. BANERJEE: The steam generators, I guess, have a lot of insulation here.

MR. BUTLER: There is certainly a greater amount of debris that the evaluation methodology would have you take into account. There are a number of uncertainties that we're having to somehow take into account, and I think the combination of those two

factors alone explains a lot of the difference in the size.

MR. CARUSO: Without being specific, are there any plant designs that cluster at one end of this graph or the other?

MR. BUTLER: No, no. That is one of the things I did look at and I didn't see a particular design variation. There seems to be some utility or company strainer/vendor combination factors that tend to cluster sizes together. I think that's a combination of how conservative they have been.

CHAIR WALLIS: Well, this is a rational difference. It's not just a completely aleatory thing. So randomly, depending on the assumptions they make, they come up with a small screen or a big one because there is more Cal-Sil in some plants and more fiberglass. It's a rational thing.

MR. BUTLER: Some of those factors I will go through in the next couple of slides here, but variability is -- plant design has a big impact, because a plant with 16 feet of NPSH margin that's an all RMI plant is going to be a small strainer. Whereas, a plant that has very little margin and a lot of fiber has to have a much larger screen to keep the pressure drop down.

The conservatism in methodology and retained margin, however you want to call that, some plants decided just to address margin by installing the largest strainer they could fit into their containment footprint or their strainer well, however their design was.

So the size is not specifically tied to what their evaluation methodology called for. It's just that was bigger than what was called for and that the additional cost by throwing on an extra module while you have got a chance is not prohibitive, so go ahead and do it.

CHAIR WALLIS: Unless it's counterproductive.

MR. BUTLER: Unless it's counterproductive.

CHAIR WALLIS: And causing too much debris.

MR. BUTLER: And I suppose --

CHAIR WALLIS: For certain LOCA.

MR. BUTLER: -- you could take a module out if you needed to. So I have covered these slides. There we go. As far as how people are going forward, they have already scheduled when they are going to install their strainers. Two units have already

installed last year. 30 units are doing it in 2006, 33 in 2007 and one unit is doing it in the first quarter of 2008.

When this is scheduled to occur is highly dependent upon how their outages fall out. Most plants are on an 18 month outage cycle, so they either -- you know, they usually have just one opportunity and the window here between now and the end of 2007 to install it, so they are doing it there. This shows you a little bit more detail on the installation. Not surprisingly, because plants have fall outages, you're seeing a peak in the fourth quarter of 2006 and the fourth quarter of 2007.

Beyond the strainer replacement activities, the survey that we sent out did ask some questions to get a little bit more information on what plants are doing in other areas. There are a number of activities to reduce problematic insulation materials. I think as time goes on, that will occur more and more. There are limitations on how quickly these insulation materials can be removed. Both factors of cost and radiological concerns limit how quickly that can come out.

Certainly, as plants change out major components that might have problematic insulation

materials, they are going to take care of those problems as part of the change out, steam generator change out, pressurizer change out. Those are going to, you know, probably go with an insulation type that is less problematic.

There are also a number of changes to modify or reduce problematic coatings and latent debris. Some plants are really upping their activities to make sure that debris sources like tags and other things that could come into play on a strainer are addressed up front.

Containment modifications beyond strainer installation that will be looked at are things like debris transport, interceptors, changing the flow path, moving debris preferentially to an area where it can be isolated and not make it to the strainer. And, of course, there are a number of activities that are going on in the downstream effects area, both physical modifications to the flow stream and a number of areas where the testing is being performed.

CHAIR WALLIS: Yes. If you had a big enough area, you would think you would have sort of a settling tank before you went to the strainer.

MR. BUTLER: Well, that's one of the things that I had wanted to mention several times

today when people are making comparisons between what is being tested and what will actually occur in a plant.

Go through the scenario of this. There is a period of time where you have got a fairly quiescent pool before you have started the strainer up where those things are settling out. It's only 30 minutes or more in the event when you start up the recirculation pathway. So that is very different than the way a lot of the tests are conducted, and I think they are conducted in a conservative fashion to move a lot of this material toward the strainer.

But staff has raised some good points in terms of agglomeration activities and making sure that the flow field is prototypic. So that's something that the strainer vendors are going to have to address.

As part of that, I guess we have already noted that, that all plants are going to be doing prototypic strainer testing or the vendors are going to be doing that taken into plant-specific characteristics. A number of plants identified plans for plant-specific testing for debris generation and transport.

I don't have any details on that testing.

My question was fairly general on whether or not anything was planned, and this would include activities that have already been completed. So I don't have all the information here, but just to make the point that a lot of activity is either underway or is planned.

The same thing applies for coating debris generation and transport and I am aware of a number of test activities in that area. And there are plans for plant-specific testing of downstream effects of debris bypass and that is testing on particular components and probably in the area of different field designs.

Some of the activities I have mentioned is the WOG Chemical Effects Testing activity that was recently completed and the WCAP should be available shortly, strainer qualification testing that you have heard about. There is a WOG activity that will begin any day now to look at alternate buffers to provide plants with an alternative to their current buffers of TSP or some hydroxide.

There is a couple of different coatings tests that are looking at reducing the conservatism in the zone of influence for qualified coatings. The SER modified the evaluation guidance to have plants assume a 10D ZOI for qualified coatings unless testing could

be provided to support a lower ZOI. So the intent of this is to lower that conservatism.

MEMBER DENNING: You mentioned plant -- I'm sorry, it's back under plant-specific testing. You mentioned there on the bottom plans for plant-specific testing for downstream effects. Are there fuel vendor-specific tests that you're aware of?

MR. BUTLER: Certainly, things have been discussed. I don't know how far they are in that discussion, whether the tests are actually performed.

MEMBER DENNING: Okay. Thanks.

MR. BUTLER: So, in summary, a lot of activity going on right now. Some of the limitations, constraints, that we're dealing with in terms of schedule kind of has forced a very conservative application and resolution approach in certain areas, but there are some key areas of certainty that we're having to deal with, you know, through additional testing.

And I imagine a lot of these activities will continue well beyond the installation of the strainers, so that if nothing else you can recover some of the margin, basically recover operating margin so you're not --

CHAIR WALLIS: So how conservative are

you? I mean, you wouldn't go to the extreme of saying that we have got a little bit of Cal-Sil and we have got a huge amount of fiber, that because we know there is a thin bed effect, we're going to assume that the whole -- all the Cal-Sil arrives first with a little bit of fiber and covers everything with thin bed before anything else happens?

You're not going to sort of assume that kind of extreme case, are you?

MR. BUTLER: I wouldn't.

CHAIR WALLIS: You wouldn't? No, but, I mean, I was just wondering what you mean by conservative application of evaluation methodology, because there are some things you could do by being conservative, which might appear to be really extreme, but they are not unimaginable.

MR. BUTLER: The balance, the problem with this, one of the problems with this issue is trying to be realistic, you know, because the combination of conservatisms in each of the areas that you would look at is so unrealistic that hardly anyone could live with the result.

CHAIR WALLIS: So you have -- finding an adequate level of conservatism is difficult.

MR. BUTLER: Yes.

CHAIR WALLIS: Because as soon as you give up a little bit of conservatism, people can say, well, you're not being conservative.

MR. BUTLER: Right.

CHAIR WALLIS: So I don't know how you decide something like that.

MR. BUTLER: That's something that we have struggled with and I know that the staff has struggled with it, and this is a design basis analysis area where, you know, you, you know, traditionally have to be conservative and it's difficult to bring in risk-informed aspects to that decision process.

DR. BANERJEE: Well, if you look at LOCA, your peak clad temperature was what you wanted to predict, right, as you want to predict the pressure loss or whatever is available for NPSH. Yet, instead of following a sort of methodology where you develop a model to predict this and then sort of test it against experiments and so on, you have taken a purely experimental route where it's very hard to evaluate whether you are being conservative or not.

You know, if you change a little bit in the experiment, you will have a different result and you can get very different results. So what seems to be totally lacking is some framework to interpret

these experiments as people have had in LOCA. If you just tried to develop a correlation for the peak clad temperature, it wouldn't be very easy. I don't think you could do it.

So you are trying to develop a correlation or do a test which is pretty ad hoc. It will be like doing an out reactor test or something on a small scale. There is no scaling studies. It's really hard to see how this all fits into the real thing. A little test done here with some conditions and you're saying this is how this whole thing will behave in reality. You know, I don't see that connection. There is nothing to glue the two things together.

MR. BUTLER: This may not be an adequate response, but I will give it a try. The range of phenomena and variability of conditions that you're having to look at on this would make it, in my mind, almost impossible to come up with a correlation that could address --

DR. BANERJEE: I'm not saying a correlation. I'm saying a methodology, which you can't have a correlation for peak clad temperature either. You have a LOCA code, right? Here the LOCA code is based on certain scientific principles and the correlations which enter are at a very different

level. It's like the settling velocity of a particle or a fiber or whatever, things that you might be able to know something about.

MR. BUTLER: Well, a lot of that is just what we did in developing the evaluation guidance that the staff subsequently reviewed. That does provide a lot of guidance to plants in terms of the debris source term that makes it to the strainer screen. It does not tell you how to determine the head loss across that screen. That is to be determined through prototypic testing.

DR. BANERJEE: But it may depend on various factors like which component is convected in what way to the screens and which arrives first. You know, the results can change a lot depending on a lot of these things, and that is unfortunately the reason why there is such uncertainty. If you do an experiment in Los Alamos, then you do it in Battelle, you get two completely different answers and those are ostensibly the same tests.

MR. BUTLER: You will get a different answer probably.

DR. BANERJEE: And by a factor of 10.

MR. BUTLER: If you do it 10 times, you will get 10 different answers.

DR. BANERJEE: Well --

MR. BUTLER: That's the part of the --

CHAIR WALLIS: And, of course, when you get a big spread in results, how many do you need before you can evaluate an uncertainty? You certainly can't get much of an uncertainty from two tests which are trying to duplicate each other and dumped. It doesn't give you much handle on the uncertainty. It just tells you there is a difficulty duplicating the test. It doesn't tell you that if you did another 10 you wouldn't get a much bigger range.

MR. BUTLER: Well, I mean, there has been enough --

CHAIR WALLIS: So we look at all these.

MR. BUTLER: -- head loss testing to tell you the direction certain things go that --

CHAIR WALLIS: Certain anomalies.

MR. BUTLER: More finely chewed debris, whether you use a garbage disposal versus something else to chop it up, is going to give you higher head loss than, you know, less finely chewed debris. Which is right, I don't know, but you certainly know how to get higher head loss for your tests or lower head loss. That is known. So that's it.

CHAIR WALLIS: Is it, because in some of

these tests in Lab A and Lab B, Lab B's results are bigger than Lab A's and sometimes it's the other way around. So I don't think we know that well what it is that makes the difference. We're finding out.

MEMBER DENNING: Since that's a difficult question to answer, let me ask you another difficult question. No, this may not be so difficult. NRR talked a little bit about some alternative water supplies, that type of thing, that one could consider as potential to account for uncertainties.

Is there anything that the industry is doing with regards to that? That is in case things don't work in accounting for uncertainties, are they considering things with alternative water supplies and specifically developing CMGs that would be directed towards the implementation of those things. Do you understand what I'm saying?

MR. BUTLER: That was part of the set of compensatory actions that I mentioned that the WOG looked at and that plants have implemented. How far they can go with that, there are a number of plant-specific factors that have to be brought into account. There are limitations on how much water you can put into the containment without coming into other factors like equipment operability.

MEMBER DENNING: Yes.

MR. BUTLER: And even structural concerns with the containment.

MEMBER DENNING: So are you saying that the plants already have CMGs that are relevant and that there isn't anything else that will be done for the future or, I mean, we're learning about some of the difficulties of the overall problem for the long-term, perhaps not just for interim things. And I'm just wondering whether there was more that might be provided in the long-term to handle the "well, what if" cases in case the things that we think are going to work don't really work.

MR. BUTLER: All I can say is it's an area that has been looked at by plants. Like just about everything else, you could always do more in any area. I mean, making modifications so that you don't have a limitation on the flood level, so that you can flood-up to cover the top of the core.

MEMBER DENNING: Yes. I don't mean to imply that's a good thing to do.

MR. BUTLER: Right.

MEMBER DENNING: Because I don't know the answer, but it's obviously the kind of thing that one could potentially do.

MR. BUTLER: One could potentially look at a whole range of actions, yes.

MEMBER DENNING: But as far as you know, industry doesn't really have plans right now to do more in that area, that they are oriented towards this?

MR. BUTLER: At present the attention is focused on the modifications necessary within a design basis space to keep the recirculation path open.

MR. DINGLER: This is Mo Dingler. Let me answer that. Some of the changes that the WOG did plans for implementing those as interim and as permanent, so they may keep some of those like -- I will just use an example.

Refilling the RWST tank. That may become a permanent EOP or ERG. They are still looking at that and what they are -- some of them, it may go away because you're putting in bigger sump screens in that. So each individual plant will look at what they implemented and see which one they want to maintain as more permanent or permanent and others that are not.

MEMBER DENNING: Thanks.

MR. BUTLER: I'm done.

CHAIR WALLIS: That's it? Okay. Thank you. You have gained us a bit of time. Can we now

proceed with the WOG presentation?

PARTICIPANT: Yes, it's in the upper right hand corner on the machine.

MR. DINGLER: Upper right hand corner?

PARTICIPANT: Hit escape.

PARTICIPANT: No, escape.

PARTICIPANT: Just minimize your window so you can see the desktop.

MR. DINGLER: Okay.

PARTICIPANT: Is that yours?

MR. DINGLER: That's mine right there.

PARTICIPANT: F5.

MR. DINGLER: Thank you. I'm slow on computers. I get told every time I test a computer, I get in trouble. I'll go ahead and start. What I want to do is give an overview of what the Westinghouse Owners Group has done in GSI-191.

CHAIR WALLIS: Before you get started, could you tell us the size of the holes in the bottom of the fuel?

MR. DINGLER: The size of the holes in the bottom of the fuel is either the same size or greater than the openings in the sump screen on that for a majority or for all plants that I know of. We had to evaluate that as an Information Notice in '97/'98,

some time frame that it came out and we evaluated it.

And, also, there is bypass flow for a majority of the plants, alternate flow paths. If those P grids get blocked, some of the three loop down flow plants will do a little more evaluation. They have very little bypass flow or alternate bypass flow. So there is alternate flow paths for a majority of the plants.

CHAIR WALLIS: So some of these openings would appear then to be bigger than some of the passageways through the spacers?

MR. DINGLER: That is correct.

CHAIR WALLIS: So we might assume then that some of the material might breach into the spaces. I thought that these grids were put there to prevent metallic material going in and rattling around in the spacers to cause fretting, but apparently it wouldn't catch everything.

MR. DINGLER: There is an ongoing battle between normal operations and fuel leakers that --

CHAIR WALLIS: Right.

MR. DINGLER: -- the Commissioners are wanting us, as an industry, to minimize or eliminate against the long-term LOCA efforts that's going on. So we're running a conflict between which one is going

to come out and how we're going to settle it. I do know a lot of plants, as Graham Wallis asked, was -- has looked at bypass flow and decided the openings of the sump screen, reducing the amount of fines by debris interceptors, as John put in some modifications to reduce the transport of that to minimize that concern.

CHAIR WALLIS: Okay. Maybe you should go back now to your presentation.

MR. DINGLER: To my presentation. What I want to do is give you an opportunity or what the WOG has been doing. I'm Mo Dingler or Maurice Dingler. I work with Wolf Creek and I am also Chairman of the Systems and Equipment Subcommittee that is responsible for this issue.

What I want to do is go over the activities. We have been involved actively since 1999. Some of us have been involved since '97. We now represent all PWRs. As of the 1st of the year, the B&W fleet joined the Owners Group, so we have all PWRs within the Owners Group at this point. There is some discussion of whether we have to change the name now. That is another issue, but that is ongoing.

We have done 10 major projects or are planned. We have five completed and five ongoing. We

have got over 20 man-years of effort so far and this doesn't include what the B&W OG has done prior to 2006.

What I want to do is give you an overview of the completed projects and also the current projects. This is at a very high level on that. We started out working on Generic Letter 97-04 and future and involved the industry. We are participating in the PIRT panels that was going on both for debris transport for dries and ice condensers and also containment coatings research back in the early days on that. We also provided the summary of at-power radiation dose surveys.

A lot of discussion going on about the Bulletin and the potential ERGs and EPGs went on that the WOG developed, approximately, 10 to 12 different scenarios, both pros and cons. Plants implemented it. We issued three volumes. One was the Westinghouse Emergency Response Guidelines and one was the CE Emergency Guidelines. These were focused on changing our emergency procedures.

We did look at the SAMs and SAM says if you lose something, put water in and we looked at those and those were adequate of getting as much water in to maintain core cooling. So we did look at that,

but these are most of our EOPs and stuff like that.

Then the other ones, as John said, John Butler says, that we provided input to the two NEI documents, Condition Assessment, NEI 02-01, also, the Plant Sump Performance Evaluation, NEI 04-07. Now, some of the completed -- and also the completed one is we did for the industry what was important to put in the PRA, a generic template for modeling sump blockage, what was the parameters to consider in blockage and stuff like that.

Some of the probabilities we're still looking at, adding and tweaking those values. Part of the project was not to put probabilities on this, but just give them what's important to consider in the models.

Some of the current projects we got going on is the chemical and corrosion products with the ICET testing. We participated with EPRI and the NRC in developing the test plan, commenting on the results and stuff like that to develop the ICET Test Program that was discussed today. Also, we gave some inputs for a follow-on project and I will get to that in a minute.

We looked at the downstream effects on that and developed the methodology that was discussed

earlier on today. We have some comments to resolve with the NRC ongoing on that and that's for fuel blockage and that. Some of the discussion on that is to look at sump screens, some plants decided a sump screen size and then working around that for downstream. Others has made an integral process of you have this opening, this size of sump screen, what is the downstream effects. So it's an integral process of going on and working through those things.

We also just completed -- as of last week, we issued the document. It was the methodology of post-accident chemical effects on that. What we also did as part of that is what we call bench testing or small scale. We looked at developing a debris particulate generator that would generate the mix for the plant based upon their parameters, how much zinc they have, how much aluminum they have, how much Cal-Sil they have or calcium available to develop a plant-specific issue.

We also validated that against the ICET test and some of our projections the same as did the filtration and the settling rate of that particulate we produced in potable water, everybody says tap, I'm a civil engineer, so it's potable water to me. Go in and say did it settle at the same time as the -- is

the filtration rate the same through a filter? We did this and verification on that to make sure it was there.

CHAIR WALLIS: Now, this path-specific precipitant mix, presumably could depend on where the pipe break occurs.

MR. DINGLER: That's correct.

CHAIR WALLIS: It's not as if it's something that's unique to a plant. And if the break occurs near a place where there is a lot of Cal-Sil, you get Cal-Sil. There could be a break which occurs somewhere else and you don't happen to have Cal-Sil in that vicinity.

MR. DINGLER: That's correct.

CHAIR WALLIS: So there are quite a few different mixes you can get in the same plant.

MR. DINGLER: Now, I'll speak for, let's say, the six plants that have Cal-Sil. I think four plants have Cal-Sil outside the bioshields. So we have very little transport to it. A couple of plants have them, approximately, 99, 98 percent all over, so you've got a lot of stuff. So each one, you've got to add in saying the generation is where is your break? Is your break considered?

In other words, do you have to consider a

secondary break outside the bioshield? Then that Cal-Sil may come in to effect. Other plants have safety grade fan coolers. They won't necessarily have to consider a secondary break outside the bioshield. So those have to be factored in when you generate that.

Also, how much pH you have when your pH becomes available. We talked about mission times. If you run sodium hydroxide through the RHR heat exchanger, it cools it down, so you have secondary precipitate being formed, that's what we got to look at. So all that is factored into the generator and stuff like that.

MEMBER DENNING: Have you looked at the vendor, the filter vendor plans for doing these tests? And is it practical to add in chemistry into those tests? And would you use this kind of guidelines to say well, this is the chemistry that you ought to be performing those tests under?

MR. DINGLER: We did a set of verification against potable water against the ICET test particulates, so the solubility and the filtration were pretty much the same. I don't have the exact detail in my head right now, but that's so we could test with potable water. There is some discussion ongoing with the NRC on that right now.

MEMBER DENNING: So you're saying that the chemistry effects are not significant under those conditions that you just talked about where you could replace the chemistry with potable water?

MR. DINGLER: Well, the testing is potable water, do the flume test and stuff like that. You will find that the buffer, I've got one going on over buffering. It depends on the buffering of you've got aluminum hydroxides formed if you have sodium hydroxide plants. You have calcium phosphate being formed. You have TSP. Based upon what we're seeing in the generation of those flocs, both of them are treatment of water. They treat water, potable water to clarify water, also that goes to those then, properties.

We looked at the filtration and the settlement duration both in the high-pH, low-pH against what we generated in tap water or potable water. We found out that they were pretty well similar in properties. Does that answer your question, Richard? I'm not sure.

MEMBER DENNING: Yes, it just surprises me based upon what I have seen so far in chemistry tests that it would not have a significant effect.

MR. DINGLER: We see it has significant

effects of generation, but not necessarily in the filtration and the settling rates.

DR. BANERJEE: But you see significant effects in head loss, too?

MR. DINGLER: We're not --

DR. BANERJEE: You haven't done anything?

MR. DINGLER: We haven't done head loss.

MEMBER DENNING: Oh, I'm sorry.

DR. BANERJEE: Yes.

MR. DINGLER: We have not done head loss.

MEMBER DENNING: That's what I interpreted.

MR. DINGLER: Sorry.

MEMBER DENNING: Was that you were saying it didn't affect the head loss.

MR. DINGLER: Yes, it affects head loss. I mean, in other words --

MEMBER DENNING: If it affects head loss, does that then mean that when these tests are done by the vendors that they are going to have to include chemistry, realistic chemistry in those "head loss tests?"

MR. DINGLER: Well, what I'm saying is it affects the head loss. It affects the head loss by an amount of how much is getting to your sump screen.

Based on the filtration, the filterability of these particulates, we're seeing that we validated against what was in the ICET test which was pH upper -- integrated pH, integrated some temperatures in that, that we saw that the filtration or the filterability were pretty much the same, no matter what kind of water we used.

MEMBER SHACK: You're saying that if you generate aluminum hydroxides, for example, in something that is tap water rather than for 2800 boric acid, then you're still getting something that looks like ICET 1.

MR. DINGLER: That's correct, sir. Thank you. Appreciate that.

MEMBER SHACK: Then the same with the calcium phosphate, it's calcium phosphate.

MR. DINGLER: That's correct.

MEMBER SHACK: Thanks.

MR. DINGLER: Any other discussion? Some of the current ongoing projects we have got right now is some of the plants are about 10 units is looking at qualification of lead blankets for shielding. The title is a little misleading. If we leave lead blankets in for shielding and work at power, does that become a debris source?

So we're looking at taking 500 degree F qualified blankets and less than 400 degree temperature blankets preventing a jet impingement test, a soak test and a limited debris characteristics evaluation, so plants understand if that becomes a debris source or not and they can leave it in at power.

Alternate buffer as you heard that we got sodium hydroxide, TSP and Borax or sodium tetraborate. I remember, you know, Reagan and his Borax team, but on that we saw that the Borax shows, let's say, about half the amount of precipitants being formed in TSP and sodium hydroxide, approximately, I think one is 49 and one is 63 percent. So there is other agents out there that we can provide the same buffering agent for PA-SEE and iodine catchers. The potential out there shows less debris chemical reactions going on. So we're looking at those as we speak right now.

In summary, WOG considers this a high priority. We have been coordinating this to support licensing and NEI and the NRC in resolution of the GSI-191. As you can tell, we've got about over 20 man-years on it already. Some of us have been involved since '97. WOG actually since '99. And we will be continuing and looking at ways to help resolve

this solution as we go forward.

I'll open up for questions.

DR. BANERJEE: I guess the question Richard was asking about doing tests in these facilities on head loss using appropriate chemistry, are you planning any tests like that?

MR. DINGLER: The Owners Group is not, because right now there is -- say there's five different vendors and each one of those vendors have slightly different sump screen configurations and stuff like that.

DR. BANERJEE: So they will do the tests?

MR. DINGLER: We have asked and they will be providing those tests for the individual licensees.

DR. BANERJEE: Okay.

MR. DINGLER: Since there is so many different varieties, as Ralph Architzel said, there is one plant that did their own design. The rest of them are looking at the five vendors. And each one is slightly different. Some -- one vendor may provide one plant a square one. One might do a round one and one stacked/raised and one is all over the place.

DR. BANERJEE: But these tests are done in different flumes with different types of upstream conditions and adding debris. Is there some

standardization of this going on?

MR. DINGLER: That --

DR. BANERJEE: Do you leave it up to the vendors to do whatever they feel like?

MR. DINGLER: I think our position is the industry and the NRC was that we need to do testing that represents our plants and flow velocities, what do they call it, bulk velocities, getting to the sump or approach velocities right near the sumps, whether you have a screen that's in the sump pit itself or screens that's on the floor, scaling and that, that's ongoing discussions with each individual vendor, licensees and the NRC.

DR. BANERJEE: So you're out of it?

MR. DINGLER: The Owners Group is out of it, yes.

DR. BANERJEE: All right.

MR. DINGLER: I'm not out of it, because I've got a plant, too.

DR. BANERJEE: Yes. But the Owners Group is out of it?

MR. DINGLER: The Owners Group is out of it.

MEMBER DENNING: But you do feel that they would have to then add precipitants to represent the

precipitants that one would expect?

MR. DINGLER: That's correct.

MEMBER DENNING: Is that what you're saying?

MR. DINGLER: Um-hum. You've heard some talk about vertical head loss loops and that, get a bump up, that's very good if you, in my opinion, this is my opinion only, have uniform distribution across there, that will probably give you a good figure. If you don't have uniform distribution, that bump up may not be correctly used. I think there was some discussion on that and you saw some of the slides on that.

So that's what makes these complex screens a little more complicated is you may not or have uniform distribution across the screens.

CHAIR WALLIS: Now, all these numbers are PA-SEE- something or another.

MR. DINGLER: That's my nomenclature to keep track of it for accounting purposes.

CHAIR WALLIS: Is that the name of the program?

MR. DINGLER: Yes, that's the name of the program.

CHAIR WALLIS: It's not the title of a --

it's not the name of a report that goes with the program?

MR. DINGLER: No, sir.

CHAIR WALLIS: It is not? It's not.

MR. DINGLER: Well, there is a title plus a PA-SEE-183, that's the number that goes into the program to track the costs and stuff like that.

CHAIR WALLIS: Well, I mean, so there is a program?

MR. DINGLER: That is the program, yes.

CHAIR WALLIS: Okay. The thing I'm wrestling with is you've described a lot of interesting activities. I have no way of telling whether the product of these activities is useful or whatever until I see something. I don't want to be involved as being the reviewer of your activities, but somebody has to find out if all this product is actually turning out to solve the problem.

MR. DINGLER: As we talked, in other words, the NEI documents, NEI 04-07, was issued for an SE and we received that. We are submitting the downstream ones for an SE and we will be presenting the chemical bench testing for information.

CHAIR WALLIS: So the useful products will be subjected to a safety evaluation by the NRC?

MR. DINGLER: The downstream one will be an SE and then the other one is more of a data report and stuff like that, so that's for information. All the other documents that's listed if a plant uses them, it's open for audit reviews when they do the plant-specific. Like the lead blankets, 10 units for participating on that, so that will be available for them, the 10 plants.

CHAIR WALLIS: What we have heard from the staff this morning was that they had a lot of RAIs and so on from the work which industry was doing. We have heard from you that you are doing a lot of good activities, and presumably they will have questions about those.

MR. DINGLER: Sure.

CHAIR WALLIS: I just don't know how we evaluate whether or not these activities are solving the problem, since I haven't really seen the kind of thing that I could apply criteria to to evaluate them.

PARTICIPANT: We have another meeting in June to talk about technical stuff then.

DR. BANERJEE: It depends on what the question is. Are we supposed to, I mean, take an overview of this and factor in these activities and try to say yes, it's going in the right direction or

we should maybe think of something else or something else? So in that case, we need to have some more information. Is the SE enough? Is that what you're asking?

CHAIR WALLIS: I'm just wondering what is our role?

DR. BANERJEE: Our role?

CHAIR WALLIS: And I --

DR. BANERJEE: To see where all these pieces fit, I guess, and where it's going.

CHAIR WALLIS: Well, yes, I see a situation having been described here, which is more like a story, but that's not the basis for a technical evaluation by me. I would have to look at some data or something, some kind of model or some predictive method or some tool to be used with sophistication and all that kind of stuff and I haven't seen any of that. So I'm not quite sure how I can contribute to this except to say that there seemed to be an awful lot of aspects to this story. And whenever I see a slide from the staff, it seems to indicate there are a lot of questions yet to be answered.

MEMBER DENNING: Well, let me -- you know, there is a model, I think, that they are proposing. Let me say what I think it is and, please, you can

help me. The model goes like this. First of all, you look at the zone of influence and you determine how much debris is generated there. Okay. And there is some more work that may be done on that.

Then you take that and you flow it down by -- and there was some experimental work, but mostly it's a lot of expert judgment on how it transports down to the sump region. But so anyway, we have got a very crude model and definitely the staff thinks that's very conservative, you know. It's a little hard to say, but it's not a very theoretical model.

It's very -- you know, and then you've got the CFD analysis for the pool as far as carrying the stuff in the near region. And then I think the old model was then you used the correlations to tell you what the head loss was going to be, but now, the approach is you figure how much gets to the near region and then you do these vendor-specific experiments and it takes into account how much fall out you have in the near region and how much goes on to some simulated screen and you get the head loss.

Now, maybe there are a number of different tests you do, because they are recognizing well, it might make some difference for some things. But that's the kind of -- so there's this -- at the very

end there's an experimental piece that's put in that makes me uncomfortable. But I think that that's the approach that I think industry is taking.

CHAIR WALLIS: That's correct.

DR. BANERJEE: And it also factors in or will need to all these chemical processes that will go on as it goes to the screens.

MEMBER DENNING: But what I'm hearing is that well, maybe what you do is you have to say okay, I can estimate how much precipitant there is going to be and then when I put in my -- when I dump in my amount of stuff that I'm going to dump in in that experiment, you also dump in an appropriate amount of precipitant material, so that it affects then however --

CHAIR WALLIS: Well, more chemicals or something.

MEMBER DENNING: What's that?

CHAIR WALLIS: Something that's more typical of what's actually there in the path.

MEMBER DENNING: Yes, chemistry wise. Now, that's kind of -- I see the gross model that's now being described.

DR. BANERJEE: Then there is another piece to that besides the chemistry, which is how much

passes through that screen and where does that go?

MEMBER DENNING: Yes. And we haven't seen what I would say is a model for that, although, you know, as to how you do that piece of the analysis.

CHAIR WALLIS: We are going to hear tomorrow from results of tests --

MEMBER DENNING: Well, I guess --

CHAIR WALLIS: -- that were done in New Mexico.

MEMBER DENNING: Well, I think that the staff understands how you do some pieces of it, like when you've got little bits of debris that are going into pumps and stuff like that and the impingement and whether the material is hard enough not to erode. The big thing that I see in that piece of it is how much gets collected in various areas that could lead to loss of coolability of the core. That still seems to me to be a --

DR. BANERJEE: So cooling.

MEMBER DENNING: Yes.

DR. BANERJEE: Loss of coolability and loss of --

MEMBER DENNING: Yes.

DR. BANERJEE: I guess the issue though is that in each of these very, let's say, steps we

haven't heard what are the key dominant phenomena. To me it's not apparent what is important and what is not. I don't know to begin with what you should be trying to study. We know chemical is important. We know fiber is important. We know particulates are important. There isn't -- I'm used to seeing a PIRT or something and then from that a scaling analysis.

I mean, if you go into the loss of coolant analysis business, that's how they do things. There is nothing equivalent to that being done here. There seems to be no systematic approach of that nature where people are trying to take each step in this process, write down what is the important things and then how to scale them properly, whether the experiment is applicable or not to the model you are developing.

There's this whole scaling applicability, all this stuff, none of this is done. Sort of an ad hoc mash.

CHAIR WALLIS: I'm thinking we may say thank you very much, unless you have something else to tell us at this time.

MR. DINGLER: I don't, no.

CHAIR WALLIS: Do any of your colleagues from the WOG want to tell us anything more?

MR. DINGLER: I don't think so. I think I'm the only one here right now.

CHAIR WALLIS: They don't want to be subject to questions either.

MR. DINGLER: That's right. They don't want the Chicago Massacre on Valentines Day.

CHAIR WALLIS: I think we should like to finish up today with -- what's this, this is the highlight of the whole day, this is the coatings.

MR. YODER: We've got some coatings.

CHAIR WALLIS: This is the autoclave business.

MR. YODER: Not necessarily. What I'm going to do is kind of lay out for you what testing is ongoing and then some of the challenges we see. Okay. We're ready to proceed?

CHAIR WALLIS: Yes, please.

MR. YODER: My name is Matt Yoder and, as I said, we're going to go through some of the coatings issues of GSI-191.

The primary issue here, and I think you have heard from several of the speakers today, is that the staff has taken a conservative position for the zone of influence for coatings, for the debris generation and the transport of coatings and that is

unqualified coatings and qualified coatings that have been degraded or that are within that zone of influence.

Now, the staff's guidance also says that if plants would like to take exception to any of these conservatisms, they can perform testing and try to justify a different position.

CHAIR WALLIS: So the zone of influence was made conservative by making it bigger than you thought it was in terms of its diameter?

MR. YODER: That's correct.

CHAIR WALLIS: It wasn't in terms of its direction or anything. It's still assumed to be a sphere.

MR. YODER: That's correct.

MEMBER KRESS: Yes, but wasn't that sphere developed by taking a jet and going out to the point where it no longer does damage and --

CHAIR WALLIS: And making it the same volume, but it's not clear that a jet which is aimed in a direction where the coatings happen to be or whether -- you know, is going to be more or less conservative than having a sphere which lets, you know, the same volume be affected, but only in the sphere.

MR. YODER: Well, the ZOI, the 10D ZOI is loosely based on what was used for the BWRs, which was the conical type of jet.

CHAIR WALLIS: These are conical, yes.

MR. YODER: And that was a 10D jet out to that conical region, so this is really much more conservative to that because this is a sphere of that radius.

CHAIR WALLIS: But it has the same volume, so it doesn't go out so far but --

MR. YODER: No, this is actually a greater volume than that.

CHAIR WALLIS: Okay.

MR. YODER: Yes.

MEMBER KRESS: And it just takes the diameter out to the -- or the radius out to the point of damage.

MR. YODER: Correct. Whereas, before it was a cone, 10D, and then a cone out to that point.

CHAIR WALLIS: Right.

MR. YODER: Now, you're talking about a sphere.

CHAIR WALLIS: But I thought it was a sphere of the same volume as the cone.

MR. YODER: That's --

CHAIR WALLIS: It actually doesn't go so far?

MR. YODER: In the ANSI Jet Model, that is how it is done.

CHAIR WALLIS: You know how good the ANSI Jet Model is?

MEMBER DENNING: That's what the ANSI Jet Model does, but you do it the way Tom explained it where you go out and then you take that whole sphere?

MR. YODER: Correct.

DR. BANERJEE: It's typically 10 or 12 diameters? What is that, the break diameters?

MR. YODER: For coatings?

DR. BANERJEE: Yes.

MR. YODER: What we have laid forth in the guidance is 10 pipe diameters.

DR. BANERJEE: Right.

MR. YODER: Now, I will talk about some of the testing that's going on now.

DR. BANERJEE: 10 break diameters, right?

MR. YODER: Right, the diameter of the pipe, the break pipe.

DR. BANERJEE: Yes.

MR. YODER: I will talk a little bit about some of the testing that is ongoing to try to reduce

that.

CHAIR WALLIS: This is all kinds of coatings now?

MR. YODER: Correct.

CHAIR WALLIS: Because of uncertainty about qualified coatings?

MR. YODER: Well --

DR. BANERJEE: Unqualified coatings.

CHAIR WALLIS: Qualified coatings, if they are well-prepared and they are new, seem to be very resistant to jets.

MR. YODER: That's correct. Within the ZOI it would be any kind of coatings, qualified or unqualified. And then outside of that zone of influence, you would be talking about the unqualified coatings or the coatings that were originally qualified that have somehow become degraded through whatever damage mechanism over time. Okay?

DR. BANERJEE: Let me ask one question on this, too. There is an effect, obviously, of momentum or other things, you know, mass transfer due to the jet hitting certain regions. So within this 10 diameters, the velocity of the jet is taken into account and outside it's not or in --

MR. YODER: For --

DR. BANERJEE: Let's say testing an unqualified coating.

MR. YODER: Sure.

DR. BANERJEE: When you do it in an autoclave, you have steam or whatever coming out.

MR. YODER: There would be no jet impingement in that kind of testing. It would be subject to spray like you would see in the bulk of the containment, not necessarily that jet that you would get from a pipe break.

DR. BANERJEE: Okay. That's good, clarified.

CHAIR WALLIS: Now, when you do tests on these things, you just direct a jet at them or something for --

MR. YODER: For zone of influence testing --

CHAIR WALLIS: If you're actually in the containment, a jet goes out and hits the containment and spreads along the wall in some ways and it's not quite the same thing as just putting a coating in a jet.

MR. YODER: That's correct.

CHAIR WALLIS: Okay.

MR. YODER: So I think the reason that a

sphere is used is because if you were to have some pipe or a column or something directly in front of a jet, you would then get spray out to the sides and in all directions. So by taking a spherical area, you kind of encompass all that.

CHAIR WALLIS: Right, that's the idea.

DR. BANERJEE: It would pretty well be steam, right? It's not going to be --

MR. YODER: It's going to be a two phased jet. It's going to be steam and then --

DR. BANERJEE: By the time -- it will evaporate.

MR. YODER: Right.

DR. BANERJEE: Right?

MR. YODER: It will be --

MR. ARCHITZEL: Super-heated.

MR. YODER: -- super-heated steam, so it will expand as it comes from the pipe.

DR. BANERJEE: Right.

MR. ARCHITZEL: Mostly, liquid.

MR. YODER: Go ahead, Ralph.

MR. ARCHITZEL: Well, just to comment, I think it's definitely two phased. It's mostly liquid.

DR. BANERJEE: Oh, is it? Well, it's stated --

MR. ARCHITZEL: There's a little bit of steam in there, but it's coming out of the RCS so fast.

CHAIR WALLIS: It's mostly liquid, mostly liquid.

MR. ARCHITZEL: Mostly liquid.

DR. BANERJEE: I see. I didn't realize that. Okay. Well, so there is an erosion effect as well.

PARTICIPANT: Yes.

CHAIR WALLIS: You wouldn't want to be a coating in that jet.

DR. BANERJEE: No. I wouldn't want to be anywhere near that jet.

MR. YODER: Typically, what you see, I will address this slide in a second, but since we're talking about it, what you see in this kind of testing, when you do see failures within that zone of influence, within that jet, it is erosion type failure. It's not coming off in big chips or sheets. So that's also laid out in the staff's guidance, that for that volume, that ZOI, you assume that those coatings are failing as 10 micron particulate and then they are going to transport.

CHAIR WALLIS: Now, they are only being

bombarded by a two phase jet. They are not being bombarded by pieces of reflective metal insulation?

MR. YODER: No.

CHAIR WALLIS: Because there's lots of debris flying around in there for awhile.

MR. YODER: Well, you're talking about an area in the immediate vicinity of a pipe break, so at this point you're generating all of that kind of RMI and all that kind of debris and you're not necessarily impinging it onto that surface.

CHAIR WALLIS: But you are impinging some of it on the surface.

MR. YODER: I would imagine that --

CHAIR WALLIS: I mean, some of it.

MR. YODER: You might entrain some of the surrounding materials.

MEMBER SHACK: Blow it into 10 micron particles, I mean.

MEMBER KRESS: Yes, you have already got it.

CHAIR WALLIS: But this is all the same.

MEMBER KRESS: You have got to cut it up pretty little.

CHAIR WALLIS: Some of it is not so small.

MR. YODER: So testing that what we're

aware of to date, as you heard earlier, two groups have done some ZOI testing. We don't have the formal data yet, but I can tell you that we received presentations recently and you're talking about reducing that conservative 10D ZOI down to something like four or five pipe diameters for most coatings.

For the inorganic zinc coatings, they are more porous in nature, so they tend to erode at lower pressures. So for those kind of coatings, you're talking about something more along the order of seven or eight pipe diameters. So you actually end up with a ZOI for epoxy type coatings and then a ZOI for the inorganic zinc.

DR. BANERJEE: So the two industry groups, they are with qualified and unqualified coatings?

MR. YODER: No.

DR. BANERJEE: Or they are only with unqualified?

MR. YODER: Qualified coatings, testing qualified coatings, because you assume that unqualified coatings are going to fail regardless of where they are in the containment.

DR. BANERJEE: But then you're testing the unqualified.

MR. YODER: Yes. Well, that's the next

bullet here, is there is also -- obviously to say that 100 percent of the unqualified coatings fails is as conservative as you can get, right? So there is also testing going on, being done by EPRI, where they have subjected some actual plant samples of unqualified coatings to a DBA type autoclave test where they are subjected to elevated temperatures and spray for a period of time. And the idea was to quantify how much actually fails.

DR. BANERJEE: So this is outside the ZOI?

MR. YODER: Correct. That would be coatings outside of the ZOI, unqualified coatings outside of the ZOI.

DR. BANERJEE: So are there unqualified coatings potentially within the ZOI, too?

MR. YODER: Yes, and those would have to be considered in that debris term.

DR. BANERJEE: 100 percent?

MR. YODER: Correct.

DR. BANERJEE: All right.

CHAIR WALLIS: Well, I saw a table of results. I'm not sure whether this is proprietary or not, but it had sort of tables or entries of epoxy and zinc and so on.

MR. YODER: Yes.

DR. BANERJEE: Alkyds.

CHAIR WALLIS: And sometimes alkyds, sometimes 95 percent of it was torn off and sometimes 1 percent from what looked like almost the same experiment. I just wondered if this is gathered in the quality of the coatings or something. I don't quite know how to take it when I have got very different numbers --

MR. YODER: Within --

CHAIR WALLIS: -- in what looked like similar --

MR. YODER: -- this group that we're referring to as unqualified coatings, you have got --

CHAIR WALLIS: It looked like similar experiments.

MR. YODER: -- a wide range of coatings.

CHAIR WALLIS: A very wide range.

MR. YODER: Right. These are anything that haven't been through the rigor of the actual testing, so they could be anything that came in on a piece of equipment or something that was put in as a repair in a plant without having the proper level of QA. So there is a wide range of these coatings and you would expect to see, you know, some of them will perform much better than others.

DR. BANERJEE: And these were -- I remember with pieces that industry sent or something, there were 16 pieces that were stuck in autoclaves.

MR. YODER: That's correct. This testing was performed on equipment, electrical cabinets and pipe hangers and various pieces of equipment that they were able to obtain from licensees. And I want to also point out that, you know, the results of all the -- all this testing that I'm talking about here is still preliminary to the staff. We haven't performed formal reviews of any of this.

And, you know, to the extent that I can, I will try to tell you what the preliminary indications are, but we will be reviewing these in detail as we move forward with this process. The other --

CHAIR WALLIS: And all these things go into the chemical soup.

MR. YODER: That's correct. Other testing that we discussed this morning is the NRC sponsored testing that attempts to look at the transportability of the coatings. And, as I said this morning, we're looking at both those unqualified coatings, because they tend to be lower density, the alkyd type coatings, and then also the qualified type coatings

that you would expect to see either in the degraded state outside of the ZOI or failing from within the ZOI.

Also alluded to this morning are some of the key challenges that we see here is that really we don't know how these things are going to fail outside of that ZOI. Are they going to fail as the 10 micron particulate? We have put that forth as guidance, because that's going to give you the most transportability.

So any licensee who would try to say that the coatings won't transport, because they fail in large enough pieces, that they are going to settle out prior to making it to the sump, is going to have to provide some kind of analysis, test data, perhaps the same kind of autoclave data of their own specific coating type in order to make that transport judgment.

MEMBER KRESS: When you say 10 microns, are you assuming this is a sphere?

MR. YODER: Yes.

DR. BANERJEE: In the autoclave tests, there were no -- I didn't see any measurements of particle size for these coatings.

MR. YODER: They are --

DR. BANERJEE: Are there any measurements

for these?

MR. YODER: As an appendix to that EPRI report I believe there is some data --

DR. BANERJEE: Yes.

MR. YODER: -- of the particles that were captured on filters downstream.

DR. BANERJEE: Right, but did they size those?

MR. YODER: I believe that general observations were made.

DR. BANERJEE: Okay.

MR. YODER: I don't know. I don't know if they attempted to do -- I don't believe that --

DR. BANERJEE: No.

MR. YODER: -- a mass balance was attempted to try to capture all of the material that failed. It was more looking at the screen and then making some measurements of what you could see on those filters.

DR. BANERJEE: These's lots of pictures but, yes, anyway, I didn't notice any numbers. Okay.

CHAIR WALLIS: These coatings, what are they made out of typically?

MR. YODER: Well, as I said, the unqualified coatings are a wide range of materials.

CHAIR WALLIS: There might be a powder of some sort with some kind of a binder or something that was with it.

MR. YODER: For the qualified coatings you're typically talking about either an epoxy, self-priming epoxy system, where you have two layers of an epoxy type coating or you would have this inorganic zinc primer that you have heard about with an epoxy topcoat on it.

CHAIR WALLIS: What does the inorganic zinc primer look like?

MR. YODER: It's got --

CHAIR WALLIS: It has got zinc particles in it, in a suspension?

MR. YODER: It's maybe 5, 10 percent fine zinc particles with an ethyl silicate binder, so you can think of it as kind of like a concrete. It doesn't really behave. I guess when I say that, what I'm referring to is if you look at the surface of this stuff, it's very porous like the surface of concrete would be.

CHAIR WALLIS: I'm just wondering if the zinc particles are stripped of their coating, so you have got a whole lot of zinc subject to chemical effects, which is not protected by anything.

MR. YODER: That's part of the ICET that was performed.

CHAIR WALLIS: Did they --

MR. YODER: There was zinc in those tanks.

CHAIR WALLIS: But did they actually use very finely divided zinc that was --

MR. YODER: It was the same material that we're talking about here where this inorganic zinc primer is actually coated onto a surface.

CHAIR WALLIS: But was it broken up by a jet?

MR. YODER: No.

CHAIR WALLIS: Then I think it would be very different if it were broken up by a jet, so you have got a cloud of tiny zinc particles, you know, in a boric acid solution, because it hasn't yet been buffered. I don't know what happens, but it's not the same thing as having a coating in an ICET tank.

MR. BATEMAN: This is Bill Bateman. But what you have to recognize though is that the jet hits the epoxy. The epoxy is on top of the zinc.

CHAIR WALLIS: Yes, but everything gets shattered, doesn't it?

MR. BATEMAN: Well, I think from the results that we have seen -- Matt, I don't know if

you're going to get to that in your slides.

MR. YODER: Well, within that, within the zone of influence, we would assume that all of that coating is destroyed.

CHAIR WALLIS: Well, I think he is going to say it doesn't get destroyed.

MR. YODER: Within that ZOI, whatever the ZOI that we come to, if we take 10D as the staff guidance says --

CHAIR WALLIS: It doesn't disappear then. It assumes some other form and you need to --

MR. YODER: That's correct. It's going to turn into a fine particulate.

CHAIR WALLIS: Okay.

DR. BANERJEE: This is your 10 micron particle?

MR. YODER: That's correct.

DR. BANERJEE: Yes.

MR. YODER: Now, I think what Mr. Bateman is referring to is in some of the testing, we have seen that that top layer of epoxy will start to erode and it will never make it down to the zinc.

CHAIR WALLIS: That's very different. You're assuming it's all made into finely divided particles.

MR. YODER: That's correct.

MEMBER KRESS: When you do that, is one of the particles pure zinc and one part pure epoxy and another part is particle pure binder or is each particle a mixture of those?

MR. YODER: Well, in this testing that we're referring to, no attempt was made to capture the particles after the fact, so it's hard to say. I would imagine you would have fine pieces of epoxy, fine pieces of zinc and maybe some that were some combination.

CHAIR WALLIS: But if zinc is going to react chemically with the fluid, it's going to do it much more readily, presumably, if it's very finely divided.

MR. YODER: I agree. It has a much higher surface area after the break.

CHAIR WALLIS: Possibly very quickly.

DR. BANERJEE: Now, looking at these unqualified coatings, if these are -- they are mainly zinc chromate primer with an epoxy phenol, right? That is about 60 percent or is that? Am I reading it wrong? No, sorry.

Alkyds are there. So did you do any tests with these in the zone of influence or only outside of

the zone of influence?

MR. YODER: Well, the testing -- let me just restate this.

DR. BANERJEE: Yes.

MR. YODER: EPRI conducted the unqualified coatings testing and that was only looking at conditions outside of that ZOI, so it wouldn't be subjected to any kind of a jet impingement at all.

CHAIR WALLIS: There were some preliminary tests done before the ICET in which they just put zinc in a bottle with some fluid and measured, rather inconclusive results, but I think that there were reactions.

MR. YODER: I'm unaware. We might have to ask the people from research tomorrow.

CHAIR WALLIS: Yes, we'll ask them. Okay.

MR. YODER: The other point that I want to make, and we have touched on it many times today, is a lot of this testing is proprietary to one vendor or to one group that is doing the testing, so it may be difficult for the staff to take testing from Plant A and apply that to Plant B who doesn't have the access to that same report. So we may be able to draw inferences and inform our judgment, but we can't necessarily cross that balance to somebody else who

doesn't have that same data.

So this is my last slide, the path forward for coatings work. As we said, if a licensee chooses to follow that staff guidance, we believe it is very conservative and then they would be able to size their strainers accordingly and provide enough margin, we would be satisfied.

For a case where a licensee wants to vary, you know, in the area of ZOI or the size of the coatings debris or the amount that transports, we'll be using this testing that we have been discussing along with any plant-specific testing that might be performed on plant-specific coatings to inform that judgment and then make a judgment on whether we approve of the methodology they are using.

DR. BANERJEE: How will they use the EPRI data, because the EPRI data is very, very -- will they use the EPRI data, let me ask first because --

MR. YODER: Based on the original submittals --

DR. BANERJEE: Yes.

MR. YODER: -- I think at least a half dozen plants, probably more, will use that EPRI data perhaps to reduce the volume of unqualified coatings that they have to use in their sizing of the strainer,

perhaps to look at the size of those particles also.

DR. BANERJEE: Because the EPRI data is rather spotty. I mean, it's not a very wide sample, because the number of samples sent to them weren't that large. So at the end of it, there is wide variability. I mean, when you say alkyds, it can be anywhere from 54 percent to 12 percent or something.

MR. YODER: Right.

DR. BANERJEE: So what number will they use?

MR. YODER: Well, I think that when the staff performs that evaluation, we're going to look at it on a plant-specific basis. So a licensee would have to show either that they have alkyd X or take the most conservative, meaning which alkyd failed the most, and that would be staff's stance.

DR. BANERJEE: I see.

MR. YODER: Unless you can prove that you have, you know, that more rigid alkyd or the more better performing alkyd, then the staff would want you to take a more conservative number.

CHAIR WALLIS: Part of your assumptions relate to reality here. And if you assume that coating gets all broken up into 10 micron spheres of its constituents, then how it gets transported is

going to, you know, be how that sort of stuff would get transported. But you may not be able to create that kind of a mixture in a test because it isn't what really happens.

So how do you do transport testing on a hypothetical mix?

MR. YODER: Well, I can talk a little bit about the --

CHAIR WALLIS: I mean, if you're forced to assume something, how do you test how it gets transported --

MR. YODER: Well, again, we'll --

CHAIR WALLIS: -- if it's only an assumption?

MR. YODER: We'll hear more from Research in the days to follow, but let me talk a little bit about the NRC sponsored testing.

What we attempted to do there was take a range of coatings of various densities, unqualified and qualified, and then take a range of sizes, everything down from 164th of an inch up through 1 and 2 inch chips, so that we can try to cover that gambit in our confirmatory testing, so that when a licensee comes in and says I have chips that are a half inch based on testing that I performed and the analysis

that I performed, we have data to say whether or not their transport analysis --

CHAIR WALLIS: But these are now chips. These are not the 10 micron particles.

MR. YODER: That's correct. The transport testing, the confirmatory testing by the NRC is of chips and the stance is that fine particulate is going to readily transport.

CHAIR WALLIS: I would think it will. I think 10 micron spheres would very readily transport.

MR. YODER: And that's the staff's position.

CHAIR WALLIS: Right.

DR. BANERJEE: Well, your data also showed that 10 is not necessarily conservative. There is data down to 1 micron. There is a wide distribution.

MEMBER KRESS: There needs to be a particle distribution.

DR. BANERJEE: Yes.

MR. YODER: I think in reality you will see some distribution of particles from 1 to 1,000 microns or --

MEMBER KRESS: I think in order to evaluate this problem, you need to know what that is.

MR. YODER: Well, I think that the basis

for the 10 microns is we --

DR. BANERJEE: It's probably the average.

MEMBER KRESS: It may be a mean.

MR. YODER: It's a mean and we understand the behavior of particulate on a fiber bed, so we can, you know --

MEMBER KRESS: Could you do something arbitrary like call that the mean of a log normal distribution and adjust the amount in each size so that you get the total quantity, total mass, I mean, something like that?

MR. YODER: Well, I know that the guidance that we have given to some of the vendors when we have gone to like some of the flume testing where they are using chips of various sizes, that we want them to characterize what is that range of chips and things like what is the mean surface area of that chip, things like that.

MEMBER KRESS: Yes.

CHAIR WALLIS: Well, what are the chemical tests that are being done with these very finely divided zinc particles if they are created?

MR. YODER: I'm sorry, was the question what --

CHAIR WALLIS: What chemical tests have

been performed with these zinc particles down to 1 micron size?

MR. YODER: You referenced testing of fine particulate and I'm not aware of that.

CHAIR WALLIS: I think there were zinc coupons. It's very different from --

MR. YODER: That's correct.

CHAIR WALLIS: And zinc coupons did have some reactions with some of the mixes, as I remember.

MR. YODER: That's correct.

MR. DINGLER: Dr. Wallis, this is Mo Dingler. In our WOG testing we took zinc powder and put it through the bench test, saw a very low reaction at that time.

CHAIR WALLIS: You stirred it up with what, boric acid?

MR. DINGLER: Yes, boric acid and then put a buffer to it. We used zinc powder.

CHAIR WALLIS: You saw very little reaction?

MR. DINGLER: In relationship to the head loss and stuff like that. I can't remember the exact details off the top of my head. That was in a presentation last week and I think it's available if they want to look at it, but we used zinc powder and

put it through boric acid and both sodium hydroxide, TSP and Borax.

CHAIR WALLIS: Okay. So that data is something that, what, are you going to give it to us or something? How do we get hold of it?

MR. DINGLER: That's in the WCAP we're submitting to the staff.

CHAIR WALLIS: Which is now proprietary?

MR. DINGLER: No, it's a Class 3, nonproprietary.

CHAIR WALLIS: So that will appear eventually on a CD or something for us?

PARTICIPANT: Yes, before March.

CHAIR WALLIS: Before March?

PARTICIPANT: As soon as I get it.

CHAIR WALLIS: So we got a few more feet of material to read?

PARTICIPANT: Probably.

CHAIR WALLIS: Okay. Thank you.

PARTICIPANT: Another cart load.

DR. BANERJEE: What is sponsored transport testing? It's only chips, you said?

MR. YODER: That's correct.

DR. BANERJEE: Chips of what, paint and things?

MR. YODER: The testing I'm referring to here is only transport of coatings, so chips of --

DR. BANERJEE: Chips.

MR. YODER: -- alkyd paint, epoxy point, zinc paint.

DR. BANERJEE: All right.

MEMBER KRESS: Are you calling them -- we are with an open stream?

MR. YODER: It's actually -- and, like I said, we'll get into all these details in the Research presentation, but it's actually a plexiglass channel.

MEMBER KRESS: Channel.

MR. YODER: Yes.

DR. BANERJEE: Open channel?

MR. YODER: Yes.

CHAIR WALLIS: Okay. Thank you. Well, I still have the same. I'm still in the same situation. I have seen this description of a lot of stuff going on. It sounds very interesting, but I don't have any basis for evaluating it technically.

PARTICIPANT: Yet.

DR. BANERJEE: We'll see after tomorrow.

CHAIR WALLIS: Maybe after tomorrow we'll have some -- tomorrow is all technical information, isn't it?

DR. BANERJEE: And we have the day after.

CHAIR WALLIS: But it may not answer some of the questions we had today.

MEMBER KRESS: We don't know how we're going to summarize this. Oh, I'm sorry. Tomorrow we'll hear from Bill Shack.

PARTICIPANT: And Mike Scott.

CHAIR WALLIS: Mike Scott wants to reassure us.

MR. SCOTT: Well, one thing I'm sure of is you'll still have questions after tomorrow.

DR. BANERJEE: Ralph, do you have the NEI report on CDs?

MR. ARCHITZEL: Which NEI report?

DR. BANERJEE: The one that they referred to.

MR. ARCHITZEL: The guidance document?

DR. BANERJEE: Yes.

MR. ARCHITZEL: I have that, yes.

CHAIR WALLIS: We have it somewhere on near effect.

MR. SCOTT: What I would like to do --

CHAIR WALLIS: Mike Scott, how long have you been involved with this project?

MR. SCOTT: About two weeks.

CHAIR WALLIS: Official weeks. Okay.

MR. SCOTT: So you can expect an in-depth analysis from me.

MEMBER KRESS: You're going to give us a new perspective as someone from --

MR. SCOTT: That's right. A cold-bodied reader. There you go. What I would actually like to do is just clarify a couple of points that we may or may not have made clear initially from a management perspective.

This is the slide out of Jon Hopkins' initial presentation that speaks to our path forward for resolving the issue, and I was advised perhaps that there was a misimpression that the staff is standing pat on its safety evaluation and that we don't anticipate changes to it.

While we have not identified the need for changes, at this point, it is certainly correct to state that we recognize that more information comes in every day and if the results of the testing lead us to revise the SE, we'll certainly do that. If the testing leads us to issue additional generic communications, we'll do that.

As you know, we just issued a supplement to our information notice and there may be more of

that to come. Not to say we're predicting the future, but I just wanted to make the point that we're very much open to the need to develop new documents or guidance as things develop.

CHAIR WALLIS: Since you're on this figure, when I noticed it before, I noticed that there was no input to the ACRS. Somehow we come in from outside and we magically --

MR. SCOTT: Wait a minute, wait a minute. Oh, okay.

CHAIR WALLIS: -- issue a review with no input and this leads to closure.

MR. SCOTT: This slide was described by Jon Hopkins as busy and it was busier before the dry run took some of the boxes out of it, but we certainly were making sure that we had your input to the process, at least one input and we recognize --

CHAIR WALLIS: What's puzzling to me is how do we have -- most effectively give input to this process? We can't do everything. We cannot possibly do everything. What is the best role that we can have to help you folks solve this problem?

MR. SCOTT: Why don't --

CHAIR WALLIS: Besides keeping quiet, which is not --

DR. BANERJEE: Or an option.

MR. SCOTT: Why don't we have that discussion again after you hear the Research presentations?

CHAIR WALLIS: Okay. Okay.

MR. SCOTT: Fair enough.

CHAIR WALLIS: And your folks are going to be here or at least some of you are going to be here.

MR. SCOTT: Yes.

CHAIR WALLIS: I don't think you all have to be.

MR. SCOTT: We're planning to have most of the key players here for the presentations for tomorrow and the next day. One other thing I would like to do is kind of sum up management's perspective on the path that we have taken. I think this has been referred to, but I sort of laid it out in logic terms here just to give you our views on how this is going.

We recognize, as you all do, that there are many uncertainties on this issue and that some of those uncertainties are likely to be difficult to reduce or are going to take a significant amount of time to reduce them. As you know, as you're going to hear about more tomorrow, the staff and the industry are doing testing to support reducing these uncertainties.

Nevertheless, in view of the complexity of the issue, which we have all talked about, and the staff's viewpoint that most of the existing strainers are greatly clearly undersized, staff believes that inaction until the uncertainties are resolved is not appropriate. We believe action is needed now. Therefore, we are pushing the industry, as we discussed, to make the modifications to reduce the vulnerabilities before December or before the end of December 2007.

Our judgment is that the larger strainers that the industry plans to put in, which have been discussed, will not do harm and are highly likely to reduce the risk. As you heard from Mo Dingler, the strainer modifications that are going in are being installed in conjunction with analysis of the downstream effects, so that we're -- again, we're anticipating that these strainers are highly likely to help the problem.

Furthermore, once the strainers have been modified, if we find from the results of the testing that is ongoing that additional modifications are needed or additional plant measures are needed, there are various options that are available. So we believe that the appropriate situation, given all these

factors, is for the strainer modifications to proceed in parallel with continuing to reduce the uncertainties on the issue.

CHAIR WALLIS: Well, how are you going to show that these strainers, making the strainers much bigger is going to reduce the risk of blocking up the core with debris?

MR. SCOTT: I would say that a path that is being taken, and those who have been at this a little longer than me can jump in if they prefer, is that we will show or the licensees will show that if they are going to put a modification in that involves a much larger strainer, that, number one, the larger strainer will reduce or tend to positively influence the differential pressure issue at the strainer and, number two, it will not result in an uncoolable situation in the core.

CHAIR WALLIS: Well, I have not seen any prediction anywhere of how much debris gets to the core. So how are you going to reduce the risk of something which no one has yet predicted?

MR. SCOTT: Point taken and we'll get back to you on that.

CHAIR WALLIS: I think that's a very important issue. It may have been a sleeper or

something all along, but it's obviously something. Unless we are so totally misled or misguided or foolish, it seems --

MR. HANNON: This is John Hannon of the staff. I think you will hear some more about this tomorrow. We have the results of the screen bypass test that do illuminate that subject plus we know from the work that is being done with the GE active design that roughly 30 percent of the debris that gets to the strainer gets pushed through.

So there are some facts that we have at our disposal now on that subject. So we will be continuing to evaluate that as we move forward to make sure there is no adverse impact in the coolable.

CHAIR WALLIS: 30 percent gets through.

MR. HANNON: Yes. You heard earlier that it was ground, much of the material gets ground up and, on the average, about 30 percent. At least that's the number that I recall from having the discussion.

CHAIR WALLIS: Well, where does it go?

MR. HANNON: Into the downstream flow path.

CHAIR WALLIS: Where does it finish up?

MEMBER DENNING: Where does it finish up?

Does it then exit the reactor coolant system at some point or does it accumulate in it?

DR. BANERJEE: This is -- the NEI guidance has a way to evaluate that, right, where it goes? So one has to take a look at that, at least we should look at the guidance before. Is that what you are saying, that that's the source term for the deposition in various parts of the system?

MR. HANNON: That's correct. One of the things that we'll also do is one of the plants that we audit will be one of the active strainer designs. That will be one of the issues we'll be looking at.

DR. BANERJEE: One of the things is that they are doing experiments for each strainer design for each plant. That's what we have heard more or less. Perhaps they could also measure what gets through, so we would have a number at least there.

MR. WHITNEY: It's very typical. This is Leon Whitney. It's very typical during the strainer test in the pools and whatnot to take grab samples of what goes downstream. That is not missed. They do take the samples. Now, how they deal with the issue of where it goes, etcetera, is a separate thing, but I didn't want you to think that they do not take the samples.

DR. BANERJEE: And do they find out how much and what particulates are in those grab samples?

MR. WHITNEY: The samples are analyzed.

DR. BANERJEE: All right.

MR. WHITNEY: So, again, what --

DR. BANERJEE: So they have that.

MR. WHITNEY: The conclusion of the downstream issue is yet to be provided.

DR. BANERJEE: Um-hum.

MR. ARCHITZEL: I probably shouldn't be saying this, but we had a position in the SE that you can't credit the debris for forming a filter bed. So another issue we found in the pilot audits was these testings. I didn't mention all the issues we found. One of the issues we identified was the credit during the conduct of a test for the filtration of the fiber bed you may have on that bed.

We would -- of course, if we're asking them to evaluate downstream, we would ask them to look at a semi clean strainer for that aspect of that evaluation. So a lot of that data that is collected will show a beneficial effect of filtration. Unfortunately, we're going to hold them back from crediting that when the --

CHAIR WALLIS: Because --

MR. ARCHITZEL: Because you would have a low fiber type situation accident that has passed through or at least behind it.

DR. BANERJEE: Well, so that means that they will have a lot of stuff getting through the semi clean strainers.

CHAIR WALLIS: It depends what arrives first, too, doesn't it?

DR. BANERJEE: Yes.

MEMBER KRESS: You're saying there is a range of accident sequences at a given plant depending on where the LOCA occurs?

PARTICIPANT: Yes.

MEMBER KRESS: So you have to look at that whole range of possibilities.

MEMBER SHACK: Yes. I mean, they frequently have high fiber sequences, low fiber sequences, you know, high particulate sequences, low particulate sequences.

CHAIR WALLIS: Well, I would imagine that the fines arrive first. They are with the water. Isn't it hard to imagine that fiberglass would outpace the water and it's rushed to the screen, but the fine --

MEMBER DENNING: Fibers will transport

pretty well.

CHAIR WALLIS: I mean, so they might arrive with the water or later. The fines will probably come with the water, presumably.

DR. BANERJEE: They would both come, I would think, you know, some fiber and some particles in there.

MEMBER KRESS: Probably finer than 10 micron. That's a lot of split there.

CHAIR WALLIS: I wasn't sure it was going to be a study process. I think I raised this question before. As the thing, as the accident progresses, you get piles of fiberglass sort of stacking up on staircases and here and there and everywhere, and then it makes dams and you get these lakes and then the dam breaks and there is a rush of fluid, which isn't a steady process and it's -- you know, so it's not as if it's just -- you just calculate everything as happening in a nice, steady scenario. You would get bumps and sudden surges and whatever.

MEMBER KRESS: Bumps and rises.

CHAIR WALLIS: I know.

DR. BANERJEE: Yes, but with these big surface areas, likely most of the stuff is -- if it's captured and forms a thin bed or something, then there

would be a filtration effect. I guess what they are saying is that they are not going to give credit for that, because there are some scenarios where that won't happen and you can get all the stuff going through, at least the fines.

CHAIR WALLIS: Well, this is important.

MR. ARCHITZEL: Ralph Architzel one more time. I would like to point out one vendor did come in and talk about it. We will take engineered solutions to fine mesh filters downstream or upstream, so there is an option to reduce that term that doesn't rely on the accident placing the fiber there. And I guess we would be somewhat considering of the fact you can't have inconsistent accidents.

You can have an accident that has tons of debris and no fiber solely, so your term could go down, but you can't assume a filtration bed there, but you don't need massive amounts of particulate perhaps in that second case either. It's difficult. We'll have to evaluate that.

CHAIR WALLIS: Okay. We have probably finished for the day, 5:00.

DR. BANERJEE: Good timing.

CHAIR WALLIS: We're ahead of the game.

MEMBER KRESS: Yes.

CHAIR WALLIS: We didn't expect to be, because we were behind and we were asking all the questions. Maybe if there had been more answers, we would have been here longer, because we could then have gone back and questioned the answers. And, certainly, if we had seen some data and graphs and theories, we could have been here for a much longer time.

MEMBER KRESS: Oh, we would have been here forever. They have learned that.

DR. BANERJEE: I think tomorrow.

MR. SCOTT: Yes, wait for tomorrow. There will be more tomorrow. Wait for tomorrow.

CHAIR WALLIS: Yes, everything is going to be interesting tomorrow. Okay. We will see you folks then in the morning. I hope you have a good sleep. We're going to -- what is the right word?

MEMBER KRESS: Oh, recess.

CHAIR WALLIS: We're going to recess until 8:30 tomorrow morning.

(Whereupon, the meeting was recessed to reconvene tomorrow at 8:30 a.m.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on Reactor Safeguards Meeting

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

John Mongoven
Official Reporter
Neal R. Gross & Co., Inc.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MEETING OF THE SUBCOMMITTEE ON
THERMAL HYDRAULICS
ROOM T2B3, 11545 ROCKVILLE PIKE, ROCKVILLE, MD
February 14-16, 2006

ACRS Contact: Ralph Caruso (301) 415-8065
E-mail: rxc@nrc.gov

- PROPOSED SCHEDULE -

Tuesday, February 14, 2006

Topic	Presenter	Time
Introduction	G. Wallis(ACRS)	8:30 - 8:35
1. Opening Remarks	M. Scott (NRR)	8:35 - 8:40 am
2. Overview of GSI-191 Resolution Status: GL 2004-02 Responses, Audits of Licensees, Overview of Status and Path Forward	T. Hafera, J. Hopkins, D. Cullison, R. Architzel (NRR)	8:40 - 10:40 am
** Break **		10:40 - 11:00 am
3. Chemical Effects	P. Klein (NRR)	11:00 - 12:00 noon
** Lunch **		12:00 - 1:00 pm
4. Removal of TSP	M. Hart, D. Harrison(NRR)	1:00 - 1:30 am
5. Downstream Effects	T. Hafera, S. Unikewicz (NRR)	1:30 - 2:00 pm
6. Coatings	T. Hafera, M. Yoder (NRR)	2:00 - 2:30 pm
** Break **		2:30 - 2:45 pm
7. Industry Response to GL 2004-02	J. Butler (NEI)	2:45 - 4:00 pm
** Break **		4:00 - 4:15 pm
8. GSI-191 Activities of the Westinghouse Owners Group	M. Dingler (WOG)	4:15 - 5:30 pm
Recess		5:30 pm

Wednesday, February 15, 2006

Generic Safety Issue 191
Chemical Effects Testing

Topic	Presenter	Time
Introduction	G. Wallis (ACRS)	8:30-8:35 am
9. Opening Remarks, Introductions	M. Cunningham(RES)	8:35-8:40 am
10. Overview	R. Tregoning (RES)	8:40 - 9:00 am
11. Chemical Effects Research - ICET Program: Overview, Technical Program, and Results	B.P Jain (RES) B. Letellier (LANL)	9:00 - 11:00
** Break **		11:00 - 11:15 am
12. Chemical Speciation Prediction: Overview, Technical Program, and Results	B.P Jain (RES) V. Jain (CNWRA)	11:15 - 12:15 pm
** Lunch **		12:15 - 1:15 pm
13. Chemical Effects Head Loss Testing: Overview, Technical Program, and Results	P. Torres (NRC) W. Shack (ANL)	1:15 -3:15 pm
** Break **		3:15 - 3:30 pm
14. Head Loss Correlation Development: Overview, Technical Program, and Results	W. Krotiuk (RES) C. Enderlin (PNNL)	3:30 - 5:00 pm
15. Closing	M. Evans (RES)	5:00 - 5:05 pm
Recess		5:05 pm

Thursday, February 16, 2006

Generic Safety Issue 191
Chemical Effects Testing

Topic	Presenter	Time
16. Opening	R. Tregoning (RES)	8:30 - 8:35 am
17. Throttle Valve Clogging Testing: Overview, Technical Program, and Results	R. Tregoning (RES) B. Letellier (LANL)	8:35 - 9:30
18. Coatings Transport Testing: Overview, Technical Program, and Results	E. Geiger (RES) A. Fullerton (NSWC)	9:30 - 10:30 am
19. Closing	M. Evans (RES)	10:30 - 10:40 am
** Break **		10:40 - 11:00 pm
20. Committee Discussion		11:00 - 1:00 pm
Adjourn		1:00 pm

Note:

Presentation time should not exceed 50% of the total time allocated for a specific item.

Number of copies of presentation materials to be provided to the ACRS - 50.

Overview of Resolution Status and Plans for Generic Safety Issue (GSI)-191

Presented by Jon Hopkins
NRR/DPR
ACRS Subcommittee on Thermal Hydraulics
February 14, 2006

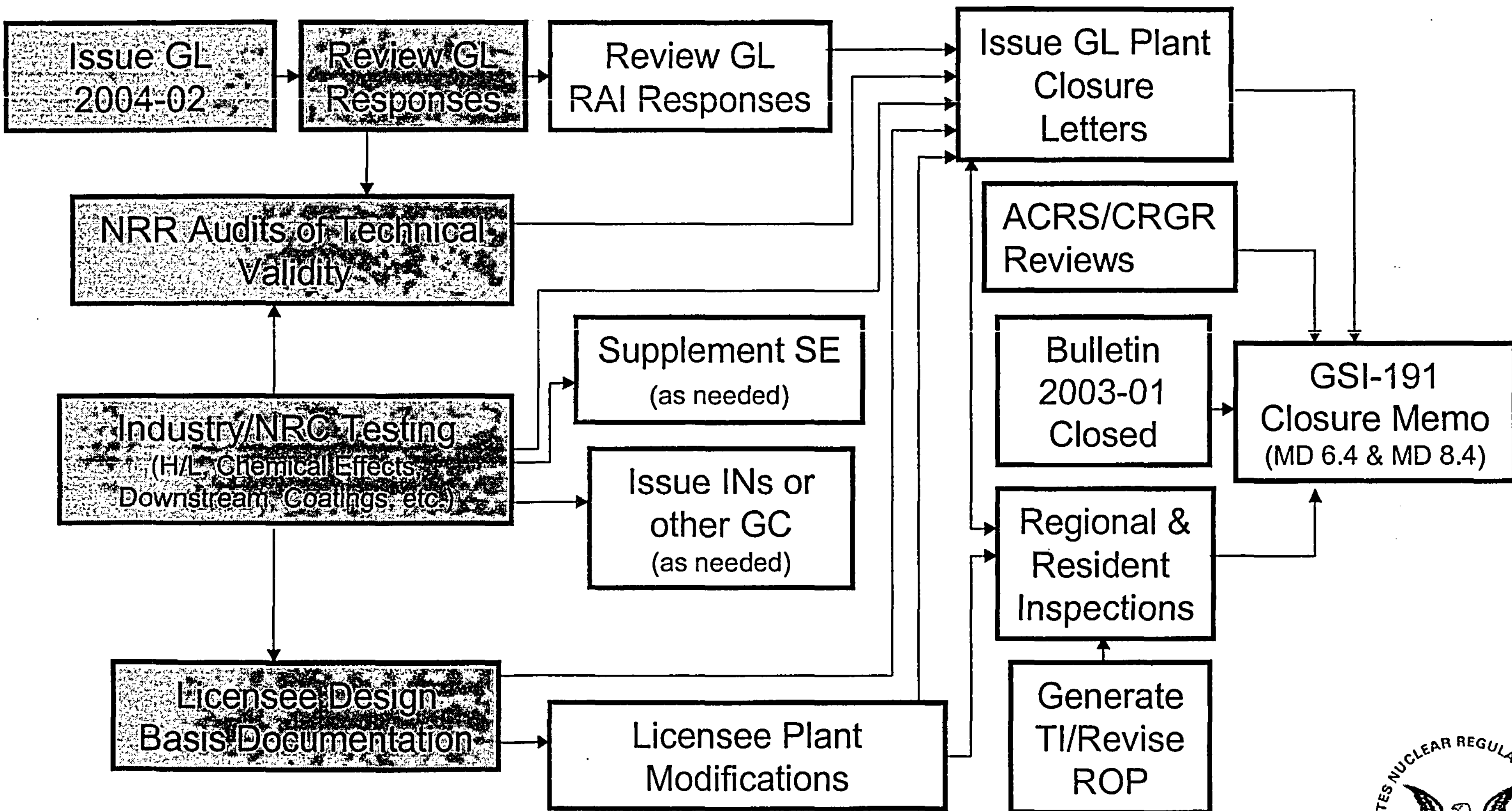
Purpose of Presentation

- Update the Subcommittee on progress to date in addressing GSI-191, challenges and issues that remain, and plans for addressing the challenges and closing the GSI
- Additional details on many subjects discussed today will be provided in Office of Nuclear Regulatory Research (RES) presentations next two days

NRR Presentations

- Overall Path Forward
- Bulletin 2003-01 and Generic Letter 2004-02 Status
- Audits of Licensees
- Near-Field Effects
- Chemical Effects
- Removal of Trisodium Phosphate
- Downstream Effects
- Coatings

GSI-191 Resolution Path Forward



Acronyms for Figure

GC	generic communications
H/L	head loss
IN	Information Notice
MD	Management Directive
ROP	Reactor Oversight Process
SE	safety evaluation
TI	Temporary Instruction

Bulletin 2003-01/ Generic Letter 2004-02 Status

Presenter
David Cullison

ACRS T/H Subcommittee Briefing
Rockville, MD
February 14, 2006

Purpose

- To update the ACRS Thermo-Hydraulics subcommittee on the status of Bulletin 2003-01 and Generic Letter 2004-02

Bulletin 2003-01 Status

- SSIB has requested the NRR Generic Communications Branch to "globally" close Bulletin 2003-01
- Davis Besse Option 1 - "50.46 is met."
- All other PWR licensees chose Option 2 - interim compensatory measures (ICMs) to reduce risk while resolving GSI-191 issues.

Bulletin 2003-01 Status

- SSIB criteria to close a plant response under Bulletin 2003-01 were at least one ICM in each of the six ICM categories of the Bulletin:
  - Operator training on indications of and responses to sump clogging
  - Procedural modifications to delay switchover to recirculation
  - Ensuring alternative water sources for RWST refill or to otherwise inject into the core or spray into containment
  - More aggressive containment cleaning and increased foreign material controls
  - Ensuring containment drainage paths are unblocked
  - Ensuring sump screens are free of adverse gaps and breaches.

Bulletin 2003-01 Status

- Some Notable ICMs:
  - All PWRs can aggressively cool down for small (and some medium) LOCAs, directly entering into shutdown cooling and thereby avoiding recirculation.
  - Some licensees stopped one (high volume) containment spray pump during the injection phase of the LOCA event.
  - RWST refill upon initiation of recirculation may provide injection backup later in an event

Generic Letter Purpose

- Based on the identified potential susceptibility of PWR recirculation sump screens to debris blockage during design-basis accidents requiring recirculation operation of the ECCS and CSS and the potential for additional adverse effects due to debris blockage of flowpaths necessary for ECCS and CSS recirculation and containment drainage, the staff is requesting addressees:
  - Perform an evaluation of the ECCS and CSS recirculation functions in light of the information provided in this letter and, if appropriate, take additional actions to ensure system function.
  - Submit the information specified in this letter to the NRC.
- Require addressees to provide the NRC a written response in accordance with 10 CFR 50.54(f)

Requested Action

- Using an NRC-approved methodology, perform a mechanistic evaluation of the potential for the adverse effects of post-accident debris blockage and operation with debris-laden fluids to impede or prevent the recirculation functions of the ECCS and CSS following all postulated accidents for which the recirculation of these systems is required.

- Individual addressees may also use alternative methodologies to those already approved by the NRC; however, additional staff review may be required to assess the adequacy of such approaches.

- Implement any plant modifications that the above evaluation identifies as being necessary to ensure system functionality.

Generic Letter - Requested Information

- By September 1, 2005:
  - Confirmation of compliance
  - A general description of and implementation schedule for all corrective actions, including any plant modifications, identified while responding to this generic letter.
    - Efforts to implement the identified actions should be initiated no later than the first refueling outage starting after April 1, 2006.
    - Provide justification for not implementing the identified actions during the first refueling outage starting after April 1, 2006.
    - All actions should be completed by December 31, 2007.
    - If all corrective actions will not be completed by December 31, 2007, describe how the regulatory requirements discussed in the applicable regulatory requirements section will be met until the corrective actions are completed.

Generic Letter - Requested Information Continued

- Sep 2005 submittal (cont):
  - The submittal should include, at a minimum, the following information:
    - clean screen NPSH margin
    - the extent of submergence of the sump screen (i.e., partial or full) at the time of the switchover to sump recirculation, and the submerged area of the sump screen at this time.
    - the maximum head loss postulated from debris accumulation on the sump screen, and a description of the primary constituent(s) of the debris bed. Includes chemical effects

Generic Letter - Requested Information Continued

- Sep 2005 submittal (cont):
  - The submittal should include the following information (cont):
    - the basis for concluding that water inventory required to ensure adequate ECCS or CSS recirculation would not be held up or diverted by debris blockage at choke-points in containment recirculation sump return flowpaths.
    - the basis for concluding that inadequate core or containment cooling would not result due to downstream blockage.
    - verification that close tolerance sub-components in pumps, valves, and other ECCS and CSS components are not susceptible to plugging or excessive wear due to extended post accident operation with debris laden fluids.
    - verification of the structural strength the trash racks and screens.
    - if an active device is selected in lieu of or in addition to a passive approach, describe the device and associated analyses.

Generic Letter - Requested Information Continued

- Sep 2005 submittal (cont):
  - Licensing bases changes
  - Programmatic controls

Generic Letter 2004-02 Responses

- Confirmed that all PWR licensees are upgrading or have recently upgraded their sump strainers.
  - 66 of 69 plants are replacing their existing sump screens
  - Remaining 3 plants had previously replaced their screens
- However, much of the requested information was not provided

Specific Review Results

- No plant was able to completely answer the questions requesting specific results of their evaluations
- Most plants did not provide an adequate general description of and planned schedule for any changes to the plant licensing bases
- Most plants plants provided a description of the existing or planned programmatic controls
- Most plants did not address chemical effects appropriately
- Few plants addressed downstream effects

Schedule Challenges

- Due to a late start by industry, licensees still waiting for the results of testing
- License Amendments - Due to schedule slippages and late submittals, the staff's ability to review and approve the amendments to meet licensees' startup schedules may be challenged

Schedule Challenges Continued

- Already five plants have requested additional time to complete their corrective actions with at least one additional request expected
  - So far the requests have been to complete corrective actions during Spring 2008 outage
  - Staff is considering criteria for evaluating extension requests

Future Staff Actions

- Commission Paper and Regulatory Issue Summary being prepared
- Issuing RAIs for September 2005 Responses
- ACRS meetings with the thermo-hydraulics subcommittee (Feb 14-16) and the full committee (Mar 9-11)
- Ongoing chemical effects and coatings confirmatory testing
- Audits of selected plants
- Verification of hardware changes by regional inspectors

Pilot Plant Audit Program and Audit Status

Presenter
Ralph Architzel

ACRS T/H Subcommittee Briefing
Rockville, MD
February 14, 2006

Overview

- Similar to BWR closure
- Audits planned to complement:
  - Generic Letter response reviews
  - Inspections by Regions of modifications
- Two volunteer pilot audits conducted:
  - Crystal River Unit 3 (CR3) and Fort Calhoun Station (FCS)
- Two audits in process:
  - Watts Bar and Oconee

Pilot Plant Review Program: Benefits to the NRC

- Lessons learned:
  - determined resource needs for future reviews, audits, and/or inspections
  - enhanced research and testing programs and future inspection activities
  - enabled the staff to use less resources to review September 2005 GL responses
- Early identification of issues that need to be further addressed and clarified in the safety evaluation
- Early review of the requests for license amendments, Technical Specifications changes, and/or exemptions

UNITED STATES NUCLEAR REGULATORY COMMISSION

Pilot Plant Review Program: Benefits to the Pilot Plants/Industry

- Get staff clarifications early regarding GL 2004-02
- Fee waiver for NRC review of related license amendment requests
- Focus and prioritize open items impacting resolution
- Lessons learned enabling the industry to make higher-quality September 2005 GL responses
- Get staff clarifications of any problem areas in GL 2004-02 early-on
- Helps the industry focus and prioritize the open items impacting GSI-191 resolution

Pilot Plant/ Audit Programs:

- Pilot Plant Review Program issued and presented to industry at the PWR Sumps Workshop
- Results of first pilot provided before GL 2002-04 responses due
- Audit activities for both pilots completed before September 2005 responses due
- Audit plan in place for remainder of sample audits

NRC GSI-191 Pilot Program

Initial Pilot Reviews

- Joint effort
- Chance to exercise the approved methodology
- Identify new/innovative approaches
- Meetings to identify issues
- Permits early problem resolution

NRC GSI-191 Pilot Program

Review Process Lessons

- Resources required
- Team approach
- Regional Involvement
- Key plant-specific areas incomplete
  - Coatings (ZOI & transport)
  - Debris transport
  - Head loss
  - Downstream effects
  - Chemical effects

NRC GSI-191 Pilot Program

Industry Lessons Learned

- Coatings ZOI data needed
- Margin for chemical effects issues
- Downstream effects – WOG evaluation
- Debris transport
- Head loss calculations/tests
- Engineering judgment can be used, but must have a strong technical justification

Pilot Program
Computational Fluid Dynamics (CFD)

- Evaluation of CR3 output
- Running CFD with licensee's input deck for Fort Calhoun (proprietary to Alion)
- Purchased hardware and software for future audits

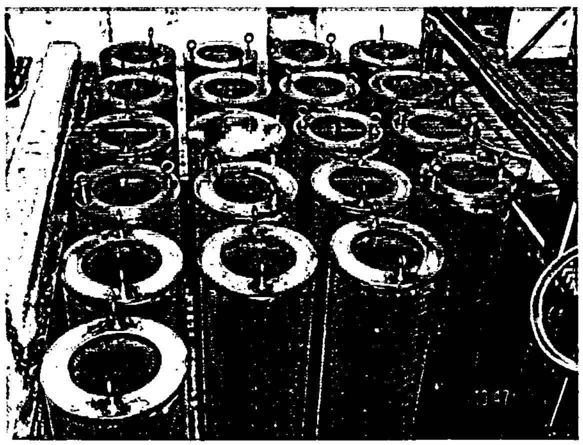
Fort Calhoun: Computational Fluid Dynamics (CFD)

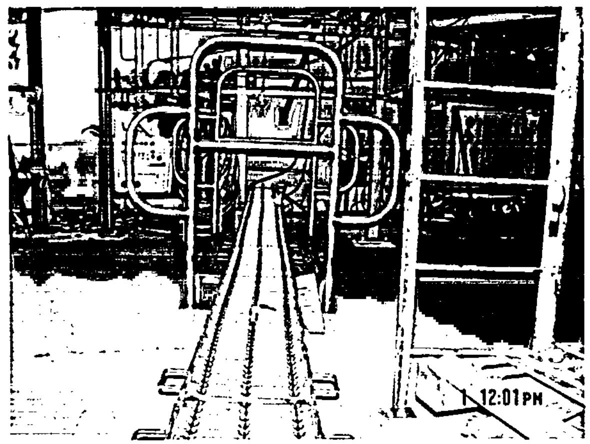
- CFD performed to predict the steady-state containment pool velocities during recirculation phase using Flow-3D code
- Identified issues with non-uniformity of containment spray addition to containment pool
  - Refueling cavity drainage
  - Run-off from containment surfaces
- No well-defined basis provided for determining the CFD mesh block nodalization above the containment floor

Crystal River 3

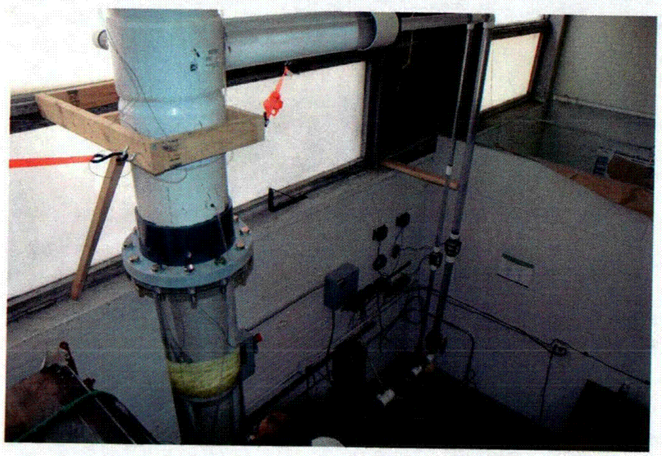
Increasing strainer surface area by over a factor of 13 (from 86 ft2 to 1139 ft2): Enercon Services, Inc. Top Hat Strainers

Other changes include debris interceptors, flow diverters and distributors

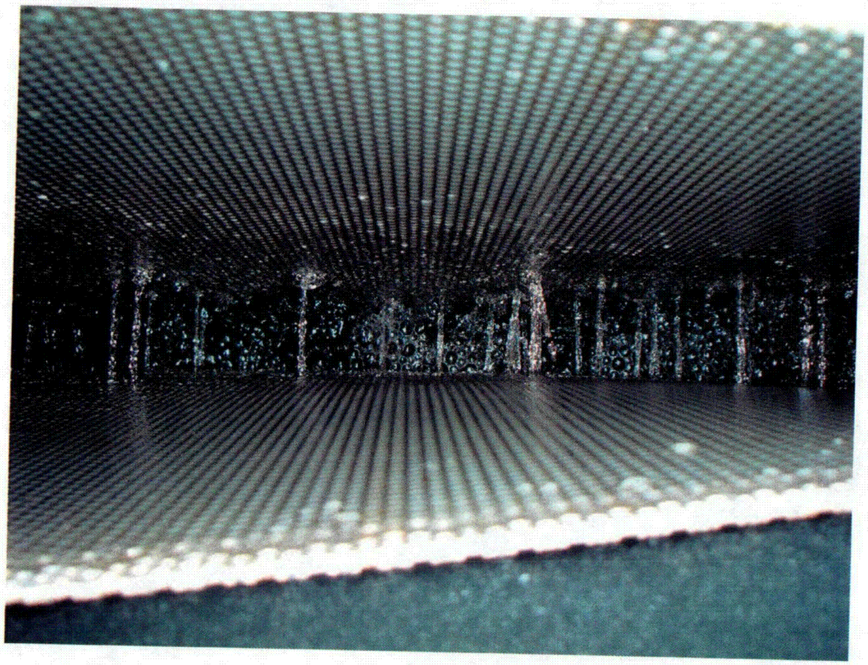




Thin Bed Testing at Alion
CR3 Pilot Audit



NRC GSI-191 Pilot Program
Alion



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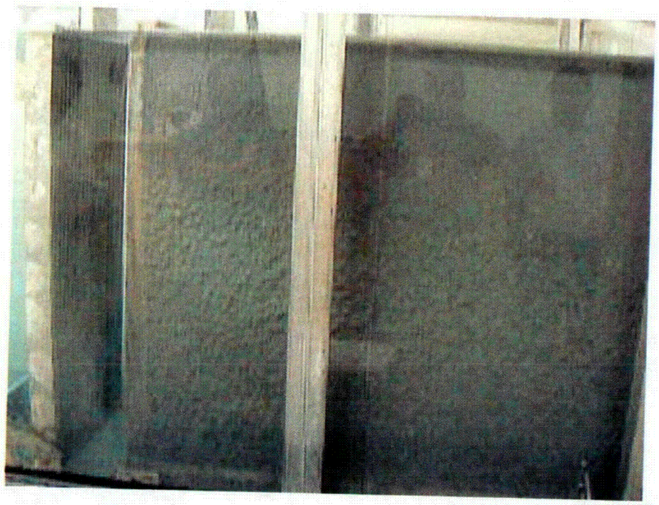
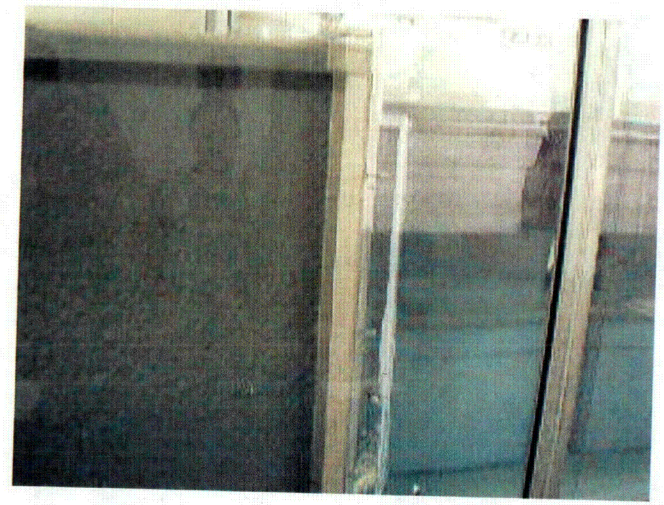
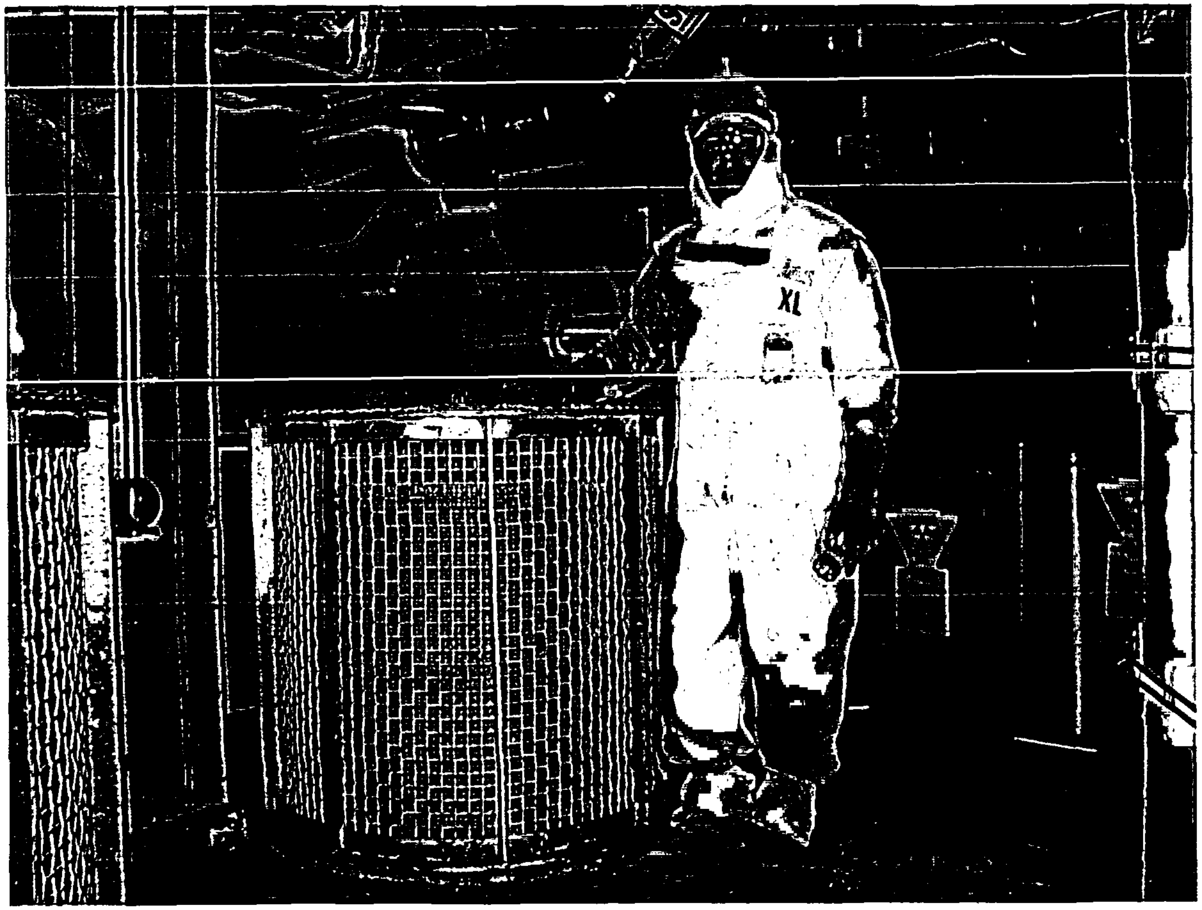
Pilot Program
Alion Visit





Fort Calhoun

Existing Strainer 56 ft2 to New 2800 ft2 (tentative)



NRC GSI-191 Pilot Program

Fort Calhoun with GE Passive Stacked Disk Strainers

Will pass out proprietary photos but not discuss. This will allow ACRS members to visualize the strainers and the testing

Near field effect: To be discussed later

Oconee Audit

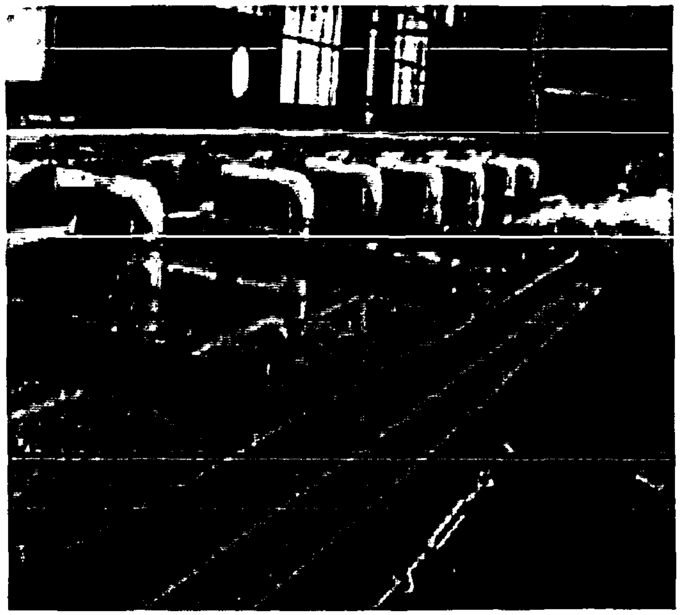
- RMI plant, with little fibrous insulation.
  - Large quantities of RMI at a strainer has been shown to actually decrease head loss from fibrous and particulate debris
- 5,000 square foot horizontal CCI "pocket" type strainer
  - Design head loss with full debris load is 0.1 ft
  - Staff observed strainer testing
- Containment over-pressure credit of approximately 2 psi is still needed to zero the NPSH margin calculation
- Downstream and chemical effects analyses are not compete
- The "baseline analysis" (break location, debris generation, debris transport, etc.) is still in draft from the contractor
- The audit is currently on hold until supporting information is finalized.

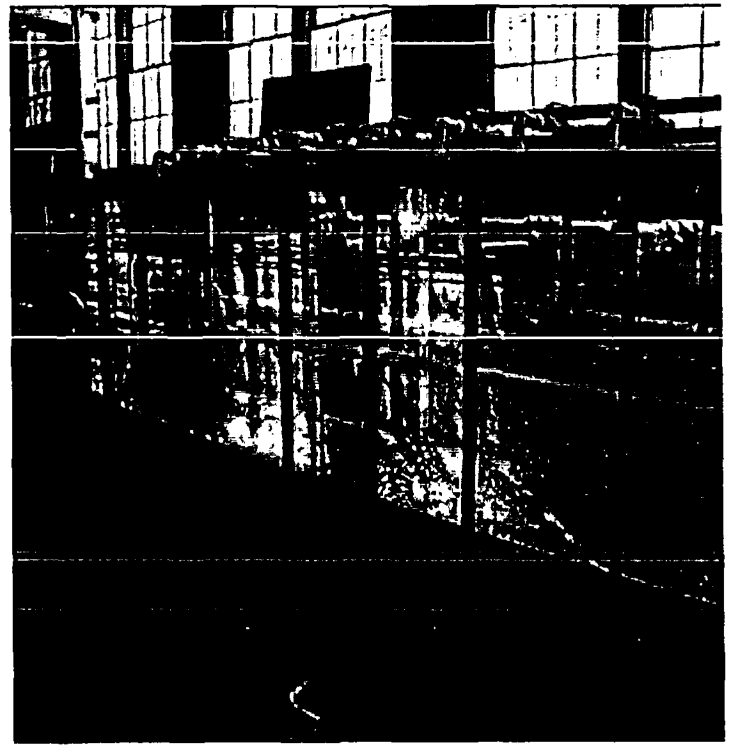
Watts Bar Audit

- Staff observed strainer testing at Alden Research Labs (Framotome Areva)
  - PCI Sure-Flow Stacked-Disk Strainers
  - Design intended to have significant margin
- Licensee's analyses and modification packages to be completed and delivered to staff
- Audit to continue in detail with meeting on March 2, 2006

Watts Bar Audit

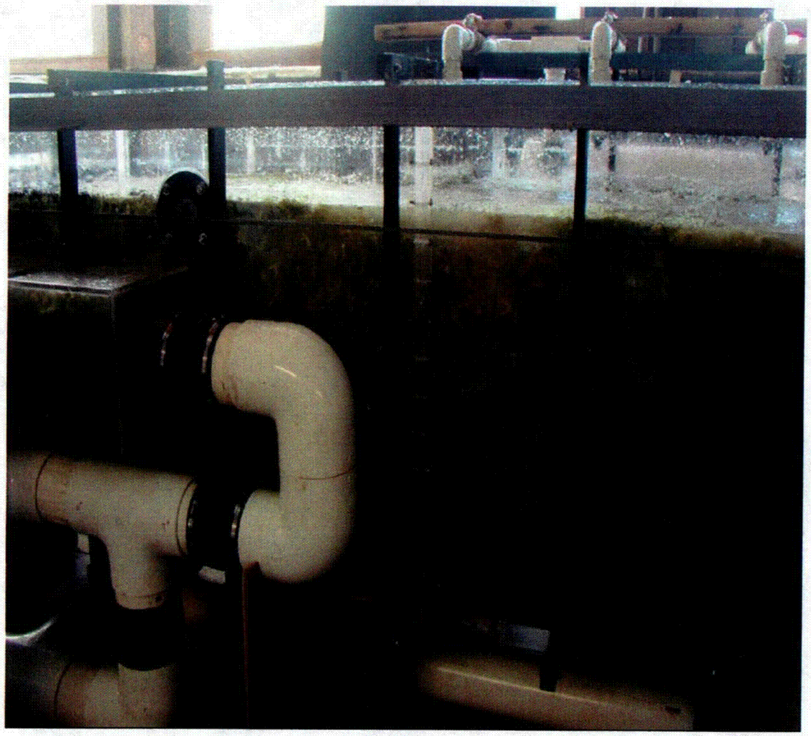
Testing of PCI Strainers at Alden Research Labs

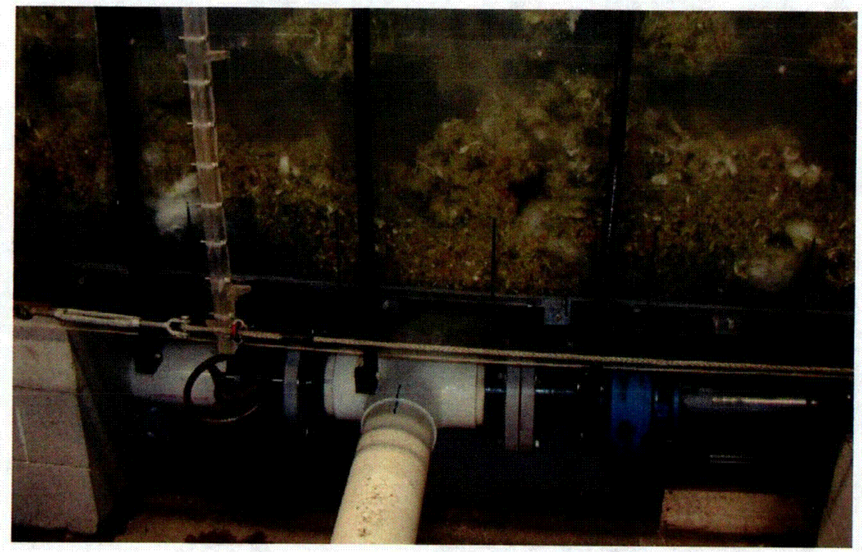




Watts Bar Audit

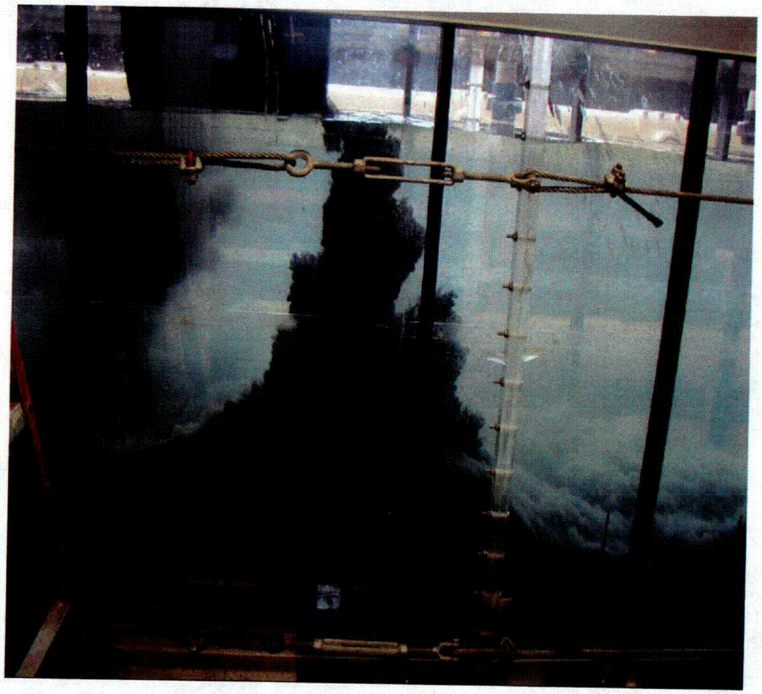
Testing of PCI Strainers at Alden Research Labs





Watts Bar Audit

Testing of PCI Strainers at Alden Research Labs



Near Field Effect And Prototypical Head Loss Test

Presented

By

Shanlai Lu

NRR/DSS/SSIB

ACRS Thermal-Hydraulics Subcommittee
February 14, 2006

Background

- **Safety Evaluation - Head Loss**

  1. NUREG-CR/6224 correlation is not appropriate for many PWR LOCA debris types, e.g, Cal-Sil. It is a useful tool for scoping analysis.
  2. Plant-specific tests are needed.

- **Industry Approach**

  All 69 PWR units plan to perform plant-specific prototypical head loss tests. Five vendor teams have developed test programs to meet the need.

Near Field Effect

Key vendor testing approach

Testing a reduced section of the replacement strainer design in a tank of water where the test strainer module is connected to a recirculation loop that pumps water from the tank through the test strainer and returns the water back into the tank.

Phenomenon observed

Large quantity of transportable debris does not reach the strainer surface and settles upstream from the testing module due to debris agglomeration.

Application

Significant head loss reduction results in smaller strainer size or lower head loss than a design following NRC SE and NEI Guidance Report.

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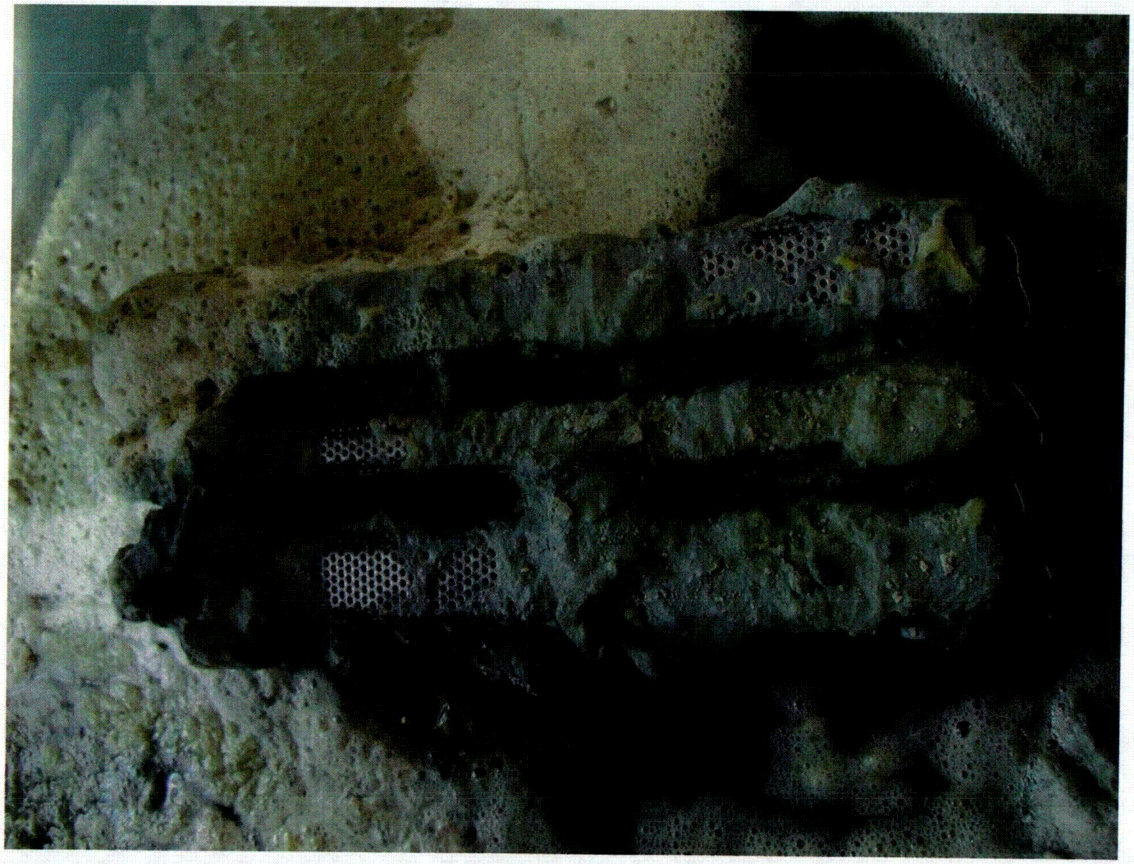
Near Field Effect – Debris Loading On The Strainer

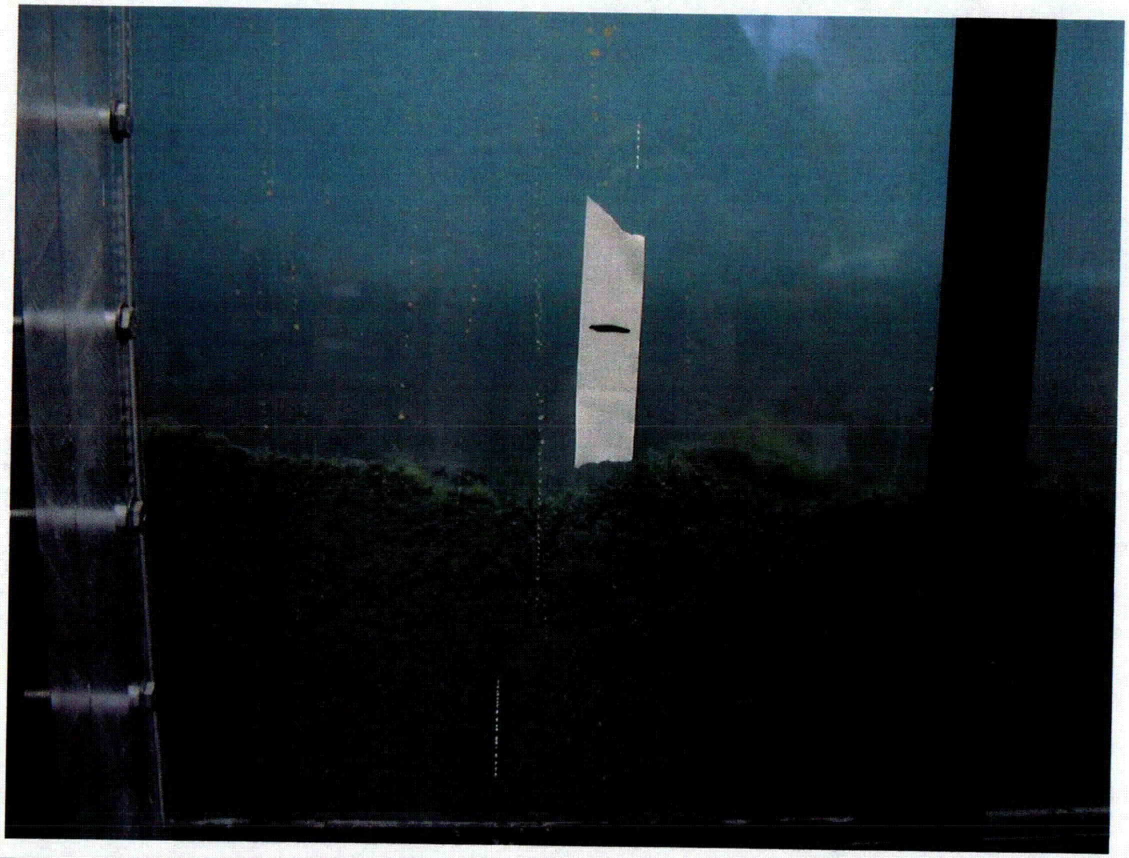
High fiber/particulate loading prototypical head loss test.



Debris Loading On
The Strainer Surface

Near Field Effect – Debris Settlement Upstream

High fiber/particulate loading prototypical head loss test.



Debris Settled Away From The Strainer Surface

Near Field Effect - Prototypical Head Loss Test

Staff Concern:

Multiple vendors and licensees have decided to design the new strainer based on prototypical head loss test results, which take credit of debris settlement near the strainer. However, no proper scaling analysis and testing procedures have been developed to justify the test results.

Regulatory Action:

A RAI is issued to request licensee to provide scaling analysis,develop proper testing procedures/matrix, and, reconcile the near field effect with other parts of transport analysis. A SE supplement is considered to ensure the adequacy of licensee's head loss testing results.

Staff Expectations - Prototypical Head Loss Test

- Proper testing debris material
- Scaling between the test strainer module/tank and the plant replacement strainer/pool conditions
- Proper extrapolation of the room temperature head loss test results
- Proper timing of the debris introduction
- Sufficient testing matrix covering the important potential variations in test procedures and debris accumulations

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Conclusions

- Industry is moving forward to conduct large number of prototypical head loss tests as part of new strainer design effort.

- Staff plans to

  Follow up more vendor head loss tests;
  Perform licensee new strainer design audits;
  Conduct confirmatory head loss testing and apply RES test results.

Chemical Effects: Status and Plans

ACRS T/H Subcommittee
February 14, 2006
Paul Klein – NRR

Outline

- Description of Issue
- Chemical Effects Status
  - Interactions with RES and Industry
- Challenges
- Path Forward

Chemical Effects – Description of Issue

- Chemical effects history previously summarized, most recently during 07/05 ACRS T/H Subcommittee meeting.

- Issue – interaction between plant materials and the post-LOCA containment environment may produce chemical products that could contribute to head loss across the sump screen.

Status – NRR Overview

- Testing to date has produced basic technical knowledge concerning chemical effects:
  - 15 months ago (ICET 1 in progress) unknown if chemical products would form in representative plant environments

- Additional testing/analysis is needed to support licensee plant specific chemical effects evaluations.

- Licensee's responsibility to evaluate and account for head loss from plant specific chemical effects. Staff's responsibility to perform independent review of licensee evaluations and ensure licensee actions sufficiently account for chemical effects.

NRR Interfaces with RES

- ICET & Bench Top Tests – provided basic knowledge concerning formation of chemical products in representative post-LOCA containment environments.

- Head loss tests – provide confirmatory information to support staff's independent review of licensee's GL 2004-02 responses.

- Chemical Speciation Prediction – assessed commercially available computer programs ability to provide the staff a predictive tool for chemical species formation.

Status – Implications From RES Results

ICET

- Variations in insulation materials or chemical buffering agents produced significantly different chemical effects:
  - Plant specific conditions differ from ICET and may lead to products different than those observed in the ICET tests
  - Testing is needed to determine head loss consequences

- Chemical products formed at different times:
  - Timing of chemical product formation is important since plants gain significant pump NPSH margins with time

- Some results raise questions about downstream effects
  - Temperature dependence for precipitant formation in ICET 1, 5
  - Calcium phosphate deposits affected flow meter in ICET 3

Status – Implications From RES Results

Head Loss

- TSP buffered environment - significant head loss may result from calcium phosphate if it forms within a containment pool or from continued cal-sil dissolution within a sump screen debris bed
  - Initial TSP test environment was selected based on ICET observations concerning early product formation and product characteristics
  - Debris bed composition affected the head loss due to chemical effects

- Head loss test results from sodium hydroxide and sodium tetraborate buffered environments expected within months

Status – Implications From RES Results

<u>Chemical Speciation Prediction</u>

- Modeling, when refined by data and observations from ICET, was in broad agreement with experimental results, with better agreement for first days of test.

- May provide some insights for environments outside ICET tests, but modeling alone not sufficient to predict interactions due to inherent limitations (e.g., inability to account for reaction kinetics, need to suppress precipitation of certain minerals in the database, metals passivation, etc.)

Status – Generic Letter 2004-02 Responses

- Limited information concerning overall chemical effects evaluation strategy and detailed plans related to industry chemical effects evaluations

- ICET environment most similar to plant (some plants can fit several) →

- RAIs sent February, 2006

			Plants
ICET 1	NaOH	Nukon	25
ICET 2	TSP	Nukon	20
ICET 3	TSP	Nukon +Cal-sil	6
ICET 4	NaOH	Nukon +Cal-sil	9
ICET 5	$Na_2B_4O_7$	Nukon	9

Status – Other Interactions With Industry

- Public Meetings
- Information Notices 2005-26 and Supplement 1
- Staff feedback to industry on WOG Test Plan
- Staff visit to observe WOG chemical effects tests
- Staff to receive WOG test report
- Ongoing discussions with screen vendors
- Plant Audits

Challenges

- Developing sufficient understanding to ensure licensee actions sufficiently account for chemical effects.

- NRC, industry tests to date have provided basic technical knowledge, many uncertainties need to be evaluated on a plant specific basis.
- Thermodynamic based computer models have inherent limitations in their ability to model/predict species in a post-LOCA containment pool.
- No industry lead organization for assessing plant specific chemical effects head loss - licensees pursuing plant specific testing with multiple screen vendors.

Path Forward

- Licensees have a number of options available to address chemical effects:
  - Change plant materials,
  - Change pH buffering chemical
  - Over-design screen area
  - Screen back-flush, screen cleaning
  - Active strainer design
  - Redundant sumps
  - Pump NPSH margins increase with time, ICET tests showed formation of some chemical products is time dependent

Path Forward - Chemical Effects Evaluations

- Staff not planning to issue design guidance to address chemical effects or the associated head loss consequences
  - Licensee is responsible for determining and accounting for head loss from plant specific chemical effects
  - NRR to rely on information from confirmatory RES work to perform independent evaluation of licensee chemical effect evaluations

Westinghouse Owners Group GSI-191 Activities

Maurice Dingler (WCNOC), Chairman

Systems & Equipment Engineering Subcommittee
Westinghouse Owners Group

Slide 1

Westinghouse Owners Group
GSI-191 Activities

WOG GSI 191 Efforts

- Actively involved in GSI 191 activities since 1999
- WOG now represents all PWRs (W, CE and B&W)
  - B&W jointed as of 1/01/06
- 10 major projects (5 completed, 5 on-going)*
- Over 20 man-years of effort*

* Does not include B&W OG efforts prior to 2006

Slide 2

Westinghouse Owners Group
GSI-191 Activities

Completed WOG Efforts

- Generic Letter 97-04 and Future Generic Letters Related to Sump Blockage and Coatings Issues (MUHP-6015/Task 1119/Task 1126)
  - **Objective:** Participate, summarize and inform the CEOG/WOG of the evolving regulatory interest and requirements associated with post-accident sump performance issues. Provide input to NRC research.
  - **Results:** WCAP-16007, Generic Letter 97-04 and Future Generic Letters Related to Sump Blockage and Coatings, March 2002
    - Volume 1 Risk-Informed Containment Sump Debris Evaluation
    - Volume 2 Summary of PWR At-Power Radiation Dose Summary
    - Volume 3 Pressurized-Water-Reactor Debris Transport in Dry Containments-Phenomena Identification and Ranking Tables (PIRTs)
    - Volume 4 PWR Debris Transport in Ice Condenser PIRTs
    - Volume 5 PWR Containment Coatings Research PIRTs

Slide 3

Westinghouse Owners Group
GSI-191 Activities

Completed WOG Efforts

- **Evaluation of Potential ERG and EPG Changes to Address NRC Bulletin 2003-01 Recommendations (PA-SEE-0085)**
  - **Objective:** Evaluate potential changes to ERGs and EPGs as required by Bulletin 2003-01 and the impact of these changes on licensing basis, Technical Specifications, and design basis and operational issues.
  - **Results:** WCAP-16204, Evaluation of Potential ERG&EPG Changes to address NRC Bulletin 2003-01 Recommendations, March 2004
    - Volume 1 Engineering Evaluations and Analyses Report
    - Volume 2 Proposed Changes to Westinghouse Emergency Response Guidelines
    - Volume 3 Proposed Changes to CEN-152 Emergency Procedure Guidelines

Slide 4

Westinghouse Owners Group
GSI-191 Activities

Completed WOG Efforts

- **Generic Task to be Performed by Industry to Support Closure of GSI-191, Assessment of Debris Accumulation on PWR Sump Performance (PA-SEE-115/Task 2060/MUHP-6017/MUHP-6018)**
  - **Objective:** Develop a methodology and guidance to assess debris transport, debris settling, filtration efficiency of a sump screen fiber bed and resulting pressure drop.
  - **Results:**
    - Condition Assessment Guidelines Debris Source inside PWR Containments (NEI 02-01)
    - PWR Sump Performance Evaluation Method (NEI-04-07)

Slide 5

Westinghouse Owners Group
GSI-191 Activities

Completed WOG Efforts

- **Resolution of ECCS Sump Blockage Using Risk Informed Approaches (PA-SEE-150)**
  - **Objective:** Develop a risk informed approach to support resolution of the ECCS containment sump blockage issue.
  - **Results:** WCAP-16362, PRA Modeling Template for Sump Blockage, April 2005
    - A generic template for modeling sump blockage in the PRAs

Slide 6

Westinghouse Owners Group
GSI-191 Activities

Current WOG Efforts

- **Characterization of Chemical and Corrosion Effects Testing in Support of GSI-191** (PA-SEE-166)
  - **Objective:** Perform chemical corrosion testing to determine effect on containment sump performance in post-accident environment. Provide corrosion test plan and test bases. Conduct and witness testing at the NRC/EPRI test facility and participate in industry meetings.
  - **Status:** Los Alamos National Laboratory to issue ICET Data Reports as an NRC NUREG documents
  - **Results:** GSI-191 Integrated Chemistry Effects Test WOG Follow-On Test Parameters, .
    - Test Plan: Characterization of Chemical and Corrosion Effects Potentially Occurring Inside a PWR Containment Following a LOCA, October 2004
    - Review and provided input to the test reports

Slide 7

Westinghouse Owners Group
GSI-191 Activities

Current WOG Efforts

- Evaluation of Dowsnstream Sump Debris Effects in Support of GSI-191 (PA-SEE-195)
  - **Objective:** Develop a methodology, including acceptance criteria, to evaluate the effects of debris ingested into the ECCS and CSS during recirculation following a LOCA and minimize or eliminate the need for additional component testing. Effort includes collecting available component wear, erosion and blockage data due to debris ingestion.
  - **Status:** Responding to NRC comments, WCAP-16406 to be revised and submitted to NRC for SE.
  - **Results:** WCAP-16406, Evaluation of Downstream Sump Debris Efforts in Support of GSI-191

Slide 8

Westinghouse Owners Group
GSI-191 Activities

Current WOG Efforts

- **Method for Evaluating Post-Accident Chemical Effects in Containment Sump Fluids** (PA-SEE-275)
  - –**Objective:** Provide licensees a method to predict the plant specific formation of chemical precipitates following a LOCA. Design, construct, and test equipment needed to generate a plant specific precipitant mix (proof-of-principle particulate generator). This equipment can be used to experimentally confirm the design margin for new sump screens.
  - –**Status:** Final report issued to membership
  - –**Results:** WCAP-16530, Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191

Slide 9

Westinghouse Owners Group
GSI-191 Activities

Current WOG Efforts

- **Qualification of Lead Blankets Used for Shielding (Debris source)** (PA-SEE-286) approximately 10 units included in the project.
  - –**Objective:** Establish a baseline level of performance for qualified and unqualified lead blankets by performing jet impingement tests, a soak tests, and a limited debris characterization evaluation.
  - –**Status:** Program just approved, will be starting shortly.
  - –**Results:** The test results will be documented in Westinghouse report (WCAP)

Slide 10

Westinghouse Owners Group
GSI-191 Activities

Current WOG Efforts

- **Alternate Buffer for ECCS (PA-SEE-286)**
  - **Objective:** Identify a replacement buffering agent for TSP or NaOH to reduce or eliminate agent formation of certain chemical precipitants.
    - Identify possible replacement buffering agents and evaluate risks and benefits
    - Measure dissolution characteristics of possible replacement buffers in solutions containing dissolved calcium
    - Perform bench scale tests with possible replacement buffers to determine acceptability
  - **Status:** Program just approved, will be starting shortly.
  - **Results:** The test results will be documented in Westinghouse report (WCAP)

Slide 11

Westinghouse Owners Group
GSI-191 Activities

Summary

- GSI 191 is a high priority issue with the WOG
- WOG will continue to support licensees, NEI and NRC in the resolution of GSI 191
- WOG has been and will continue to be actively involved in the successful resolution of GSI 191

Slide 12

Removal of TSP – Impact on DBA Dose Analysis

Presenter
Michelle Hart

ACRS T/H Subcommittee Briefing
Rockville, MD
February 14, 2006

Implications of Removal of TSP on DBA Dose Analyses

- One plant has proposed to temporarily take TSP out of the containment for 1 operating cycle, until new buffering agent is chosen and installed
- Removal of TSP without other buffering agent leads to loss of pH control and potentially sump pH < 7
  - NUREG-1465 and RG 1.183 (AST) imply if pH < 7, iodine re-evolves from sump
  - Also for AST, iodine species assumption of 95% particulate, 5% gaseous predicated on pH > 7
  - Gaseous iodine removal by sprays during recirculation phase is dependent on sump pH (SRP 6.5.2)

Preliminary Look

- LOCA dose calculations – AST or TID-14844 for reference plant
- Simplistic assumptions
  - 100% iodine re-evolution modeled by assuming no removal mechanisms, no plate out in containment
  - For AST, iodine species assumed to be TID values of 91% elemental, 4% organic, 5% particulate
- Results
  - Likely to meet offsite dose (Part 100 or 10 CFR 50.67)
  - Not likely to meet control room dose (GDC-19)
    - Temporary compensatory measures (KI and SCBA) may give enough credit for control room dose

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Conclusion

- Loss of pH control negates some assumptions in current DBA dose analyses that show compliance with GDC-19 and Part 100 (or 10 CFR 50.67 for AST plants)
- Plant-specific analyses needed for any plant proposing to remove TSP without installing an appropriate buffering agent in its place
  - Temporary use of KI in control room may be necessary to meet GDC-19

Industry Activities to Address PWR ECCS Sump Performance

John Butler
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GSI-191, PWR Sump Performance

- GSI 191 applies to all pressurized water reactor designs
  - 69 PWR units in U.S.
- Each unit is unique in one or more important design aspects:
  - Insulation materials
  - Containment coatings (both qualified and unqualified)
  - Containment design (compartmentalized, open)
  - Sump design
  - NPSH requirements
- The high level of design variation requires plant specific resolution approach for each plant

NEI

Evaluation Guidance Development

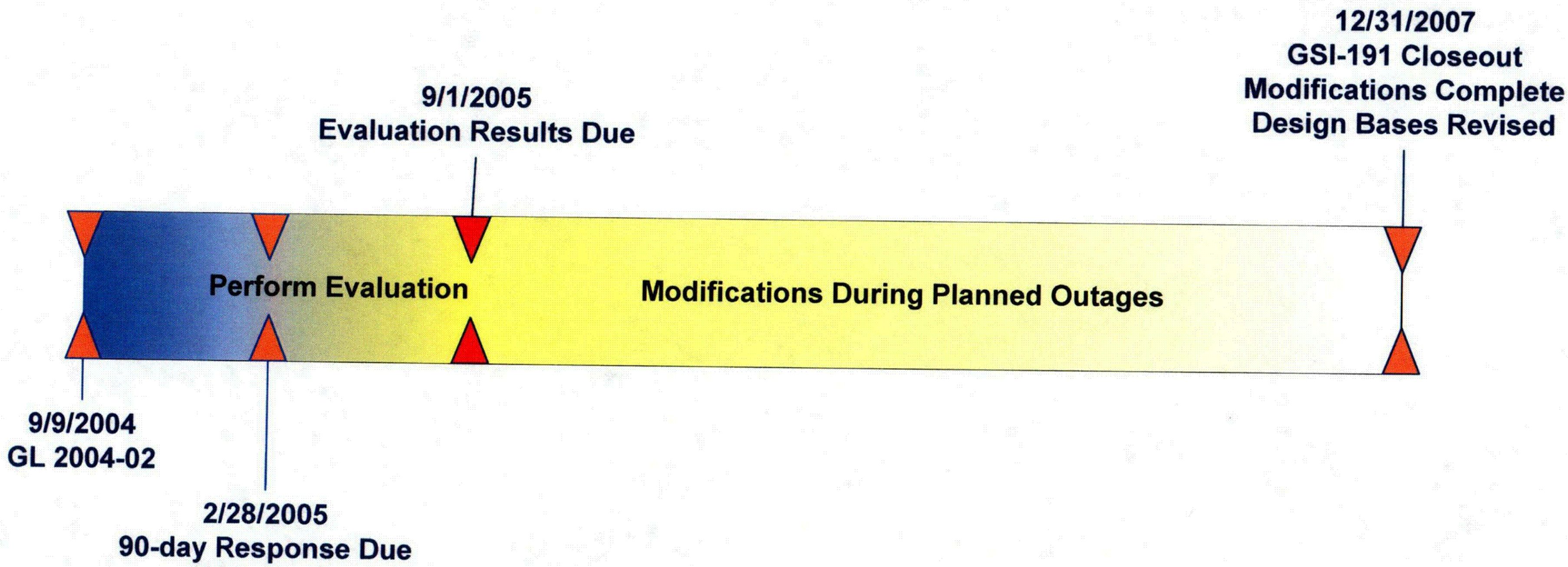
- Development of Industry Evaluation Guidance began following issuance of NUREG/CR-6762, Parametric Evaluation for PWR Recirculation Sump Performance (2002)
- NEI 02-01, Debris Sources Inside Containment (2002) issued to begin plant data collection activities
- Bulletin 2003-01, Potential Impact of Debris Blockage on Emergency Sump Recirculation at PWRs (2003) called for compensatory actions

NEI

GL 2004-02

- GL 2004 02, *Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors*, issued September 2004
- Requested PWR licensees to perform an evaluation of recirculation functions and, if appropriate, take additional actions to ensure system function
- GL schedule:
  - By 2/28/05 – provide description of evaluation methodology to be used and schedule for completion
  - By 9/1/2005 – provide results of evaluation
  - By 12/31/2007 – complete all actions, including necessary plant modifications

GL 2004-02 Schedule



NEI

C01

Industry Guidance (NEI 04-07)

- Evaluation guidance, developed in coordination with the WOG was issued December 2004
- Developed to provide a practical and realistically conservative set of methods to guide PWR resolution activities
- Conservative baseline methods allow for performance of scoping calculations
- Used to identify "problem areas" and focus on cost effective areas for refinement and resolution

NEI

NRC SER on NEI 04-07

- A safety evaluation report (SER) on NEI 04-07 released in December 2004
- SER modified NEI 04-07 guidance
  - Calls for more conservative treatment in some areas unless additional testing is performed
    - Example: 10D ZOI for qualified coating
  - removes some simplifications and calls for plant specific development and justification
    - Example: Coating thicknesses to be determined by each plant
  - Restricts realistic treatment for low risk spectrum of breaks
    - Example: "nominal" parameters not to be exceeded during normal operation

NEI

Supplemental Guidance

- WOG guidance was prepared to support evaluation in two areas not addressed in NEI 04-07
  - Downstream Effects
  - Results from Industry/NRC Chemical Effects tests

NEI

Downstream Effects

- WCAP 16406-P, *Evaluation of Downstream Sump Debris Effects in Support of GSI-191*
  - Issued June 2005
  - Addresses wear, abrasion and blockage impacts of sump screen bypass
  - Methods identified in WCAP used to perform Downstream Effects Evaluations for sump performance

NEI

Integrated Chemical Effects Tests

- Jointly sponsored by Industry and NRC
- Tests conducted between 11/2004 and 8/2005

Run No.	Date Started	Date Ended	Date Quick Look Report Publicly Released	Date Final Data Report Released
1	11/21/2004	12/21/2004	None released	Jun-05
2	2/5/2005	3/7/2005	20-Jul-05	Sep-05
3	4/5/2005	5/5/2005	20-Jul-05	Nov-05
4	5/24/2005	6/25/2005	12-Jul-05	Nov-05
5	7/26/2005	8/25/2005	28-Oct-05	Jan-06

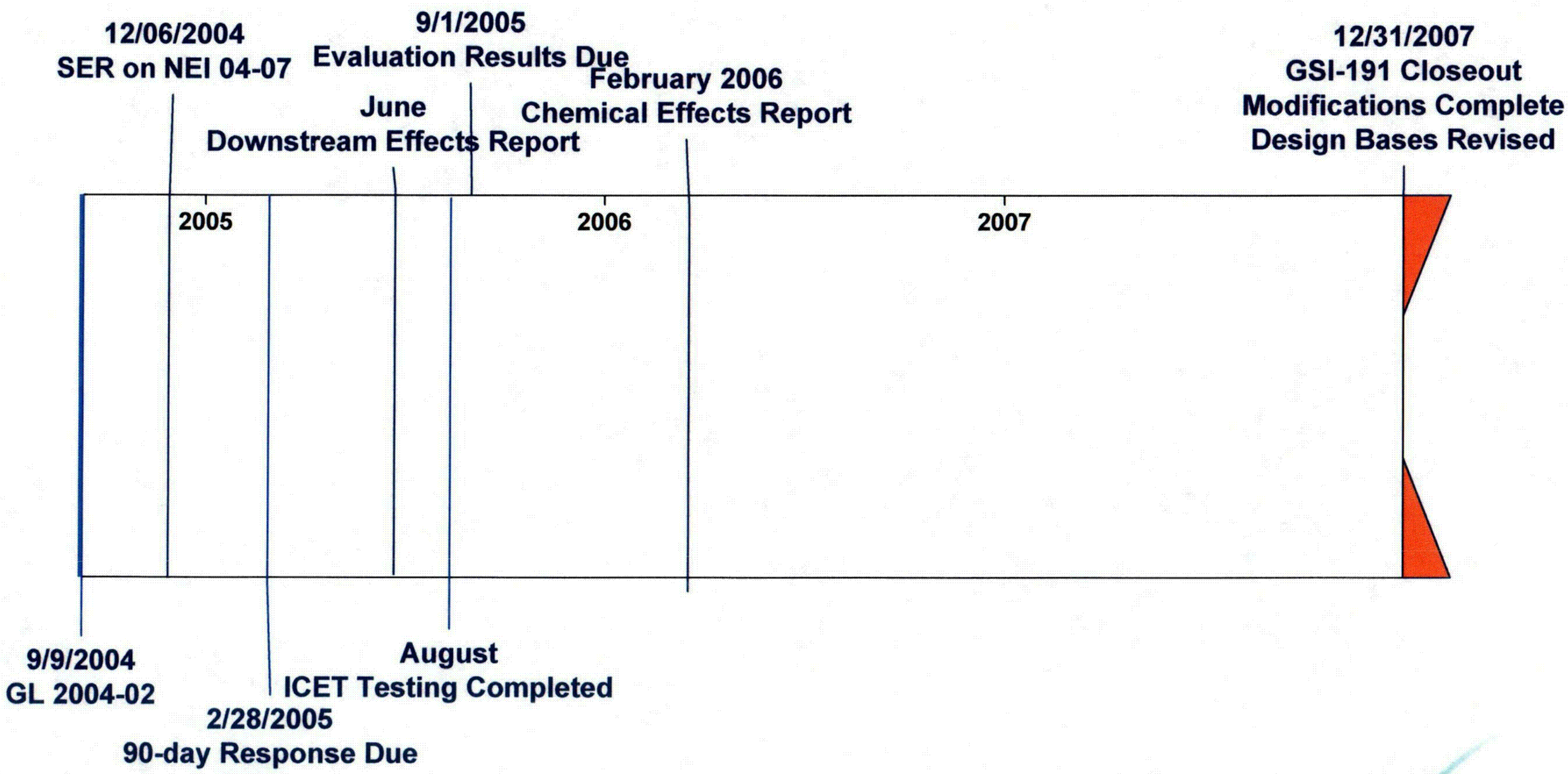
NEI

Bench top Chemical Effects Tests

- WCAP-16530, *Evaluation of Post-Accident Chemical Effects in Containment Sump Fluid to Support GSI-191*
  - Issued February 2006
  - Addresses chemical reactions and products in containment sump fluid
  - Provides input for use in plant specific evaluation of chemical effects

NEI

GSI-191 Resolution Schedule



C02

Status of Industry Activities

- NEI distributed a short survey to industry on January 19th to collect information on plant GSI-191 resolution activities
- Survey responses from all 69 PWR units were returned on or before January 30th

NEI

Survey Results

- All 69 plants have completed evaluations necessary to assess need for strainer modifications
  - Three units have assessed that their current strainers are appropriately sized
    - Confirmation activities are underway including strainer validation tests
  - Sixty-six units plan to replace their current strainers

NEI

Strainer Vendors

- Of the 66 units planning to replace strainers, 65 have selected a vendor/design concept
  - One plant finalizing design evaluation before selecting vendor
  - Five strainer vendor teams:
    - Enercon/Alion/Westinghouse/Transco
    - Framatome/PCI
    - GE
    - CCI
    - AECL

NEI

Replacement Strainers

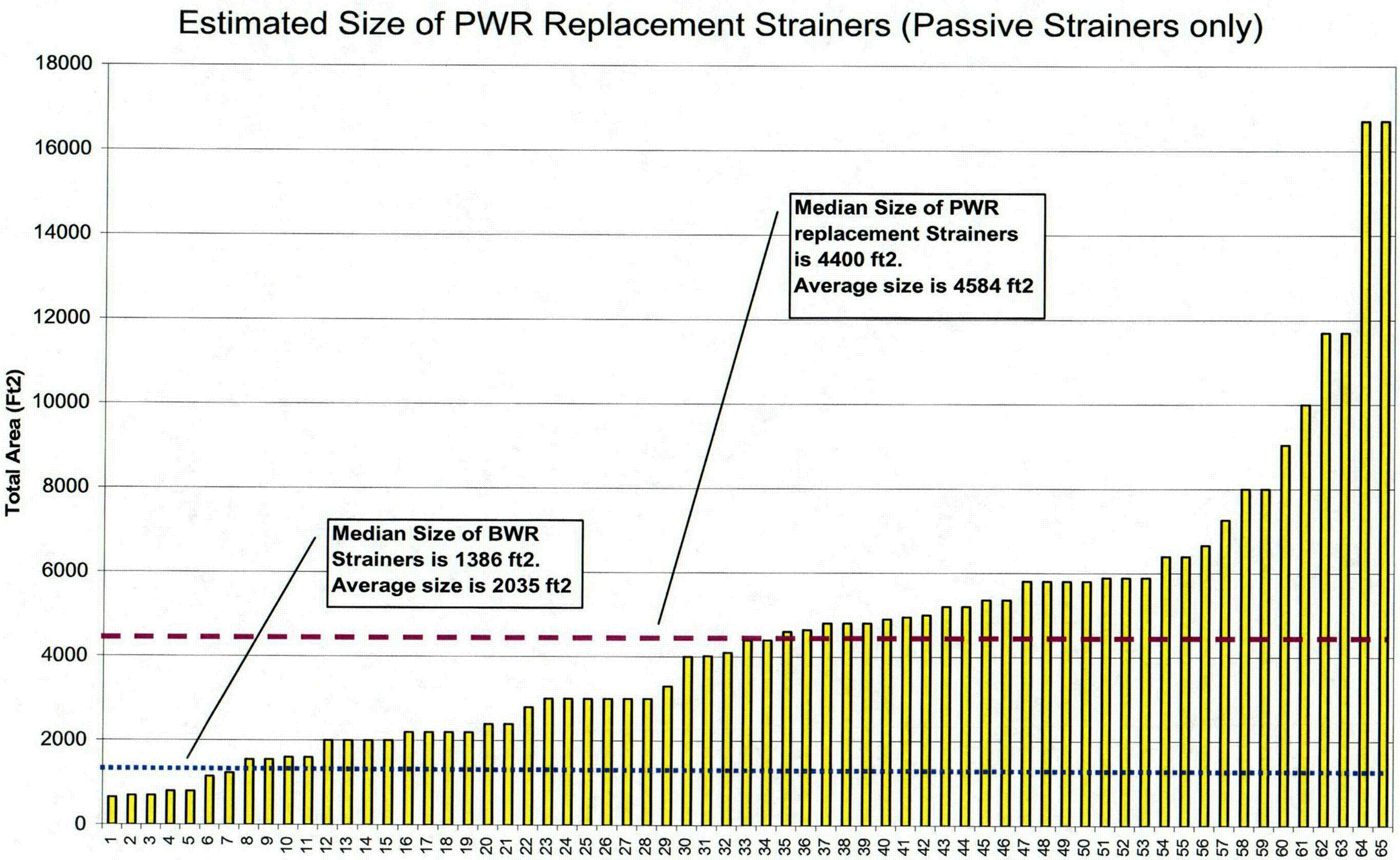
- Active – Passive – Undetermined
  - Four units intend to install active strainers
  - Remaining units are passive strainers
  - Two units expressed a need to reconsider active due to difficulties with expected size of their passive strainer

NEI

Estimated Strainer Size

- The estimated size of replacement strainers (passive only) ranges from 650 ft2 to 16700 ft2
  - Median size of PWR replacement strainers is 4400 ft2
  - Reflects estimated total screen area across all injection pathways
- For comparison, the median size of BWR strainers is 1386 ft2; ranging from 475 to 6253 ft2
- Final strainer sizes are subject to change based on ongoing evaluations and testing

NEI



Estimated Size of PWR Replacement Strainers (Passive Strainers only)
Total Area (Ft2)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Median Size of PWR replacement Strainers is 4400 ft2. Average size is 4584 ft2
Median Size of BWR Strainers is 1386 ft2. Average size is 2035 ft2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65

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C03

Factors Affecting Strainer Size

- The variability in sizes reflects a number of factors, including:
  - Plant design
  - Conservatism in methodology application
  - Retained Margin

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Plant Design Factors

- Plant design factors include:
  - NPSH margin
    - NPSH margin for plants ranges from greater than 10 ft to less than 1 ft
  - Containment insulation materials
    - All RMI plants vs. All Fiber plants
  - Coatings
    - Level of unqualified and degraded coatings

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Conservatism in Analysis

- The evaluation methodology includes a number of noted conservatisms
  - Included to facilitate evaluation
  - Others directed by NRC SER
- Use of NUREG CR 6224 correlation for headloss is noted area of conservatism
- All plants indicated that plant specific strainer qualification tests would be performed
- Plants may adjust their final strainer size based upon these results

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Addition of Margin

- Most plants indicated that their strainer size reflected the addition of margin to account for uncertainties
- Others sized their strainers based upon the maximum size accommodated by existing containment footprint

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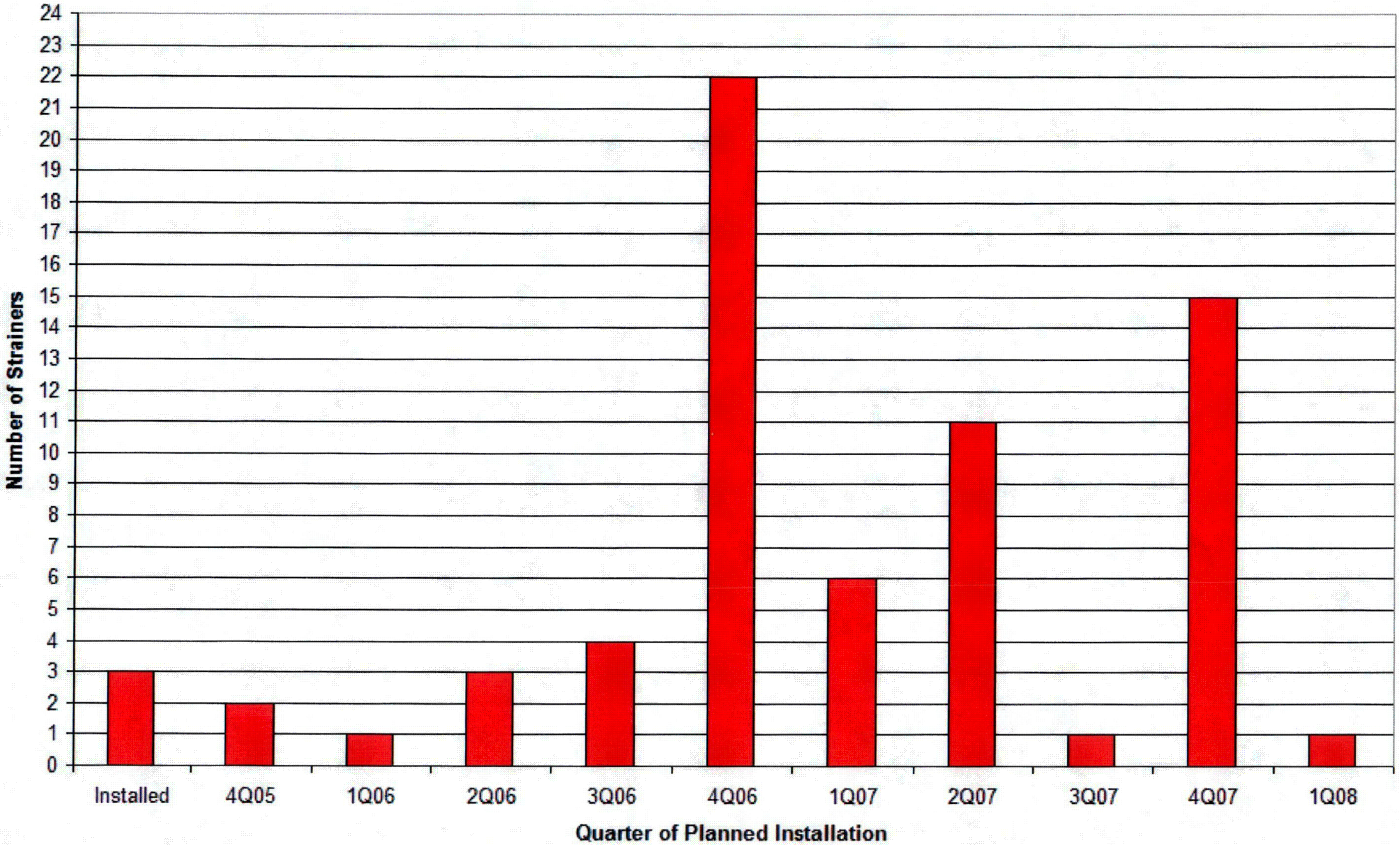
Installation Schedule

- Excluding 3 units who are retaining their current strainers
  - 2 units in 4th quarter 2005
  - 30 units in 2006
  - 33 units in 2007
  - 1 unit in 1st quarter 2008

Planned Strainer Installation



C04

Other activities

- Actions to address debris sources
  - ~45% identified near term actions to modify or reduce problematic insulation materials
  - ~20% identified non-programmatic changes to modify or reduce problematic coatings and latent debris
- Containment modifications beyond strainer installation
  - >30% identified modifications affecting debris transport (e.g., debris interceptors)
  - >20% identified other modifications affecting flood-up level, equipment storage
- Downstream effects
  - >50% indicated plans for modification of downstream flow pathways
- Programmatic changes

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Plant Specific Testing

- All 69 units identified plans for prototypic strainer testing
- ~35% identified plans for plant specific testing of debris generation and transport
- ~46% identified plans for plant specific testing of coatings debris generation and transport
- >50% identified plans for plant specific testing for downstream effects of debris bypass

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Industry Test Activities

- WOG Chemical Effects Testing
- Strainer Qualification Testing
- WOG Alternate Buffer Project
- STARS Coatings Tests
- FPL/ARIVA Coatings Tests

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Summary

- Activities for plant-specific resolution of GSI-191 are well underway
- Remaining uncertainties are being addressed through conservative application of evaluation methodology, testing and strainer design
- Industry sponsored and plant-specific testing activities will continue in support of final designs

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GSI-191
Coatings

Presenter
Matthew Yoder
NRR/DCI/CSGB

ACRS T/H Subcommittee Briefing
Rockville, MD
February 14, 2006

Description of Issue

- NRC adopted conservative default positions for zone of influence (ZOI), debris generation, and transport of coatings debris to the sump due to lack of available test data
- Plants may use different positions if justified with testing

Status to Date

- Two industry groups recently (late January, early February, 2006) conducted coatings ZOI testing
  - Formal test data is not yet available
- EPRI testing on non-qualified coatings complete
  - Staff will evaluate this report as part of the GL review
- NRC sponsored testing on coating transport recently started (late January, 2006)
  - Formal data not yet available

Challenges

- Characteristics of coatings debris unknown (size of chips or particles)
  - Transport evaluations depend heavily on debris characteristics
- Some industry testing is proprietary, and may only be applied to a limited number of plants

Path Forward

- For licensees deviating from staff guidance, evaluate treatment of coatings based on available data:
  - Industry ZOI test data
  - EPRI data on unqualified coatings
  - Plant specific testing to justify debris characteristics and transport
  - NRC sponsored transport testing