Official Transcript of Proceedings ACRST-3344

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
530th Meeting

PROCESS USING ADAMS
TEMPLATE: ACRS/ACNW-005

SISP - REVIEW COMPLETE

Docket Number: (not applicable)

Location: Rockville, Maryland

Date: Thursday, March 9, 2006

Work Order No.: NRC-911

Pages 1-301

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

TR04

DISCLAIMER

UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

March 9, 2006

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, taken on March 9, 2006, as reported herein, is a record of the discussions recorded at the meeting held on the above date.

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

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

+ + + + +

530th MEETING

+ + + + +

THURSDAY, MARCH 9, 2006

+ + + + +

The meeting was held in Room T2B3, 2 White Flint North, Rockville, Maryland, Graham Wallis, Chairman, presiding.

PRESENT:

GRAHAM WALLIS	CHAIRMAN
GEORGE E. APOSTOLAKIS	MEMBER
J.SAM ARMIJO	MEMBER
MARIO V. BONACA	MEMBER
RICHARD DENNING	MEMBER
DANA A. POWERS	MEMBER
OTTO C. MAYNARD	MEMBER
WILLIAM J. SHACK	MEMBER
JOHN D. SIEBER	MEMBER AT LARGE
THOMAS S. KRESS	MEMBER
WILLIAM J. HINZE	ACNW

PRESENT (Continued):

JOHN LARKINS DESIGNATED FEDERAL OFFICIAL

DAVID FISCHER STAFF ENGINEER

CONTENTS

P R O C E E D I N G S

(8:33 a.m.)

CHAIRMAN WALLIS: The meeting will now come to order.

This is the first day of the 530th meeting of the advisory Committee on Reactor Safeguards. During today's meeting, the committee will consider the following:

The final review of the Clinton early site permit application;

The staff's evaluation of the licensees' responses to Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized Water Reactors";

The results of the chemical effects tests associated with PWR sump performance;

The final review of the license renewal application for Browns Ferry Units 1, 2, and 3;

And the preparation of ACRS reports.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Dr. John T. Larkins is the designated federal official for the initial portion of the meeting.

We have received no written comments nor requests for time to make oral statements from members of the public regarding today's sessions.

A transcript of portions of the meeting is being kept, and it is requested that the speakers use one of the microphones, identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

I will begin with some items of current interest. I'm happy to note that Sam Armijo is now an official member of the ACRS. I'd like to welcome him aboard, but I don't see him.

DR. LARKINS: He's currently getting a badge to get in.

CHAIRMAN WALLIS: He's getting badged. Well, let's welcome him when he gets badged and comes back.

I'd also like to welcome Dave Fischer back to the ACRS after a lapse of over 20 years. He joined the ACRS staff on March the 6th of this year. He'll be working on several subcommittees, including future plant designs and early site permits. He has a Bachelor's degree in math from the U.S. Naval Academy and a Master's degree in engineering management from George Washington University.

He started work with the NRC with the ACRS in April 1981 and was a senior staff engineer when he left in 1984. He's worked in various NRR branches. For the past several years he's been a senior reviewer in the mechanical and civil engineering branch. Among the things he worked on were the review of South Texas projects multi-party exemption, 10 CFR 5069, and revising the ECCS rule, 5046(a).

Please welcome Dave back.

(Applause.)

CHAIRMAN WALLIS: I'd also like to welcome Derek Widmayer. He joined the ACNW staff on March the 6th. So you will see him around even though he is not one of our staff members. He'll be working on the West Valley demonstration project draft environmental impact statement performance assessment review and other projects.

He has a Bachelor's degree in geotechnical engineering from the George Washington University and a Master's degree in environmental management from the University of Maryland.

He joined the NRC in the spring of 1980 in the Division of Waste Management and worked on promulgation of 10 CFR Part 61.

Please welcome Derek.

(Applause.)

CHAIRMAN WALLIS: A few other announcements. You each should have a copy of the research report. We intend to finish that in draft form in this meeting. We need your comments. Please read it and get your comments ready for Dana Powers.

If you don't have a copy, obtain one from the staff.

You should also have received a copy of our response to the SRM with regard to handling anticipated additional work load in advanced reactors and COLs. If you have any comments, please give them to John Flack. We're not going to review this as a committee. It will be reviewed by the PNP.

I'll remind you that we will be interviewing three candidates for the ACRS during lunch today. You should have a schedule for that.

Also, please note that we will have a picture of all members on Friday at two o'clock in the subcommittee room. So be suitably prepared sartorially

In the items of interest, there are

three speeches by Commissioners of note. At the beginning and towards the end there is a description of changes in management in the Regulatory Research Division, which may be of interest to you.

Now, we have a lot to do today. I'd like to proceed with the agenda. I call upon Dr. Dana Powers to get the first item going, which is the final review of the Clinton early site permit application.

DR. POWERS: Mr. Chairman, I'd like to call your attention to the fact that Dr. Bill Hinze is with us from the ACNW. He has been assisting us in this review of the early site permit.

The members are aware that we have in the past -- and I think it was September -- reviewed the early site permit for a new plant on what is now or adjacent to the Clinton Power Station site; that we found this early site permit application to be well done and complete, save for the seismic. The seismic analysis, not that we found anything wrong; it was that the applicant came in with a new performance based approach to the seismic constraints for the design of any plant on this site. It was an approach new to the staff. It, in fact, is based on an industry standard that had

evolved from work done by the DOE for its nuclear facilities.

And in our interim letter, we were unable to review that because the staff itself had not reviewed that material and accepted that approach.

That has been done now. Yesterday we had a subcommittee meeting in which we went through in a fair amount of detail the equations, analyses, and philosophy of that new performance based approach to the seismic analysis.

It was quite a good meeting in which both the applicant described his approach and the staff described their review in a fair amount of detail.

What I have asked them both to do is to give a capsulized version of the material. Many of you were there. So this will be a refresher course for anything you forgot overnight, which some of us as the age progresses, that's an important consideration.

And I've also asked them to give us a thumbnail sketch on where we stand on the application itself. I think it is our intention to at the conclusion of these presentations, to prepare

a letter that finalizes our review of this early site permit.

With that, come on.

MR. GRANT: Thank you very much.

My name is Eddie Grant. I'll be filling in this morning to provide you the initial portion of this discussion, and Dr. Carl Stepp here will begin when we get to the seismic discussion that's over my head.

Welcome.

DR. POWERS: I thought it was under your feet.

(Laughter.)

MR. GRANT: Apropos. Welcome and thank you for letting us have this opportunity. We do appreciate it. We would like to, again, fill you in on where we stand and what we have plans for with regard to the early site permit application.

Just in way of one quick refresher, Dr. Powers had indicated that we would be adjacent to the Clinton Power Station. Clinton Power Station is what you see here on the slide. You can tell where there is a hole here that was going to be Unit 2. We chose not to use that particular hole. We'll be back in the back side there.

Thank you.

We'll be using this unit back here for the new units just, again, on an aside for information.

What I'd like to do today is do some quick introductions, identify the significant changes sine the draft safety evaluation report. Just a couple of words on the geotechnical approach, and then we'll talk a little bit about our seismic evaluation again, since that was the major topic that was still open the last time we met in September. Address the supplemental DSER issue closures, again, briefly, and summarize.

Our project team. Marilyn Kray is the project executive sponsor. You'll probably see more of here as we begin to come through with some of the new start COLs, as she is also the spokesperson for that particular set of projects.

Christopher Kerr is our senior project manager. He's somewhat new to the team. You may recall that Tom Bundy wa with us before, and he had moved forward to managing those new start COL projects as well. So Chris is filling in on that for Exelon.

I'm the safety and emergency planning

lead, and Bill Maher is the environmental lead, who is also in the audience if there are any questions on that.

Of course, the four of us couldn't do it. We were supported by quite a large team. The prime contractor was CH2M Hill. They did the environmental reviews, the site redress information, the geotechnical reports and work, and prepared the emergency plan.

CH2M Hill then had some subcontractors as well: WorleyParsons, who did the safety work which prepared the Chapter 15-type discussions; Geomatrix who did the seismic work; and then along with Geomatrix we had a Seismic Board of Review, of which Dr. Stepp is the head of that particular board, and they did an expert independent review, and of course, advised us along the way on what we were -- how were we proceeding and what we could do differently, what we should do differently, and where we needed perhaps some extra help. And, of course, there were others who did various types of things such as the borings and the other types of site investigations.

RPK Constructural Mechanics Consulting is Dr. Robert Kennedy, who is in the audience if we

need some help there. In responding to specifics about the performance based methodology. He is one of the individuals at our Seismic Board of Review recommended that we bring on to keep us with this new performance based methodology, and he has quite a background in that area.

Sergeant Lundy did a brief -- well, not a brief review. They did quite a thorough review of our draft application as we got ready to make sure that we were actually prepared and ready to go and we were sending in a complete application, and then, of course, Morgan Lewis was our legal counsel.

Just a quick refresher again. We're talking about a site that's in the middle of central Illinois. There is a Clinton Power Station there existing. It is adjacent property, and it is owned by AmerGen, which is an Exelon generation subsidiary.

The applicant is Exelon generation company, and again, it is a wholly owned subsidiary then of Exelon Corporation.

Significant changes since the draft SER, this is when we spoke with you back in September. Since that time we have closed all of the open items, including the seismic ones. At the time we

cam to you in September, we were closed on all of the open issues from the February DSER but had not yet had a sufficient amount of time to address the seismic items, but they are all now closed as well, and the staff has completed all of their confirmatory items.

Again, a significant change is that the staff has accepted the SSE ground motion spectra that we had proposed based on the performance based methodology.

There were some minor revisions from what you was in September in response to the open items where we made some changes at the suggestions of the staff and incorporated that suggestions.

Another significant change is documented criteria for permit conditions. At the time that we had the draft SER in February and then again some of the items in September, there were quite a large number of proposed permit conditions, and there was at the time in February no set criteria for establishing what should be a permanent condition and what should be a combined license action item. The staff has done a good job in putting down some criteria for that, and they've applied that, and we saw a significant drop in the permit conditions. We

now have six, I think, proposed instead of somewhere in the high teens, I believe, for the initial. So we'd like to thank them for that. We think that was good work.

The geotechnical approach. I'd like to move on to that and say just a few words there. We did bill on the existing Clinton Power Station information. We had quite a thorough investigation when we were building Clinton Power Station and had done quite a few borings and arrangements, other investigations out in the area where we are looking at placing the early site permit project. So we built on that.

We looked at the regional geology by doing the literature searches, the site geology, again, from specific site work and exploration there in the way of borings and several other methods that were used to determine what the geotechnical layers looked like there underneath the site such that it is, indeed, under our feet.

We also used quite a bit of laboratory testing then to verify that, indeed, we were seeing the same types of soil conditions that we expected based on the earlier work.

We did confirm that the conditions are

as we expected to find, and of course, we did provide updated information that we then used in the seismic work.

And at this point I'd like to turn it over to Dr. Carl Stepp, who will fill us in on more details of that seismic evaluation.

DR. STEPP: Thank you, Eddie.

The seismic evaluation generally followed the guidance in Regulatory Guide 1.165 with the one exception or there are a couple of exceptions which I will highlight. As permitted by or given in the guidance in 1.165, the starting point for deriving the seismic ground motion response spectra was the EPRI SOG hazard results of the mid-1980s, the late 1980s, and as required by the guidance, the region of the site was fully investigated, and data were compiled to update the database since the mid-1980s.

That database was then evaluated to assess the impact on seismic source definitions, and the assessments that were carried out to do that were implemented using the SSHAC Level 2 assessment methodology and then a new PSHA was performed for the site.

The first departure from the regulatory

guidance was in the determination of the SSE ground motion spectrum using the PSHA result. The regulatory guidance provides for a reference probability based criteria, which is intended to achieve hazard consistent results from site to site based on the median probability of exceeding the design motions for the set of existing operating plants that have the most current seismic design.

We departed from that approach and instead applied the performance based approach described in ASCE 43-05, and the results of the performance based assessment were compared to the core damage frequency results from 25 nuclear plants that have PSHA.

We followed, again, the guidance in Reg. Guide 1.165, in the derivation of the ground motion, deaggregating the hazard and determining the controlling earthquakes, and then computing forward, in a forward sense the ground motion at the site.

There is actually not significant guidance in the regulatory guide and the standard review plan concerning site response. We used the NRC's most recent documentation of site response calculation methods which is contained in NUREG CR-6728.

In updating the results, of course, one of the primary sets of information that was updated was the seismicity record, historic earthquake catalogue. We started with the EPRI catalogue which had records in it, records of earthquake activity from 1777 through 1985, and we updated that using USGS catalogue from 1985 to 1995 and a Council on the National Seismic System catalogue from 1995 through 2002.

And as you can see from this plot of the two sets of data, the regional pattern of earthquake activity is unmodified and for the most part recurrence in maximum magnitudes of the earthquakes themselves, also unmodified by this set of data.

DR. POWERS: Just for information to members who haven't been following this, you might just want to highlight the major seismic zones that you had to consider in your early site permit.

DR. STEPP: Let me see if I have not. I do not.

DR. POWERS: Well, I think you can just highlight them on the map.

DR. STEPP: Okay. Going back then to this slide, the major seismic zones that we need to contend with are the Mississippi embankment zone,

which is the area up here of the most dense earthquake activity; the Wabash Valley zone, southeast of the plant site; Alasoa (phonetic) zone of large and fairly frequent earthquake activity. These are the two well defined seismic source zones in the entire site region.

We also defined a background zone. The background zone in this incidence covers generally the stable platform region around the site, and earthquakes in that zone were assumed to recur randomly, spatially, consistent with our inability to associate any specific earthquakes with specific confined sources.

The importance of the background zone is that it explains and captures in the hazard modeling all of the earthquake activity that is not specifically associated with the well defined sources.

Can we go to the next one?

One important, as it turned out, set of new information that became available after the mid-1980s largely is the information to do with liquefaction studies. A significant amount of effort has been put into looking at liquefaction features and associating those features with the

occurrence of large earthquakes, and an information base was developed that indicated there are repeated large events in the New Madrid seismic zone during the past 2,000 years, which required us to reconsider the frequency of large earthquakes in that zone or reassess, I should say.

And there is evidence of large earthquakes in the Wabash Valley zone during the past 12,000 years, as well, requiring us to reassess the maximum magnitudes in that source zone.

And then there is evidence of moderate earthquake activity within the near region of the site, within the background zone region of the site, approximately 40 miles or so to the southwest of the site during the past 6,000 years, causing us to have to reassess the maximum earthquakes for the background zone.

So these were significant updates of the previous seismotectonic model or seismic hazard model, if you will, that were used to compute the hazard for the site.

We implemented, as I said earlier, the performance based approach to determine the SSE ground motion spectra. This viewgraph shows the horizontal and vertical spectra, the horizontal

spectrum being the solid line, the vertical spectrum being the dashed line, and they are plotted and compared with the Reg. Guide 160 standardized spectrum scaled to .3 G at 33 hertz, which is the seismic design basis for a number of the standard plants.

The staff has reviewed and interacted with Exelon and its consultants to understand the details and to assess the details of the approach that was used to derive the ground motions, and they have accepted these ground motions as being adequate for the site and is explaining the earthquake hazard in the site area.

The actual site specific SSE ground motion will be compared with the design basis spectrum at the COL stages. That has not been selected.

There are a number of open issues that were resolved since the last draft of the SER, and I will go through each of these one by one. The first open issue had to do with magnitude estimates for the New Madrid maximum earthquakes.

It has been the situation that those large earthquakes that occurred nearly 200 years ago, the evidence has been reassessed many times and

was reassessed again during the period when we were performing this work, and the new estimates of those magnitudes were put forward.

We assessed those new magnitude estimates and did a sensitivity study to show the impact on the hazard at the site on the SSE ground motion. The ground motion was adjusted. Less than ten percent impact was found.

There was a second item, which was a conversion of the distance of various proponent ground motion models that were included in the EPRI 03 composite ground motion model. Those different models, various models have different measures of distance from the earthquake source, hypocenter nearest distance to the fault and point source epicenter.

And the process that was used to convert all of those various different distance metrics to a single distance measure was a matter of some lack of clarification originally. We provided additional detailed description of how that was done, and the staff found it acceptable, an acceptable explanation.

There was the issue of the site velocity model for response analysis. The principal

requirement there was a further justification of using a single mean velocity model and variability about it to represent the variability and strength and stiffness of the soils beneath the site.

The resolution there was a commitment on the part of Exelon to remove the top 60 feet of material which was really the soil profile that was in question.

There was a question about the dynamic response analysis that were provided for the site, specifically a question about the use of a module reduction in damping (phonetic) curves that were used for the site, and also the imposition of a 15 percent cap on the reduction in motions that could be the result of nonlinear deformation in the site response analysis or nonlinear response.

The solution there was to demonstrate that the module reduction damping curves that were used actually were appropriate for the site. They decided that they did represent the materials at the site. The staff accepted that demonstration.

And the 15 percent cap on reduction of the damping for the site was imposed. It was demonstrated that it changed the ground motion spectra by less than two percent.

There was a question about the adequacy of the SSE ground motion to represent the local prehistoric earthquake in the Charleston area of Illinois. That's about, as I mentioned earlier, 40 miles from the site to the southeast.

We went through several analyses showing how the deaggregated earthquakes distributed and how they represented the controlling earthquakes, and we did a calculation to demonstrate that for the estimated magnitude of the earthquake that the ground motions that were estimated at the site were, in fact, enveloped by the SSE ground motion spectra.

DR. POWERS: You said Charleston. I think you meant --

DR. STEPP: I meant Creekville (phonetic). I'm sorry. I just realized that I misspoke there. Charleston on my mind.

(Laughter.)

DR. STEPP: And finally, we had a question about the performance based methodology, and basically the question really had to do with clarifying the parameters of the methodology, the justification for those parameters. We provided detailed descriptions of each of those parameters and their justification in response, and that was

largely the topic of the discussion here yesterday, and the staff found those responses acceptable.

And I think that closes the --

MR. GRANT: There was one additional item there, the 254-1, where there was some language in our SSAR that indicated to the staff that we might be considering not doing any additional borings, and we clarified that to assure that, indeed, we would look at the reg. guide and follow that guidance.

With that though we'll come to a summary closure here. Again, all open items are closed on the SSESP for the Clinton Power Station area. All confirmatory items have been completed and the SSE ground motion spectra has been accepted.

Any questions?

DR. POWERS: Members have any questions for the speakers?

(No response.)

DR. POWERS: Thank you very much.

MR. GRANT: Thank you.

DR. POWERS: We will now turn to the staff who had the chore of reviewing and assessing this methodology on the performance based approach to the SSE ground motion spectrum.

MR. SEGALA: Hi. I'm John Segala. I'm the senior project manager for the Exelon early site permit safety review. The purpose of our presentation is to discuss an overview of our safety review of Exelon's early site permit application and answer any questions from the ACRS.

We're going to sort of do a quick overview of project milestones, Exelon's early site permit safety review, key review areas, overview of our open items, permanent conditions and COL action items, and touch on FSER conclusions and then give you the overview of our seismic review.

We received the Exelon early site permit application on September 25th, 2003. We issued our final safety evaluation report in February 17th of 2006, and we briefed the ACRS subcommittee yesterday on Seismic.

Upon conclusion of today's ACRS meeting, we are looking for receipt of a final letter from ACRS on March 30th, and then we would issue our final safety evaluation report, including your letter in a NUREG in May, and then have the hearings and the final Commission decision.

The final safety evaluation report documents are a review of the applicant's site

safety analysis report and their emergency planning information. Exelon requests an early site permit for a total of 6,800 megawatts thermal power rating, and Exelon has chosen not to submit a specific design, but to envelope multiple designs in what they call plant parameter envelope, and so that's what the staff reviewed.

The key review areas are listed here. I'm not going to read them all, but it gives you a sense of what we reviewed in the final safety evaluation report. Principal contributors, we had a total of eight reviewers with support from multiple contractors reviewing the application.

For the open items, we had a total of 40 open items. There was 33 open items in the draft safety evaluation report and seven open items in the supplemental draft safety evaluation report which focused on seismic and geology and geotechnical reviews.

We also closed out the confirmatory items. As Exelon indicated, we originally had 15 permanent conditions in the draft SER and the supplemental draft SER, and after applying the new criteria, came up with six permanent conditions.

We also have 32 proposed COL action

items. Those are items that will be reviewed at the COL stage, and there were 17 of those in the draft safety evaluation report, and with the new criteria we applied essentially the items that were permanent conditions and the draft safety evaluation report became COL action items. So there was a shift there.

In terms of the conditions, as an overall conclusion, as an overall conclusion, the site safety and emergency planning is acceptable and meets the regulations. In terms of seismology and geology, the site is acceptable from a geologic and seismologic standpoint and meets the requirements of 10 CFR 100.23, and the sort of overview of how we came to that conclusion, I'll turn it over to Dr. Clifford Munson.

CHAIRMAN WALLIS: If I can ask a question here, when I read the SER I noted that you had a statement that the suitability of the site for development of adequate physical security plans. Now, I don't know if we're allowed to discuss this here, but how do you give the public some sort of assurance that this is the case? I don't know how you make that judgment.

MR. SEGALA: What the reviewer looks at

is you look at the amount of area around the site, and you look at is there adequate standoff distance where you could develop an adequate emergency plan.

There are other ways. If you don't have the distance, you can put in barriers when the plant is built to make up for the fact that you don't have the adequate distance. So basically that's the review that's done, is they look at the land that's owned by the applicant, and they look at is there adequate standoff distance.

MR. MUNSON: My name is Cliff Munson. I'm the primary reviewer of the geology-geophysics portion of the ESP application.

The staff was not expecting a performance based approach in the ESP application. So to review this new approach, we decided to get input from other seismic and civil engineering experts in the agency. So we formed a SITAG group, Seismic Issues Technical Advisory Group, and that group served in an advisory role to NRR and helped us to review this new performance based approach.

I'd just like to point out Dr. Andrew Murphy is the chairman of the group and he's here in the audience with us today.

In addition to SITAG, we also had

outside contracting assistance from USGS and Brookhaven National Lab for our review of this new performance based approach.

I'd like to start off with the three main conclusions that we reached for our review of the performance based approach. The first conclusion that we reached, that it's based on a sound technical approach.

The second conclusion we reached is that the performance based SSE achieves a safety level generally higher than operating plants.

And the third conclusion is that the performance based SSE adequately reflects the local ground motion hazard.

In the process of going through each of these conclusions, I'll describe our open items and how we resolve those open items. The first conclusion, performance based approach based on a sound technical approach, I'd like to do a brief introduction. The performance based approach is risk-based in that it considers both seismic hazard specific to this site, as well as generic fergility (phonetic) for systems instructors and components.

The basis of the performance based approach is that a target -- and much of our review

focused on this target. Is it an adequate target? Is the number sufficiently low enough to result in an SSE that we felt provided an adequate level of seismic safety?

The performance based SSE can be determined by two approaches. The first approach is the design factor method, which is in ASCE 43-05, and the second approach is a direct integration of the risk equation.

The advantage of using the second approach for the staff was that it allowed us to verify the models that were used and the parameter assumptions that were made to arrive at the design factor method. So the staff used that to resolve its open items.

A basic intro to the design factor method, the performance based SSE is determined by taking the ratio of the two uniform hazard response spectra at several different spectoral frequencies and then taking the ratio of the two spectoral acceleration values to determine the design factor and then to determine the final SSE.

The amplitude ratios for the Clinton site were close to two, and design factors, the performance based approach has a minimum value of

one. So it can't go below one, and those values ranged from one to 1.3.

DR. POWERS: But do you have some feel for how steep the hazard curves could be at other sites? I mean, I assume this is a relatively flat one.

MR. MUNSON: Right. Clinton is a relatively higher hazard. It's probably one of the most significant hazards in terms of earthquake in the central and Eastern U.S. So it has a hazard curve that is almost more California-like than other sites we'll see in the future.

DR. POWERS: But I mean how high could AR be, for example, or low?

MR. MUNSON: I believe AR could go up to as high as four or so.

CHAIRMAN WALLIS: I'm a little bit surprised you said it was california-like because the preamble to this whole discussion starts off with the statement it's one of the most stable geological regions in the United States.

MR. MUNSON: But it's surrounded by New Madrid. We've got Wabash.

CHAIRMAN WALLIS: That's right.

MR. MUNSON: I mean, you have that

moderate Springfield earthquake. So, I mean, we're not talking Florida or Texas here.

So there is some significant seismic concerns here for this site.

Go ahead to the next.

You can also directly integrate this risk equation to determine the SSE. This risk integral is a combination of the hazard curve and a fragility curve, and this is a hazard curve for five hertz and a fragility curve. So multiplying these two together and then solving for the SSE that meets the target --

CHAIRMAN WALLIS: It would be good if you actually showed when you meld them together you've got a bell shaped curve or whatever you want to call it.

MR. MUNSON: Yes, I have that figure in the ASCE. I didn't bring it, but the portions of the hazard curve and the fragility curve that are not down here in the tails are what combine to form that bell shaped curve.

The performance target used for the ASE approach is one times ten to the minus five per year, and in the ASCE 43-05, that corresponds to the most stringent seismic design class, Seismic

Category 5, and it is also required to remain essentially elastic, Limit Class E.

DR. POWERS: Yeah, I think it's important to understand what that class refers to. it is the concluding significant inelastic deformation.

MR. MUNSON: Right. So the goal, the one times ten to the minus five per year, is targeting that onset of significant inelastic deformation. That's what we want to avoid, and we're setting that at this low frequency value.

CHAIRMAN WALLIS: Well, this target came from ASCE, did it? And has it been essentially endorsed by NRC now as a result of this process you've been through?

MR. MUNSON: Well, our review of the Clinton SSE using this target, we found that to be acceptable, the resulting SSE to be acceptable using this target. We haven't completely as an agency come to a final conclusion on whether this is going to be an acceptable target for future applications. There's discussion of a targeting seismic core damage as opposed to directly targeting seismic core damage as opposed to targeting this intermediate damage state.

So that's kind of an ongoing discussion right now, but we were able to verify that the SSE that Clinton determined using this target has an adequate level of safety compared to other nuclear power plants.

DR. POWERS: If I struggle with the analysis that I have to go through to detect essentially elastic behavior of structures versus the analysis I have to predict core damage, it seems to me that the easier job is the elasticity calculation than the core damage calculation. The less uncertain calculation --

MR. MUNSON: Right.

DR. POWERS: -- is elasticity versus core damage.

DR. BONACA: Plus, I mean, I see an advantage in the issue of elasticity because, again, it deals with containment, for example, is a criterion that I appreciate will describe what expectation I have of the containment. I don't have the same result if I go to a core damage frequency on this picture for four months, you know, relative to CDF.

MR. MUNSON: Right. The advantage we were contemplating is that this method doesn't

achieve a consistent seismic core damage frequency for all sites. As Dr. Kennedy stated yesterday, for all of the 28 sites, it's going to be between one times ten to the minus six and five times ten to the minus six.

So there is a range. We have to determine if that's an acceptable range. This Clinton site is near two times ten to the minus six. So it's sufficiently low.

DR. POWERS: Those are really bounding calculations because you've assumed that M is 1.67.

MR. MUNSON: And we also don't take credit for redundant systems, you know that we're doing a single failure approach. So the attractiveness of targeting a seismic core damage value would be that we would have -- all sites have the same seismic core damage frequency value.

So we're looking at that issue right now as a SITAG and hope to reach a resolution on that soon.

Some of the other assumptions, the approach assumes a linear hazard curve between ten to the minus one, ten to the minus five.

Could you go to the next?

So that's in this region right here.

The method assumes a linear hazard curve, and the staff was able to verify that that's a conservative assumption because there's a slight downward curvature of the hazard.

Some other modeling assumption that fragility is modeled using a lognormal distribution with a standard deviation of .4, and for this approach targeting the onset of significant inelastic deformation, they do not take credit for a margin. They assume that the seismic margin is one.

So in conclusion, the staff concluded that the performance based approach achieves both high and consistent level of seismic safety. This method does not take credit for seismic margin.

We determined that the performance target is conservative and that the methodology makes conservative parameter and modeling assumptions.

CHAIRMAN WALLIS: Well, you say conservative performance. Performance target is this one times ten to the minus five?

MR. MUNSON: Right.

CHAIRMAN WALLIS: What's your basis for saying it's conservative?

MR. MUNSON: Well, our basis is that the

resulting performance based SSE achieves a seismic core damage frequency of close to one times ten to the minus six.

CHAIRMAN WALLIS: So you believe it is conservative in terms of its effect on core damage frequency.

MR. MUNSON: And it's conservative in light of the outcome or the final result of the performance based SSE. It can also be considered conservative because one times ten to the minus five is the median seismic core damage frequency for the IPEEE results for seismic PRAs for those sites, and this is a minimal damage stage, and so we're comparing something at a minimal damage stated to something at a much higher damage state.

So on the basis of those two reasons, that's why we considered it a conservative --

CHAIRMAN WALLIS: Well, I can understand why parameter modeling assumptions can be conservative, and that's the normal definition of conservative. So it's a target, and it's not quite clear to me how a policy based target like this can be called conservative, but I just wanted to ask.

MR. MUNSON: Well, certainly if they had used a higher target, we would consider that

unconservative.

DR. POWERS: Well, isn't the conservatism that you're saying acceptable performances will be short of any sort of hazard to the public? I mean, you barely deform the material if everything goes awry here, yet you're treating that as an acceptable. Worse than that is unacceptable. Better than that is acceptable, and yet it's far short of actually damaging fuel and releasing radionuclides. That's where the conservatism lies, isn't it?

MR. SIEBER: Actually you're saying plastic.

DR. SHACK: You know, there's conservative. You've picked your approach here, and you say there's no credit for seismic margin, but it's really the fact that you have the seismic margin that makes the CDF so low when you've picked this target.

I mean, if they had built that into the criterion, then their CDF would have been ten to the minus five. They left it out of the criterion and so you end up with your one times ten to the minus six.

So I wouldn't say there's no credit for

seismic margin. It's the seismic margin that really gives us the resulting low CDFs.

MR. MUNSON: Right. Well, earlier versions of this performance based approach they did use a 1.67 for this target, for the one times ten to the minus five target. So the SSEs were lower, and that was what was being debated in the late '90s-2000 time frame. So this is a more conservative approach.

DR. SHACK: Yes. It still comes back to what do you consider an acceptable seismic CDF. IF ten to the minus five is okay, then that's one number. If you'd like something a little closer to ten to the minus six, then that's a different number.

MR. BAGCHI: This is a good time to point out at this point that you're only focusing on one last aspect of choosing the design ground response spectrum. There are plenty of conservative assumptions in modeling of the probabilistic seismic hazard.

For example, the capping of the damping valleys (phonetic).

MR. MUNSON: To also reassure ourselves, we compared the seismic core damage frequency values

for the performance based SSE using that margin of 1.67; we compared that to some of the other nuclear power plants that had performed seismic PRAs, and as I stated, Clinton falls close to ten to the minus six, and that gives us in terms of recurrence of the ground motion a much higher value, in terms of frequency a much lower value than most of the other sites.

If we talk in terms of Reg. Guide 1.165 type of SSE for the Clinton site, we know a couple of points, and one of those points would give us a recurrence interval way up here, close to about 12 million years of recurrence.

So I guess I could say that the applicant was justified in trying to use a different approach than what we had in Reg. Guide 1.165 to come up with their SSE.

DR. POWERS: I mean if the situation was that it was unnecessary for adequate protection of the public to go to such a long occurrence, seismic.

MR. MUNSON: Right, and if you remember Grand Gulf, they did use 1.165. Thy used the reference probability that was in 1.165, and they didn't have any difficulties. So it depends on the site.

And hopefully going forward we could have a more --

CHAIRMAN WALLIS: I was just looking at that plant there. There's one plant there that's something like 5 P to the minus four.

MR. MUNSON: That's Haddam Neck.

CHAIRMAN WALLIS: Okay. That's the one.

MR. MUNSON: So it's gone.

For our third conclusion, we wanted to make sure that the SSE adequately reflected the local ground motion hazard, and so we took a closer look at the Springfield earthquake.

The earthquake occurred approximately 6,000 years ago about 60 kilometers southwest of the ESP site, and magnitude estimates ranged from 6.2 to 6.8. So we asked the applicant to provide us ground motion estimates from that event to insure that the SSE enveloped that.

So they provided us with median 84th percentile ground motion, and they did it for two different cases, for magnitudes ranging from 6.2 to 6.8 and then for a magnitude of 6.3, which is a more recent estimate of the earthquake for the Springfield area.

So the staff was satisfied that that

ground motion was enveloped by the SSE.

That concludes what I had to present on the seismological performance based approach. Any questions?

MS. DUDES: Excuse me. This is Laura Dudes.

I just wanted to reiterate something. I know you may have questions, but that Cliff had mentioned. I'm the Branch Chief for New Reactor Licensing.

As we spent several hours yesterday talking about the seismic method used in this early site permit application, that was the key challenge in the review of this application. When the staff learned early on in receipt of the application that we were going to be reviewing a unique approach to seismic, we had to retool our approach to this application.

This resulted in approximately seven additional months of review time. We brought in, as Cliff mentioned, outside experts as well as we made the positions that are reflected in the safety evaluation report an agency-wide consensus. That is, we worked across other offices, NMSS and Research, to make sure that our staff experts in

this area were able to review the work that was being done.

Also, this agency-wide consensus on a specific application is not our preferred method to review and approve these new generic approaches. So in conjunction with the work that we've done in this specific early site permit application, this work will inform, but this is not the end of this review. This is actually the beginning, and the work done on the Clinton early site permit application will inform a regulatory guide to address this issue in a broader agency manner, and it is important that we work to complete that regulatory guide and have these conversations. I know that we'll be back with the ACRS on this issue in a generic manner.

And because there are many sites that are coming up with COL applications that may have similar issues with seismic activity and may want to use a similar approach, we have an early site permit application expected in August of 2006.

We expect a similar type of approach to be used. So I appreciate the conversations from the subcommittee and the committee today, as well as the work that has been done, and I just wanted to make it clear that the staff does not feel done in

looking at this issue, and in fact, it's just the beginning.

Thank you.

DR. POWERS: Thank you.

It strikes me that the important finding of the subcommittee meeting was the depth that the staff went through to understand and to validate not only the general philosophy of the approach, but indeed the parameterization that was involved, which I found comforting.

Are there other questions you'd like to pose to the speakers?

We do intend to write a letter on this material, and we have collected comments. Bill, you have provided comments from the ACNW perspective of this material. Thank you very much.

Any other comments?

(No response.)

DR. POWERS: I'll turn it back to you, Mr. Chairman.

CHAIRMAN WALLIS: Thank you.

DR. POWERS: Setting a new record for on-time delivery.

CHAIRMAN WALLIS: Yes, we are an hour ahead of time. Normally I would say that's a good

thing, but I just wonder why we are so much ahead of time when we know we have a great deal of work to do today and we're dying to get on with it and we're not allowed to do it.

DR. POWERS: Obviously very poor planning on the part of Planning and Procedures Subcommittee.

CHAIRMAN WALLIS: Well, I'm not sure that we had a proper hand in it.

So we have to take a break until 10:45, and your assignment is to read the research report and to do your other jobs so that we're ahead of the game by the end of the day. We'll take a break until 10:45.

(Whereupon, the foregoing matter went off the record at 9:35 a.m. and went back on the record at 10:46 a.m.)

CHAIRMAN WALLIS: Please come back into session.

This is the first of three hours we have on the sump issue. Three will be in these three hours a compression of what our subcommittee heard in two and a half days. I think there may even be some more to be added beyond what the subcommittee heard about. So this is one of the priority

matters that the ACRS is considering at this time.

This morning we're going to hear from NRR, and we may also hear from NEI if there's time, on the responses to the Generic Letter 2004-02, and on the path forward to resolve this issue, GSI-191.

I don't usually like to say too much in introduction, but I want to bring up a few points that the subcommittee focused on.

The responses to the GL were reported by the staff to be all incomplete. There are many REIs that have been issued, and there turned out to be gaps in all important areas, particularly downstream effects and chemical effects.

And yet at the same time, many plants are going forward planning hardware changes. So the question before us really is: are they ready to make appropriate decisions? Has the staff been able to evaluate these decisions based on what we know now, or perhaps some of them may rush into changes that they may later have to modify?

The suitability of these plan changes is being assessed by as I understand it, by proof tests; that the screen manufacturers are doing tests, and also the licensees are doing small scale chemical effects tests to model these particular

plants.

Now, the subcommittee questioned how these sorts of tests can be used to assess performance in an actual plant situation in view of the many phenomena going on and the different kinds of LOCAs and different parts of the plant with different sorts of debris from different locations. A whole lot of different things going on, without some kind of a structure of theory or models, how are these proof tests going to be applied to show that the right decision is being made in installing some screen?

The subcommittee also asked about downstream effects, particularly those in the core region as a result of debris bypassing the screens, and it appeared to us that the knowledge base for assessing these effects was, if not inadequate, at least appeared as if it might not be adequate. There didn't seem to be a quantitative or analytical or modeling predictions for what would happen as a result of not too much of a proportion of this debris actually bypassing the screens and reaching the core. So we would like to hear about that.

Now, this afternoon we're also going to hear about research results, some of which are quite

notable, and they may also have an influence on the resolution of this issue. So this looks like a pretty important matter for the committee to consider.

We are very happy to see that Brian Sheron is here to start us off. Maybe you will clarify everything for us nicely.

So, Brian, if you're ready, please go ahead.

MR. SHERON: Okay. Thank you.

I'm Brian Sheron. I'm the Associate Director for Engineering and Safety Systems in NRR.

I had asked the staff. I said I'd like to address she committee for maybe about five or ten minutes at the introduction here to kind of put a perspective on this, on where we are. This issue has gained the attention not only of senior management in the agency, my supervisor, Mr. Dyer, but also all of the Commissioners.

I think over the past several months we have given I don't know how many briefings to the Chairman or certain Commissioners on this. I would point out that at the RIC both on Tuesday and on yesterday, both the Chairman mentioned this issue in his speech, and Commissioner Jaczko spent a fair

amount of time mentioning it. Both, I think, indicated the need to reach closure on this fairly quickly as a safety issue.

If I could get the first slide, please.

I was just talking with Tom over here, and I said I believe it was the ACRS that first raised the issue of chemical effects. So for that we, I guess, thank you.

(Laughter.)

CHAIRMAN WALLIS: Better then than later.

MR. SIEBER: Even harder than that.

MR. SHERON: As they used to say about ACCS, we probably put a lot of kids through college on this issue.

MR. SHERON: But I think you raised a good point. I mean, I just want to point that out. I mean you guys are right on the money in terms of addressing an issue because it has turned out to be a real issue.

It raised additional concerns obviously about debris loading on screens. We raised the issue. I think -- I'll be as blunt as I can -- I think the industry kind of hoped that this would go away. We did our scoping experiments. The Office

of Research did. I think they did a super job, and what they identified is that it's a real issue. It didn't go away.

And I think most licensees are now realizing that this is a significant issue that they've got to deal with.

When we first issued our generic letter and our bulletin, for that matter, we felt that we had given the industry substantial time to deal with this issue. If you look at the time between when the first bulletin went out and when we identified what we believed was an appropriate closure date in the generic letter, it was about five years, I think, and we felt that was sufficient time to address the issue and to design and install the modifications.

As I said, you know, some of these issues have become much more complex than what we originally envisioned, but most licensees right now are approaching the issue by planning significantly larger screens with excess margin to account for areas of uncertainty.

I looked at a few of the we got from the generic letter, and while you're right, there was a lot of areas where we didn't have a lot of

technical detail, they did point out that the size screens they put in they would identify what they believed was excess margin that could accommodate these effects down the road when they did get the information and could confirm those margins.

In some cases, I think these licensees put in literally the largest screens that the containment could accommodate. We have a couple licensees that are pursuing an active design. I don't know if you've ever seen the movie with they call it the plow and the comb now and the like, but it sweeps across.

There are some plants that are doing it because when you start putting in larger screens, it can affect outages. It impacts their lay-down areas, and it can cause problems because then they would have to go in and remove these screens and everything just so they could get through the outage.

So a lot of them, I think, or not a lot, but a few actually pursue the active strainer design because of economic tradeoffs between outage times and, you know, whether they want to go to an active trainer versus a passive.

Next slide, please.

CHAIRMAN WALLIS: Well, can I ask you? When they decide on a large screen, do they have a set of specifications the screen has to satisfy, such as the passing of ions or something? This is somewhat fine, but it has to satisfy that they designed to --

MR. SHERON: Well, I think that there's a debris size. Id' have to let any of the staff if you want to.

MR. HAFERA: Yes, there are specifications for fuel designers in terms of what can the maximum size that can be passed into the primary system.

CHAIRMAN WALLIS: And the quantity?

MR. HAFERA: Well, quantity is probably more based on size of a vessel and characteristics of the debris in terms of how large will the debris pile be; how well will it transport; how well will it sink or settle or will it just pass through the vessel depending upon --

CHAIRMAN WALLIS: But it's not just a question of building the biggest screen. You can. there are set specifications which are clear that they're trying to meet.

MR. HAFERA: That's why the process of

evaluating your screens is fairly long, fairly arduous, and in many cases iterative.

CHAIRMAN WALLIS: Thank you.

MR. SHERON: We've recently confirmed our expectation to licensees that we still expect modifications to the sumps to be in place by the end of 2007.

I will point out that we've told licensees that if they have legitimate reasons for not being able to meet that date, that they should come in and request an alternative date that they believe they can meet and to provide us with the reasons why they need the extra time.

These are legitimate reasons if, for example, they tell us they need more time to finish some testing or to complete design work that would assure that the sump they were putting in was going to address or you know, be technically defensible, then we would consider it.

So far we have, I believe, five utilities that have requested extensions beyond December 31st, 2007, and we're evaluating those. So you know, I do want to point out that while we said December 31st, 2007 was an expectation, it's not a regulatory requirement anywhere.

It was our expectation, and we said that if you need further time, you need to come in and just talk with us and present your case. And some licensees are doing that.

I think at this point in the whole process, both the staff and the industry have concluded that installing modified strainers at this time is the correct thing to do. We think from a safety standpoint this is the right thing to do. There are plants out there that have very small screens. You know, I don't want to say you can count the square foot on your fingers, you know, but maybe it's in two digits; it's not in three digits or anything.

From the standpoint of why we think that's acceptable, we think, again, putting in the larger screens we think at this time makes the plant safer. It's the right thing to do. It's going to make these sumps much more likely to perform acceptably in a potential accident.

Also, as I said before, and I'll show you a slide here in a little bit, most of these licensees, we think, are putting in the largest screens that they can practically accommodate in there.

The point is that, you know, we worry about we always hear the term, you know, "gee, we don't want to have to do it over again. We don't want to have to redesign the screen, you know."

Where we are right now is that they're putting in the largest screens, and somewhere down the road when we do the confirmatory work with regard to demonstrating you can handle chemical effects and, you know, debris transport and so forth, if it turns out that some of the smaller area screens, for example, don't perform acceptably, the solution is not going to be to go back and redesign their screens.

What they're probably going to have to do is look at eliminating the debris loading in the first place. They're going to have to go in and figure out can I get this buffer out of containment. Can I replace it with an alternate buffer that is not chemically reactive? Can I eliminate some offending insulation and replace it with something that's not going to transport and the like?

Can I sharpen my pencil, do more experiments and reduce my zone of influence such that I can get a calculated debris loading that's less, or do I go to an active strainer, or do I go -

- for example, the Finns are using a nitrogen back-flush system and they just blow the stuff off the screen.

The point is that it's not going to be a matter of, gee, I made the screen the wrong size. I've now got to go back and redesign it and make it bigger. It's going to be we need to do something more besides just change the screen.

CHAIRMAN WALLIS: Wait a minute. Have you flipped the slide here?

MR. SIEBER: Yes.

CHAIRMAN WALLIS: Please don't. Please don't.

MR. SHERON: Oh, I'm sorry.

PARTICIPANT: No, I did that.

MR. SHERON: Oh, okay.

CHAIRMAN WALLIS: Because the downstream effects can be accommodated through engineering evaluation. This is a concern that the subcommittee really raised. It doesn't take much debris to be on a spacer in the fuel bundle and really affect the cooling in that area.

MR. SHERON: And I'm going to let the staff -- they'll address that.

CHAIRMAN WALLIS: We're going to have to

hear about that, I think.

MR. SHERON: Yeah, they'll address that in their presentation. I wasn't planning on getting into it.

CHAIRMAN WALLIS: I don't think it can be left to chance and subsequent evaluation without some assessment now.

MR. SHERON: But the solution is not to do nothing also.

CHAIRMAN WALLIS: I wasn't suggesting that, but you should do it knowingly.

MR. SHERON: I agree.

We also did some checking. We asked the industry if they had additional time would that influence how they would design their sumps, and the answer was that a nominal amount of time -- and I say "nominal" is anywhere from six months to a year or maybe a complete cycle -- to do additional analyses would not really affect their modified strainer installation plans.

The reason is most plants have already either designed and ordered their new screens or actually have them on site and are ready to be installed at their next outage. So this is basically they've already committed to larger

screens, and that any further time right now was not going to change, you know, that design.

CHAIRMAN WALLIS: And the staff knows how to evaluate these things which they've already decided to install? That's something we're going to try to establish, I think, in this meeting.

MR. SHERON: We're not claiming that we have all of the answers, sir. We're just saying that, you know, we think this is the right thing to do. It's the safer thing to do at this time. We recognizes there's uncertainties. We recognize there's issues. They need to be addressed, but the question is do you wait until we do all of that or do you do it --

CHAIRMAN WALLIS: Do you have a strategy that you have to develop? I understand that.

MR. SHERON: Yeah. Next slide.

CHAIRMAN WALLIS: We're also trying to save you from any untoward decision.

Did you finish that slide? I'm sorry.

MR. SHERON: Yes. Yeah, I finished the last bullet on it.

CHAIRMAN WALLIS: What was the last bullet? That was? I'm sorry.

MR. SHERON: I just said that the

industry said that they would not --

CHAIRMAN WALLIS: Okay. Thank you.

MR. SHERON: -- they would not be able to do anything different if they had any increased amount of time.

In terms of path forward -- and you'll hear more about this obviously when the staff goes through their presentation -- but we don't believe waiting for all testing and analysis to, you know, try and address every single issue would result in unacceptable strainer modification installation --

CHAIRMAN WALLIS: I wondered what is it that you would need from a test in order to say, "Gee, whiz, that's so important that we're going to have to take account of it." There are some pretty noticeable results from some of the tests we've heard about, and I just wonder how notable they need to be before you say, "We need to know more about this before we make a decision."

Are you simply going to say, "We're not going to accept any new information"?

MR. SHERON: No, I don't think we're going to say we're not going to accept --

CHAIRMAN WALLIS: You see what I'm getting at. There are some quite striking results

from --

MR. SHERON: Yes, and I would like to say that the staff, you know, hopefully will get into that in more detail in their presentation.

CHAIRMAN WALLIS: Yes, but you see, it's just not the waiting. It's what you're actually learning from the testing that you have to think about.

MR. SHERON: Yes. And the approach I'm trying to describe is that we would put in the larger strainers now because we think on balance, based on everything we know, we think that's the right thing to do. We recognize that the industry and the staff still need to follow through with the confirmatory work to address all of these issues, you know, but that's something that can follow on, but we don't want to stop licensees from putting in the installations now.

And as I said, if you looked down on the third bullet there, further testing and/or analyses will be done to confirm the acceptability of the margins that are being basically advertised in these screens.

You know, and our conclusion is basically that the current schedule for modified

strainer installation should be maintained, and we think will provide a signification improvement in safety compared to current strains.

CHAIRMAN WALLIS: Looking at your second bullet, the decision to remove buffering agent like triphosphate --

MR. SHERON: Well, yes, TSP is the --

CHAIRMAN WALLIS: -- TSP, might be an easier thing to figure out in terms of its value added than the strainer design.

MR. SHERON: Yes, and the industry has a program, and at some point, I guess, you know, either they may present it to you, but they're looking at alternate buffering agents. I forget some of them that they're looking at, but they're looking at some that are not as reactive. I think all of them, you know, do have some chemical interaction potential.

One of the things --

CHAIRMAN WALLIS: That's interesting. What you're saying is you're saying put in the strainer and then we'll see if you need to remove your TSP. It might be a better decision to say, "TSP we know is harmful. Take it out."

MR. SHERON: Well, if they put in a

strainer that is so big and it can be demonstrated that even if, you know, they have TSP and cal-sil in a debris loading from that still doesn't clog their strainer, then it may be acceptable.

CHAIRMAN WALLIS: May be. It may be.

MR. SHERON: Right. But as I said, that's a longer term effort that I think the industry is looking at to say can they remove buffering agents.

That's something that we've challenged them. We've said what is driving it. It's obviously the iodine retention. Is it from a TID type of source term?

Palisades came in a couple of weeks ago, and they're proposing to remove -- they want to get a license amendment to remove TSP from the containment for one cycle. The problem is that they're going to need -- they said they still need SSEBAs and KI for the operators in order to meet the dose requirements.

But the question is: what's driving that? And they said they would need that even if they used the alternate source term, not a TID source term.

But there are questions, and then the

industry obviously had concerns about long-term corrosion. IF you don't have a buffering agent from circulating a boric acid solution, but that may be more predicated on a licensee's desire to restart a plant.

CHAIRMAN WALLIS: It seems to me you have to at least make a calculation based on what we know now, what we're learning every day, knowing how much goop is produced and knowing something about the area of the strainer and knowing how much goop has been found to produce a problem, at least make some order of magnitude assessment about whether or not you're taking a big risk by making this decision about this decision about this strainer. presumably this is going on.

It might be that in that case they might decide remove the buffering agent now because trying to solve the problem with a strainer is much less secure than the decision to remove the buffering agent.

Well, I'm saying removing the buffering agent has other ramifications obviously.

CHAIRMAN WALLIS: Yeah, I know. I understand that, but I was just wondering about your priorities in saying fix strainers first and then

think about buffering agents.

MR. SHERON: Well, we've encouraged the industry to look at both of these. Okay?

MR. KLEIN: Dr. Wallis, if I might interrupt, Paul Klein from NRR.

I believe they're working the problem in parallel. There's a total of six units that have a combination of cal-sil and TSP, and they are in the midst of a program to evaluate alternate buffering agents, and I believe that you will see some action from some of these plants.

CHAIRMAN WALLIS: Thank you.

MR. SHERON: If I could just go to the last two slides, and then I'm going to sit down and let the staff get on with their presentation.

These are NEI graphs that they provided us, but this will give you an idea of the spectrum of screen sizes that are being proposed.

CHAIRMAN WALLIS: Is this spectrum because the plants are inherently so very different or is it because there's a great uncertainty about what they should do?

MR. SHERON: I'm going to guess it's because there's a great spectrum in design differences.

CHAIRMAN WALLIS: So there's a rationale about why one is so huge and one is so small?

MR. SHERON: I think it has to do with just available area and the containment design.

CHAIRMAN WALLIS: Oh, available area rather than the problem to be solved?

PARTICIPANT: It's greatly affected by the amount of the bad acting materials that they have in the containment.

CHAIRMAN WALLIS: I would think it would be, yes.

MR. SHERON: And the next slide just shows you the plant strainer installation schedule based on the number of plants -- well, this is number of strainers versus time, and as you can see, most of them, I think, with the exception -- well, this shows one. That number on the bar in the far right is now up to five I believe, if we accept their proposals.

CHAIRMAN WALLIS: This is installation by the fourth quarter of this year, which means they must have decided already?

MR. SHERON: Yes. Yes, there are plants that have already installed.

CHAIRMAN WALLIS: So we should say that

the decision has already been made to install these strainers. Did you take that message away?

MR. SHERON: Yes.

CHAIRMAN WALLIS: Okay.

MR. SHERON: Yes, they've gone out and they've probably signed contracts to have these strainers fabricated and brought on site and scheduled for installation.

Anyway, that was really all I wanted to point out, is that, you know, from an office standpoint, from NRR office standpoint, we believe that letting the plants go ahead and put these strainers in at this time, modified strainers, to get the increased area we think is the safer thing to do. We recognize that there are still uncertainties, a number of them.

Our plan is to continue to work with the industry as well as with the ACRS, you know, and address these issues that you've raised. You know, we recognize that we're probably not going to get down to a real super detailed level of exactness, you might say. What we want to make sure is that we have reasonable assurance. That's our standard, and the like.

And you know, I'd point out that you

know, we're making decisions here on incomplete information. We do that every day in NRR, you know. So I'd love to tell you we have some fixed criteria in everything that we use. We don't.

Every situation is kind of unique, but this is just another example of making a decision based on engineering judgment and all of the information that's in front of us at the time.

CHAIRMAN WALLIS: Now, I have to ask you. You said that essentially plans are already there and the decision has already been made to install these strainers. So your approval of these plans has already been given. Is that true?

MR. SHERON: Well, no. Licensees are doing these installations basically at their own risk.

CHAIRMAN WALLIS: You say at their own risk, and then they come in and try to say that now we have satisfied the requirements?

MR. SHERON: Yes. In other words, we issued REIs. We got a letter from NEI the other day. I think it was last Friday that said that the industry basically was, you know, really stretched in terms of resources and most of the design and engineering talent was being used to complete the

designs and get the procurements and so forth to get these strainers installed, and that they felt that the information we were looking for in the REIs was two things.

One is that a lot of it was not available yet, and second is they felt that if they had to take people off of completing the designs and installation work on these strainers to answer these questions, it would cause further delays.

CHAIRMAN WALLIS: So where does NRR come into this then? I mean, it seems as if --

MR. SHERON: Licensees will eventually -- what they told us in the letter, what NEI said is that licensees would provide us the information that was requested in the REIs for the plants that were installing strainers, I believe, in FY 2006 -- or was it calendar year?

MR. SCOTT: Calendar year 2006.

MR. SHERON: Calendar year 2006. They said they would provide us with the information by the end of calendar year 2006, and for the plants that were installing strainers in calendar year 2007, they would provide us with responses to the REIs by the end of --

CHAIRMAN WALLIS: So they're taking a

risk, and they're installing these things. They're going to then make the excuse for why they're going to work and send it to you. You're going to evaluate it, which isn't going to be easy, and then you may or may not say that they now meet the requirements.

MR. SHERON: Well, as I said though, if we find a problem where we say this strainer is still not going to perform, I said, you know, the solution may not or is likely not going to be "gee, you have to tear it out and put in a bigger one."

They will probably have to take some other action to either reduce the debris loading, you know, or maybe go to a more active system like a backflush. I don't know.

But, yes, I mean, the industry is taking a little bit of a risk by going ahead and installing these without having the NRC staff, but you know, it's not clear to me, too, if we had 69 plants coming in providing us with all of this information, whether we could process it in time, you know, to give everybody a safety evaluation saying that --

CHAIRMAN WALLIS: In time or even afterwards. How long would it take you even when they've done all of this and submitted a more

complete response? How long is it going to take you to evaluate those responses from 69 pounds?

MR. MARTIN: This is Tom Martin from the NRC.

Just to answer, if I may interrupt Brian, once that information becomes available which is not right now, hopefully we could address those issues much, much more efficiently at the later time, when the subsequent testing information becomes available.

But we do feel that although there is some risk on the part of industry for installing the larger strainers now, we believe that there's less of a risk to industry to do so because they're essentially improving the safety of their system by increasing the size of the strainers, which right now are significantly smaller and much under question about their ability to accommodate any expected debris load that might occur during a loss of coolant accident.

CHAIRMAN WALLIS: thank you.

DR. DENNING: Can I follow up with a question? I think that there is some dilemma here in terms of the fact that we know that there's an issue in there, and I think most of us believe that

large strainers is a better situation, and I think that you're absolutely correct in taking the position of let's let them put in the strainers.

I think that the downstream effects we haven't seen enough yet to really understand what the total implications are there, and they become larger with the large screens. So that's kind of the new thing that we have to be concerned about.

I do worry that active strainers may enhance the downstream effect issue, and that's the only thing that really kind of concerns me. Is it a mistake? I mean, should you say, "Stop. Don't do anything." You know, that's the only thing that concerns me, that you may actually enhance a problem with an active strainer just because we haven't seen enough of the downstream.

But my real concern here is in the longer term whether NRR is going to have the tools to really perform the longer term evaluation, and we've heard that research is very close to being done. Whereas the reality is I don't think they are that close to being done, and I think we have to really look carefully at whether there is additional research that's required, particularly in downstream.

And so I wanted to get a feeling for what's NRR's position here on additional research. Do we have the tools or almost have the tools in hand that are going to be required to perform that review, you know, at the end of this process.

MR. SHERON: Well, from a more global standpoint, first off if there's a technical issue out there, we will turn to the industry. Okay? And they will need to provide us with data, okay, experimental data.

We have to look at what they're performing, what they're doing. Okay? If we believe that there is still substantial uncertainties or questions, then we may turn to the Office of Research and ask them to do further work, either to develop models or to do experimental work.

But I think the first thing we would do is that if there is an issue here that needs to be addressed, we would turn to the industry and expect them to provide us with the necessary information.

If they tell us that they're not going to, then obviously we have a decision to make. We have regulatory tools in our tool box, as I say. I don't know whether I can order them to do research, but I can certainly tell them that their sumps are

no longer considered operable if they don't provide sufficient data.

So I think that would be our approach, first, is to get the information from the industry. If we still think that there is uncertainties or areas that need further exploration, that would not be appropriate for the industry to get them, we would turn to the Office of Research and ask them to provide us with more information.

I don't know, Tom, if you want to say anything on that.

MR. HAFERA: Well, not to get ahead of ourselves, but we're going to cover downstream effects, and remember though that the size of the strainer is not necessarily proportional to the amount of downstream effect. A small strainer with a large hole will have much more downstream effect ramifications than a large strainer with tiny holes. That's one basic premise.

The other thing to remember is ECCS systems by design, their highest vulnerability point is at the suction side of the pump. Centrifugal pumps are much more susceptible to cavitation and problems on the suction side than they are on the discharge side. So downstream effects in many ways,

there's a lot more margin. There's a lot more area where we don't necessarily need to be as precise.

There has been research. We know some research that was done at Penn State regarding grid strap heat transfer. So there is some knowledge there.

We're building on knowledge that has been developed through the industry for years. This issue has been around for years, and we don't feel that it's necessary to go back and recreate a lot of things. That doesn't make a whole lot of sense to go back and recreate studies and research that's already been done.

So downstream is an issue. We understand that the subcommittee had a number of good questions about downstream effects, and we agree with all of them. They were all valid questions, and we are in the process of trying to develop solutions to those questions, and we think we have a plan in place to get those answers.

MR. MARTIN: We have a couple of very good slides in the next presentation on this. I suggest because of the time constraints that we very quickly go through some of the background slides that we've already covered and get to some of the

issues that --

DR. BONACA: I just had a question related to that. Are you saying that you view that larger screens are going to be part of the solution, whatever the solution is going to be anyway?

MR. MARTIN: Yes.

MR. MAYNARD: Sine I haven't been in previous meetings, just for my own clarification, when we're talking larger screens, are we talking about larger physical area or are we talking about larger openings in the screen?

MR. HAFERA: Typically we're talking about larger area. The modern screens that are complex configurations are typically the hole sizes that most licensees are proposing are a twelfth of an inch to a sixteenth of an inch. They're very small.

So then, you know, when we talk downstream effects, you know, you have holes in your core barrel that are an inch and a half, two inches. It's pretty tough to clog an inch and a half hole with something that's going through a twelfth of an inch hole.

MR. MAYNARD: Normally you have different size of screens. You have a set of screens

there. I just want to make sure that I understood we're talking about area as opposed to opening.

MR. HAFERA: Now, there are some plants that are still using what we call the trash rack preliminary design. Again, this issue is plant specific. That's what it all comes down to. It really is. It's plant specific.

And that's what I thought since I haven't been on the previous meeting. I wanted to make sure I wasn't going by an assumption that was wrong. Thank you. I appreciate it.

CHAIRMAN WALLIS: Well, Brian, I really appreciate your giving us this overview of where you stand and what you're doing. That was very helpful, indeed.

MR. SHERON: Okay. Thank you.

MR. SCOTT: Just to proceed expeditiously to really quickly intro the three of us who are up here, for those who don't know me or for like Apostolakis who thinks I'm still with the ACRS staff, I'm Mike Scott, and I'm currently the Chief of the Safety Issue Resolution Branch for NRR, and now that we did a chair shuffle, to my immediate left is Tom is involved extensively with downstream effects.

He's also going to be talking to you about the other technical subjects in the interest of not having eight or ten speakers up here, but we have additional folks in the audience who are very knowledgeable. You've already heard from Paul Klein. So if you have a particular question about one of their issues, we'll have them step to the microphone.

And to Tom's left is John Hopkins, who is the PM for the GSI 191 issue, and John is going to start us off with discussion.

MR. HOPKINS: Okay. Thank you, Mike.

Why don't we go to the next slide.

Again, I'm John Hopkins, project manager at NRR.

We met with the subcommittee last month, as Dr. Wallis said, and the purpose of this presentation is to update the full committee on progress to date addressing GSI 191.

Next slide, please.

These are the topics we tend to address, and mainly the issues as you can see are chemical effects, coatings and downstream effects, and downstream effects will include a discussion about the vessel.

Next slide, please.

CHAIRMAN WALLIS: So there's no problem in predicting pressure drop?

MR. HOPKINS: Pressure drop you say?

CHAIRMAN WALLIS: There's no problem predicting head loss? You said these are the main issues.

MR. HOPKINS: I'm not saying there's no problem predicting head loss.

CHAIRMAN WALLIS: Oh, okay.

MR. HOPKINS: I'm saying these are the issues that are larger today to the staff, let's say.

Okay. This is the overall objective of GSI 191 dealing with making sure that we have good ECCS. I'm sure you're all aware.

CHAIRMAN WALLIS: And when you say debris blockage, you mean debris blockage of the screen and the sump rather than the reblockage in the core.

MR. HOPKINS: That's correct.

CHAIRMAN WALLIS: Is that what you mean?

MR. HOPKINS: Yes.

CHAIRMAN WALLIS: Or do you include both?

MR. HAFERA: We include both.

MR. HOPKINS: We include both. Sorry. I stand corrected. We include both.

CHAIRMAN WALLIS: Thank you.

MR. HOPKINS: Next slide.

Go through some of the history. We issued the bulletin in 2003. NEI methodology was submitted to the staff some 22 months ago, almost two years. We reviewed that issue, the safety evaluation the end of '04, and the information notices and supplement referred to there about chemical effects.

The first information notice was basically TSP and cal-sil. The second one supplemented that, but was still broader, but still chemical effects.

Next slide, please.

The main review that the staff is doing now is to the responses to our generic letter. Industry submitted responses in September 2000 -- no, excuse me -- detailed responses September 2005. We sent out requests for additional information last month.

As Brian Sheron mentioned, NEI responded to us representing industry and requested that they

sort of reply to those REIs on a more industry-wide scale versus each plant taking the detailed REIs, and so the plants intend to supplement their responses, and for this calendar year of installation they'll supplement those responses by the end of this year, and net year if they're installing a strainer next year, they'll supplement within three months following the outage.

CHAIRMAN WALLIS: Now, this first bullet, does that include adverse effects of post accident debris blockage in the vessel?

MR. HOPKINS: In general, yes.

CHAIRMAN WALLIS: Do you get any responses from them about what happens when you get a little bit of fibers on a spacer in a bundle?

MR. HOPKINS: We have not gotten any responses from licensees at this time or the owners group, but we are working on that.

CHAIRMAN WALLIS: So we don't know anything yet. We don't know.

MR. HOPKINS: Well, I think that's an exaggeration to say we don't know anything. We're not completely ignorant of the issue. Again, as I mentioned, there's testing that has been done. There is studies that have been done historically.

CHAIRMAN WALLIS: It would be very nice to see results of those tests.

MR. HOPKINS: Okay.

CHAIRMAN WALLIS: Can you supply them to us? Are they tests of --

MR. HOPKINS: I can ask. I don't have them yet either. As I say, I agree that, as I mentioned, the subcommittee raised a lot of good questions. In many cases they --

CHAIRMAN WALLIS: And we want some good answers, too.

MR. HOPKINS: -- were the same questions that I had already asked. That doesn't mean I have the answer to them.

MR. SCOTT: And Tom is going to speak in a little more detail in a couple of slides down the line about what we've got planned in that area.

MR. HOPKINS: At the bottom of the slide, I'd just like to point out where it talks about license amendments the staff has received a few license amendments so far. We know some more are coming in, and our review of those, you know, we have a relatively short schedule if the licensees don't get them into us, and so that's a bit of a concern.

Next slide, please.

MR. MAYNARD: Could you just characterize the license amendments? What are those for?

MR. HOPKINS: Well, they vary, but they could include alternate source term. They could include possibly delaying switch-over.

And this slide, pretty much Brian Sheron has addressed all of the material on this slide previously in his presentation. So to go through our presentation, unless there are any questions I'd like to turn it over to Tom Hafera.

CHAIRMAN WALLIS: When you wrote the report of the subcommittee, you were a bit more forceful about the incomplete list of the replies to the generic letter, but I think we've probably covered that enough.

MR. HOPKINS: Well, that's true.

CHAIRMAN WALLIS: Because if I pull the slides that you gave us then, they look a bit different from these ones.

MR. HOPKINS: Yes, and I think as you stated, we had two and a half days in the subcommittee and we have much less time here. So --

CHAIRMAN WALLIS: I just wanted the rest

of the committee to know that you had said that there were responses lacking in all areas and things like that.

MR. HOPKINS: That's still true. We still stand by that, yes.

MR. HAFERA: Okay. Chemical effects are corrosion products, gelatinous material or chemical reaction products that result from the post LOCA environment interacting with materials in containment, and that's the definition that we've used. That's mainly for the members of the committee who may be new and haven't seen that before.

As Dr. Sheron mentioned, based on ACRS input, we have determined that that is a significant issue, and we are including it in the resolution process.

Again, we found that chemical effects can affect both up stream and downstream of the strainer, and that has to be evaluated as is part of the systematic process.

Next slide.

MR. ARMIJO: Just a quick question.

MR. HOPKINS: Sure.

MR. ARMIJO: To what extent have you

addressed the effects on the core fuel. Will these compounds coat the fuel cladding plug at low channels in the fuel assembly? Has that been analyzed and evaluated?

MR. HAFERA: At this point in time we don't have any real hard information on that. We have requested the owners group and our research department has identified that there were some studies done on calcium tiplate on fuel assemblies. We're still looking for that information, but at this point I will also point out all the ICET tests showed byproducts to be precipitants and not films. We did not see any films, particularly films played out on any type of metallic surfaces.

CHAIRMAN WALLIS: But there were coatings. The surfaces were coated. There was a white powder that coated surfaces in the loop, I understand.

MR. HAFERA: Well, again, it's a precipitant. It's a powder, and it's not a film. He specifically asked about films.

MR. ARMIJO: But on heat transfer surfaces or just on isothermal surfaces? I mean --

MR. HAFERA: That was isothermal testing, yes.

MR. ARMIJO: You're still going to have some heat transfer.

MR. HAFERA: Quite possibly, yes. so that question has been raised. We are working on that.

CHAIRMAN WALLIS: Well, when you heat it, it may have a different consistency.

MR. HAFERA: Correct. Boiler scale. We know what boiler scale is.

PARTICIPANT: We have a lot of crud in these systems.

MR. HAFERA: Every plant has it. You know, every not just nuclear plants; fossil plants, lots of plants.

The next slide here, this shows a rough schematic of the method that we're using to address chemical effects. It shows the high level industry effects, high level efforts by the NRC. It shows that ICET was a joint test program by the industry and the NRC. So it shows in both boxes.

Also, obviously it doesn't show all of the interactions between us and the industry. There's a lot of other interaction that goes on. At the same time it does show in the bottom boxes there what the industry's responsibility is. It is the

industry's responsibility to perform the evaluation, and it is the NRC's responsibility to perform the review.

And I think, you know, the results and chemical effects we're going to discuss even later today. We've discussed it with the subcommittee and the main committee a number of times. We believe that our position is the staff has essentially completed the initial testing that's identified this is a significant issue, and it's now up to the industry to complete whatever studies are necessary to resolve the problem.

Next slide.

Just some high level path forward items for chemical effects. So we recently got a Westinghouse Owners Group report involving different chemicals and chemical effects. The staff is currently reviewing that and expects to comment on it shortly.

We will continue to interact with screen vendors and NEI in the plants. In fact, probably even in a more frequent basis here in the near future as we start to come to close to developing a finished methodology for this process.

And the staff will also use information

from the confirmatory research that's being done from the Office of Nuclear Regulatory Research in terms of evaluating chemical effects.

And I think Dr. Sheron pointed out very well that chemical effects are only one small piece of the large issue, and we've continually told licensees that we recognize this is a large, complex issue. It has to be done in a systematic process. It may require a number of iterations, but all factors have to be included and chemical effects is just one of them.

They may find that after you're done with large strainers, you may need to go back and remove insulation, double jacket insulation, put in debris barriers, a number of backflush systems. A number of other options are still available for this issue.

DR. DENNING: Will you develop review guidelines such that to help the reviewers perform independent regulatory analyses?

MR. HAFERA: Paul, do you want to?

MR. KLEIN: Yes, I'll talk that. Paul Klein from NRR.

We are currently working on a plan that would include items to be evaluated within a review,

but I don't know that I'd characterize it as formal review guidance.

DR. DENNING: We had seen some draft review guidance related to downstream effects that is not very quantitative or doesn't provide much guidance, and I was wondering if you planned based upon research results to come up with approaches towards bounding perhaps pressure drops, calculations, and things like that.

MR. KLEIN: If you look at the research that's currently underway, a lot of it is parametric studies that are designed to inform us about general trends, how things like temperature or pH or other parameters might affect the chemical product formation and head loss.

Once we complete the research, it will be a good time for us to sit down with research and try to put all the information together in a way that makes the most sense, then for NRR to perform the reviews.

CHAIRMAN WALLIS: I notice that your presentation doesn't say anything about PNNL experiments on head loss, whether it's cal-sil and fibers.

MR. HAFERA: I believe Rob will be

covering that.

CHAIRMAN WALLIS: We're going to hear about this this afternoon.

MR. HAFERA: Later, yes, this afternoon.

CHAIRMAN WALLIS: But it seemed to clearly indicate that you can't just use a correlation, that it depends very much on how that is formed, what pressure drop you get and what the history of it is, and presumably that has got to be considered in your evaluation of these plants or maybe not.

MR. HAFERA: That's correct. What we are finding is typically all licensees are qualifying their head loss and their strainer design based on testing, and therefore, that's why the staff is pretty much maximizing our opportunities to observe testing at the various facilities so that we can --

CHAIRMAN WALLIS: What you're learning from PNNL is how you do the tests can have an enormous effect on the answer.

MR. HAFERA: Okay.

CHAIRMAN WALLIS: I think that's probably what you're learning, isn't it?

MR. HAFERA: I would defer to Rob

Tregoning this afternoon on that one.

CHAIRMAN WALLIS: But I think we saw that. I think that's what we saw in the subcommittee. This gets back to the question of how you're going to interpret those tests.

Is someone going to tell us how you're going to be able to interpret these tests and apply them to a plant? Is that scheduled for any presentation this morning or not?

MR. KLEIN: With respect to chemical effects?

CHAIRMAN WALLIS: No, the big effects, the proof tests that they're doing to use those screens instead of doing head loss correlation predictions. Is anyone going to address that issue or is that --

MR. SCOTT: We do not have that as part of the presentation this morning.

CHAIRMAN WALLIS: It was something that the subcommittee was curious about.

Okay. Move on.

MR. KLEIN: I think one thing to add, that we do have a number of questions about the way those tests are being conducted, and we intend to engage industry moving forward to try and resolve

some of the issues that have been raised.

If I could just add one other point of clarification before you move this slide, the staff has not yet received the Westinghouse chemical effects report, but we do expect it in shortly.

MR. HAFERA: Okay. Our next major topic for today is coatings. The staff adopted very conservative positions for coatings for this issue, zone of influence, debris characterization, failure rates, and what type of failure, and coating transport.

We also left that open. That position was taken based on a lack of accepted test data. We also left that open for plants and vendors to, if they wanted to challenge those positions, they were welcome to, provided they provide technical justification, and perform some testing and test data.

CHAIRMAN WALLIS: Now, some of these coatings sheets of stuff, like if you cut up a piece of paper or something.

MR. HAFERA: Chips.

CHAIRMAN WALLIS: Chips. Some of them seem to become the powder and the basic elements, sort of the zinc coatings.

MR. HAFERA: Correct.

CHAIRMAN WALLIS: You get these tiny, little particles. And so the tiny, little particles presumably would go through a screen unless there was something to stop them. We don't seem to know what coatings do when they get to screens is my point.

MR. HAFERA: Well, we are currently -- and that's on my next slide or I guess I don't have it on my slide. We currently have a test program that was just completed at Carderock Navy facility testing --

CHAIRMAN WALLIS: Well, they didn't look at coatings going onto a screen.

MR. HAFERA: Hang on, hang on. They tested the transport of coatings.

CHAIRMAN WALLIS: That's right.

MR. HAFERA: That's correct, and they tested transport of coating chips and how they may get to the screen. The screen vendors have done a number of tests with coating chips on screens and how they may impact head loss, and there has even been one vendor that even put coating chips and buried their screen in coating chips, and they found out they didn't get a lot of head loss.

And as far as coatings being particulates, a coating particulate is really no different than a latent debris particulate or different than a particulate generated from the LOCA from any other source. It's a particulate and it's analyzed based on its size and its density and its ability to transport.

Once you take into account transportability, how does it behave on the screen, well, that again is part of the analysis depending upon how much fiber do you have on the screen, what the design of your screen, how big are the holes on the screen, and what are the velocities near the screen.

CHAIRMAN WALLIS: Well, the curiosity that I have is that we've done tests on cal-sil particulates and fibers, and it has taken us a year or two to get to the point where we've had a lot of uncertainties in the results. So I just want to be sure that you're doing adequate work on coating particulates as well.

Well, and again, particulates are mainly unqualified coatings or coatings within the zone of the influence, and what we found is the industry has just recently completed some testing in that area.

They've just done two rounds of testing. The Westinghouse Owners Group and Framatome have just done that. We have yet to get the formal reports for that.

CHAIRMAN WALLIS: So it's down the road somewhere.

MR. HAFERA: So, again, it's very close.

And we are also looking at contracting out some review of that data with some expertise on two-phased jets.

Next slide.

Downstream effects. We need to recognize that design of systems for handling debris laden fluids is a mature science. There are industries that do it every day.

CHAIRMAN WALLIS: It's a mature engineering.

MR. HAFERA: Mature engineering.

CHAIRMAN WALLIS: Thank you.

(Laughter.)

MR. HAFERA: There are industries that do it every day. Even utilities have coal fired plants, and they pump coal slurries every day. They know what it is and they know how to do it. Paper mills pump fibrous debris every day all the time.

It's also a skill set that is in the tool box of most experienced professional licensed engineers. Most licensed engineers you call pump vendor or valve vendor. You tell them, "Yeah, I need to pump something with fiber in it. Yeah, I need to pump a fluid with particles in it," and they'll tell you, "Okay. Give me a specification, and oh, you don't need Pump B. You need Pump D."

So it's not --

CHAIRMAN WALLIS: Do you think the design of a core for handling debris laden fluid is mature engineering?

MR. HAFERA: We're going to get there. Okay?

CHAIRMAN WALLIS: Well, you made that statement there. I just have to --

MR. HAFERA: Well, that's correct. That's correct, but it says systems. Okay? Design of systems, okay?

All of the licensees are using the WCAP, which was published last June. The WCAP provides a template for the process that's going to be used to evaluate this.

Now, what we find is it's almost impossible to provide specifics, to provide numbers,

to provide guidance in terms of what your limits are, what's acceptable, what's not acceptable in terms of boundaries, hard boundaries because every plant is different. Every plant's debris sources, every plant's zone of influence is different. Every plant's transport is different. Every plant's screen design is different. Every plant's debris penetration source term is different.

So we can't -- for us to try to put a hard boundary on it is nearly impossible. What we can do is we can say, "Here's your cookbook. Here's your steps that you need to go through to perform this evaluation," and that's essentially what the WCAP provides.

We're working with the owners group currently. That doesn't mean the WCAP is perfect. We don't believe it's perfect either. I think the subcommittee raised some questions. We've raised questions, and we're working with the owners group to try to resolve those issues.

CHAIRMAN WALLIS: The questions we have are there's all these things that you have to do that the WCAP advises you to do. What's the evidence that it works?

MR. HAFERA: Okay.

DR. DENNING: Incidentally, with regard to the WCAP, I think it does a reasonable job of explaining how you handle debris and where it might collect, but one of the areas where I think it's really missing is the effect of fibers on fuel pins themselves, and I don't think people realize, at least based upon the conversations we had at our subcommittee meeting, how difficult it is to cool a rod that has even a little bit of fiber wrapped around it.

Now, the WCAP says there's a propensity for fibers to wrap around rods, that if the fibers get there, the expectation is to wrap around. All you have to do is fill one channel a centimeter high, and you can't cool it relative to what the criteria are that you're talking about. There's very little driving force to drive flow through that type debris associated with a fibrous bed, and that just isn't there.

Now, that's not a major crisis as far as if you melt down a little bit of a fuel pin, whether that's going to lead to massive core melting, but with regards to what we heard with the criteria for coolability, which are the same as 50.46(a), you get a little bit of fiber into that core and no

demonstration you can prevent build-ups in very small regions. You can get local melting with that type of situation.

MR. HAFERA: Well, if you have some information in terms of testing or studies that show that, I would appreciate you giving it to me because that --

DR. DENNING: I have some hand calculations that are trivial that show that it's very difficult to get flow through a small amount of fiber.

MR. HAFERA: Well, okay. Now, I recognize if we're going to move on to as far as the core is concerned, we recognize, we recognize that there are some issues in terms of getting debris into the core. You have to have a very good understanding. The difference between hot leg breaks and cold leg breaks is significant. Hot leg breaks you have high flow through the core. Your concern is developing a debris bed at the bottom.

Cold leg breaks you don't have high flow through the core. Your concern is build-up of debris, but by the same token, the cold leg break, your velocity is probably not high enough to carry debris up into the core region. It will probably

most likely settle to the bottom.

I understand that we're not sure of that. We're questioning that, but that's what we're hearing from others.

As far as transporting small amounts of fines to grid straps, again, we understand that that is a potential. You take a small core. It's probably limiting, 121 fuel assemblies, 14 by 14 fuel, nine grid straps. You're talking on the order of 300 collection sites, 300,000 collection sites. You know, that can be arduous to try to understand.

So we've taken that into account and we currently have issued a contract. We're going to try to run some TRACE and RELAP codes with debris laden water to try to understand at least sensitivity to this issue.

But at this point I would say the discussions that I've had with not just industry, but staff and people that have worked this issue for a number of times a long time, I look around this room and I see a lot of gray hair. I mean, we all build knowledge over time, hopefully.

CHAIRMAN WALLIS: But did anybody ever put debris laden water in something like a rod bundle test facility? Any kind of experimental

results from it?

MR. HAFERA: Supposedly there has, but I don't have that data yet. I've been told that it's out there, and I've asked for it, but I don't have it yet. So we're looking for it, but we're going to run some TRACE and RELAP codes as far as --

CHAIRMAN WALLIS: That doesn't really tell you whether the fibers grab hold of the spacers and --

MR. HAFERA: But that will tell us whether we have a concern with localized temperatures or bulk core temperatures.

CHAIRMAN WALLIS: If the node size is small enough.

MR. HAFERA: Yes. In terms of the larger piece of downstream effects in terms of systems, we're also going to get a contract with some expertise in tribology for --

CHAIRMAN WALLIS: Well, you're looking into the issue.

MR. HAFERA: Absolutely.

CHAIRMAN WALLIS: You're certainly looking into it.

MR. HAFERA: As I said --

CHAIRMAN WALLIS: But you can take a

gamble on solutions before you get these answers.

MR. HAFERA: Well, the licensees are taking the gamble on the solutions, I believe, because the essence is, again, if you think of ECCS operability, core vulnerabilities, the systems are much more vulnerable to clogging the sump screen, is a much bigger issue. Most people feel that if you've got water in the vessel, it doesn't matter if the water is pristine or not. It's going to remove the heat.

The heat removal is defined by Q is equal to M, dot, delta H. That is not --

CHAIRMAN WALLIS: It depends on what the LOCA M, dot is.

MR. HAFERA: Well, it depends on what the LOCAL M, dot is. That's correct.

DR. DENNING: Be very careful because with a little bit of debris around the rod you can't get the water there.

MR. HAFERA: You have to also understand pressurized water reactors, right? Open cores, large holes in core barrels, large bypass flow paths, and even if you blocked the bottom core plate, your RHR pump shutoff head is about 300 pounds. You block the lower core plate, it's going

to pump water backwards up over the steam generator. It's going to dump back into the hot leg.

Where is it going to end up? It's going to end up on top of the core. Water is going to find its way. So we understand these are all issues, and --

CHAIRMAN WALLIS: We're going to take this up in the future, too. We've got to move on.

MR. HAFERA: And there are a number of questions that we need to investigate, but we also believe at this point it shouldn't stop us from going forward, and we feel that the margins will outweigh the uncertainty.

CHAIRMAN WALLIS: I think we've heard enough about where you stand on this.

MR. HAFERA: Okay. Next slide.

MR. SCOTT: We've probably already discussed this one.

MR. HAFERA: I believe we've already discussed this one. It essentially shows where we're going forward. I think I've already discussed that one.

The next slide, and I'll turn it over to Mike.

MR. SCOTT: Okay. You all saw this, if

you were subcommittee members, saw this slide last month, and I get to present this because I'm the only one that really likes it, but for me at least what this slide does is it shows the steps that we plan to take to get to the bottom line.

And items that you see highlighted in green are those items that are either complete or are in progress at least to some extent.

If you pull out your subcommittee notes, you'll find that this --

CHAIRMAN WALLIS: You haven't fixed it up. You've got the ACRS reviews with no input to them whatsoever.

MR. SCOTT: You know, I really tried to do that, but your committee is present in so many different areas of this that it was just too busy. So I had to give it up.

It's busy anyhow, but there are some points to be made here. As we talked about the subcommittee, when we came before the subcommittee, we said we have REIs out. We're expecting to get REI responses. We now have a somewhat revised plan that we're going to get supplemental generic letter responses which will address the intent of the schedule that Dr. Sheron talked about.

Clearly, when we get to that point, and it is down the road a ways yet, we are going to need to have appropriate criteria for evaluating the responses that come in. So as has been said by speaker after speakers, we don't have all the answers today. So this is where we get at the end of the process.

We review those supplemental responses. We make a look at the modifications. We are doing selective audits of the modifications during this process. So we're going to be looking at what the licensees have done.

The regions are actually going to be inspecting to make sure that the modifications have been put in as designed by the licensee. We're looking at the vendor testings we talked about.

We're looking forward to input by the ACRS, as we've talked about. So all of these things figure in together that gets us later on to the end, to the closure of GSI 191.

It's a complex drawing because it's a complex issue.

And the final slide that we have here, this mostly repeats what Dr. Sheron said earlier. I think, Dr. Wallis, you characterized this as a

gamble. I don't think we would agree with that characterization. We see that enlarging the strainers as a do it near term measure is appropriate, and enhances safety. We believe it is the appropriate thing to do.

We expect as Dr. Sheron mentioned that these modifications will be installed by the end of '07, and as he also stated, we may require additional measures or the licensees may identify the need for additional measures as the industry and the NRC continue to evaluate the information that comes in from the various testing that's going on.

We have provided some guidance to the licensees and to the industry. However, as was said also repeatedly, the licensees are responsible for addressing the issue. We have identified the issue. We have conducted research to verify that it is a potentially significant issue, and we expect the licensees to resolve it.

The industry has stepped forward with development of additional guidance, and we are going to comment on that guidance both in the chemical effects area and in the downstream effects area.

The solutions, as we talked about, because of the greatly varying conditions in the

plants, the solutions are largely plant specific. You're not going to find a one size fits all solution for this.

At the end of the day, so to speak, the issue of closure will be based on compliance with 10 CFR 50.46 and the other applicable regulations.

And that concludes our prepared remarks.

CHAIRMAN WALLIS: Thank you very much.

Does the committee have questions for these presenters?

(No response.)

CHAIRMAN WALLIS: No questions? Then thank you again, and we are ready to take a break for lunch. We don't have time to hear NEI. Thank you very much for being here, but we had such a good time with the staff, we couldn't fit you in. We'll fit you in this afternoon.

We'll take a break.

DR. DENNING: Are we going to make a modification in our interviews? I mean, can we have until ten after and then --

CHAIRMAN WALLIS: I would think so. I would think we could take a break until one o'clock and we'll just --

DR. DENNING: Well, should we be back at

1:10?

CHAIRMAN WALLIS: We'll work it out. Let's go off the record.

(Whereupon, at 11:57 a.m., the meeting was recessed for lunch, to convene at 1:26 p.m., the same day.)

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

MEMBER WALLIS: So let's go back to session. We're going to hear from NEI on the sump issue. I'm sorry we are late. We got tied up with some other matters. We will endeavor to catch up, but we also want to make sure that we hear the things we need to hear, so if we have to run overtime, we'll run overtime. Please introduce yourself and carry on, Tony.

MR. PIETRANGELO: I'm Tony Pietrangelo, Senior Director of Risk Regulation at NEI. John Butler from NEI, also. First of all, we always appreciate the opportunity to appear before the ACRS, always a pleasure. GSI-191. I'll be the first to admit that we're not in an ideal situation here. There's some remaining uncertainties that we're still grappling with. We have plans to deal with those, but I think from the outset of this, the Commission has pushed the staff pretty hard, and pushed the industry pretty hard to resolve this issue and get it behind us. I mean, it's a unique issue in that it's not a one-size-fits-all, it's very plant-specific. John is going to cover a lot of the details of that in his presentation, but at a certain point, you've got to move on with a

practical solution given those uncertainties, and deal with them the best way you can, because it's the right thing to do.

Just a little history from when the generic letter was issued in September of 2004, our guidance was sent to the staff just a little bit before that. We did not have anything in our guidance that addressed chemical effects and downstream effects. When the SER endorsing our guidance and providing some additional information came out in December of 2004, that was the time the first ICET Number One test was conducted.

I think at the time, the hope was that the ICET test would not demonstrate that chemical precipitants were going to be an issue. Maybe we shouldn't have been surprised, but it is an issue, so we need to deal with it.

At that point, folks were already moving forward with conducting the evaluation. We were meeting with the staff throughout the year in 2005, before the generic letter responses were due in September. We knew, and I think we tried to tell the staff that it's unreasonable to expect that the September 2005 responses were going to close the book on chemical effects and downstream effects

given that we were still conducting the ICET tests. And those were joint NRC/industry tests.

MEMBER WALLIS: I'm glad you mentioned the word "downstream effects."

MR. PIETRANGELO: Yes. We've continued to move forward. You're going to hear a lot more about what the Westinghouse Owners Group has done, now the PWR Owners Group has done. We've got a plan on chemical effects. I'm feeling a lot better about that we got our hands around this thing, together with the WOG, bench-top testing, and vendor qualification tests that are going to be performed on a plant-specific basis. We feel like we've got a closure plan on --

MEMBER WALLIS: Do you have a plan on downstream effects?

MR. PIETRANGELO: I'm going to get to that, Dr. Wallis. We're not as far along - I'll get to that right now. We're not as far along on downstream effects, but I think as the staff mentioned in their presentation, that's a lot more blocking and tackling, fundamental engineering stuff, a little less science project kind of stuff that we can deal with. And at least in my perspective, the downstream part is secondary to the

strainer part. That's the first effect. I mean, if the strainer is clogged, you're going to get a big downstream effect that you don't want. Okay? So we've got to move forward with --

MEMBER WALLIS: At least you keep the debris -- at least you know where the debris is when the strainer is clogged.

MR. PIETRANGELO: That's correct. So we need to improve our understanding. I appreciate the discussion on the fuels before; but, again, to be in the situation that you were discussing, you probably had a pretty big LOCA already, a lot of debris around the screens and things, and they're worrying about these fibers, a pretty tortuous path to get to that point. The strainers are the things we need to focus on first, and that's what we're trying to do. And I don't discard, I don't want to be flippant about those concerns at all. We need to understand it better, and we're trying to do that.

The other issue I did want to mention is coatings. That still remains a significant uncertainty. We owe the staff a response to a letter we received in January. We plan to respond to that by the end of this month, and I'm reasonably certain we're going to have a lot of discussion on

that, but it's something we need to come to grips with, so we're not in an ideal situation. This is not the way I think neither the staff, nor us, the industry, likes to resolve generic issues this way, but it's the right thing to do.

This issue has been around for 25 years. There was already one GSI on it before that was closed. We've got another one, and we need to close it. I think --

MEMBER WALLIS: It's the right thing to do because you need to close it, or because you know what you're doing?

MR. PIETRANGELO: It's the right thing to do because based on our knowledge now, what we have out there today doesn't appear to be conservative. Okay?

MEMBER WALLIS: So you're going in the right direction anyway.

MR. PIETRANGELO: Absolutely. I think the arrow is going in the right direction. We don't know everything. We never will know everything on this issue. There will always be uncertainties associated with the phenomenology involved in trying to evaluate this issue, but I think at the end of the day, we can provide reasonable assurance that

technical concerns that have come up can be reasonably addressed. So given where we're at and where we're going, I think the vector is in the right direction.

One last thing before I turn it over to John. Because of what I just said, I think it's a mischaracterization to call this, and I think I got it right, Dr. Wallis, a horrible gamble on our part. I put it in quotation marks. I think it was from you, but I don't think that's the right way to characterize what we're doing.

MEMBER WALLIS: I don't remember any word "horrible."

MR. PIETRANGELO: "Horrible gamble." Again, we know we've got something out there that we don't think is conservative enough. We like to do things in a conservative way, and as John goes through the presentation I'm sure you'll have more questions and we can come back to them. Again, I appreciate the opportunity to chat with you about this.

MEMBER WALLIS: Thank you. We appreciate your remarks, too.

MR. PIETRANGELO: Turn it over to John.

MR. BUTLER: Shall I continue? As Tony

mentioned, my name is John Butler. I'm a Project Manager at NEI, and what I want to do is kind of give you an overview of some of the industry activities that are currently underway. The first two slides of my presentation are kind of the history. For the sake of time, I'm going to skip through some of those because we all recognize there is a history here. I'll start with Generic Letter 2004-02. That has been the driving document that the industry has been using lately as far as what they're trying to resolve. The schedule that that generic letter put forward calls for a completion of modifications by December 31st, 2007, and that's the schedule that the industry is trying to meet.

Now one thing I wanted to point out with that schedule is with the issuance of the generic letter in September of 2004, at that point they did not have any evaluation guidance. That did not come out until December of 2004 with the SER. As Tony mentioned, that evaluation guidance did not fully address, or did not address downstream effects, did not address chemical effects.

Subsequent to the issuance of that evaluation guidance, the WOG did some additional testing and studies, and has put out some additional

guidance for downstream effects; but during that period in which people formed their evaluations or intending to form their evaluations, there were significant gaps in their knowledge base that are now having to be filled.

The modifications as shown in this graph are done in a several year period, but one thing that needs to be kept in mind is there are specific opportunities that plants have to install any modifications, an outage. It is very uncomfortable to a utility to have to start an outage specifically to make one of the modifications, so the desire is to install modifications during planned outages.

MEMBER WALLIS: I think what Brian Sheron told us was that the industry had made the decision to take this step, and that essentially it was going to happen, that these modifications will occur, and that the NRC will then respond to them. But you're not asking us for any advice about whether or not to do something, you've already decided to do it.

MR. BUTLER: Yes. The guidance industry is using right now is NEI 04-07. I believe this Commission has seen that guidance. The intent of that guidance was to set up kind of a baseline set

of practical conservative methods that utilities could use, and to use the results of that evaluation to identify what their most significant areas are, that they can then go back and use a more refined method to reduce some of that conservatism.

The SER on the evaluation guidance added some additional conservatisms to address some areas that the staff felt needed additional testing to support the guidance. The supplemental guidance that I mentioned earlier was prepared to address downstream effects. That was issued the middle of last year, and the chemical effects testing was performed by the WOG to extent the results of the ICET test, and provide a bridge from that integral test to the testing that is being done by each of the strainer vendors to validate the debris loads that are used in the plant specific strainer qualification tests.

These next two slides just provide a little bit more information on the two WOG documents, one on downstream effects. This was recently provided to the staff for information, for an SER, I believe.

MEMBER WALLIS: Does this guidance address coolability of every part of the fuel?

MR. BUTLER: The downstream effects, WCAP, I don't think provides a lot of guidance in the fuel area, so that's an area where there's some additional activity underway.

MEMBER WALLIS: Are you undertaking additional activities in that area then?

MR. BUTLER: Yes. Yes. Well, I say not me personally, but Westinghouse Owners Group. The chemical effects WCAP was completed in February, or last month, and it should be provided to the staff this week, I believe is the schedule for that. But that is currently being used by each of the utilities and the strainer vendors to support their qualification tests for the strainers.

I'm going through this fairly quickly. I want to get to the --

MR. PIETRANGELO: John, cover that last slide. I think that's an important slide. That one.

MR. BUTLER: This one. This is just the bench-top chemical effects test. These tests were performed by Westinghouse in November and December of last year, where they tried to quantify on a separate effects basis all the different chemical reactions that can occur, taking into account the

wide variety of species, of insulation of the materials that are present, the range of pH conditions, buffer materials that are present in various --

MEMBER WALLIS: Does this end up as some predictive methods of equations and that sort of thing?

MR. BUTLER: Yes. So the results of bench-top tests are being used by the strainer vendors to, in effect, develop additional debris load that results from chemical effects. And it's being treated as an addition to the overall debris load, which includes latent debris, fiber, whatever could be present in the containment.

MEMBER DENNING: But not a predictive methodology for predicting head loss. Basically, it says input to these proof tests that are planned.

MR. BUTLER: Exactly. Correct. Now to give you a sense of the industry activities, we did conduct a survey to get the status of these activities as of late January. In summary, all 69 plants have completed an evaluation to get an initial estimate of whether or not they need to make a strainer modification, and as a first-cut of what that strainer size will be. Three units at two

sites have assessed that their current strainers are appropriately sized. The other 66 units plan to increase the size of their strainers.

Of those strainers, there's two basic designs; there's passive strainers and there's an active strainer that's being prepared by GE. There are five strainer vendor teams. They're listed on this slide; Enercon, Alion, Westinghouse, Transco making up one team, with approximately 17 units for that team, Framatone, PCI, approximately 17 units there. GE has both a passive strainer design and the active strainer design. CCI and AECL also have passive strainer designs, so these five teams are providing strainers for the U.S. PWR market. There are four units that intend to install active strainers. The rest of the units are passive strainers.

Now this slide you've seen before. Brian had it in his presentation this morning. Several things I want to point out on this slide. First off, it's a remarkable slide, a great variety of strainer sizes there. First off, there are estimated sizes, so in many cases the final strainer size will be different than what is projected here. The wide variety is due to a number of reasons.

At the lower end, these are predominantly plants that have all RMI, so they don't have a lot of fibrous insulation contributing to their debris loading. They also probably are plants that have a lot of NPSH margin, so they have a low debris loading contributing to the head loss, and they have plenty of margin to accommodate a head loss, should they get it.

At the other end of that range are plants that have a lot of fibrous debris contributing to head loss, or a lot of coatings materials, or chemical effects that are contributing to the particulate loadings, and they have minimal NPSH margin so they can't accommodate a lot of head loss across a screen, so that drives them to install a larger screen area to minimize that head loss.

What's also reflected here is the intent to address some of the uncertainties that remain by installing either the largest strainer they can accommodate within a containment, or installing a strainer that has significant additional margin in its screen area to accommodate some additional head losses that could occur from chemical effects and other phenomena still being investigated. So I wouldn't look at this as final. There will be

modifications to it, but it does give an indication of the direction the plants are going.

I've already addressed these points, but there are a number of factors that are playing into the different strainer sizes that plants have.

MEMBER SHACK: Is anybody doing anything like just making a bigger water storage tank, increasing your capacity so --

MEMBER SIEBER: Just keep pumping.

MEMBER SHACK: Keep pumping instead of recirculating.

MR. BUTLER: There are modifications to the containment design to increase the ability, improve the ability to restore or add water. There are also changes to the containment designs to increase the flood-up level, because that contributes directly to NPSH, the driving head, so there are plant modifications beyond some of the strainer change-outs.

MR. PIETRANGELO: In addition, some of the compensatory actions that were taken in response to the bulletin - I know the WOG did a study on some of those actions - things like do you need both containment spray pumps running immediately until you're into recirc. I think we'd much rather have

that water going to the core, maybe, than not going to the core, so a lot of those actions have already been taken.

MR. BUTLER: This slide shows the planned scheduled for installation of the strainers. You can see that there's a significant number of plants that are planning to install strainers in 2006, specifically fourth quarter of this year, and approximately half installing in 2007.

As I mentioned earlier, the schedule for installing strainers is affected by when the planned outages are. Most plants are on 18-month cycles, so if you have a two-unit site, you typically have within this window that plants are dealing with a plant that has an outage in 2006, and a plant that has an outage in 2007, so that's when you schedule those units to install their strainers.

Now getting back to Dr. Shack's question, there are a lot of other modifications that plants are looking at beyond strainer modifications. There are modifications to modify or reduce problematic insulation materials. In some cases, this is very difficult, costly to change, so I think Brian mentioned it earlier, they may not be going as far as they can, or in some cases it's very

inconvenient to make the change right now so they're trying to do what they can easily, but there is probably always more that can be done.

In some cases, you have plans to change out a steam generator in a future outage, so it's more cost-effective for them to change out that insulation material as part of that steam generator change out, versus changing it now when they're going to have to change it out sometime in the near future anyway, so there are a number of factors that play into the plans for how plants are addressing this issue.

There are changes to deal with problematic coatings, and a number of plants are making significant changes in their containment housekeeping procedures to reduce latent debris loadings. Some plants are installing debris interceptors, or making other modifications that change the flow path, transport flow path within a containment to affect the amount of debris that makes it to the strainers. And a significant portion of the plants in looking at downstream effects or having to make modifications to their downstream flow paths to either modify their throttle valves or make other valve change outs, or

some other modification to address the downstream flow paths, and all plants, I believe, are making programmatic changes to address, in effect, changes to their design basis that comes about with the installation of the new strainers and all the other --

MEMBER WALLIS: Are you folks doing downstream flow pathway experiments, or are these change outs based on -- what are they based on?

MR. BUTLER: There are -- as far as tests and experiments, there are some tests being done.

MEMBER WALLIS: Test of affect of debris on valves, for example, that sort of thing?

MR. BUTLER: I'm not sure about valves, but some tests on other, like pumps and motors, but it's plant-specific. It's not an industry-wide program to address those components.

MR. PIETRANGELO: Plus the vendor qualification tests on the strainers, I think all have a downstream component to that, if you will, that will factor back into the licensee's specific evaluations.

PARTICIPANT: On that list, I don't see anything about -- yes, I do - coatings. Could you

tell us a little bit more about how they would treat coatings? Is this going to be removal and recoating surfaces, or some kind of a stabilization process?

MR. PIETRANGELO: There's a range of plans in that area. In some instances, if plants -- I know of one plant that has decided to treat all their coatings as unqualified coatings, and per the guidance, as an unqualified coating you assume it all fails and transports, so they're trying to accommodate a significant debris source.

MEMBER WALLIS: That's a large source.

PARTICIPANT: Yes, it is.

MR. PIETRANGELO: All right, but that's the gamut. Other plants are performing tests to --

PARTICIPANT: Re-qualify the coating?

MR. PIETRANGELO: They're performing tests to reduce the zone of influence that you have to assume. All the qualified coatings fail following the blast, so it involves blow-down tests for these coatings to see what they can support, reducing it down from the 10-D that's currently in the guidance to something smaller. There are plants that are doing additional testing on their unqualified coatings to get a better idea of how they fail.

MEMBER WALLIS: All these plants are doing all this stuff, and then they're going to submit something to the NRC saying we've done all this stuff, and now we're all right. Is there some effort by NEI to review these solutions for the plants to tell them that yes, we think they are all right, or how do they know that what they've done is adequate?

MR. PIETRANGELO: No, at the end of the day, a licensee has to have the defensible technical basis for what they put in their plant.

MEMBER WALLIS: Are you helping them to have a good one in some way?

MR. PIETRANGELO: We're trying real hard to help them.

MEMBER WALLIS: How do you do that?

MR. PIETRANGELO: Well, we're doing what we can generically. We can't test all these different plant-specific things. We're trying to help coordinate generic testing, the sharing of information, the coordination between what the WOG does, what EPRI does, what the vendors, so the licensee gets the information they need so that they can put their technical basis together for what they put in their plant.

MEMBER WALLIS: It's almost like a final exam for the licensee then.

MR. PIETRANGELO: Kind of, yes. Yes, t his issue, because it's so plant-specific, defies us doing the magic bullet. There is no magic bullet on this issue.

MEMBER WALLIS: No, but you might be able to look over what they've done and give them advice as to what they're planning to do, give them some advice.

MEMBER SIEBER: It's people-intensive.

MR. PIETRANGELO: Well, there's your guy that I have to do all that. We don't have a real big staff at any time. We try to leverage the --

MEMBER WALLIS: You don't have a technical advisory role then in this.

MR. PIETRANGELO: No, not a technical advisory role, no.

MR. BUTLER: This slide very quickly - and there's also, beyond the modifications, there's a lot of testing going on. Some of this testing is industry-wide, some testing is plant-specific, others could be done by groups of utilities to share resources, but quite a few plants are involved in additional testing to address their needs.

MEMBER WALLIS: I'm not quite sure how you do plant-specific testing of debris transport. You're not going to build a plant and transport debris in it.

MR. BUTLER: What they're looking at - you may have a particular coating system that has its own characteristics in terms of how it fails, and its specific gravity.

MEMBER WALLIS: Presumably, they're going to put barriers up above the sumps on some of the floor. You're going to test those barriers for effectiveness or something. Is that the kind of thing they do?

MR. BUTLER: I don't know if there's testing of --

MEMBER WALLIS: Debris cascades down the stairwell, are they going to do some testing? There's so many things they could do, I just want to know what they should be focusing on.

MR. BUTLER: Well, that was the intent of the guidance, by providing a very conservative baseline to allow them to idea from my resources, where do I get my biggest bang for the buck reducing --

MEMBER WALLIS: That very conservative

baseline is pretty conservative, isn't it?

MR. PIETRANGELO: It was more of a scoping study, as John said, focus in on those areas that are going to be problematic for you to be able to focus the testing that you do, or the information that you seek elsewhere.

MEMBER DENNING: This view graph doesn't address the strainer tests that are planned. Is that true?

MR. BUTLER: Well, actually the first bullet there, all 69 units are doing prototypic strainer tests.

MEMBER DENNING: Oh, I'm sorry. That's where it is. Okay. Now I'm with you. Now with regards to those prototypic strainer tests, which looks to me like it's really the heart of the plan here, is there going to take materials that they believe are going to be characteristic of fibrous material and/or whatever, including things that are supposed to be representative of chemical effects generated materials.

MR. BUTLER: Right.

MEMBER DENNING: And they're going to dump them into some test loop and see what the head loss is. True, basically?

MR. BUTLER: Yes.

MEMBER DENNING: Now with regards to the chemistry, they're not going to set up chemistry and generate the products there. They're going to put in some chemical forms that they believe are characteristic of what came out of the separate effects test, which isn't a good characterization, but those other tests. And you think that you can really represent the characteristics or chemistry?

MR. BUTLER: Well, the burden to show that the testing or the characteristics of these particulates in a neutral pH tap water environment are representative of the actual performance of these same particulates in a borated buffered, high temperature environment, so that will have to be demonstrated by the vendors.

MEMBER DENNING: And I know that the NRC staff has some limited plans for the development of predictive tools. Do you see the industry developing also predictive tools, or do you see it just -- those predictive tools just taking you up to kind of the face of the screen, and then it turns into an empirical correlation. That's the plan.

MR. BUTLER: Yes.

MEMBER DENNING: Okay.

MEMBER WALLIS: Now these prototypic tests, I've seen pictures where there were, say a lot of cylindrical can-like strainers arranged in some fairly big pattern. Now if there are 64 of these, they're not going to test 64 full-scale strainers. I wonder how they're going to assess how the debris distributes itself in the real plant among a big array of strainers, when they can only test a few in their facility.

MR. BUTLER: Well, the testing, which I can't go into specifics because I just don't know the specifics, but generally they test these strainers as modules, so they're not testing one cannister.

MEMBER WALLIS: Well, we know if you have a whole array of cannisters, the debris is going to see the first cannister first and so on.

MR. BUTLER: Right.

MEMBER WALLIS: It's not going to deposit uniformly over all of them.

MR. BUTLER: There's a need in doing that flow testing to be, in effect, conservative on how the debris gets to the strainer.

MR. PIETRANGELO: It's a scale test, too. Is it not, to some degree.

MR. BUTLER: The surface area is scaled, yes.

MEMBER WALLIS: This was one of the questions the Subcommittee had, was then you can test one strainer. But then how does a whole array of strainers in some flow path, which is quite plant-specific, get performed? It's not clear to me how you predict how the array performs from the test of one unit.

MR. BUTLER: It probably would be instructive, and I can work toward this, to see if we could get a meeting some time in the future to have representatives from the different strainer vendors to talk to this Commission.

MEMBER WALLIS: If we have the time, we'd love to do that.

MR. BUTLER: Shall I continue? Some of the test activities, the broader test activities, they've already been touched on, but there is the WOG chemical effects testing which was completed last year, and the report should be going to the staff this week. There's the strainer qualification testing that we've also mentioned that's being done for each strainer. WOG has an activity underway to look at alternate buffers, and this would involve

replacements for TSP or sodium hydroxide, also looking at what the impact would be for not having a buffered environment within the containment, what the impact would be.

The STARS group of utilities is doing some coatings testing. This is the testing to reduce the zone of influence, the zone of destruction for qualified coatings. Similarly, FPL in combination with AERVA NP is conducting some testing to reduce the zone of influence. And as I mentioned earlier, there are also individual plants that are doing their own coatings testing to address their specific coating issues.

Summary is that there's a lot of activity underway by the plants to install larger strainers and make modifications to their plant to address this. Understanding there are some key areas that still have to be resolved, WOG, EPRI and NEI are trying to assist them in providing them the information they need to resolve this, but these activities are occurring in parallel right now. But our intent is to try to close out these issues in the most appropriate fashion and still maintain the schedule that's been put forward by the generic letter.

MEMBER WALLIS: Thank you. Do the committee members wish to ask NEI any more questions? Can we move along with the RES presentations? I don't see any raised hands or anything. Thank you very much.

MR. PIETRANGELO: Thank you.

MEMBER WALLIS: It's always good for us to hear different points of view. Rob, are you going to be the key speaker here?

MR. TREGONING: Yes.

MEMBER WALLIS: Does Mark Cunningham want to say anything, or has he left?

MR. TREGONING: Mark had planned to be here, and he sends his regrets. He was here, certainly. He planned to open up my session with some remarks. Unfortunately, due to the delay, he had another 2:00 meeting that he couldn't reschedule, so he does send his regrets and apologies.

MEMBER WALLIS: Okay. So if he comes back, we'll give him a chance.

MR. TREGONING: If he comes back you can -- he would certainly welcome a chance to speak at that point.

MEMBER WALLIS: You may have said it all

by then. Well, I think you have some important information to give to us, so please go ahead and do it.

MR. TREGONING: Yes. I want to caution everyone. I know I have a bit of a reputation of being somewhat long-winded in front of the Committee, and Mr. Sieber is shaking his head yes, so I think there's violent agreement on that. But we were asked to summarize about a day and a half's worth of Subcommittee presentations down to, I think I have an hour now, so it's been a very difficult task but we'll try to do that. I will say, though, that there's probably still too much material to cover here in the hour. I tried to tailor things so that the things that I think are most important are up in the beginning. However, as is always the case, if you would like to direct us to certain points of the presentation, we'll certainly be flexible enough to do that.

I do want to provide an overview, and I am the spokesperson up here, but I do want to want to acknowledge, ths is eight different research programs conducted at multiple labs. There's a lot of other PMs and a lot of laboratory work that's been focused on this issue. If I can't answer any

specific technical details, hopefully through either one of the PMS in the audience, where I think I have representatives from just about all of the labs on the phone bridge here, hopefully one of us will be able to address whatever question you may have. And if we can't, we'll certainly try to get back to you.

So this is Mark's slide, and he told me somewhat what to say, but since it's his slide, I'll try to move quickly. The point he really wanted to make here is the research that we have set up has really been focused on addressing specific questions with respect to the generic letter resolution. As you've been told countless times, it's a complex issue. There's lot of technical issues and areas that need to be addressed. We focused the research that we've been conducting over the last year, and that we're planning a lot of this, as we discussed, we're planning on finishing up the initial phase to looking into these questions by the spring time frame, somewhere between April to June. So these are the specific questions. We're going to be going much more into detail on these questions today, as I move through this.

The philosophy that we've had is that, again, we certainly recognized within research that

there's issues that are important that needed to be addressed by NRC research, and we've tried to focus on technical areas where we think the largest uncertainty is. And we've tried to define that uncertainty using input from both the ACRS staff, and the industry. Certainly in the area of chemical effects, it's been mentioned once already that a lot of the genesis of that work stemmed from ACRS comments. And other work that we've undertaken here, as well, on some of the head loss correlation development work has also been prodded by ACRS questions and concerns, so we've tried to take into account all the various stakeholders in designing this research program.

By and large, the testing results that I'm going to show are parametric or scoping in nature, with the objective to evaluate and identify the important variables that affect a specific area. And the strategy has been to try to evaluate those variables over a range of representatives conditions as much as we can.

One thing I will say in the area of sump modifications, understanding the representative conditions has sometimes been a moving condition, because modification in designs have been ongoing in

parallel, so in many cases it has been a challenge from a research perspective to try to keep up with the latest approach velocity screen sizes that people are postulating.

MEMBER WALLIS: So your objective is to do parametrics and scoping studies to evaluate, but it's not to develop a comprehensive validated, predictive tool.

MR. TREGONING: Not certainly to deal with the --

MEMBER WALLIS: Not yet.

MR. TREGONING: Not to deal with this issue from LOCA break, through downstream cooling of the core. No, that's not certainly been an objective of it.

MEMBER WALLIS: But you're exploring all the important phenomena in scoping that.

MR. TREGONING: That's been the objective, certainly. Yes. And again, the goals from this, there's one program that we've talked about a little bit that was conducted jointly with industry, integrated chemical effects test. I'll be providing more information on that subsequently. All of the other programs, the goal or the objective is to be confirmatory in nature. And by

confirmatory, the idea is that it'll provide information primarily to assist the staff in their assessment of the generic letter evaluation so that they can ensure that we have adequate resolution of this issue.

There's four technical areas of study that we have research in, and I've tried to organize them, again, in ways that I think are of most interest to least interest within the Committee at this time. We presented information on all of these areas in February. We're also, I think, scheduled to come back in June. And some of the areas that we have just provided some approach status on, especially in the area of coatings transport, we'll have more information in June, so today is really a snapshot as to where we are in this research program at this point in time.

The chemical effects area --

MEMBER WALLIS: You'll have more information in June? I thought you were supposed to be finished by April.

MR. TREGONING: Yes, but we won't have reported that information to you.

MEMBER WALLIS: Until June.

MR. TREGONING: Yes. That's when we're

next scheduled to come. You know, we finish in April, we at least need a month to make sure everything is okay before we come in front of this Commission again, so June is still going to be rather aggressive, I think.

In the area of chemical effects, the prime objective has been to investigate contributions that chemical effects may have to sump screen head loss. We realize there's a downstream component, as well, but research to-date has focused on sump screen head loss. There's two separate objectives; one program, the ICET program, has really just a scoping study to determine if chemical byproduct formation can occur, and may be important within these environments. And then follow-on work has looked at characterizing, predicting, and investigating head loss for some of the significant byproducts.

In the area of particulate head loss, we're looking to integrate testing results with analytical model development to come up with correlations for evaluating head loss for PWR insulation materials. We are doing some work in downstream effects.

MEMBER WALLIS: It doesn't include

coating tips then, head loss stuff.

MR. TREGONING: The initial testing that we've done in terms of particulate head loss has been all fibrous and calcium silicate particulate types of tests. There was a statement made earlier that coating particulate would be expected to be similar to any other sort of particulate.

MEMBER WALLIS: Is that similar to cal sil? I'm not sure you want it to be similar to cal sil.

MR. TREGONING: Well, the key thing with particulate in terms of its effects are what's the size distribution of the particular compared to the void spacing of the fibrous bed that it's trying to go through.

MEMBER WALLIS: Should we then take it that the results you get for cal sil might also apply to particulates from coatings?

MR. TREGONING: That's certainly the understanding and hope. Now if the particulate sizes end up being quite a bit different than cal sil, then you have to revisit that philosophy, obviously, but most of the particulate -- again, with cal sil you get a distribution of particulates, so I'm reasonably confident, but I wouldn't go

further than that, that the particulate test will be a good surrogate for looking at particulate coating head loss.

Now any head loss due to coatings chips, that's a bit of a different matter, something that's not particulate. But with chips, one of the issues has been really how much of that will actually transport to the sump screen. And most of the evaluation assumptions are assuming that particulate will be the form, and it's certainly the form that's most likely to make it to the sump screen.

Are we doing some work in the area of downstream effects. We are not investigating core coolability. We have two programs that we've had in this area. The first one has been looking at the quantity and the characteristics that affect debris which is ingested at the screen. And then we have a second program that says okay, once you have debris that makes it through the screen, how does that affect clogging within high pressure safety injection throttle valves? And we chose HPSI throttle valves as a surrogate for a lot of downstream potential clogging areas, because it's one of the more tighter clearance, yet high flow rate areas within the ECCS system, so we thought it

would be a good surrogate for examining clogging throughout that system.

MEMBER WALLIS: So how much gets through the screen is going to be determined by these proof tests, not by some sort of predicting method.

MR. TREGONING: In terms of screen bypass, there's - and I might ask someone from NRR to jump in here if I misspeak.

MEMBER WALLIS: Well, LANL did some tests where they could make a lot of stuff go through by doing certain things, but that's not really prototypical.

MR. TREGONING: No, that's not.

MEMBER WALLIS: So are you going to take the prototypical results from industrial tests. Is that -- maybe that's beyond your field, but it seems to be the source of information.

MR. TREGONING: There's two sources of information. Certainly, the LANL study is one source of information for screen bypass. However, as part of these prototypical tests, as well as evaluating head loss, they're also evaluating essentially bypass debris as a function of time. And I know there is still discussions with staff at the NRC to come up with the criteria for how that's

going to be evaluated in terms of actually finalizing the debris source term. And I think I heard yesterday that at least from NRR staff, most of the licensees are expected to use the prototypical testing to provide the basis for their debris source term. And, Tom, I don't know if you want to elaborate on that, or if anyone.

MR. MARTIN: Yes, we have been having a lot of discussions, and most of the vendors and licensees are using specific testing for the specific screen design that they are installing. And as Rob mentioned, the discussion is, if they're doing a test designed to do head loss and collecting a downstream sample, we're not sure the downstream sample is prototypical of what you would see for a downstream test, so we are working with the Owners Group and the screen vendors for that issue, and we're expecting to be able to resolve that pretty soon.

MEMBER WALLIS: Thank you.

MR. TREGONING: Okay. Let me move into the area of chemical effects. Again, I've touched on the objectives a little bit. I just wanted to identify the programs associated with each objective. The ICET program, which was our first

one to evaluate if chemical byproducts are a concern. That was conducted at Los Alamos National Lab. We followed that up with some testing to evaluate the potential for the byproduct formation that was observed within the ICET test to actually contribute to sump screen head loss. That's been conducted at Argonne National Laboratory. And we also have some work to try to predict using thermodynamic models, the amounts and types of solid species which will form in these environments, and that work has gone on at the Center for Nuclear Waste Regulatory Analyses, which is at Southwest Research Institute.

So briefly, you've heard a little bit already about ICET in the NRR presentation. I want to give at least a flavor. We've had two very long Subcommittee presentations on this, so I just want to give a flavor here quickly of what we found. The approach for ICET has been to evaluate byproduct formation over the 30-day mission time, so there wasn't a focus on early in the LOCA/post-LOCA scenario really looking at what could form over long mission times. And that's really one of the driving forces behind conducting isothermal tests, which the ICET tests were.

We used industry surveys to inform the tests and develop representative test parameters, choose the amounts of materials we were using, and the types of materials, and then pick flow conditions. Everything associated with that test was informed by industry surveys, as best as we could, as existed at that time.

There were contributions from both submerged and un-submerged material, so there was a submerged portion that was tested, as well as a portion that was subject to sprays. We looked at aluminum, copper, zinc, galvanized steel, concrete, fiberglass, and calcium silicate insulation.

MEMBER WALLIS: The insulation aged?

MR. TREGONING: The insulations were not -- they were thermally treated, I don't want to say aged in the sense that they weren't aged within a plant, but they were subjected to temperature history through flat-plate heating that would simulate the thermal gradient that would exist on insulation next to a pipe or a hot metallic surface. The reason for that was we knew many of the organics burn-off very quickly, so that that thermal treatment was done to burn-off the organics in a percentage of that fiberglass insulation.

CHAIRMAN POWERS: My question is, is there a difference in what you bought to test and something that's been sitting around for 10 years?

MR. TREGONING: When you say "sitting around", I assume you mean sitting around on piping, or --

CHAIRMAN POWERS: Actually, I mean sitting around. But sitting around on piping is just as good as sitting around on anything else for the purposes of my question.

MR. TREGONING: Yes. I'm going to --

MR. KLEIN: Rob, let me jump in here, if you don't mind. Paul Klein from NRR. The calcium silicate that we used, I believe, was sitting around in one of the licensee's warehouses for a long period of time.

MR. TREGONING: That's true. That was, again, I wouldn't call it aged because it wasn't in application, but it had been sitting around for a long period of time.

CHAIRMAN POWERS: But the calcium silicate isn't.

MR. TREGONING: Be more specific, if you could; what do you mean? In terms of what? What's the brand?

CHAIRMAN POWERS: Well, if I look at the calcium oxide silicon dioxide phased diagram, I'd find ten compounds. Which one is it?

MR. TREGONING: I'll ask. I know LANL is on the line. Jack or Bruce, can you respond to that? I know certainly give a trade name. We bought it through PCI, and we do have elemental breakdowns in terms of what species were available. Perhaps, you can comment a little bit more on that question.

MR. LETELLIER: Rob, we couldn't understand the question. We couldn't hear the question.

MR. TREGONING: Would you repeat it, please?

CHAIRMAN POWERS: I just wondered what the calcium silicate insulation really was, what's the compound?

MR. LETELLIER: We don't have a compositional breakdown. We've got some of the elementals on the original product, and we provided that information in our test reports both before and after the thermal pre-treatment heating, but the composition varies, and we do have some XRD analysis that supports some of the mineralogy associated with

the calcium silicate product, if that's what you're asking for.

CHAIRMAN POWERS: That would do.

MR. TREGONING: Okay. Thank you, Bruce.

CHAIRMAN POWERS: Well, is he going to tell me what it was?

MEMBER WALLIS: Silicate, it's diatomaceous earth, isn't it, which is mostly silicates of calcium. There's other stuff in it, too.

MR. TREGONING: Yes. Usually, 80 to 90 percent is pure calcium silicate. There's binder, and then there's other forms of - I don't want to call them impurities - but there are other compounds that are in there, as well. As I get to the fourth bullet in this slide, the main thing that was simulated in terms of making these plants as representative as possible of the actual plant conditions, was to use a scaling constant. And what was kept constant was either the ratio of the surface area of the coupon material, or the weight of volume of the insulation to the containment water volume, so those were constants that were meant to be representative, and that's how we always intended to scale up or utilize these results or have

licensees utilize this information.

There were five unique tests conducted. We looked at tests with all of the major buffering agents that are out in plants, either sodium hydroxide, trisodium phosphate, or sodium tetraborate. We spanned a range of buffered pHs from seven to ten, and then we varied the insulation mixture, we either had 100 percent fiberglass NUKON insulation, or a mixture of 80 percent cal sil to 20 percent fiberglass. And there's a rough correspondence as to what plants they correspond to, but I should indicate that that's not an exact correspondence. There's probably no one plant that we simulated with this particular mix, but the plant numbers indicate that that plant was closest to this condition, in our estimation.

Here's a picture of the ICET test loop. You see the test chamber, and the recirculation piping. It's essentially 250 gallons of water used, and the submergence line is about at the crease of the insulation between the upper and lower chamber window, just above where you see the re-circulation piping entering into the chamber. So the area above that chamber is un-submerged atmospheric subjected to just the humid environment and corrosion effects

due to that, while coupons that were submerged are located below that pipe.

Moving right along to significant results that we found from those tests, it's fair to say that every test that we conducted there was some sort of product that was observed. But, again, the amount and type of product varied quite significantly. In test number one, which was a sodium hydroxide NUKON test, we observed a white precipitant. We later identified that most likely to be aluminum oxyhydroxide. We found deposits within the insulation itself. You see a picture of that on the right, some of the deposits, which are coating some of the new constrands. And we saw significant weight loss of the submerged aluminum coupons on the order of 25 to 30 percent weight loss of those coupons. And right there, the first picture to the right shows the precipitate. The precipitate was not visible at the test temperature of 140 degrees, but it was visible upon cooling.

The second test, which was the trisodium phosphate NUKON test, we didn't see any precipitate, but we did find insulation deposits in those tests. And in test five, I grouped the new contest separately versus the NUKON cal sil test, so that's

why I've got a test five. Test five was very similar, which was the sodium test and NUKON test, very similar products to test one. However, we had much less of the products, and they were slower to form at lower temperatures. We also had much less aluminum weight loss in that test. In fact, I think it was essentially no aluminum weight loss.

In test three, this was the trisodium and cal sil NUKON mixture test. This was the one where during the test, and actually very early in the test, within about 20 minutes of initiating the test, a white flocculent material was observed. And then post test, there was a white substance again, which we've later come to believe is calcium phosphate or one of the various derivatives coating the test material chambers. And we also found deposits within the insulation itself.

In test four, test four was a sodium hydroxide and cal sil NUKON test. That one --

MEMBER WALLIS: Excuse me. That white substance that got in the insulation bag was a gooey sort of substance.

MR. TREGONING: Yes. Yes.

MEMBER WALLIS: Okay.

MR. TREGONING: We've characterized it

as being almost like white --

MEMBER WALLIS: You used a lot of technical terms. How would you --

CHAIRMAN POWERS: Would you give me a quantitative description of "gooey"?

MEMBER WALLIS: No, they're the ones.

MEMBER SIEBER: It's page four.

MEMBER WALLIS: It's not just a sort of dry powdery stuff. Can you describe it in more detail for the Commission?

MR. TREGONING: Yes, I don't want to go too much out on a limb, so I might ask someone from LANL to jump in. But characterizing it as, I don't like to use the term "gelatinous", because gelatinous has a whole series of characteristics that I don't know that we've rigorously identified for this, but it certainly had many of the same characteristics and physical quantities that you would associate with a gelatinous or an amorphous-type of material.

MEMBER WALLIS: The texture of face cream, is that it?

MR. TREGONING: Well, we didn't use goo, but we used face cream as our way to describe it.

MEMBER SIEBER: Goo is very descriptive.

MR. TREGONING: Bruce, do you or anyone at LANL want to elaborate on that?

MR. LETELLIER: I'm not sure I can offer more, except additional qualitative description. We chose the description of face cream because it has the consistency of a finely dispersed suspension. In my opinion, it's not particularly sticky or self-adhesive. I guess it shares very easily. You can rub it between your fingers, and it's finely dispersed in like a slurry. It sort of gives me the impression that it is a suspension of very small particulates, and whether they are well-hydrated in an amorphous manner, I wouldn't speculate.

MR. TREGONING: Yes, thank you. The other point I'd like to make there --

CHAIRMAN POWERS: Give the defraction pattern measurement.

MR. TREGONING: Well, let me make one point, and then I'll answer that question. In test number three and four, there was a lot of cal sil particulate that was put in that test. And what happens is, it's very difficult to isolate the chemical product from the particulate. In fact, if you look in the picture, while the chemical product is white, you see there's a brownish appearance of

what's on top of the insulation bag, so you had particulate that was mixed very thoroughly, and very definitively with the chemical product. So getting separation of that, and when you do defraction pattern measurements, the isolator region to get just the product versus combinations of product and particulate was not the easiest thing to do.

MEMBER SHACK: Centrifuge didn't work?

MR. TREGONING: Again, I'll defer to Bruce to see if he wants to -- did you catch the question there?

MR. LETELLIER: I'm sorry. We can't hear the committee members very well.

MR. TREGONING: The question was, did centrifuging work, were you able to isolate in any way the chemical product from the particulate to try to get some defraction pattern measurements to identify, to clarify if it was amorphous or not.

MR. LETELLIER: Again, in our post-test recovered samples, much of that was well mixed. And although we did some TEM measurements, honestly, I can't recall whether there showed any evidence of amorphous behavior in the same way that we did observe in test one for the aluminum silicate compounds.

MR. TREGONING: We have the information. What I'll do, I think both of us need to go back and delve into that test report a little bit to make sure we get you the correct answer. So let's do that, and we'll certainly get back to you on that. It's a very valid question. And sometimes, I think Bruce and I, we've seen so many of these TEM patterns that we start to mix up tests sometimes, so let us make sure we get the answer to your question specifically.

MEMBER DENNING: Rob, when we look at the NUKON Day-15, what are seeing there? Do we know whether we're seeing some of this white substance adhered to the fiber, or is that separate?

MR. TREGONING: No, I think you can see by the picture. The fibers are obvious, and you can see, again I'll use the word "filmy", amorphous, gelatinous, at least in appearance between the fibers. So whether it's actually adhering or lodged, I don't know that I'd be that definitively descriptive. But it's certainly well-intertwined within the fibers.

MEMBER DENNING: One of the things that concerns me is the planned integral tests that the vendors are planning, where they would take

materials that are supposedly characteristic of the materials and thinking that you can dump them all into the pot, and have them arrive at the filter, and in any way be representative of what's formed in this kind of situation.

MR. TREGONING: It's an excellent question, and a very valid point. We've had a number of concerns about the effectiveness of chemical surrogacies. We think it's important not just to mimic the physical characteristics, but also as much as you can, the chemical and electrical characteristics, as well, because they affect agglomeration, they affect how the material may interact with whatever fiber bed or other obstacles that it may come into contact with, so that's an incredibly valid question, and one that I know that the staff has been working very diligently with the industry on to try to address some of those issues.

MEMBER ARMIJO: Could you explain why you picked 60 degrees Centigrade for all these tests? And secondly, how sensitive would these results be to a higher temperature, or even a lower temperature?

MR. TREGONING: We did some initial -- again, I'll harken back to the original objective,

was to observe what would happen over the full 30-day mission time. And there were some initial corrosion rate studies done analytically to predict how much contribution you would get from the relatively short time, yet high temperature corrosion event, versus the lower temperature longer term event. We tried to do two things. We tried to predict if we would have different species that might form at those higher temperatures that we wouldn't see if we just did testing at the lower temperatures. But more importantly, we were looking at the amount of dissolve aqueous concentration that we would have. And by and large, what the simulation showed was that the events really dominated in terms of the amount of aqueous contribution by the longer term, lower temperature environment.

MEMBER ARMIJO: So te higher temperature regime was pretty much ignored, because normally the reaction rates would be a lot faster, and that could make a big contribution.

MR. TREGONING: That's true. In this case, again, the expectation was that it was not. However, after conducting these tests, especially in tests where we noticed that we had some sort of

corrosion inhibition that occurred, we did see some tests where we had some initial corrosion that occurred early in the test, and then some sort of either inhibition or passivation. Something happened to decelerate or stop corrosion.

We've certainly gone back after those results and questioned - okay, for that specific event, that short-term, higher temperature environment is something that may need to be considered, because in that situation, it could affect the amount of loading or the amount of product that you have.

CHAIRMAN POWERS: There has been a lot of work on the corrosion of aluminum in base solutions. And my recollection is that the conversion from the gibsite which is the gelatinous to the dolomite, which is crystalline, is very hydrothermally sensitive, so I'm just wondering if goo goes to granules differently as you go up in temperature?

MR. TREGONING: I don't know if Mark Plasky is from LANL, but he might be the best person to address that question. Mark, are you -- we're having trouble hearing the questions, so did you hear that, Mark? Are you there?

MR. LETELLIER: Mark is not with me today, Rob.

MR. TREGONING: Okay.

MEMBER WALLIS: I think what we may be determining is that you're raising more questions by ICET. You may have to move on, because ICET doesn't answer many questions. I think from your experiments, your report was that it's all plant-specific, and they've got to do tests corresponding to each plant.

MR. TREGONING: Well, the main conclusions for ICET were, again, that the products form which need to be considered, that could have a significant effect.

MEMBER WALLIS: Well, if you read your executive summary or something, it says it's plant-specific, and we need plant-specific tests.

MR. TREGONING: Well, certainly, one of the other prime conclusions of ICET, and again, this isn't surprising, but small variations to important variables can make a big difference to the types, nature, and products that form; be that time, be that temperature, be it pH, be it the mix of metals that you have and non-metallics in a specific test. We saw that, certainly, here, where we changed on

variable in the test matrix and got dramatically different results in some cases, so that really has led to that conclusion that the plant-specific, and an understanding of the plant-specific environment is an important consideration to really try to assess.

MEMBER WALLIS: There are effects and they're plant-specific.

MEMBER SIEBER: It's even more complicated than that. Even in a given plant, it depends on where the get impingement is as to what the components of the slurry or the mixture is, so you can't take a representative sample of a plant with regard to quantities involved. You may get the right constituents quantities, can't tell.

MR. TREGONING: Well, in relation to debris that you might have that's added into the mix, that's entirely true. The submerged metallic components might -- they'll be a function of the size of the LOCA more than the location would be my stipulation with that.

MEMBER SIEBER: Okay.

MR. LETELLIER: In reference to an earlier question, the mineralogy of calcium silicate is primarily togramite and calcite. And we have the

complete SRD spectrum if you'd like to look at it, as well as percentage, composition by compound is largely silica oxide and calcium oxide.

MR. TREGONING: Okay. Thanks, Bruce. You didn't have the liberty to see that Dana Powers had got up and left before the eloquent explanation, so we'll just have to get that information to Dana. But thank you for responding.

MEMBER WALLIS: There is some calcium oxide in there.

MR. TREGONING: Yes. So the next phase, once we completed ICET, we certainly realized that there were products that we had to try to understand some of the ramifications associated with those products. So then we moved relatively quickly into doing some chemical head loss testing. The objective of this testing, to date, has been to simulate the chemical products observed in the ICET test, examine effects of those products over a broad range of environmental variables, again looking at time, temperature, and concentration as prime variables. While ICET was integrated, these tests for understanding have been - we made a conscious decision to make them single effects tests. And what we've tried to do is recreate the ICET

environment, and use that as an input condition to many of these tests. And again, plant relevance has been evaluated using many of the similar scaling parameters that were in place for ICET, either the mass of product per containment volume, or the mass of product and debris per sump screen area. We think those are very important scaling parameters.

Now most of the testing to-date has focused on the trisodium phosphate environment. We focused on that environment initially because that was the one that gave us chemical products that appeared to be certainly neutrally buoyant, easily transportable, and they occurred relatively early-on in the post LOCA mission time.

In terms of MPH margin, the onset of re-circulation through the first few hours is usually the critical time, so we thought these byproducts had the most potentially deleterious effects in terms of head loss, so we focused most of our initial testing on those environments. See a couple of plots here, which again, they essentially show head loss both with and without calcium phosphate types of products compared to baseline tests with just new NUKON and cal sil. The baseline tests are the light red, and the chemical tests are the dark

red. And essentially all they're intended to show is that when we have an equivalent amount of chemical product in these tests, the head loss that you get is much greater than with the corresponding amount of cal sil.

MEMBER WALLIS: You have just shown two here, but if you look at the test result of test one/two, and test three/nine, the resistance of the bed is such that you've essentially clogged it up. I mean, the resistance is over 100 times as much as it is with no goop.

MR. TREGONING: We ran tests where we clogged up the loop without any goop, certainly.

MEMBER WALLIS: Right. So I think the Commission needs to know that it's possible to essentially block up the screen essentially completely with this product. It's not a question of a factor of three or something, it can be a factor of 100, 200 in resistance in some of the tests.

MR. TREGONING: Well, again --

MEMBER WALLIS: You don't have time to go through that.

MR. TREGONING: Yes, I don't want to confuse these tests with the PNNL test. The

objective here was to look --

MEMBER WALLIS: No, I'm not confusing with PNNL. I'm saying even in these tests, there are places where the flow rate essentially went to zero.

MR. TREGONING: That's true.

MEMBER WALLIS: Almost so, you couldn't get stuff through that screen.

MR. TREGONING: That's true. Five PSI is about as high as we go here because that's the limitations. We can't get --

MEMBER WALLIS: The flow rate might go down to not just there, it might go down to .01 or something.

MR. TREGONING: That's certainly true. Yes. Thank you for the clarification.

MEMBER APOSTOLAKIS: Can you explain one of the figures in more detail, please?

MR. TREGONING: Okay. Let me --

MEMBER APOSTOLAKIS: Do you have a pointer?

MR. TREGONING: The light red line is essentially -- thank you. The red lines are pressure drop, the blue lines are fresh velocity. All these tests were .1 feet per second initially.

This initial line is the same amount of NUKON and cal sil, so we had the same amount of loading in both tests. The only difference between these two tests is that the upper red line had trisodium phosphate, which allowed these chemical products to form. The other test had no trisodium phosphate, so when we had no trisodium phosphate, we went up, we got a very stable head loss at about 1 psi. When we added the TSP, we allowed formation of calcium phosphate and we got much stronger increases in head loss.

MEMBER APOSTOLAKIS: Thank you.

MR. TREGONING: Let me move on to the next phase or aspect of this program, and that's the prediction of chemical product formation. The approach here has been, at least initially, to evaluate the feasibility of utilizing commercially available or off-the-shelf thermodynamic simulation codes for predicting chemical species formation. There's been some up-front work to measure corrosion rates of important materials to use as input for these codes. Initially, we performed some initial blind predictions so we could see how well the codes could predict what we saw in the ICET experiments without any sort of test calibration from the

experiments whatsoever. Then we also did some studies where we calibrated the predictions by what we saw from the ICET testing. And the way the calibration was done is - the way these codes work is they predicted the most thermodynamically stable species will form. That's not always the one that's kinetically most favorable, so what was done is if there were species predicted that were not observed in the ICET testing, they were just precluded from forming until the right species were occurring.

This next chart shows the best results we got, or among the best results we got were when we did the calibrated simulations. And this shows results for calibrated simulation of the ICET-1 test. The red squares are the simulations, the green triangles are the ICET results, fairly good predictions of pH. That's not too surprising. There's a lot of codes that can do a decent job of predicting pH. We did a reasonable job of predicting aluminum until we got up to around 350 hours. Same thing with calcium, we over-estimated slightly the amount of silica. One of the reasons for the differences with time is there was no passivation models applied in these simulations, so a lot of times with many of these tests you did

start to see corrosion inhibition that occurred in various points in the test, and that's just not captured at all in speciation modeling.

MEMBER KRESS: Now what you have here is rated dissolution of these materials, plus the chemical equilibrium once they get in.

MR. TREGONING: Yes, that's right.

MEMBER WALLIS: It's encouraging that you can make some of these predictions.

MR. TREGONING: It is encouraging, but again, I don't want to over-sell their effectiveness, because again, we've gotten the best results when we knew what species were that we'd seen, so I wouldn't want to hold out hope at this point that those codes by themselves could be used in data where you don't have similarly good benchmarking experiments, so that's where we're at with the codes at least to-date.

MEMBER KRESS: I presume the rate of dissolution is the major point. I mean, once you get the stuff in there, it's going to --

MR. TREGONING: No, that's --

MEMBER KRESS: Especially, mark out species you don't think are going to do that.

MR. TREGONING: That's entirely true,

but the thing we've noticed is getting the right corrosion rates, again, especially in the nature of multiple chemical effects. Usually the corrosion rate experiments are all single effect-type experiments where you look at one metallic species. Now we --

MEMBER KRESS: Are those well-stirred, by the way, so you don't get --

MR. TREGONING: You don't get - yes.

MEMBER KRESS: -- surface layer effects.

MR. TREGONING: Yes. I may ask the Center to comment on that, but essentially yes. They're all performed as per ASTM standard corrosion rates, and so obviously, they want to make sure that they don't have inhibition of corrosion due to stagnant conditions.

One of the things we did do in this testing, some of the initial work, we were getting very inaccurate predictions of silicon in the NOH environment. Silicon is well-known to be dissolved by high pH solutions. We didn't see that in the ICET test, and the reason being is there is an interaction between aluminum and silicon, that when we started looking at multiple corrosion experiments with just silicon and aluminum in the same beaker,

it great inhibited the production of aqueous silicon, so these multiple effects can certainly be important in terms of the corrosion rate aspects, and that's what you try to balance when you have a code, how well do you actually have to know that to predict a complex environment.

So some initial conclusions that we've reached with all the studies that we've done so far in the area of chemical effects; certainly, the products, precipitants, and gelatinous materials can form in these environments. I said this one, that small changes to important variables can significantly affect what happens.

Certainly, the products that we've looked for can contribute significantly to sump screen head loss under the proper set of conditions. And in TSP environments, we found that small inventories of dissolved calcium can contribute significantly to head loss. And by dissolved calcium, there's other sources of calcium potentially in these environments other than cal sil. There some cal sil in many fibrous insulation, and certainly unexposed concrete, and potentially latent debris, as well.

As I said earlier, blind predictions

using these thermodynamic models with only the input corrosion data --

MEMBER WALLIS: Does TSP react with any -- paint fragments or paint particles?

MR. TREGONING: I would say that's still largely a bit of an open issue in terms of the epoxies and some of the other qualified coatings, at least the expectation and the conjecture has been no, but I don't know that it's been demonstrated yet today.

MEMBER KRESS: On these blind predictions not being very successful, but when you go back and recalibrate it with the actual PCs, they're pretty good.

MR. TREGONING: Yes, and that's the final goal.

MEMBER KRESS: Your interpretation of that seemed to be that the species that didn't show up, the chemical statement, the equilibrium statement was probably were inhibited by the kinetics. Now it looks to me like you could make a pre-guess on the kinetics of these things just looking at species and kinetics, and we'll say wow, we won't expect to see this one, or this one, this one, and actually do what you do with calibration.

Do you plan maybe to try that and see if it would work?

MR. TREGONING: It's certainly -- other than trying to develop a full kinetic model, that's certainly --

MEMBER KRESS: Yes, a full kinetic model might be difficult.

MR. TREGONING: Yes, that's certainly --

MEMBER KRESS: Especially in the dissolved state, but you could actually look at individual kinetics of reactions and say wow, we won't expect to see this, and mark it --

MEMBER WALLIS: Even though the code predicts it?

MEMBER KRESS: Yes, the code would predict it because the code is actually there for infinite time, and you could make some kinetic predictions ahead of time and mark some of them out. I don't know if that would work or not. It may be an approach.

MR. TREGONING: That's an excellent suggestion. I will say, and I didn't go into this, we have a peer review group that's advising us on chemical effects, and we're meeting later this

month. And one of the objectives of that is to try to identify, at least from my end, try to identify what some of the biggest issues are and things that we need to understand to have, again, at least a conceptual understanding of what will play out in the post LOCA environment. And I think that's a potentially attractive approach to at least look into.

Let me move on a little bit. I know there's interest in this from Professor Wallis, so I want to make sure that we cover this testing that we've done in the area of particulate head loss. This is coupled work between the testing and modeling. The testing is being conducted out of Pacific Northwest National Lab. The modeling is largely being done by Bill Krotiuk here of the staff. The objectives of that are to develop an approved model to conservatively predict pressure drop and compression of a debris bed on a sump screen, initially focusing on standard, fibrous and particulate components. However, there's certainly desire, if it works out, to possibly try to advance the model to deal with coatings chips, as well as chemical product, but this initial work is only looking at fibrous and particulate components. And

the test data has been structured to support the model development so that empirical constants can be analyzed, and then we can also independently validate the applicability of the model. And, again, we're trying to do it over a range of conditions which we feel are broadly representative of plant conditions. And then finally, the testing itself we're also doing to experimentally investigate some important mechanistic variables and parameters which affect head loss.

Briefly go into modeling here, and Bill is available if we have specific questions. The basic model is based on classic form of the porous medium flow equation or the Ergun equation. It counts for viscous and kinetic flow terms, although I think it was pointed out, rightly so, that the kinetic flow terms in these cases are largely negligible due to the velocities involved. Working on developing an improved method to predict debris bed compressability, and also developing saturation conditions so that you can at least have criteria to understand when your fibrous bed is saturated with particulate. And when you get into saturation that's, we believe, really is what drives those conditions where you have very large head loss. The

other thing we're trying to do is identify for a given fiber bed what the limiting particulate concentration is, which again would drive these various large head losses.

The model itself, there are two formulations; one is a simplified model with just one homogenous control volume. Another will have two control models so that we can investigate saturation over very localized or thin part of the bed, either on the top or on the bottom, or somewhere in the middle. And the model assumptions and validity are being evaluated and assessed with not only head loss data that's being measured out at PNNL, but also prior work that's been done at LANL, and then also some of the chemical work that's being done at ANL.

MEMBER APOSTOLAKIS: So will you be able then to make a statement regarding the uncertainty in predictions of this model, since you will have some test later, or you're not --

MEMBER WALLIS: I think we're going to get to it. It's an interesting figure you can look at to see, and maybe reach your own conclusion about that.

MEMBER APOSTOLAKIS: There is a figure

later?

MEMBER WALLIS: Yes.

MR. TREGONING: It's in the next slide, actually. I can jump right to it in the interest of time.

MEMBER WALLIS: Yes, we might want to do that. Right.

MR. TREGONING: So some of the test data that we've used, I'm on slide 18 now. We've done some work to look at the effect of sequencing on head loss, so this graph really shows three different things. One, where we premixed all the particulate and NUKON insulation together, and that gives you head loss in this range. Now head loss over velocity, head loss varies with screen approach velocity, so many of these are one premixed combination, and we've just increased or decreased the velocity to measure head loss. But we've done some tests with premixed cal sil and NUKON where we've gotten a certain head loss. Then when we start to sequence it and form the NUKON bed first, then add cal sil, and let me remind you that it's the same amount of NUKON and cal sil in all of these tests. The only difference is the sequencing of the debris, whether we mix them together, or we have the

NUKON go first, or the cal sil first.

Now you can see, we get very large head losses in this case. It's a bit of a laboratory anomaly because it occurs when we added the cal sil first followed by the NUKON. But what actually happened was most of the cal sil passed through the screen. The NUKON came behind and formed a bed, and then it came around and deposited on top of the screen. So the only real difference between these results and these results is the amount of delay time before the cal sil was deposited on the bed. And you can see, certainly that - and again, this is a fact that I think has been relatively well-known. I don't know that it's been quantified this well before, but you can certainly get situations where debris sequencing, if you form your fiber bed and it forms effective pre-filter to filter out particulates effectively, you can reach a situation pretty quickly where you get large amounts of head loss due to particulate.

MEMBER WALLIS: So what I did, I took those points on the right and extrapolated them to the origin. It's sort of linear, but slightly curved curve. It's curved, it goes down even lower. And then I took the value and compared it with that

blue square at the top there, and I said we've got a ratio of over 100 to 1 in results, depending on how we do the experiment.

MR. TREGONING: Yes, although being an experimentalist, I don't like to interpolate too much.

MEMBER WALLIS: It's 100 to 1, it's within -- maybe 300 to 1, but it's order of magnitude. That's impressive. Right?

MR. TREGONING: Well, again, head loss in these tests, it's probably fair to say that these tests has essentially caused complete blockage. So the amount of pressure drop you get is a function of your system at that point.

MEMBER WALLIS: So the uncertainty is enormous if you just don't --

MR. TREGONING: I don't like to use --

MEMBER APOSTOLAKIS: In the vertical direction, right?

MR. TREGONING: Yes. I don't know that I'd use the word "uncertainty", as much as variability.

MEMBER WALLIS: Well, variability. It depends upon things which are not normally known very well. It does have a reason, we think. It's

not entirely arbitrary, even. If you knew why it was, and you had to do it --

MEMBER APOSTOLAKIS: You don't know how it will actually evolve.

MR. TREGONING: These are very repeatable. We can repeat these very well in the lab.

MEMBER APOSTOLAKIS: What is this telling you now from the accident?

MR. TREGONING: Well, it's something that we've certainly been aware of, but we know that the debris arrival sequence is an important consideration, and it's one that --

MEMBER APOSTOLAKIS: And in real life, can you say anything about what the sequence will be?

MR. TREGONING: Maybe Ralph, or Tom will want to jump in from NRR on this.

MEMBER APOSTOLAKIS: I mean, is it equally likely that that can be in any one of these reviews?

MR. ARCHITZELL: Ralph Architzell from NRR staff. I could tell you a little bit about the testing that's gone on, which is more homogenous in these prototype testing you've been hearing about

earlier. But there is a half an hour period minimum where the debris -- you're not going to get -- you are going to have at least a half an hour until you get to recirculation on these LOCAs, so there is some basis to say a homogenous situation has validity to it. The chemical effects could be a little harder, and they come in with time, to justify that type of situation, but the general debris term, you could make a case that homogenous is acceptable.

MEMBER APOSTOLAKIS: So that means what in terms of this figure, that most likely it will be on the right?

MR. TREGONING: And the testing that we have observed to-date has by and large been homogenous testing situation, well mixed at the start of research, so that's just feedback.

MEMBER WALLIS: Well, let's look at this, though, carefully, because the high point is due to getting a thin layer saturated with particles. And what they're doing here is they're getting it somewhere in the mix, probably on top of it. You might get that anywhere. You might get it just on a piece of the screen somewhere, and it's homogenous everywhere else, but you've got a thin

layer somewhere else. So if the fine particles arrive later or something, or they go to certain parts of the screen, they could still make this thin bed effect, if they're not diluted with enough fiber. Isn't that true?

MEMBER DENNING: I still think that the bigger issue here is that doesn't account for chemical effects. This is just particulate and fiber mixed, and I can believe the arguments about homogeneity largely in these accident sequences as far as this part of the problem is concerned, but once you start to get the chemical effects, then there definitely is layering, I think a later arrival of the chemical constituents.

MEMBER WALLIS: Well, then you get the two working together.

MEMBER DENNING: At least you get the two, once you move together, and we haven't --

MEMBER WALLIS: You've got a few more little particles that have been all around the loop, through the reactor and are coming back.

MR. TREGONING: Yes, maybe.

MR. ARCHITZELL: This is Ralph Architzell. I want to make one more comment about the prototype testing that have observed to-date,

and that is that the vendors typically do two conditions, where the thin bed is a conditioning, and that's generally the controlling condition versus the more debris-laden type condition, so they at least do a thin, not be the specific thing, but it's a mixed thin bed probably, but they do do a thin bed test in addition to the larger one.

MEMBER KRESS: So these tests, I presume you varied the approach velocity by a valve or a pipe to slow it down, so these were all for fixed screen size.

MR. TREGONING: That's correct.

MEMBER KRESS: Now if you had a bigger screen, you'd get a different result.

MR. TREGONING: Again, the relevant scaling parameter is debris per screen area, so that's what the tests have tried --

MEMBER WALLIS: You mean whole size you're thinking, you're thinking of the whole size?

MEMBER KRESS: No, no. I was thinking total area. I don't know how you know this, because now it is, now they're putting in bigger screens.

MEMBER WALLIS: This is also horizontal screen, isn't it? I mean, most screens aren't horizontal. It's not typical of a real screen.

MEMBER KRESS: So what do you mean by is it a typical debris per screen that we now have, or is it projected to what they expect to have?

MR. TREGONING: Bill, you may want to weigh-in on this. I can tell you most of the mass loading that we're using is meant to be representative of the modified configuration.

MEMBER KRESS: Modified conditions.

MR. TREGONING: Yes.

MR. KROTIUK: Also, this testing was -- this is Bill Krotiuk. This testing was really mimicking the conditions that were used in the initial LANL testing, so the basis for that really was, I guess, LANL could defend the basis for those initial values of the NUKON and the cal sil, but I would assume that they came up -- they did some sort of surveys to come up with that.

MEMBER WALLIS: Can you show us the LANL points on this graph?

MR. KROTIUK: The LANL points, it's not on this particular version of the graph, but it's over on the right end over here.

MR. TREGONING: Typically right around in here.

MEMBER WALLIS: Below everything, or

it's typically down there somewhere.

MEMBER APOSTOLAKIS: Is there such a thing as a typical approach velocity?

MR. TREGONING: Well, most of the newer modified screen designs which are moving to bigger designs, one of the advantages of that is it in general dramatically reduces the approach velocities. Many of the plants are down around this situation, around .01.

MEMBER WALLIS: That's where your highest points are.

MR. TREGONING: .005.

MEMBER APOSTOLAKIS: Well, if you have these sequences.

MR. TREGONING: Well, the highest points - again, they're somewhat -- they're limited by sort of the absolute system capabilities. And the velocity is low because that's all that was getting through the bed at that point, obviously.

MEMBER APOSTOLAKIS: Now you're not showing any model predictions here. Right?

MR. TREGONING: No, this is just a -- just test.

MEMBER APOSTOLAKIS: So the line there is just to illustrate the different regions.

MR. TREGONING: Yes. And the way we do this, Bill had mentioned, we form the bed at higher velocities; the reason being, just so we can conduct tests rapidly, and also ensure ourselves that we have a relatively uniform bed, and we don't lose a lot of debris in settling within the loop, so we typically form the bed at higher velocity.

MR. KROTIUK: Well, high is .1.

MR. TREGONING: Yes, .1.

MEMBER WALLIS: Then the velocity falls off as you get more resistance?

MR. TREGONING: No, then once we form a stable bed, we always cycle through velocity to see what happens, what's the head loss as a function of velocity. Now there's some pre-compression when you form at higher velocities. It's not realistic of the actual situation, but the stipulation is if you form at .1 and you go down to what would be expected to be a realistic approach velocity --

MEMBER WALLIS: That blue square at the top there, how did you ever form it at .1? How did you ever get up to there?

MR. TREGONING: Well, again, it started at .1, and then it --

MEMBER WALLIS: So it would be

astronomical if you had that condition.

MR. TREGONING: Again, it was almost complete clogging, so I mean, the pressure drop is limited by whatever the system can maintain at that point.

MEMBER WALLIS: So you form it, and then the velocity goes down. These are very interesting, and I think the question is, does this have anything to do with what would really happen in a realistic screen? This is a horizontal screen. You have to look very carefully to get the situation. Is it ever likely to happen in reality?

MR. TREGONING: Well, my basic point is I still believe -- the prime point I would derive from these results is not -- I wouldn't focus so much on this maximum pressure drop, or even the difference. I'd focus on the point that making sure we understand and design around the fact that the arrival sequence can dramatically affect your results. That that's the most important consideration that comes out of these results, and it's something that we - not only we, but the industry and the staff - need to be wary of as we evaluate these various tests and evaluations to make sure we've satisfied ourselves that we don't have

this condition.

MEMBER WALLIS: Thank you.

MEMBER MAYNARD: Can you clarify for me just the geometry of the screen? You said it's a horizontal. Are we talking about just a horizontal screen across the --

MR. TREGONING: Yes. Let me pull the LANL loop up. I don't have the PNNL, but once you've seen one loop, you've seen them all, essentially.

MEMBER MAYNARD: Explain that loop, please.

MR. TREGONING: What did I say? I misspoke.

CHAIRMAN POWERS: You said LANL.

MR. TREGONING: LANL, sorry. The screens here, usually what happens is there's debris insertion somewhere behind the screen, and debris floats down at a uniform velocity, gets deposited on the screen. There's usually pressure transducers across the screen to measure head loss, as well as in-line flow meters and in the pump to pump the fluid around. So the screens in all of these tests are horizontal, and the debris is arriving vertically, so it's enhanced or it's being driven by

not only the velocity, but also by gravity in these tests.

MEMBER WALLIS: You haven't done one the other way around where you bring it up from below?

MR. TREGONING: No, we haven't.

MEMBER WALLIS: It would make a difference. It would. First, a drop will hold it on there once it gets there.

MEMBER MAYNARD: Well, I think also a vertical or a cage-type screen like you actually have in the plants, I would think you'd see some big differences, surface versus the bottom. This provides useful information, but it is not representative of what's out there.

MR. TREGONING: Yes. No, it was never intended to be, and certainly we realize the containment doesn't look like a closed loop, certainly. And many of the -- this doesn't take into account the geometric design factors of the screen, which are designed to avoid these situations, but really to give us information on a fundamental level. And one of the things we've always argued, that head loss for a given amount of debris is always going to be conservative across a vertical screen, so we're trying to test in some way

some of the bounding or limiting conditions.

MEMBER WALLIS: You could say one of the messages is this is a very well defined experiment designed to give a result which ought to be predictable, and yet you have a lot of difficulty predicting it, even though it's designed to be the most predictable possible configuration. If you took a real screen, it's much more complicated geometrically, the arrival times are different, different particles go different places and so on, so this is the more predictable type of situation you've got here, and you choose to make it that way.

MR. TREGONING: It certainly lends itself to better predictability. Okay. I think I've covered most of these, so let me -- what do we want to do about schedule?

MEMBER WALLIS: I think we should go ahead.

MR. TREGONING: Okay.

MEMBER WALLIS: You're going to get to the end in what, 20 minutes or something?

MR. TREGONING: Depending on questions, I can get --

MEMBER WALLIS: We started late, so --

MR. TREGONING: I can get to the end in

five minutes if needed.

MEMBER WALLIS: You can get to the end in 10 or 15, whatever you need to take.

MR. TREGONING: Okay.

MEMBER WALLIS: I doubt if you can finish in five minutes and tell us what we need to know.

MR. TREGONING: I don't know if I'll take that as a compliment or not.

We are doing some work in the area of downstream effects. I mentioned it's very targeted. We're doing work, and it's not only targeted, but it's coupled. These are two phases of experiments, where the first phase looked at debris ingestion, and we're trying to examine the variables that the effect, the amount of insulation debris that can pass through a sump strainer screen. This work has actually been published in this NUREG, and if you don't have a copy of this, I'll be happy to provide that with you.

This is work that we did not describe to you in detail at the Subcommittee meeting, so I just have a slide or two because you specifically asked for it. And then that work led into the throttle valve blockage work, where taking the debris that we

saw here, those characteristics, and injecting it into a surrogate HPSI throttle valve loop, wanted to look at the effects of clogging due to ingested debris. So the debris ingestion testing or Phase One, was all conducted within a flume which you see schematically here. There was a test screen for monitoring debris bypass, and then there was a fine screen that was used to trap particulate and fibrous debris so that it went through, so that we could do a mass balance to try to determine how much had passed through. This is the same flume that we used for the throttle valve test. The only difference was it was configured slightly differently.

We looked at fiberglass, cal sil, and RMI reflective metallic insulation debris in these tests. All of these tests were separate effects tests in the sense that each debris component was put in individually by itself, and then bypass was recorded for that particular set of conditions. And then we moved to a new test where we either changed velocity or changed some characteristic of the test.

The velocity was a constant velocity within a linear flume. And, again, I mentioned that we passed the debris individually. The principal test variables were debris size, byglomeration -

that means how finely we pre-processed the debris.

MEMBER WALLIS: This is the leaf shredder?

MR. TREGONING: Leaf shredder versus blender process, so leaf shredder for the NUKON was very coarse processing. You end up with clumps, where the blender process is more finely dispersed. The other variable was the debris location. This was primarily a variable with respect to RMI, where we had some RMI that we put along the floor, then started the velocity up and watched how it transferred, versus some that we put directly into the flow, so this would simulate RMI that would remain suspended once recirculation started. And then flow velocity was certainly a variable.

Go right to the results here, and essentially show the NUKON and the RMI results. The NUKON results are particularly enlightening because you can see the principal variable that determined what passed the screen or not was how finely processed the debris is.

MEMBER WALLIS: Well, this must depend on how you put it in. I mean, the screen is supposed to filter this out, and 90 percent of it passing seems a little fantastic.

MR. TREGONING: Well, again, this was finely processed NUKON.

MEMBER WALLIS: There's nothing built up on the screen to hold it, so it just went right through.

MR. TREGONING: Well, again, the concentration of debris, it was relatively sparse concentration. We didn't want to get situations where we had clogging that was affecting bypassing. We were really trying to evaluate what would pass through a clean screen.

MEMBER WALLIS: So this would be --

MR. TREGONING: This would be a maximum in that sense.

MEMBER WALLIS: A big screen without much debris, and it might all go through.

MR. TREGONING: If it's finely divided, either NUKON or particulate debris, yes, that's a potential.

MEMBER WALLIS: I'm trying to think how this would apply to a plant where you have --

MEMBER SHACK: It goes right to the core.

MR. TREGONING: Well, again --

MEMBER WALLIS: If you had a kind of a

LOCA which favorably produced very fine debris, because of the high velocity jet going on to particular kind of insulation, and maybe not producing that much of it, it might come around, and all of it would go through the screen, conceivably.

PARTICIPANT: A more realistic scenario, Dr. Wallis, would be a plant that's all RMI that doesn't generate hardly any fibrous debris, but has latent fibrous --

MEMBER WALLIS: It has fibers somewhere of some sort, not too many of them.

PARTICIPANT: Yes.

MEMBER DENNING: But I think we're more interested in the case where there's a lot of fiber and a big screen, and the potential for a lot of fiber to go through.

MEMBER WALLIS: They might go through the parts which haven't got covered by the --

MEMBER DENNING: Yes, exactly.

MEMBER WALLIS: I don't know we should take this as typical. This is a particular test where 90 percent went through. Change some variables, you might bring it down to --

MR. TREGONING: Well, one of the variables I want to point out is these velocities in

these tests were all greater than .2 feet per second.

MEMBER WALLIS: But still, it's still up there, it's not tending to the origin, is it?

MR. TREGONING: Well, these tests are a little bit dated. I mean, they were conducted a couple of years ago. I mean, obviously, what -- given the new tendency to move to larger screens and lower velocities, there's some data down here to look at transportability, would really be valuable in that regard. But that's where the prototypical testing that's going on in the vendors, I think there's some hope or expectation similar will fill in some of these gaps, as well.

MEMBER WALLIS: So we shouldn't take these results and use them as a prediction of any sort of what's going to happen.

MR. TREGONING: I think they certainly provide a bound, but I would argue, especially in terms of NUKON, a conservative bound in terms of the amount that could pass. You could see for much less, much coarser processed debris, it has a tremendous effect. That velocity for debris that's pretty tightly agglomerated doesn't really result in much significant debris that bypasses the screens.

MEMBER WALLIS: These are different size screens, these different points, aren't they? That's all --

MR. TREGONING: Yes, there's one-eight and one-quarter inch.

MEMBER WALLIS: It's the same debris, isn't it?

MR. TREGONING: Well, nominally processed the same way versus finely, versus coarsely. But what you see here is that the screen size doesn't play a large variable.

MEMBER WALLIS: I don't understand this finely/coarsely. I don't see anything in the description that says some of it's fine, some of it's coarse, but some of it is?

MR. TREGONING: Well, the blender process is the fine debris. BP and shredder.

MEMBER WALLIS: That's what it means, BP and --

MR. TREGONING: Sorry, I should have identified that.

MEMBER KRESS: It's not British Petroleum.

MR. TREGONING: Yes. BP stands for blender process, so all of this is the finely

divided NUKON debris.

MEMBER WALLIS: Even through the fine screen, isn't it?

MR. TREGONING: Yes. Yes, through one-eight or one-quarter. Again, there wasn't a large effect of screen size down to an eighth.

MEMBER WALLIS: Okay.

MR. TREGONING: It was more a function of, again, for the approach velocities we looked at, it was a function of the process agglomeration.

MEMBER WALLIS: So we have to know what size particles are produced by these LOCAs then, presumably, if you're going to use anything like this.

MEMBER DENNING: Well, don't forget there's fibers that this -- the NUKON -- some fraction of it is going to breakup into its constituent fibers. And they're small, and they are sustaining. For whatever that fraction is, they're going to be suspended for a long period of time.

MEMBER WALLIS: They're not very long, individual fibers?

MEMBER DENNING: They're fairly long, but the question is will they get through, or then where will they wrap, things like that. Rob, one

thing, I know we're going to run out of time, I wanted to say is, I'm concerned that we're going to shutdown a research project that isn't done yet, particularly with regards to downstream effects, and that one thing I would certainly like to see would be some experiments done with fibrous materials in the kind of situation you have here, in core-like geometries to see what's going to happen, because I don't care that the industry is going to do it.

MR. TREGONING: We certainly heard and understood the concerns that you had in the area of downstream effects. Many of the same concerns were issues, as Tom Athera mentioned, that we had, as well. One of the things we're doing now is we're considering with NRR how best to analyze and proceed, not just through code calculations, but then also potentially experiments that might address some of these issues. But there's nothing that's been certainly finalized to-date in that area.

MEMBER WALLIS: Well, I would say there's been enough surprises with every experiment you've done, that I would very much like to see experimental evidence for all these effects. They're important. Not just the code prediction.

MR. TREGONING: It's duly noted. We

certainly need to, again, we need to benchmark what we do with -- all of us are trying to address and come to a final resolution that's acceptable between the industry, and research, and NRR. And we just in research need to make sure our research is unique, not duplicative, and needed. So this is an area that we're convinced that the industry is not going to provide a rigorous technical evaluation for, then yes, it's something that we certainly need to seriously consider.

The one thing we found with cal sil which we didn't talk about, virtually all the cal sil particulates passed through any of the test screens at this velocity.

MEMBER WALLIS: I don't see how you know when this industry has done this rigorous complete evaluation if you don't know the scope of the problem. You almost have to do something yourself in order to find out the kind of questions to ask.

MR. TREGONING: It's coupled in a way, because the scope of the problem is dependent on what the individual licensee debris loading is, and that was still -- the jury is still out on that for many of the plants, so that makes the research challenging, as well, because if we just move

forward conducting experiments, and it ends up that we've totally missed the boat on what the source term is for the debris, then we've essentially done a set of wasted experiments, so we need to make sure that we're fully informed with where the industry is moving, as well.

MEMBER WALLIS: I'm just wondering if you can ever rely on just looking at what they submit without having any experience yourself of the kinds of phenomena which you have to ask about.

MR. TREGONING: Well, again, I think we've initially proposed doing some code calculations. And I think the expectation would be is that the code calculations and sensitivity analysis would be used to inform both on the need, and then what particular types of any potential follow-on experiments would be necessary at that point.

Let me move on to Phase Two. This was the valve blockage study. It is very analogous in the sense that we looked at RMI, NUKON, and cal sil debris. We picked some of the same characteristics for the types of debris, or the characteristics of the debris that would make it through, or become ingested by through the screens in Phase One, so all

the NUKON was finely processed using a blender to give us very fine debris, because that's what was most likely to pass through.

In these tests, we used one single valve surrogate valve chamber, but a flexible geometry to simulate three different valve configurations at different contact areas and seat diameters. Again, this was another parametric study, and we were really looking at developing a relationship between flow area through the valve and valve loss coefficients. And we were inferring debris retention by increases in the valve loss coefficients, because we had no way to actually observe retention in the test.

We could take the chamber off the valve and see after the test how much debris was in the chamber, but we had no way of actually observing during the test how that was blocking flow, so we were really measuring the valve loss coefficient, and using that to infer what was going on.

The principal test variables, again, are three type in size, geometry, valve gap, and we looked at both single inputs of material, and also accumulated debris over time where we had multiple inputs of debris. And we also looked at some mixed

debris situations. This is the test schematic that we used for that. Here's the same flume that we used for the bypass testing; although, here we hooked another loop up.

MEMBER WALLIS: Do you show the direction of flow here?

MR. TREGONING: Yes, the direction of flow is down through this drain, through the pump, and then through the surrogate valve here. Here's our surrogate valve, you see the pressure sensors on either side, so all of the debris is inserted just upstream of the valve and downstream of the pump, so none of the debris goes through the pump itself. And then we catch buckets up here with fine screens to catch whatever debris --

MEMBER WALLIS: This surrogate valve, it's a real valve that's been cut open or something?

MR. TREGONING: No, it's not a real valve. It's a valve that was specially machined so that we could swap in different --

MEMBER WALLIS: It's the same dimensions as a real valve?

MR. TREGONING: Similar flow characteristics. I won't want to say similar dimensions. What we did is surrogate valve allowed

us to vary both the contact area, the seat diameter. They were certainly referencing --

MEMBER WALLIS: It looks very much like a real valve.

MR. TREGONING: Yes. So let me go to some of the significant results for those tests. I'm just showing, this is single debris test, NUKON retention in valves, and then RMI retention in valves. And these are all percent increases in K, where K is the valve loss coefficient. You can see with NUKON that the amount of valve loss we got was very sensitive to the mass of NUKON that we loaded in or pre-loaded into the loop.

Now these masses are not meant to be representative at all in terms of how much debris loading you might get from a particular plant, so this is really just meant to be parametric in nature. All of these tests were conducted at a flow rate of about 75 gpm which is, again, within the ballpark of what's expected for flow through many of these -- through an actual HPSI valve.

MEMBER WALLIS: So you put in 100 grams of NUKON, but you only put in 10 grams of RMI?

MR. TREGONING: Well, the NUKON essentially -- yes, this was as much NUKON as we

could stuff into the loop, essentially.

MEMBER WALLIS: Well, you said it was very dependent on the mass you put in. When you go to the RMI, I only see 5 and 10 grams, so you put in less stuff?

MR. TREGONING: We certainly put in less mass of RMI than we did --

MEMBER WALLIS: Maybe that's what you got less effect?

MR. TREGONING: Well, certainly that's one potential reason for less of an effect; although, the scales are different, but we got many cases where RMI by itself, we still got 50 percent increases.

MEMBER WALLIS: A rather small quantity of RMI.

MR. TREGONING: Yes, with 10 grams or so of RMI. The key thing that we saw here, this is the ratio of the RMI maximum dimension to the gap size, is that when the RMI was just slightly bigger than the gap, say only one to two times, you tended to get relatively small effects. But then beyond about a factor of about three, you could get situations where you got relatively large effects, especially once you had some of the higher mass loadings.

Although, I would say in the plants, RMI loading would be expected to be -- you would expect to have much less ingestion of RMI debris, certainly, than you would of relatively small fibrous NUKON debris, or cal sil particulate.

I don't show the cal sil particulate, because when we just put cal sil through, we didn't get any valve loss coefficient with just cal sil.

MEMBER KRESS: K is defined as depth P over ROW V squared?

MR. TREGONING: K, it's essentially proportional to pressure over the square root of the flow rate. I think -- Bill is shaking his head yes. I'm not a thermal hydrologist, so I get into danger when I start spouting formulas here.

MEMBER KRESS: The question I have is what V did you use?

MR. TREGONING: What velocity?

MEMBER KRESS: Yes. Or did you use the Qs?

MR. TREGONING: We used the Q. We used the flow rate again of 75 gpms.

MEMBER KRESS: So step P over the --

MR. TREGONING: Yes.

MEMBER KRESS: Q squared.

MR. TREGONING: Yes.

MEMBER WALLIS: So I guess the message is there is an effect.

MR. TREGONING: There is an effect, and I will go quickly through the conclusions and go to the last part of the presentation, which is the coating transport test. This is very much of a status test at this point in that the testing has been conducted, but we're still analyzing the data, so this will be something in June we'll certainly have much more information on. For this testing, the objective is to characterize the transport behavior coatings in water under both stagnant and flow conditions, looking at five coating systems, trying to span a range of representative physical characteristics, again that are representative of actual coating characteristics, and some of the prime things we've tried to simulate are specific gravity, thicknesses, and surface roughnesses of these coatings.

We've done quiescent settling tests, and then uniform flow transport testing, both tumbling and within the flume are injected, steady state velocity testing.

MEMBER KRESS: Why did you think surface

roughness is important?

MR. TREGONING: We were curious, especially for the tumbling test, curling was certainly an important issue in terms of how much area appears to come outside of the boundary layer to allow some lifting, and I had the chips here earlier. Some of those chips are relatively rough, so I didn't necessarily know that it was an important test variable --

MEMBER KRESS: Just wanted to be sure.

MR. TREGONING: Well, we just wanted to be sure. We didn't want to do anything --

MEMBER KRESS: I would have been very surprised if it had any influence.

MR. TREGONING: Over these scales, I wouldn't say it's one of the important variables. We looked at 1/64th up to 2 inch chips. We've looked at both flat and curled chips, and in looking at the effect of flow velocity. This quickly is the transport test apparatus. The neat thing about this is there are ports here at three different levels so we can tell at the end of the test whether debris is along the surface, in the middle section, or along the floor so we can see how much settling we've had happen. And there are cameras located along the

flume, and we used those cameras to actually track each coating chip to measure velocity, three dimensional velocity of that chip, as a function of the flow velocity.

The way the tests are normally performed is that we start off at a low velocity, and then increase velocity until we start seeing both incipient and then bulk transport of the chips.

Preliminary observations, which is all I have, time to sink is influenced by surface gravity, no surprise there. The lightest coatings which are Alkyd, specific gravities just above water, didn't sink, while the heaviest coatings typically sank quickly. Again, transport velocities, again not surprising, the two variables that were most important were specific gravity and chip shape. So chips that tended to be curled tended to transport a little more readily than flat chips, again, probably not too surprising there.

The Alkyd coating appeared to transport at the lowest velocity, .2 feet per second and above. The heavier coatings had higher transport and tumbling velocities. And, again, I said the curled chips generally had lower tumbling velocities. I won't go over this.

MEMBER WALLIS: Now all of these programs, it seems to me, are producing interesting results. They've shown effects which are in some cases surprising, and they're all incomplete in that there's no conclusion in terms of a predicted capability. I wonder why you'd want to stop any of them.

MR. TREGONING: Well, you're talking to a researcher so that's a loaded question to me, why do I stop anything.

MEMBER WALLIS: I understand that there's a plan to stop work by April. Isn't there a plan to say everything is resolved, finished by April or something like that?

MR. TREGONING: When we set up our strategy for doing research, we certainly had the resolution schedule for GSI-191 in the back of our minds.

MEMBER WALLIS: Have you been able to produce results which are resolving issues, or raising questions?

MEMBER APOSTOLAKIS: When would you say that the issue is resolved? When do you declare success in these things?

MEMBER DENNING: Well, George, I think

that it's fairly -- well, it's never clear, but let me say what's going to happen. The industry is relying very heavily on some integral tests that I think are not the proper way to use integral tests. And the NRC is going to be in a position of having to evaluate those tests with their flawed nature of being integral without a good understanding of the phenomenology that's going on in those integral tests. In order to do that, we need a predictive capability, and that predictive capability doesn't have to be an accurate predictive capability, but it has to be substantially better than what we currently have. And I think that the programs are headed towards an approximate predictive capability if they are allowed to continue with some of the momentum that they currently have, and with that objective at the end.

MEMBER APOSTOLAKIS: Well, the question really in my mind is predictive capability, you're predicting something, and then you say I declare victory at some point, because now what?

MEMBER WALLIS: They have an adequate understanding, adequate prediction for whatever it is you want to do.

MEMBER APOSTOLAKIS: Understanding

doesn't help you during an accident.

MEMBER WALLIS: You have to put it in the context of the accident. You have to look at what's adequate.

MEMBER DENNING: You have some confidence that you're going to be able to recirculate and cool the core effectively, reasonable confidence. And certainly, the industry is headed towards that kind of analysis, but a really critical part of their argument is going to involve a very empirical integral test that is not well characterized, and that's where I think the rubber is going to meet the road, and where we're going to have a great -- unless the NRC has some reasonable predictive capability, they're not going to be adequately able to challenge those test results.

MEMBER WALLIS: Are there any other questions or comments?

MEMBER ARMIJO: Well, normally the integral tests that the vendor performs, he'll do a pre-test prediction based on some sort of model. Isn't that what we expect?

MEMBER DENNING: You're exactly right. That's the way it should be, but that's not the way

this is going to be. What they're going to do is they're going to take for this critical area where you have fall-out in the approach to the screen, and you have the build-up on the screen, and the head loss of the screen, they're going to use the results of their empirical test to fill in that gap. That's the way it's been explained to us, that's my understanding. They are not going to attempt to do a prediction of what those integral tests are, which is the way you really should use integral tests, and use those as, at least for that particular set of conditions, validation that you're able to come reasonably close.

MEMBER WALLIS: I don't understand how you do that. Do you have to then put in a mixed characteristic of every LOCA you're going to encounter, and then do an empirical test and look at the result, and use the numbers instead of any correlation, or theory, or modeling, or scaling, or anything?

MEMBER DENNING: Unless I've misunderstood what they've been telling us for the last two times, that's the way they're going to fill in --

MEMBER WALLIS: That's an awful lot of

tests.

MEMBER DENNING: Obviously, they aren't going to do that many tests. They're going to do it for different mass amounts, and mix in a little bit of their pseudo chemical effects material and say we've covered it. That's where I think we're headed.

MEMBER WALLIS: Is that the understanding of NRR that that's what's going to happen?

MR. ARCHITZELL: Just a little bit of clarification there. The vendors typically use the - it's been discredited, some NUREG 6224 correlation to size the screen to anticipate the head loss that's going to be achieved, so they do use that in their calculation. And they also use things called "bump-up factors", so they've had an analysis where they ever predicted head loss. Now typically, these come in way below those head loss predictions, but that's the general approach. It's not like you just do it blind. You do have some prediction on what they're going to see.

MR. KLEIN: I think from a chemical effects standpoint we have the same questions you do about the validity of adding surrogate to a flume-

type test and saying that that accounts for chemical effects.

MEMBER WALLIS: Anyone else wish to say anything at this time?

MEMBER KRESS: Well, it's easy to criticize what the industry is going to do. The question is how would you do it differently. There's limited things they can do.

MEMBER DENNING: I think that there's a little more experimental and model development work required, and that they're going to have to have some type of predictive capability for chemical effects in advance of doing these --

MEMBER KRESS: Just forget the prediction, just go run the test to get the empirical part. How could you do that differently than what they're going to do? I can't think of any other way to do it myself.

MEMBER DENNING: Well, another way you could do it would be extraordinary expensive, where you generated your chemistry.

MEMBER KRESS: Oh, okay.

MEMBER DENNING: You know.

MEMBER KRESS: I'm sorry. That would be on way, yes.

MEMBER DENNING: Just make it prototypic and --MEMBER KRESS: That's not going to happen.

MEMBER WALLIS: Well, still there's a question of how prototypically testing one green element or module is going to predict the behavior of multiple modules in some sort of an array. I don't quite know how you do that.

MEMBER KRESS: Well, one thing I would have suggested is some sort of a benchmark test where they actually do one outside of the reactor where they try to make it as prototypic as possible, then do what they want to do and see how they compare.

MEMBER WALLIS: Well, do we have any other questions for Rob or for RES, in general? We probably know as much information as we can absorb at this time. Nice job, thank you very much. We'll take a break for 15 minutes, and then we will come back here and we will hear what you've all been waiting for, Brown's Ferry.

(Whereupon, the proceedings went off the record at 3:31:40 p.m. and went back on the record at 3:48:38 p.m.)

MEMBER WALLIS: Please come back into

session. I call upon my colleague, Dr. Mario Bonaca, to lead us through the next presentation, which has to do with the license renewal of Brown's Ferry.

DR. BONACA: Yes. On October 19th, 2005, we issued an interim report on the license renewal of Brown's Ferry Unit 1, 2, and 3. That was the result of the meeting that we had in October, to review the interim SER with open items.

Since that time, the open items have been closed, and we had a number of recommendations. Item 1 was to provide a discussion of how cladding experience of Unit 1, 2, and 3 is applicable to Unit 1. Also, we requested a description of the attributes of the new periodic inspection program for Brown's Ferry Unit 1 components that would not be replaced before restart. Although we do not expect to have a program fully defined yet, but we felt that there were a number of important attributes that should be provided in the final SER. And also, we asked that standard power uprate is implemented, then prior to entering the standard operation, Brown's Ferry commit to review operating experience at a higher power level and reflect whatever lessons learned need to be reflected into the aging management programs.

The final SER ACR in-hand, we have reviewed it. It contains answers to these questions, and I think the staff and the applicant are here to discuss the final SER. With that, I'll turn to Dr. Peter Kuo.

DR. KUO: Thank you, Dr. Bonaca. Louise Lund, who is the Branch Chief for the Project Management Branch, and she's going to start with the staff review.

MS. LUND: Yes, good afternoon. I want to reiterate what Dr. Bonaca had said, in that we had worked with the licensee in order to close-out the open items that we had presented in the previous meeting that we had on Brown's Ferry license renewal, and so that's what we will be discussing. And we will be making our presentation after the applicant has made their presentation. There was a number of items that I know that the ACRS wanted to hear more details about, and that will be discussed in detail.

And in addition to that, Yoira, and also Ram were the Project Managers for this particular effort, and Yoira will be giving the presentation, Diaz will be giving the presentation for the staff. And I believe Dr. Kuo has some comments in addition

to that.

DR. KUO: Thank you, Louise. I would like to make a few comments about the status of our review, especially the subject of drywell corrosion. The reason I want to say a few words on that is that we, as late as late yesterday, we received some information from the Applicant about their UT results. And one, the information we got back late yesterday and this morning was that among the 144 locations that the UTs test was done, there's one point that apparently was some anomaly there that the thickness of the shell plate actually was below the main wall thickness, so we had several interactions with the Applicant today. We met twice today and tried to understand what was the nature of this data. And I'm sure the Applicant is going to give you a lot more information during their presentation. I just want to bring it to your attention that this issue, as of now, is not resolved. We will wait until the Applicant to give the presentation, hear some more information, and then it's very likely that we're going to provide the Committee with a supplemental to SER, because right now the SER says we have accepted the Applicant's proposal as one time inspection, but

given the information that we have now, we want to reserve the option to do something else.

DR. BONACA: Which unit are you talking about?

DR. KUO: We are talking about Unit 1.

DR. BONACA: And what was the UT performed?

DR. KUO: The UT performed several times, the earliest one is the one in 1987, and then we had 1997, 1999, and 2002, if I'm correct. If I'm not correct, please correct me. That's the information that we have, we looked at it this morning.

DR. BONACA: I was asking about when did they identify the one point?

DR. KUO: The one point started 1997, I believe. Go ahead.

MR. CROUCH: My name is Bill Crouch. I'm the Site Licensing Manager at Brown's Ferry. The date that we have was first taken in 1987, and there was no indication of any inclusions at the time. It first appeared in 1999, and was confirmed to exist in 2002 and 2004. What this indication is is what's called inclusion, and what that means, it is a small defect inside the metal itself. It is a

defect interior of the metal. It does not connect with the surface. It's a defect such a delamination or a piece of crud or trash that's inside the metal, very common to be found in rolled steel plates. It is not an indication of any type of corrosion mechanism.

MEMBER KRESS: It's always been there then.

MR. CROUCH: It's always been there.

MEMBER KRESS: Yes, you just didn't see it before. You didn't look at that spot.

MR. CROUCH: We didn't see it before. Actually, in talking to our ISO people, what they said was in the mid-90s, the capabilities of the transducers that they use improved tremendously, and since that time, they found it in '99, and every time they do it now, they find the same spot, characterized in the same manner.

DR. BONACA: I understand, but the --

MR. CROUCH: I'm sure --

DR. BONACA: I think there is a long discussion in the SER of your position of the liner, you're discussing Unit 3 standing water that you have observed, et cetera. I'm surprised that you did not discuss this issue, because whatever the

source may be, it's an important issue that should have been in the SER. And you're saying that you're considering it as an addition -- I mean, for a different -- anyway.

DR. KUO: We are considering issuing a supplement to the SER to address this issue, and the one other issue.

DR. BONACA: So you're going to submit to us the SER.

DR. KUO: Yes.

MEMBER DENNING: Would that imply that we would delay writing a letter until we receive that?

DR. BONACA: Possibly. On the other hand, I mean, we already had among ourselves some discussion about this issue.

MEMBER APOSTOLAKIS: I'm a little confused now. Was this discovered in 1999?

MR. CROUCH: The inclusion itself was first detected by the ISO people in 1999, yes.

MEMBER APOSTOLAKIS: And confirmed in --

MR. CROUCH: Confirmed in 2002, and 2004. It's a very, very small spot, just as soon as you move the transducer it goes away. It's just a

pinpoint-type spot inside the interior of the metal.

MEMBER APOSTOLAKIS: So how does that relate to what you just told us about yesterday?

DR. BONACA: Because the closure on open items regarding the issue of the seals, okay - this is the refueling seals - has been a debated point between the staff and the licensee, and has been a point of interest for the Committee, too. And the issue is that the staff wanted to have an inspection program for the liner or for the refueling seals, and the Applicant has been refusing to have that, and also proposing at the end a one-time inspection. A one-time inspection clearly has a role when you do not expect to find that there is an effect there; therefore, you just do one time an inspection to confirm your conviction that there isn't an effect taking place. If you have multiple observations, or if you have from other operating experience evidence that, in fact, there is an effect of that type taking place, then you would have to an inspection, which means a repeated inspection of the same location.

Now it's interesting to me, also, that you have performed this inspection several times, and now you would like to perform one before you

start the plant and never again.

MEMBER KRESS: Well, that defect is not going to get bigger, and it's not ever going to go away.

MEMBER SIEBER: Well, I need to ask some questions about this.

DR. KUO: If we know exactly the source of it. I mean, we just heard about this for the first time --

MEMBER SIEBER: You can say that it's a delamination, but typically you characterize defects like that, and the typical kinds of questions is what kind of exam was performed. For example, the staff says it's below mean wall, which to me --

MR. CROUCH: No, it's not.

MEMBER SIEBER: Well, that's what they said, and that's on the record. And to me, that's a corrosion mechanism, as opposed to an inclusion, piece of slag, or delamination.

MR. CROUCH: When you look at the --

MEMBER SIEBER: So you have to look at whether it's a UT exam or not, and how you characterized it, and you size it and decide whether it's required by code to be repaired or not. And I presume you're going to tell us how you

characterized it, what kinds of instruments you used, and how you dispositioned it because you've had six years to disposition it.

MR. CROUCH: Let me --

MEMBER KRESS: This was a non-operating unit at the time.

MR. CROUCH: Yes.

MEMBER SIEBER: That's right.

MEMBER KRESS: So there wasn't any real reason to be in a hurry with it.

MEMBER SIEBER: You aren't in violation because you didn't run the unit.

MEMBER KRESS: Right.

MEMBER SIEBER: On the other hand, at this late date, to find out that there is a defect that you should have characterized in sufficient detail so we know what it is, and whether it is going to grow or not grow, I think is an important point. I'm disappointed that we're discussing this at this late date.

MR. BAJESTANI: My name is Mashoud Bajestani. I'm the Vice President for Brown's Ferry Nuclear Unit 1 Restart Project. We had a presentation actually to address that. If you want to talk about that, we probably need to go ahead and

get into that right now, if that's the case.

PARTICIPANT: Yes.

MR. BAJESTANI: Okay. If that's the case, let's just go ahead and start that, and I'm going to ask our Engineering Manager, Rich DeLong, to come over here so he can go through detailed information on that.

DR. BONACA: Let me, before we start with that, let me just say that regarding the issue of whether or not we're going to write a letter, we'll make a decision after the presentation here, and maybe -- so let's leave that behind. Let's go to the normal presentation as planned.

DR. KUO: Let me also try to clarify the statement that Mr. Sieber was talking about, about the mean wall thickness. Between last night and this morning, the understanding was that there is a point that the thickness was .76. We did not have any more information than that. But after that, we met twice, and the Applicant has clarified that, and provided more information that this is an inclusion rather than just the corrosion and corroded thickness down to .76, so I just want to make it clear on the record.

DR. BONACA: Irrespective of that, I

think we will let you then go with the presentation of these issues we are proposing, I think we still need to hear from the staff why, even without the information about Unit 1, the one-time inspection was accepted as adequate, because that's important, that's an important point.

DR. KUO: Yes. During the staff presentation we will try to explain that.

DR. BONACA: Okay, very good.

DR. KUO: Okay. And so let me just turn over the presentation to the Applicant, so we can learn more information on this.

MR. BAJESTANI: And we will address this point. We picked a spot into the presentation for Rich to address that. When we get to that, he will.

MEMBER SIEBER: Why don't you go through your presentation. When you get to it, we'll just ask a lot of questions.

MR. BAJESTANI: Okay. That's what we'll do. MEMBER SIEBER: Otherwise, there'll be chaos.

MR. BAJESTANI: Okay. Good afternoon. My name is Mashoud Bajestani. I'm the Vice President, again, for the Brown's Ferry Unit 1 Restart Project. We appreciate the opportunity to

discuss with you our license renewal application for Brown's Ferry Unit 1, 2, and 3. We have put a presentation together based on some of the topics, issues, concerns from ACRS and NRC staff that we're going to share with you. We have several of our Brown's Ferry team here. We have Joe McCarthy. He's our Licensing Supervisor; Bill Crouch is our Licensing Manager; Ken Brune, he's our Project Manager for License Renewal; Rich DeLong, he's our Unit 2 and 3 Engineering Manager; and Joe Valente, he's our Unit 1 Engineering Manager.

With that, again, we're going to cover some of the issues that you just brought up. With that, I'm going to turn it over to Bill and let him start the presentation.

MR. CROUCH: Okay, thank you. As Mashoud said, my name is Bill Crouch. I'm the Licensing Manager of Brown's Ferry. I'm going to give you a little bit of a background of the history of Brown's Ferry and the configuration of Brown's Ferry. Some of you all have heard this before, and others may be the first time you've heard it, so we'll give you a little bit of background.

All three units of Brown's Ferry are General Electric BWR-4 with Mark I containments.

That means that they've got the upside-down lightbulb and a Torus-type configuration. They were all three designed and constructed to be material and operationally identical. Obviously, they are opposite hand, but other than that, they are materially and operationally identical. They have the same systems, the same components, the same environments in them, so that when you see something in one unit, you expect to see the same thing environmentally, operationally in the next unit over.

As you see there, we've got -- as everybody knows, Brown's Ferry was shut down in 1985, and the units have come up at various times, and so what we've given you there is the approximate years of operation. This is in calendar years, this is not effective full-power years. So you can see, Unit 1 has only got 10 years of actual operation; Unit 2, 23; and Unit 3, 18. At Brown's Ferry, all of our NRC performance indicators are green, and we run with a very high capacity factor. We maintain our plant in good condition.

Unit 1, which has been down since 1985, is on track right now, both materially, and schedule and budget to restart by May of '07. Unit 2 and 3,

which had restarted previously, they are currently operating at 105 percent of their rated thermal power. They were uprated in 1998 and 1999, and are operating at 105 percent OLTP.

Moving on to page 3 --

MEMBER MAYNARD: Question, clarification - the three units, any shared equipment like diesel generators, anything like that, or are they totally separate units?

MR. CROUCH: The diesels are shared. There are eight diesels that are shared between the three units. There are some common systems that are shared like your service water system that supplies cooling to the RHR heat exchanger, EECW which provides cooling water to other circulate heat exchangers. You also have some systems where you can use what's in the adjacent unit as a spare for your unit, and so there is some interaction back and forth. But the major systems, obviously, the steam and feedwater, all your ECCS systems, they are unit-specific, except even with ECCS, there are some places where they can share across in the case of certain events.

Under the license renewal application, we submitted a three-unit application in December of

2003. The license renewal application is addressing the fact that our license is expiring, and you can see there the dates which each one of them expire. When we started the Unit 1 recovery process, and we started the extended power uprate process, and we've started the license renewal process, all at approximately the same time, and so we talked with the staff to determine how are we going to package these three things going on simultaneously, so that we don't have any cases where by approving one, you're de facto manner approving the other one. So the license renewal application was put in, but it is to be addressed first. And then we'll come along and do the EPU and the Unit 1 restart, so that the license renewal application is based upon the current license thermal power of each unit.

You've got to realize that Unit 1 has not been uprated at all, so it's at its original license thermal power of 3293. Units 2 and 3, which have been uprated, they are at 3458 megawatts. There are some analyses that are in, that went into the last renewal, where you'll refer to EPU-type conditions, but in all cases, they bound the current conditions, and we're not putting them in there for the point of trying to get you to approve EPU

conditions. It was just that we did one analysis.

In the analysis, since it was done during the restart of Unit 1, there are certain aspects of Unit 1 recovery that were not complete at the time, such that the current licensing basis of Unit 1 was slightly different than Units 2 and 3, so there is an appendix to the license renewal application, that's called Appendix F or Appendix Foxtrot, that lists 13 different items that have to be completed in order for the licensing basis for Unit 1 to match the licensing basis of 2 and 3. Of the 13 items, 10 of those are plant modifications, 3 of them are programs. Plant modifications are such things as adding-in the alternate leakage treatment path. This supports the MSIV increased leakage. There is ones in there that are program-related, such things as the ISI program, the maintenance rule program, and BWR VIP, the Vessel Internal Inspection Program.

All of these modifications and programs will be completed prior to restart or implemented prior to restart, if it's a program or a DCN. All of the 5059s for these have been completed and there are no NRC actions required in order to implement these modifications or programs, so that once these

modifications and programs are implemented and in place, the licensing basis for Unit 1 will be the same licensing basis as what you have for Units 2 and 3.

The license renewal application for Units 1, 2 and 3 was prepared using the generic aging environment report REV 0. With that, I'm going to turn it over to Joe Valente. Joe is our Unit 1 Engineering Manager. He's going to talk to you about the process we've gone through to return Unit 1 to service.

MR. VALENTE: Good afternoon. I'm on page 4. For the Unit 1 restart effort, we evaluated all of the systems required to restart the unit. Now this evaluation identified all the required modifications and maintenance activities to confirm that the systems would perform both their safety requirements, and their power generation requirements. And we did this evaluation at EPU conditions, and for a 60-year life. We all switched all modifications to ensure operational fidelity between the units. The next two pages we'll talk about some of the examples, or extensive repair and refurbishment work that we've performed here.

Under the topic of fidelity with the

operating units, the first two items there, the recirc pump, variable frequency drives, and the digital feedwater, we installed the exact same equipment on the unit. What we did is the same engineering, the same hardware, all of the operation experience that we gathered from Units 2 and 3 we incorporated in the Unit 1 design, so when systems come up, they'll be seamless for operation with the operating units.

In the area of reliability, we ended up putting in a new drywell cooler, and we also replaced the HRH heat exchanger floating heads. These two items came up again from operational experience between the units. We improved our reliability there. The other area that our modifications fell into were in the regulatory issue spaces. For Brown's Ferry, we had what we call the "Nuclear Performance Plan." This identified physical changes to the plant that we needed to bring the station up to meet its design criteria requirements. Rolled into the Nuclear Performance Plan were generic letters and bulletins. A couple of examples here. We replaced all of the inner granular stress corrosion cracking susceptible piping with 316 NG piping. This piping essentially

affected our recirc system and our reactor water cleanup system.

Some other issues that fell out of the Nuclear Performance Plan, we had seismic issues. The example here is our drywell steel where we made modification to drywell steel to be able to withstand the seismic requirements and the pipe support loading requirements that they would resist.

Another Performance Plan issue we had was electrical issues. One of the examples here is our electrical penetrations. We changed out penetrations both for EQ reasons, and for Appendix J leakage reasons. An example of a bulletin here is environmental qualification. This program we started again with the EPU conditions and 60-year lives. We developed all the calculational analytical basis for it, ran that through our program, and determined all of the modifications that we needed to comply with the program. Those modifications have been designed, and a good number of them are already installed in the plant, completed work.

One of the advantages that we did have here is we were able to get into some dose reduction for operation. We were able to essentially replace

41 valves that had some considerable amount of Stellite in it with non-stellite valves, so that was a positive for us.

Going on to page 5, the maintenance area reduction you see the large pumps and motors. We refurbished all of our large pumps and motors. We refurbished the recirc pumps, and the motors, core spray, HRH, HPSI, RCIC motors. We did replace our feedwater pumps and our condensate booster pumps, just some examples of large equipment that we changed out.

We did refurbish all of our turbines, the HPSI, RCIC, feedwater turbines all refurbished, and we did replace high pressure and low pressure turbines. The valve replacement refurbishment, we either refurbished or changed out all our MODs, refurbished a considerable amount of AOVs, and also replaced out a considerable amount. Examples of some of the valves that we did refurbish, the recirc suction and discharge valves were refurbished, as well as our RHR core spray valves.

We did replace the feedwater check valves and replaced a significant number of our relief valves. Moving on to other reasons for modifications, there were some lessons learned from

Unit 3 recovery, the lay-up and the recovery period. The item there, residual service water piping into the reactor. On Unit 3, we went to recover the unit, what we found, piping was essentially cut, stayed in the unit, was exposed to air, had significant corrosion in the piping. We found the same thing on Unit 1. We replaced it all out, still replacement in the building.

On the extraction steam, the susceptible piping, in what, what Unit 1 did was instead of doing any inspection on that piping, we replaced it. We replaced it all with chromoly, 2-1/4 percent. We did this so that the FAC program on Unit 1 would be at par with the FAC programs on the operating units at May of 2007.

CHAIRMAN POWERS: Literally, how close are those piping systems? I mean, are they exactly the same layout, exactly the same material now?

MR. VALENTE: The geometry is for all practical purposes the same. The only difference, we used 2-1/4 percent. Unit 1 used 2-1/4 percent. Unit 2 and 3 had 1-1/2 percent chromoly. That's the only difference. We did do a considerable amount of raw cooling water replacement, primarily a dead legs, had the mick problems, all of that got changed

out. Basically, all the lessons learned that we saw from 3 we incorporated into Unit 1.

Other area modifications had to do with extended power uprate. There we did replacements of our feedwater pumps, modifications to our turbines, replaced condensate booster pumps, condensate pumps, and we did have to add a 10-F demineralize vessel to handle the extra water. Basically, that's just an overview of some of the major work that we did on the recovery. The key point is all the systems were reviewed for the safety requirements consistent with the operating units going up to EPU conditions, and all systems were reviewed for their power generation requirements.

As Joe talked about, we utilized the operating experience from Units 2 and 3 in order to base our modifications and maintenance in Unit 1. We've also utilized our operating experience in Units 2 and 3 to base our license renewal programs for Unit 1. On page 6 there it talks about, as I said earlier, they are identical BWR-4 reactors with Mark I containments in their design and we expect it to be the same. And even though they have been shut down over the years, they have a common building such that the environmental conditions on the

outside of all these systems had been maintained the same. We've utilized lay-up programs through all three of them. They have been the same lay-up program, so what we were going to talk about here is how our operating experience from Units 2 and 3 is directly applicable to Unit 1.

DR. BONACA: Yes, just one comment because otherwise we go back and forth on that. There's a report that was written by the inspectors in the early phase of the shutdown for Unit 1 that says that a number of systems were not in a control layout. For example, humidity wasn't controlled. After about a year or a year and a half, it went in a control mode and I agree that the lay-up became identical. I believe that your Unit 1 inspection program is to address this very issue, that you have some uncertainty about what the conditions may be resulting from this phase, and that's the point that I think I -- whether there is some compensatory action there, which is your inspection program. I just point out this so there is no confusion about why we feel that that program is important. And you proposed it, too, so you see it as important, too.

MR. CROUCH: Right. As Dr. Bonaca points out, when we shut all three units down back

in 1985, after a very short period of time, we put them into a lay-up status, but it wasn't a well controlled lay-up. And in 1987, we had an inspection that came in, looked and found that there was water in places where we did not expect to find water, particularly in the standby liquid control piping over in Unit 3. So at that point in time, we drastically improved our lay-up program, and at that point in time all three units were put in the same type of conditions as far as lay-up is concerned, and maintained from that point on.

The lay-up conditions were -- there was various types of lay-ups done. You had some systems that were put into a dry lay-up with heated, dehumidified air blown through them. There were some systems that were just simply drained and left in an air filled condition. There were other systems that were in a lay-up condition where they were filled with water. There were some systems that were filled with treated water, such as the reactor vessel and some of the attached DCCS piping, various types of lay-up conditions that have all been looked at and addressed as part of Unit 1 recovery.

During the time of Unit 3 recovery, we

went through and monitored all those conditions, and as Joe pointed out, we found problems with the HRH service water piping, in particular. We found some raw cooling water piping that had problems. We took those lessons learned from Unit 3 recovery and going into Unit 1 recovery, we applied them directly, so that as we started Unit 1 project, one of the first things we put on the list was replace HRH service water piping, replace raw cooling water piping, so we knew we were expecting to find problems.

As Unit 3 was returned to service and is now operated approximately 10 years, almost 11 years now there have been no lay-up related effects seen. In other words, as we've operated through the years, we haven't had any problems that have been traced back to oh, that was due to the fact that we laid it up poorly back in 1985. So we've seen no lay-up related aging effects during the ensuing 11 years of operation.

We took this lay-up experience from Unit 3. And other than the fact that it was slightly shorter duration, it was 10 years versus what will be 22 years. It was still of an extended period of lay-up. It wasn't like it was just laid up for a week or two. Ten years you should have reached a

stable condition, and if you were seeing a slow corrosion mechanism, it would exhibit itself during Unit 3, and we would see the same thing during Unit 1. So we anticipated what we took from Unit 3 and applied it directly over into Unit 1. As it says, repair the RHR service water, the Alpha Charlie loops, and the raw cooling water small bore piping. And it's emphasized here that the Alpha Charlie loops, because the Brave Delta loop which was next door, it was in operation for the Unit 1 - Bravo Delta was in operation for Unit 2 operation. It's one of these shared systems like you were asking about where it can supply across, and we found that the systems that were in operation like that with treated raw water, they were fine. We've gone out and we've visually inspected the insides of them. We've UT'd the pipe walls, no problems at all. The problem was the pipes were drained and just left filled with air, because they collected condensate. And in the warm conditions of the building with the condensate in there, they exhibited corrosion.

Moving on to page 7, as we --

MEMBER SHACK: That was a mic-type corrosion that you picked up, bugs started growing?

MR. CROUCH: It didn't look like mic.

It was just a general corrosion. Mic, usually you see the tubular-type thing sticking out. This pipe delaminated from the inside out, so when you cut the pipe, it was literally half-full of corrosion that had fallen off the insides layer, by layer, by layer, such that the pipe that was nominally .375 when it started out was down to less than a tenth of an inch in places. The same pipe, once you went through the wall of the building out into what's called the service water tunnels which are underground, they were cool. It's buried like 20 feet underground. The cool up there, the pipes were in fine condition. There was no degradation whatsoever to them. Had the same air going back and forth in them, but you saw no degradation, just inside the one building.

Okay. On page 7 there we talk about how we had to plan replacement of the IGSCC piping. It was basically the piping that was inside the drywell, we replaced all of that, all the large bore piping. We replaced the RDVC piping out into the reactor building from the reactor out to the pumps, heat exchangers and back.

As far as determining what was good or what was acceptable for Unit 1 restart, we did not

use the results of the lay-up program as a sole means for justifying any system. We had been out and inspected the systems, either by visual inspection or by UT inspection, to make sure that the piping out there is good and able to maintain its proper working condition. As we've gone out there we've replaced components in the various systems. We'll pull out a valve, we'll pull out an instrument, whatever. Whenever we do that, we look on the inside of the pipes to make sure that the condition of the piping systems itself is in good condition.

MEMBER SHACK: Now do you just look inside locally, or do you send a pig down to sort of survey the whole pipe?

MR. CROUCH: Many of these are great big pipes. You can see down them.

MEMBER SHACK: You can see down. Okay.

MR. CROUCH: Oh, yes.

MR. VALENTE: We did both.

MR. CROUCH: We've done both. We UT them, we send stuff down them, send fiber optics, that kind of stuff.

As Joe talked about, as part of the restart on Unit 1, we'll be implementing the same

programs and modifications so that you should see the same materials out there, the same components. The systems will operate in the same way, so you wouldn't see any operationally induced effects from one unit to the next, that you should see the same type of aging mechanisms.

We'll have the same aging management programs for the duration of the original license, and then once we roll over the period of extended operation, they will have the same aging programs for them. As Dr. Bonaca pointed out, there is a small amount of uncertainty regarding what were the effects of this uncontrolled lay-up back in the original, and the fact that you had a 22-year lay-up versus a 10-year lay-up. So in order to ensure ourselves that there's not any lay-up induced effects, we're going to implement a special program just for Unit 1 that will go through and look at the piping systems that were not replaced to make sure what they're doing. And Joe's going to talk to us about how that's being done.

MR. VALENTE: Okay. I'm on page 8. Most of you remember, in the October 2005 meeting, the Committee had some recommendations regarding this program. The program we're going to talk about

is the periodic inspection for the non-replaced pipe.

We understood your issues, and we've restructured the program here to address your concerns, so I would offer you this. Now we'll perform the periodic inspection of the non-replaced piping, and that excludes the piping that was in service supporting Units 2 and 3 to verify that no latent aging effects are occurring. Now this program will be in addition to, and will supplement the other aging management programs.

We'll perform new baseline inspections prior to the restart of Unit 1. The sample points for the baseline inspections will be identified on controlled drawings, and these drawings will be contained in a technical instruction that will proceduralize the periodic inspection program. The technical instruction will be fully developed prior to restart, and with this technical instruction in place, we can ensure that the same points are examined in the future. And we will use ultrasonic thickness measurements for the baseline and future inspections.

MEMBER ARMIJO: Joe, will you compare the baseline inspections before restart to

inspections that were done during the period of operation?

MR. VALENTE: No, sir.

MEMBER ARMIJO: So there's no correlation between what you knew earlier, or is that data lost?

MR. VALENTE: There probably is some around. I don't know what we plan to do with baseline, what --

MEMBER ARMIJO: You're going to start with a clean sheet then.

MR. VALENTE: Yes, sir. Give you a little background. This is one of the concerns that Dr. Bonaca had. We took sample information on the population of piping that we were going to salvage. We deemed the project was fully competent, that we had enough sample points that showed it was okay. Dr. Bonaca pointed out weak, that's why we're going to tell you about a different sample program. So we had that initial confidence that what we originally observed back in 2001, late 2001 when the project was undergoing a study, that we're confident that we haven't used anything.

With this increased sampling population that we go to, baselining it is T-0. That's what

we'll record. What we did find in 2001, we had nothing below nominal pipe wall, samples that we looked at. That's why we felt confident going forward.

All right. The last time we discussed the program, we had approximately 77 points that we were talking about in the sample. That was the original sample we took in the study. We revised the program and will be sampling more than 300 points. Sample selection was based on a 95/95 confidence level, based on a common environment. As shown on this page here, we've established five grouping that form the sample types for the inspection populations. These groupings are consistent with the groupings in the GALL for loss of material aging effects. Again, the sample size for the 95/95 assurance for each group will be based on NUREG-1475.

I'd like you to go to page 10, please. This is another question from Dr. Bonaca. This page shows the total scope, total system scopes that fall within this inspection program here. We talked previously, we had essentially the first 12 systems that we had looked at in our study phase. The Committee asked for the full scope. If you look

down from turbine drains and miscellaneous piping on the left side, all of the systems on the right side, we have included those into this sample population now.

DR. BONACA: So these are added to those that you have in the SER. In the SER, you have the 13.

MR. VALENTE: Yes.

MEMBER APOSTOLAKIS: This periodic program is on top of everything else.

MR. VALENTE: Yes, sir.

MEMBER APOSTOLAKIS: And what is the period, why is it periodic?

MR. CROUCH: It's on page 9.

MR. VALENTE: Okay. Well, let's go to page 9.

MEMBER APOSTOLAKIS: Oh, okay.

MR. VALENTE: Okay. I'll start here with the sample points, describe how we get our sample points. The sample points will be distributed among the various system locations that are grouped based on the common environment and ethereal pipes. Okay? Again, the sample points will come from the non-replaced piping and will exclude the piping that was supporting Unit 2 and 3 in the

operation.

Sample points will include areas where potential degradation can occur, as well as areas where degradation is not expected to occur. And, Dr. Bonaca, that was another one of your suggestions that we looked at some general areas on. We've incorporated that this time.

DR. BONACA: I'm missing something here. Are you planning to use -- how will you select these areas? I mean, are you planning to use the risk-informed ISI?

MR. VALENTE: No. What we're planning to do is we're going to look at the geometry on the piping, primarily for where some lay-up degradation could potentially occur, like low points in the system, transition points where flow may have increased. Some operational experience from Unit 2 and 3, if they had any pinholes develop. I can tell you that they haven't had many, and some engineering judgment is where we're going with this. Again, this is essentially an independent program outside of all the other programs.

DR. BONACA: So there will be also an ISI.

MR. VALENTE: Yes, sir. Yes. ISI will

be there, all of that. This is in addition to that, FAC will be there, everything.

MEMBER SHACK: And your ISI program is a risk-informed ISI program. Right?

MR. CROUCH: It will be after the unit starts. As you're aware, we're completing the first period.

MEMBER APOSTOLAKIS: Since somebody mentioned the word "risk-informed", what is the core damage frequency of your unit?

MR. VALENTE: We can get you the number, but we didn't bring it with us this time.

MEMBER APOSTOLAKIS: So it's not a number you remember.

CHAIRMAN POWERS: I think you want to then ask him what the scope that core damage frequency covers.

MEMBER APOSTOLAKIS: Oh, absolutely. Yes. So what does it cover? I guess if they don't remember the number, they don't remember the scope.

MEMBER KRESS: It's 10 to the minus 6.

MEMBER APOSTOLAKIS: Well, you've been doing risk assessment for a long time. I remember more than 20 years ago you started.

MR. CROUCH: There's the comparison of

Unit 1, 2, and 3 CDF and LERFs.

MEMBER KRESS: Don't just let George know.

MEMBER APOSTOLAKIS: Unit one, mean value of CDF is 1.77 - 10 to the minus 6; Unit two, 2.6 - 10 to the minus 6; and three, 3.3 - 10 to the minus 6. And now the question from Dr. Powers, what was the scope of this? I mean, does it include external events, fires and so on, or is it just internal events? If you don't remember, that's fine.

MR. CROUCH: I don't know. I think it's only internal events, but I don't know that.

MEMBER SHACK: Dominated by transients.

MEMBER APOSTOLAKIS: So after all these upgrades and so, I expect the accident sequences, the dominant sequences will be the same for all three units. Right?

MR. CROUCH: Yes. The only difference that you see in the three units, like we talked about some of the shared equipment.

MEMBER APOSTOLAKIS: Yes.

MR. CROUCH: Full configurations, there's some slight differences in how much shared equipment can be shared between 1 and 2, versus 2

and 3. Other than that,they're --

MEMBER APOSTOLAKIS: So what you're saying is that I shouldn't really have the frequencies. I mean, there's some dependence. That's okay.

DR. BONACA: You have some differences in fire loadings, if I understand. If I remember, you have a table that you have left there for Unit 1 you leave in place. Right? You're not going to remove that.

MR. VALENTE: Some has been abandoned. That's right.

DR. BONACA: And now regarding the frequency, I mean, you're going to inspect it now and then later, but when are you going to define your program in detail? I mean, are you going to do it before you start, or are you going to --

MR. VALENTE: Yes.

DR. BONACA: Okay.

MR. VALENTE: It will go through ISI to conform with these inspections. It's going to be detailed procedures, the whole process. Once that gets through all the reviews, it will be issued out. The baseline inspections for all the sub-groups, we'll complete that prior to restart.

DR. BONACA: Your baseline inspection is going to be much broader than whatever you're going to repeat later.

MR. VALENTE: I'm sorry. Say that again, please.

DR. BONACA: It's going to be a subset. I mean, the periodic inspection is going to inspect the subset of the start-up inspections. Right?

MR. VALENTE: Yes.

DR. BONACA: Okay.

MR. CROUCH: There are other inspections that will be done besides this Unit 1 periodic inspection program.

DR. BONACA: I understand that. I'm only saying that I was trying to understand when you're going to define completely your program. I mean, you could do it after the start. But it would be nice if there was an understanding.

MR. CROUCH: The program will be defined before restart, and we will have a baseline inspection of each point before restart.

MEMBER SIEBER: How many points will be in this period inspection program?

MR. VALENTE: There will be a minimum of 59 per group, more than 59, and that will be

dependent primarily on the geometry and everything that we get into. I fully expect a minimum of 59 for each one of those groups that he talked about on the previous page.

MEMBER SIEBER: All right. Yes.

DR. BONACA: So you said before about 300.

MR. VALENTE: Probably, yes.

DR. BONACA: Okay. Thank you.

MR. VALENTE: Basically, what the plan here is, as we've been discussing, we'll perform the new baseline before restart. We'll conduct first periodic inspection several years after the unit comes back into operation, but prior to the end of the current licensing period.

The acceptance criteria for this inspection is that the pipe wall will remain above the minimum design required wall thickness for that time to the next projected inspection. And the second inspection will occur during the period of extended operation but prior to 10 years of service. And depending on what we see, we'll determine if there's any additional inspections or confirmation that we don't have anything that's not inspected.

MEMBER SIEBER: So there's really only

two inspections, or do you intend three?

MR. VALENTE: Three.

MEMBER SIEBER: Okay.

MR. CROUCH: AT least three.

MR. VALENTE: Three.

MR. CROUCH: And if you see no degradation after the three inspections, indicating there's been no unique degradation in Unit 1, then you would suspend the program. If you are seeing degradation, then you would keep on going.

MEMBER SIEBER: On what period?

MR. CROUCH: You'd have to figure that out based on what you see.

MEMBER SIEBER: Okay. So it depends on the rate of degradation.

MR. CROUCH: That's correct.

DR. BONACA: Their evaluation is that they are projecting that there will be no failure before the next inspection, so they have to determine that from the rate, whatever you see.

MEMBER SIEBER: To suspend the program entirely or to delete points from it, you would have to project that you won't go below min wall for the remaining life of the plant.

MR. VALENTE: That's correct.

MEMBER SIEBER: Okay.

MR. VALENTE: Okay. Any other questions? Thank you.

MR. CROUCH: At this point in time, Rich DeLong, our Engineering Manager is going to come up, and he's going to address the issue on the drywell shell corrosion at this time, since this is part of the Unit 1 inspection programs. At this point in time, this will be a slight departure from what's in your books. This is a late-breaking issue today.

MR. DeLONG: Good afternoon. My name is Rich DeLong, again, the Site Engineering Manager for the operating units of Brown's Ferry. As you earlier heard, over the last several years we have done ultrasonic inspections as a preventive maintenance task in Unit 1 since 1987, and four total inspections. During the course of the inspection done in 1999, one one-by-one-inch square location of 144 taken around the, if you will, the belt of the drywall liner just above the moisture barrier at the base indicated an inclusion.

The inclusion was located within this 1.136 to 1.110 thick shell in that region at .766 inches, and that was the measurement at the time in 1999. This inclusion maintained a good back-wall

signal, indicating that this was an inclusion, and not a condition of corrosion or erosion. It also, based on the information I got from some of the technicians that have examined this inclusion, is less than 3/16ths of an inch in extent, and would not under, for instance, vessel inspections, things that characterize inclusions as either recordable or not recordable, this particular one would not classify as a recordable inclusion, primarily because the threshold for recordable inclusions says that you have a complete loss of back-wall indication when you're inspecting that inclusion with the normal straight-on UT technology; in other words, not shear wave, for instance.

MEMBER SIEBER: So you could see the back-wall, but the way you saw it was shear wave?

MR. DeLONG: No. The back-wall was seen under normal straight-on, straight-through. Shear wave was never employed in these inspections. It wasn't needed. This particular inspection was done consistent with the IWE wall thickness inspections, and the technician at the time was not necessarily looking for inclusions. They were looking for wall thickness measurements. However, it's their practice to record these so that the next technician

that comes along is aware that an inclusion exists there, and understands what they're looking at.

That particular inclusion was again noted in the inspection done in 2002 at a depth of .76 inches, and again in 2004 at a depth of .77 inches. In all of those cases, the wall thickness in that area was between 1.141 to about 1.100 on an inch and an eighth plate.

MEMBER SIEBER: Okay. Now you have definitions like recordable and reportable, and one of the characteristics is whether you could see the back wall or not, but I think there's some size characteristics, too.

MR. DeLONG: That's my understanding. Well, there are in the case of inspections done under other codes. There's certainly no criteria under IWE for even characterizing inclusions. You've got to realize at the time these inspections were done, they were being done under IWE.

MEMBER SIEBER: Well, it's still a pressure vessel then. Right?

MR. DeLONG: That's true. And, in fact, the pressure -- that was what the technician was telling me when I talked to her, that if I was doing this as a pressure vessel, this would not be

recordable, this indication. This is the individual that --

MEMBER SIEBER: Well, it is a pressure vessel, the way I see it.

MR. DeLONG: She wasn't inspecting it in accordance with that code.

MEMBER SIEBER: Okay.

MR. DeLONG: She wasn't looking, but she said if I was inspecting in accordance with that code, this would not have been a recordable inclusion.

MEMBER SIEBER: All right.

MR. CROUCH: So when you look at the data from 1987 all the way through 2004, the wall thickness and all the different plots are very, very consistent, indicating that there is no degradation occurring during this time, that the wall thicknesses within the range of tolerance of the instruments, it stays very constant. Actually, when you look at some of the measurements, the thickness appears to go up as the transducers have gotten better over the years, so there is no wall loss occurring in this area at all. So any other questions on the drywall shell?

MEMBER SIEBER: And this is a regular UT

instrument, not a thickness case.

MR. DeLONG: This is a regular UT instrument. When I was talking to the same technician this morning, she says they have like a screen, and when you run it over, you can see the inclusion appear on the screen, and then further to your right you see the back wall appear, also. And it's a very clear back wall that you see, so it indicates that the inclusion is very, very small.

MEMBER SIEBER: Okay.

MEMBER ARMIJO: I'm a little confused. Are you saying that the metal wall, the actual metal is on the order of an inch thick on an inch and an eighth starting material? I'm getting a little confused of whether the inclusion is a really big non-metallic inclusion, or whether it's --

MR. CROUCH: No, it's a very small inclusion. It is at a depth from the surface down about .77 inches deep.

MEMBER ARMIJO: Okay.

MR. CROUCH: And then it's a very small inclusion, and then if you went the rest of the depth, you'd find the back wall.

MEMBER ARMIJO: So actual metal. There's plenty of metal there.

MR. CROUCH: Yes.

MEMBER ARMIJO: Now you don't have a big glob of ceramic material in the middle of a thin wall of stainless steel.

MR. CROUCH: No.

MR. DeLONG: According to the technician, there's no indication of depth in the particular examination she did. Again, shear wave wasn't used to more accurately characterize this flaw. It's very, very small, like this was a three-eighths inch UT probe used in this examination, and the technician characterized it as less than a three-sixteenth of an inch inclusion in extent, based on the fact that the inclusion return would disappear as soon as she relocated that very small probe.

MEMBER ARMIJO: You've had several UT inspectors look at this thing. Has there been any dispute among those experts or inspectors that this is anything other than what you're reporting today?

MR. DeLONG: No. As a matter of fact, I'll read you - the lady we talked to did the most recent inspections. This is an actual note made by a gentleman who looked at this the first time in 1999, which is not the same inspector, and I quote:

"Inclusion of 0.776 inches depth maintained a good back wall signal indicating this signal was an inclusion and not a condition of erosion/corrosion."

MEMBER ARMIJO: But subsequent exam --

MR. DeLONG: And subsequent inspectors concur with that.

MEMBER ARMIJO: Thank you.

MEMBER SIEBER: Well, your process, I'm sure, has an inspector who's a level one.

MR. DeLONG: Level two.

MEMBER SIEBER: Level two. And then you have a review done by a level three. Right?

MR. DeLONG: That's correct.

MEMBER SIEBER: So a level three has actually looked at and reviewed the work of this inspector as part of your program.

MR. DeLONG: Correct.

DR. BONACA: Yes. These were inspections for Unit 1. Of course, Unit 1 never experienced any refueling for the past 22 years, so the issue of the seals for Unit 1 is moot somewhat, because the concern with the seals in the refueling is not there. Did you perform similar inspections for Unit 2 and 3 of the shell?

MR. DeLONG: Yes. Well, before you say

they're moot, that's not exactly accurate. There have been extended periods of time, even in Unit 1 when the reactor well was flooded.

DR. BONACA: Yes, in the early time.

MR. DeLONG: In early operating years.

DR. BONACA: Sure, I understand.

MR. DeLONG: It was flooded for an extended period of time post shutdown. And then, of course, it's been flooded more recently.

DR. BONACA: No, I mean, I was curious about the frequency of inspection you have made for Unit 2 and 3. I mean, you have made those inspections for t those two units.

MR. DeLONG: I'm aware of the IWE inspections done in Units 2 and 3, both up in the - you have the picture of the upper well. Both in the upper well region, as well as in the sand bed region.

DR. BONACA: It's a sand trap.

MR. DeLONG: A sand trap.

DR. BONACA: So my sense is that you are going probably to inspect this liner in the future, too, for these units.

MR. DeLONG: Well, we always inspect these liners, and I say always, each refueling

outage I send engineers in, and we do in drywell visual inspection of the liner particularly in the area of the moisture seal, because that's a particularly susceptible area.

DR. BONACA: I'm trying to understand, you had in the SER this documentation of back and forth RAIs, et cetera, regarding what program. And you committed to one-time inspection. For Unit 1, you perform only one inspection before restart. And the question is, if you're doing these additional inspections, why do you have a problem with periodic inspection at some point?

MR. DeLONG: We have what we believe to be sufficient inspections of the drywell liner under IWE, and with a one-time inspection to be able to continue to demonstrate that we're not getting corrosion of the drywell liner. You also have to balance inspection requirements against the dose accumulated doing those inspections, along with the value-added.

DR. BONACA: Couldn't you take credit for those ISI inspections for license renewal?

MR. DeLONG: I would admit that that was our position. We didn't see the need to have a separate redundant program that had to be managed to

monitor the drywell liner. Whenever we create a new aging management program that's redundant, it provides really only an administrative burden to track, and we didn't see value in that, given the fact that we have these other inspection programs to monitor.

DR. BONACA: We want to discuss this during the SER presentation, because that wasn't clear in the SER, that there were these alternate inspections being taken place. Anyway, we'll discuss it when we have the presentation.

MEMBER MAYNARD: Just real quickly, is my understanding correct - the reason this is just now coming up, it was identified by the inspector, but since it wasn't recordable, it basically stayed on notes, and it just now became known to --

MR. DeLONG: The actual presence of that information became known to the staff based on detailed questions. The original answers to the questions were based on the overall evaluation of those inspection results, which was no erosion/corrosion. Clearly, still accurate, even with the knowledge and understanding of this inclusion was noted, again not because it was recordable, but rather because as an aid to future

inspectors to know that that was there, so when they see that in the future inspections of that area that it's simpler to disposition.

MEMBER SIEBER: Right. And the --

MR. CROUCH: We were asked a question just recently to provide actual numerical values. And as we pulled out the data again to get actual numerical values, that's when we found this note in here that clearly did indicate there was not a problem, but we wanted to make sure that it got on the table and has been discussed.

MEMBER SIEBER: Well, if it's not recordable, I guess from my viewpoint, it's not an issue. On the other hand, probably some ISI inspector might want to take a look at it to make sure the paper is okay.

MR. DeLONG: Okay. Thank you.

MR. CROUCH: At this point in time, we're going to turn it over to Ken Brune. Ken is the Program Manager for Brown's Ferry License Renewal Program. He's going to talk to us about the question that was asked about have we taken any major exceptions to the generic aging lessons learned document.

MR. BRUNE: Okay. On the exceptions

we've taken, we have 39 aging management programs defined for Brown's Ferry. Looking over all 39 of them, we have eight that have taken exceptions to the GALL. And looking at the exceptions we have taken for all eight of those programs, we did not consider any of them what we would call major or really big deviations from the GALL. And all 39, including the 8, each aging management program has been evaluated and is adequate to manage aging effects for which it is credited in our application.

Now going to page 12 on the next slide, on this particular slide we've listed the eight programs which we have taken exceptions to, with a brief summary of the types of exceptions we have taken. And I'll go over a couple of those just for an example. On the first one, the electrical cable is not subject to 10 CFR 50.49, Environmental Qualifications Used in Instrument Circuits Program. The one exception that we had in that one was on the LPRM cables we used calibration results from the surveillance program instead of a loop cal.

Now in this particular case, this exception we would not consider major because if we looked at revision one of the GALL, what we're doing is now acceptable. Another example would be on the

chemistry program. The exception we noted in there was we used later EPRI guidelines for water chemistry than what's listed in the GALL because Provision One of the GALL was kind of way back there. We have Revision Zero, but essentially had like a '93 version of it.

And throwing out a third example, the inspection of overhead load and light load handling systems. There the GALL indicated that you needed to track your load cycles on your train. What we elected to do on that is to go ahead and look at the data that we had, project out the amount of load cycles that we would actually see on a reactor building crane. And in that particular case, I think the Crane Manufacturer Association would have allowed like 100,000 lifts. We had calculated out a 7,500 equivalent full load cycles, so we were well under it, so we did not see any reason to implement a program to count the number of lifts for each of these cranes. Those are the particular examples.

In the IWE Program, to throw out one more, we had taken several exceptions to that which was based on a previously approved relief request, which was granted. And, obviously, they will have to be approved again for us to continue the program.

Like I said, we have not noted any what we call major exceptions on any of these programs.

MR. CROUCH: One of the other issues that was brought up through the course of discussion not only with ACRS, but also the region came in and was looking at our aging management programs, was how do you track problems that you find through your corrective action program, and how do you track your commitments that were made as part of the license renewal application. And Rich is going to talk to us about that.

MR. DeLONG: The corrective action program at Brown's Ferry is a TVA Nuclear Fleet-wide program. It is a low threshold robust program that identifies and tracks all types of issues for resolution at our plant. We create, generate about 3,500 problem evaluation reports on an annual basis, of which about 500 receive either root cause analyses or apparent cause determinations. In the course of reviewing those, the remainder are typically there to document corrective actions on lower level events that don't necessarily rise to the level of needing a cause determination. This particular program is what we are using along with an on-site commitment tracking program to track all

of our license renewal commitments to closure.

Again, the corrective action program applies to all three TVA units at Brown's Ferry, and certainly all three TVA sites within TVA Nuclear. It ensures that we determine and document immediate action to be taken when a problem arises that requires evaluation. We do an operability evaluation, reportability determination, and certainly determination of severity, so we characterize through not only supervisor review, but senior management review what the severity of the problem is, and what type of cause determination ought to be employed.

We also use this system, of course, to track and trend problems for resolving longstanding issues that would not otherwise be maybe acted upon at a lower level. That's certainly what's important about having a system or a program that has a very low threshold of initiation.

Any condition that we identify at a Brown's Ferry unit is considered for generic implications not only to the other Brown's Ferry units, but also to the other TVA units in what's a sort of internal generic review. We also, of course, consider each event for its value, for

transmittal as internal operating experience along that same generic review line, and external operating experience.

On slide 14, we have made 110 commitments to-date related to license renewal. These commitments revise existing aging management programs to include as little as the license renewal references that are needed. In some cases, we've needed to enhance existing aging management programs to include new attributes that were specified in the generic aging lessons learned, and through the course of the application process. And finally, some implementation of new aging management programs that we did not previously have. And certainly, we've used the corrective action program to track our response to open items from the draft SER. The Unit 1-specific Appendix Foxtrot licensing basis differences, also those programs and modifications necessary were tracked in our corrective action program.

On to sheet 15 or slide 15. Just as a recap, we've had 11 existing aging management programs that were revised only to include Unit 1 scope within the program. We've had 11 that were revised or that require no enhancement, but just

revision for reference to the license renewal application. And finally, 11 that required enhancement for all units because of new attributes, program attributes specified by our application. Six new aging management programs were added, and you can see on this slide the schedule for revisions to those programs when they happen. And we also, I believe last time I was here, a question came up about the schedule. We do have a draft schedule for implementation of all the aging management programs, and are currently in the process of developing the funding packages that support the cost of some of the inspection attributes that come along.

MEMBER SIEBER: You mean these aren't free?

MR. DeLONG: Unfortunately not. As previously discussed, we have 39 aging management program implementation packages that have been developed. They've been reviewed by the operating staff, comments made, resolved and approved. And as previously discussed by Joe, we'll implement the Unit 1 periodic inspection program with a first set of baseline inspections prior to restart.

MR. CROUCH: One of the other questions that came up during the course of the meetings has

been our application of the maintenance rule to Unit 1. Let's start off by talking about what the purpose of the maintenance rule is. It's to ensure that systems, structures, and components are maintained so they perform their intended function when required. But because Unit 1 has been defueled now for 22 years, most of the systems do not have safety functions to be performed that are monitored by the rule. As a matter of fact, many of the systems are in lay-up and could not perform that safety function if they had to, because they don't have any water in them, or they don't have charged air, whatever they need. And so during this time period, the Unit 1 systems are not in the scope of maintenance rule program.

The systems, however, in Unit 1, like we talked about some of these shared systems that are there to support Unit 2 and 3 operation, they are within the scope of the maintenance rule, so that if the piece of equipment is required to be tech spec operable right now to support Unit 2 and 3 operation in Unit 1, it is within the scope of the maintenance rule program.

Back in 1997 when we had the first inspection for the maintenance rule implementation,

it was noted in the inspection that Unit 1 was not capable of going into a maintenance rule-type environment, so that there was an exemption written at that time that said Unit 1 is not under the auspices of the maintenance rule, and will not go into it until a later period of time. We would remove that exemption as we go into the restart process, as we turn the systems back over to tech spec operable. Unit 1 will be back under the maintenance rule prior to restart.

MR. DeLONG: As a matter of fact, just as a clarification, some systems will be subject to monitoring in Unit 1 prior to fuel load because those systems are required to be functional for fuel load. And I own that one, those are all mine.

MR. CROUCH: So moving on over to page 17, just kind of as a summary here, the license renewal application is a three-unit application at the current licensed thermal power, as we talked about. Unit 1 is a lot different than Unit 2 and 3 in terms of licensed thermal power at this time. We prepared the license renewal application in conformance with the GALL report, and we've used the operating experience from 2 and 3 and applied it over to Unit 1. We're supplementing that operating

experience for the non-replaced piping by this Unit 1 periodic inspection program as we described. The scope of that program was increased in accordance with the comments that we received from the ACRS back in October, so that now we'll be sampling a larger population. We'll be doing it with a 95/95-type criteria, and we'll be marking those points on drawings and going back to the very same spots out in the field so we ensure that we're getting repeatable results, and repeatable inspection points.

The aging management programs have been developed, as Ken talked about. Many of the programs are marked up and in place. All of them are marked up and in place, and they will be implemented according to the schedule, like Rich talked about, anywhere from now to 2009.

Through the course of the license renewal application, we've made many commitments, and these commitments are tracked by both our on-site commitment tracking system that's run out of the licensing department, as well as the corrective program that's applicable to all three sites. This will ensure that the commitments that we've made during this process are tracked, are implemented and

closed prior to whatever their respective due dates are. So with that, I'll ask are there any questions?

MEMBER MAYNARD: I would assume that your commitment tracking system also takes care of it's a procedure change, or a program change, that there's some flag in that that makes you review it before you just automatically change out at some future date.

MR. DeLONG: In terms of extension of the due dates? Is that your concern?

MEMBER MAYNARD: One of the corrective action, or one of the commitments is to change a program or requires a procedure change, one of the problems that can occur is later somebody that's not familiar with it comes along and changes that procedure, and all of a sudden you're out of compliance with that commitment. Most commitment tracking systems have flags in those types of things where you don't inadvertently change that at a later date.

MR. CROUCH: Yes. When we go in and make a change to a procedure like that where it's in regards to a previous commitment or some other action, it's flagged in the procedure so that you

know where that came from, so that you don't go just willy-nilly take it out, or change it or anything.

MEMBER SIEBER: I have a question that probably is not related to license renewal, but I'm curious about it anyway. When you get ready to load the fuel, I presume you're going to use some fuel out of your fuel pool as part of the core load, which would be typical, and that fuel is 22 years old since it was last discharged. Are you going to do anything special?

MR. DeLONG: Absolutely. First of all, the majority of the core load is G-14 new fuel.

MEMBER SIEBER: Okay.

MR. DeLONG: There is a small population of used or partially used fuel that comes from Unit 2, I believe 1992 or 3 vintage fuel, not Unit 1 fuel that was discharged back in '85, '86.

MEMBER SIEBER: You still have some financial value in some Unit 1 fuel, I take it. Are you ever going to use that?

MR. DeLONG: Not to my knowledge. As a matter of fact, most of the fuel discharged in Unit 1 will ultimately end up going to dry storage.

MEMBER SIEBER: Yes. All I'm thinking is that it's not burned down all the way yet.

MR. DeLONG: That's correct. You're right about that.

MEMBER SIEBER: There's a few bucks in there.

MR. DeLONG: The fuel that we've selected from Unit 2 that will go in the core was very carefully selected based on inspection. It was also ultrasonically cleaned to try to keep that Unit 1 as clean as we can, because we've spent a lot of time and effort producing source term in that unit.

MEMBER SIEBER: That's interesting. I'm glad you thought about it, but I thought maybe you would do something else. But what you're doing I think is fine.

MR. CROUCH: Any other questions?

DR. BONACA: No, I think they're ready for the staff to go through the SER. Thank you.

MR. CROUCH: Thank you.

MS. SANABRIA: Good afternoon members of the ACRS, Applicant, Staff, Public in General. I am Yoira Sanabria, one of the Project Managers along with Mr. Ram Suberatna, assigned to the Safety Evaluation Report, SER, regarding the license renewal application for the Brown's Ferry Nuclear Plant Units 1, 2, and 3. This afternoon we'll be

discussing the current status of the final safety evaluation report.

I want to acknowledge the presence of the technical staff that will be right there, and also the regional support, Mr. Malcolm Whitman, should be also in the audience. Okay, he moved to the other chair.

On December 31st of 2003, the Tennessee Valley Authority, or TVA, submitted a license extension request for Brown's Ferry Units 1, 2 and 3. The license expiration dates are December 20th of 2013, June 28th of 2014, July 2nd of 2016 for Units 1, 2, and 3 respectively. The SER with open and confirmatory items was issued on August 9th of 2005, followed by a final SER on January 12th of this year.

On March 6th of 2006, the Applicant in its letter certified that the current licensing basis differences between Unit 1 versus Units 2 and 3 satisfy 10 CFR 50.59 criteria, and the documentation is ready for an on-site audit. These 13 items regarding the CLB are going to be tracked by the region in a temporary instruction. The temporary instruction 25009-001, which is concurrence right now. Originally, the draft SER

identified two open items and three confirmatory items. During the ACRS meeting held on October 6th of 2005, confirmatory item 3.0-3 LP regarding the lay-up, it is for Unit 1 preloading inspection program, what is the latest one open item. Also, an open item was identified from the aging management inspection, as documented in a letter dated November 7th of 2005.

After verbal information recently provided by the Applicant, open item 2.4-3 regarding the drywell shell corrosion cracking remains unresolved and open. Details for the resolution and resolved open items and the status of the unresolved open item 2.4-3 will be discussed later in the presentation, as we already know the Applicant gave you a brief description of what is going on.

A supplemental SER will be issued in the near future providing additional clarification of Unit 1 periodic inspection program, as well as the drywell corrosion resolution.

An ACRS NRE report letter was received on October 19th of 2005, and EDO's response was issued on November 28th of 2005. The ACRS Committee was satisfied with the response. In the letter, the Committee made four major recommendations. The

final SER addressed all four of them. These are resolution of four open items, discussion of Units 2 and 3 operating experience applicability to Unit 1, description of Unit 1 periodic inspection program, and the evaluation of the operating experience at the uprated power level. That incorporates lessons learned into the aging management program prior to the period of extended operation.

The discussion of the open items will start with the resolution of open item 4.77 related to the stress relaxation core plate hold down bolts. The Applicant committed to perform a plant-specific analysis consistent with the BWR VIP-25 to demonstrate that the core plate hold-down bolts can withstand required loads, considering the effects of a stress relaxation until the end of the period of extended operation.

Also, committed to take appropriate corrective action if the analysis does not satisfy the specific criteria. The analysis will be submitted to the NRC for review and approval two years prior to the period of extended operation. The staff found this acceptable; therefore, the open item is considered closed.

Open item 3.0-3 LP is the Unit 1

periodic inspection program. The staff requested the Applicant to develop a plant-specific program to monitor the effects of any new degradation of the un-replaced components from lay-up that will manifest during the period of extended operation. This program will assure the level of confidence for those Unit 1 left in place lay-up components equivalent to those in Units 2 and 3.

In addition, the staff reviewed subsequent sampling methodology as documented on letter dated March 7 of 2006, to confirm consistency with the NUREG 1475, and assuring 95/95 confidence levels. The Applicant committed to develop and implement program for NRC review before Unit 1 restart. The staff found this acceptable; therefore, the open item is considered closed.

During the aging management program inspection report dated November 7, 2005, identify one open item related to the procedural heat removal service water suction pipes of the intake structure. During the last inspection, the staff found discrepancy statements for the Applicant on how these piping are going to be managed. The Applicant stated they no longer intended to perform a one-time inspection because of the difficulty of performing

such inspection with any of the units running, which requires flow through the pipes.

In a letter dated February 14th of 2006, the Applicant followed up this issue and committed to perform a one-time inspection of the RHR surface water pump head supply piping and seismic restraints by using a remote media to confirm no flow blockage. However, the staff considered this issue a non-safety component impacting a safety function. Therefore, we were looking for some such kind of amp that will look into this pipe that is consistent with GALL. And we considered that the varied piping inspection program and times will do so. The Applicant agrees to perform such inspections pending on Applicant's documentation to this is considered a complimentary item, because we're waiting for the Applicant's confirmation they will do a varied piping inspection program.

Satisfactory regional AMP inspection has been passed, have documented in letter dated 1/2006, because no additional safety issues were identified, therefore, the aging management inspection is considered closed. However, a follow-up confirmatory inspection will be performed prior to Unit 1 restart.

Earlier, the Applicant indicated that no significant degradation was observed in normally inaccessible areas of the drywell. I would like to point out that discussions of these UT examinations are provided in SER Section 3.5.2.3.1, special discussion of RAI 2.5-4.

DR. BONACA: Of the SER.

MS. SANABRIA: Of the SER. Probably this is the confusion that we have. Since the open item evolved from a scoping of the refueling seals, and we have the discussion of the UT examination of the AMR section.

DR. BONACA: I see. Yes, that's an important point you're raising, that I was going to raise myself. We heard from the Engineering Manager that this lining is subjected to periodic inspection under the ISI program.

MS. SANABRIA: Yes, and you can find --

dR. BONACA: So why didn't the staff accept that program as a license renewal program?

MS. SANABRIA: David Jang can respond to you.

DR. BONACA: Okay. Because in the text in the SER, there is no discussion of further inspections. All it says, they said that they would

not inspect it, and the staff accepted the one-time inspection after that.

MR. JANG: David Jang, Geoscientist. Dr. Bonaca, the staff review of the corrosion issue in the drywell based on the GALL report, specifically Section 2(b)1.1-2, this covers the drywell integrity review, including the corrosion and so on. And the staff position there states that normally you are using IWE inspection and the Appendix J, two major program to make sure their aging management achieved. However, if there are determined to be some significant corrosion, reason to believe you have such corrosion to exist or potentially exist, then there is the need for the examination.

In this case, the Applicant has earlier reported they have performed three, four times UT examination, first one being 1987 in response to Generic Letter 8705; second one in the case of Unit 3 was done in 1998, and Unit 2 1999, but Unit 1 dated 1999 through '02. And all these several occasions of UT examination data was available to the Applicant, and they stated, asserted in their response to our RAI in the discussion between the staff and Applicant that they did not find any

discrepancy or so-called significant corrosion or reduction in the thicknesses. They asserted that everything is in good shape.

As the staff, given that information and given an evaluation, and reporting back to the whole staff position, come to conclusion that technically they have met a staff position, and there should be no further evaluation. However, staff always want to be applying the defense-in-depth concept, so we have raised two points. The first point is, there have been some water observed in some pocket areas in 2 and 3. Okay? We give you two option; one is, you go manage, put that ring seal into AMP, and second is to give us some assurances. For some reason on the part of the Applicant, they did not want to take the first option. They opted to come back to say we would like to provide such assurance you are requesting by performing augmented inspection in accordance with the IWE, which is a guiding detailed core standards, which is embraced in the GALL. And the staff reviewed --

dR. BONACA: Before you go passed me, those inspections are beyond the one-time inspection that you got.

MR. JANG: No, they are proposing one-

time inspection.

DR. BONACA: Yes, I understand that.

MR. JANG: Okay. And that inspection calls for Unit 2 and 3 before the start of the new period. Okay? Unit 1 before the restart. They are proposing a quite detailed inspection, and the detail of that inspection method approach extends scope, report to ACR, and the staff reviews those details.

DR. BONACA: No, I understand that.

MR. JANG: Okay.

DR. BONACA: The point I'm making is that Unit 1, if you do an inspection now, which is before the restart, and you never inspect it again, what assurance do you have? I mean, you may have leakage from the seals at a later time. In fact, every time you refuel and that would give you a problem. Now what gave me comfort from the presentation to the manager was that they do periodic inspection on their ISI. So I'm saying -- I'm trying to understand why do you have to have one-time inspection if you have the ISI problem? The ISI program includes inspection of the drywell.

MR. JANG: Let me respond. You mentioned about the gasket, the seal. In this

particular VFN plants there is not a gasket. They are set up, the pipes are welded to the plate, so this is different from say Oyster Creek where gasket you have.

DR. BONACA: I understand.

MR. JANG: And the point is that these positions are such, if you can show your past performance is in-tact, there's no corrosion or essentially no corrosion, then we are saying the current position relying on the IWE ISI, two program should do, should suffice. We are not asking for additional requirements. And this Applicant --

DR. BONACA: When I read this at the beginning, I thought that if there are no further inspections under an ISI program, and there was no mention in the SER, then one-time inspection is not sufficient. That's what I concluded. But now that I know that they are inspecting this drywell under the ISI program, of course it is sufficient, because inspection already had taken place. So what you're telling me is that essentially you want to have a baseline verification of the fact that the liner is in excellent condition now as a step into license renewal. And then from that point, you also depend on the ISI inspection program they perform. Right?

MR. JANG: That's right, but I would not like to mislead you. The ISI inspection under general requirements, just a visual inspection.

DR. BONACA: Oh, so it's only visual, but visual, how can you see on the other side of the --

MR. JANG: Exactly. That's why --

dR. BONACA: Well, see, that's why it's important. I mean, I'm trying to pull this out.

MR. JANG: Yes. That's why we are relying on the past examination which shows we are in good shape.

DR. BONACA: Oh, that makes a heck of a difference.

MR. JANG: On that basis we are agreeing that you can just one time.

DR. BONACA: But why? Explain to me why. I mean, I'm not saying that -- I mean, if you do not measure the thickness, and you only look at it from the inside, you're not going to see the corrosion that is evolving on the other side.

MR. JANG: No, looking from inside region you cannot tell whether it's getting thin or not. But if you having indication, such as when you dig up something and you saw some corrosion, some

rusting, what are other indication? Then that will cause you to pick up the IWE requirements section 1420, which says if you have a potential, identifying some potential corrosion going on, then --

DR. BONACA: But you know the moment you begin to identify corrosion with looking from inside visually means that you are bulging and something really major is taking place on the other side.

MR. JANG: Yes. That could be one of the reasons you --

dR. BONACA: And so you're losing -- okay. I think we are --

MEMBER MAYNARD: Well, Mario, back to the beginning, I don't understand now why a one-time inspection is adequate.

DR. BONACA: Absolutely. I agree with you now, after we discovered the issue --

MEMBER MAYNARD: I agree. When I heard the periodic ISI, it sounded like well, it's already being done, but if it's just a visual, that's not enough. So why is one-time inspections now adequate?

MR. JANG: Okay. That's because the current position of the staff says if you show based

on past examination that things are good shape, there's no corrosion, then the staff does not ask anything beyond the ISI IWE requirements and the Appendix J requirements.

DR. BONACA: Well, that's because you had the fall-back position from the regional position, that you wanted to have the seals inspected, and you didn't get that. I mean, the licensee refused to do that, and so you said okay, then let's inspect the shell directly. And you wanted to have a periodic inspection, and then licensee said no, so they gave you one-time inspection and you accepted it. That's the way I see it described in the SER.

MR. JANG: I would like to just say with all due respect, IWE part of ASME GALL is based on many years experience and very authoritative group of standards, and they are giving us that this is the way to do it, and we had reasonable assurance that they would do adequate job.

DR. BONACA: But I understand that this is a generic issue right now that you're evaluating for license renewal. Right?

DR. KUO: Maybe, let's say that the staff needs some discussion. And, in fact, that we

are thinking about developing an IC on this very issue. Okay? And that is not a definite conclusion that the one-time inspection is adequate, or is acceptable, so the amount of staff, we really need to have some discussion.

DR. BONACA: Because we have seen Quad-Cities and Dresden, they have the periodic inspection, so you have an uneven situation there, and you have an issue that you have to deal with.

MR. JANG: So we would take your point and given the new information just given this morning, we would reassess the situation.

DR. BONACA: I appreciate that. Thank you, because finally we have all the information. And at some point it was understood --

MEMBER SIEBER: Well, I'm still puzzled why they've done three UT inspections already while the plant is not operating, and you're going to do visual inspections in the future after the plant is operating.

MR. JANG: The first one they did was in response to the generic letter 8705, which was result of discovering Oyster Creek major corrosion. And given that fact, the NRC asked all the applicable licensees to do inspection. And in

response to that request, they performed the '87 inspection.

DR. BONACA: Okay. I think we've got enough information on this to discuss and make up our mind.

MR. CROUCH: Dr. Bonaca, would it be okay, Rich DeLong would like to address this issue.

DR. BONACA: Sure.

MR. DeLONG: This is Rich DeLong again, the Engineering Manager for Brown's Ferry. A couple of clarifying points. One is, that the IWE standard again requires the utility to evaluate areas associated with the drywell liner that are subject to repeated wetting and drying, and evaluate those areas for augmented inspection. We've done that in all three units and determined that no areas under the auspices of IWE require augmented inspection based on our inspections and evaluations.

Secondly, what we committed to on the one-tie inspection is to inspect that area, which if it is degraded, would be the first area we'd see if a bellows failure would ultimately allow water to transition to the area of the shell where it can leak down to the sand pocket. We do have a quite robust design associated with the reactor well

bellows. It provides for both a four inch drain and actually an augmented two inch drain that will remove moisture associated with some type of leakage well ahead of that area that would allow wetting of the drywell shell. In addition to that, the four inch drain is fitted with a Weir Wall so that even if there is leakage into that area which comes from the bellows, that Weir Wall will keep the moisture away from the drywell liner, so we've got a significant defense-in-depth-type design to avoid putting moisture on the liner in that area. The one-time inspection will confirm that we're not seeing any moisture getting to that portion of the upper section of the drywell, and causing any type of degradation.

Again, when we looked at the area in the sand pocket area in the inspections we've done, we've seen no indication of corrosion mechanisms occurring on the exterior of the drywell shell in any of the units.

DR. BONACA: Thank you.

MS. SANABRIA: Moving on to the next slide, this is concerning what happened on today's information that we received from the Applicant. And I want to point out that since we received this

information yesterday evening, and we kept on going discussing it until noon today, I didn't have enough time to finish and finalize that. That is not wall thinning, it's an inclusion identification location. However, since this information is not available for the staff right now on the other information they need to provide all these UT examinations for us so the staff will evaluate. And also, how they can justify the integrity of Units 2 and 3, as well as Unit 1 drywell. Therefore, this item we decided to not have it closed at this point. It's going to be an open item. And we will be supplementing the SER including this information also.

MEMBER SIEBER: Do you feel that if it's satisfactorily closed and it's not recordable or reportable, that you need to write a supplement to the SER?

MS. SANABRIA: We believe that since this information give us a quantitative document data, we should supplement it since on the information that we have in the ACRS qualitative doesn't give us numbers of the UT examination.

MEMBER SIEBER: Well, it apparently doesn't tell you anything about wall thinning.

MS. SANABRIA: It doesn't tell us

anything about wall thinning, but at least they need to provide engineering justification. On the next slide, I already covered the first recommendations of the ACRS. On the next two slides, I will be covering the remaining two.

For the operating experience applicability, the staff claims that during Unit 1 - I'm sorry, the Applicant claims that during Unit 1 extended outage, the overall environmental conditions affecting external surfaces was maintained consistent with those of Units 2 and 3. Unit 1 operation following the shutdown and associated replacement/refurbishments is expected to exhibit the same aging mechanisms and rates as Units 2 and 3.

The water chemistry within this Unit 1 piping system was monitored for compliance with the water quality requirements. Affected portions of certain systems where operating experience of Units 2 and 3 showed adverse effects from uncontrolled lay-up were replaced for all three units. For example, the service water piping. The staff questions all the above.

To ensure that there are no latent aging effects as a result of the lay-up program, the staff

requested the Applicant for a targeted periodic inspection program in Unit 1 systems that were unreplaced. The targeted inspection will continue to monitor these systems and piping throughout the period of extended operation; meaning one prior to restart, one before entering the period of extended operation, and one within the period of extended operation. Therefore, the Unit 1 periodic inspection will be an acceptable mitigating action for the lack of applicable operating experience in Unit 1. Next slide.

Another ACRS recommendation is regrading the aging management review and aging management programs evaluated at the EPU level. The Committee stipulated that TVA was to evaluate Brown's Ferry operating experience at the uprated power level, and incorporate lessons learned into their aging management programs for the period of extended operation. EPU is under current review by another division in NRR. TVA committed to implement operating experience and aging management program reviews before entering the period of extended operation. This is a standard commitment for all applicants for extended power uprates.

In conclusion, on the basis of its

evaluation of the license renewal application, the NRC staff concluded that the requirements of 10 CFR 54.29(a) have been met pending resolution of open item 2.4-3. This concludes my presentation. Thank you.

DR. BONACA: Thank you. Any questions from the members?

MEMBER ARMIJO: Yes. I'd like to go back to 2.4.3. Aren't we really talking about a misunderstanding on whether something was wall thinning or an inclusion?

DR. BONACA: This is on the issue of -- yes.

MEMBER ARMIJO: Right. And if it's a misunderstanding or miscommunication, why can't this issue be closed out once the staff verifies that the data is valid, proper, level three inspector has certified that --

dR. BONACA: They will do that. I think what they intend to do, they intend to do it in the SER.

MS. SANABRIA: Yes.

DR. BONACA: Because it's an issue that has come up during the review, and that feel that the SER was not closed yet.

MS. SANABRIA: Yes. At this point, that issue was closed based on the explanation of David Jang. However, we received certain information of UT measurements that we misunderstood or it was misunderstood.

MEMBER ARMIJO: Miscommunicated or something.

MS. SANABRIA: Exactly. And that just happened yesterday. So right now we don't have that documentation in front of us to make an evaluation, continuing evaluation. And, therefore, the staff needs to look at it, make a justification or make a statement of what it's going to do, what's going to happen. That's why we opened the open issue.

MEMBER ARMIJO: Okay, thank you.

DR. BONACA: I don't know what that means for us. I mean, we --

MEMBER SIEBER: I don't think it means anything for us the way I understand it, as long as the staff follows up.

DR. BONACA: But I'm talking about in terms of issuing the letter. Do we have to wait until --

MEMBER ARMIJO: We can discuss this all later.

DR. BONACA: Yes. Okay? Are there any more questions? None. I thank you very much for the presentation and the staff, and the Applicant, and I give it back to you, Mr. Chairman.

MEMBER WALLIS: Thank you very much. I thank the presenters very much. I think we're all ready for a break. We're going to end the formal session and the transcript, and we're going to take a break until 6:00. When we come back, we will get to work.

(Whereupon, the proceedings went off the record at 5:43:51 p.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 530th 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.

Eric Hendrixson
Official Reporter
Neal R. Gross & Co., Inc.

Exelon.
Nuclear

ACRS Presentation
March 9, 2006

Early Site Permit Application
Clinton Power Station Site
Final Safety Evaluation Report

Agenda

- Introductions
- Significant Changes Since Draft Safety Evaluation Report (DSER)
- Geotechnical Approach
- Seismic Evaluation
- Supplemental DSER Issue Closure
- Summary

Exelon. Nuclear

Introductions - ESP Project Team

- Marilyn Kray – Project Executive Sponsor
- Christopher Kerr – Sr. Project Manager
- Eddie Grant – Safety / EP Lead
- William Maher – Environmental Lead

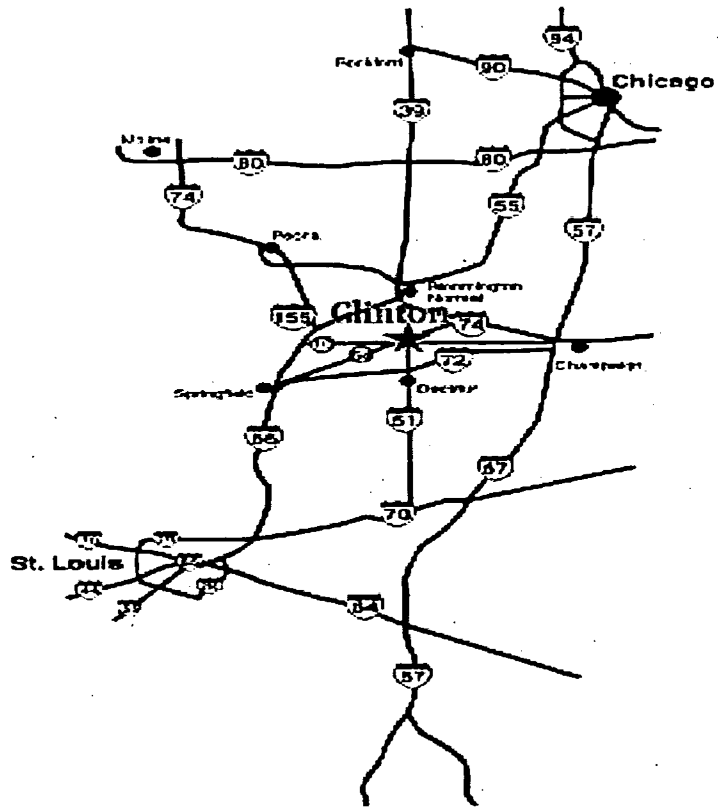
Exelon. Nuclear

Introductions – Support Team

- CH2M Hill (Prime Contractor)
  - Environmental / Redress
  - Geotechnical
  - EP
- CH2M Hill Subcontractors
  - WorleyParsons
    - Safety
  - Geomatrix
    - Seismic
  - Seismic Board of Review
    - Expert, independent review
  - Others
- RPK Structural Mechanics Consulting
  - Seismic
- Sargent and Lundy
  - Draft Application Review
- Morgan Lewis
  - Legal counsel

Introductions – Site Location

- ESP Site Location
  - Central Illinois
  - Clinton Power Station Property
  - AmerGen Owned (EGC Subsidiary)
- Applicant
  - Exelon Generation Company, LLC (EGC)
    - o Wholly owned subsidiary of Exelon Corporation



Exelon. Nuclear

Significant Changes Since DSER

- Closure of all Open Items
- Completion of all Confirmatory Items
- Acceptance of SSE ground motion spectra
  - Minor revisions in response to open items
- Documented Criteria for:
  - Permit Conditions
  - Combined License Action Items

Geotechnical Approach

- Builds on existing CPS information
  - Regional geology
  - Site geology
  - Exploration
  - Laboratory testing
- EGC ESP work
  - Confirm conditions
  - Updated information

Seismic Evaluation
SSE Ground Motion Determination

RG 1.165 Methodology

- Investigations
- Seismic sources update
- SSHAC assessment
- PSHA
- Determine SSE ground motion spectra
  - **Relative based -- Reference Hazard Probability Criterion**

EGC ESP Application

- Same
- Same
- Same
- Same
- Determine SSE ground motion spectra
  - **Performance-based – Core Damage Frequency Criterion**

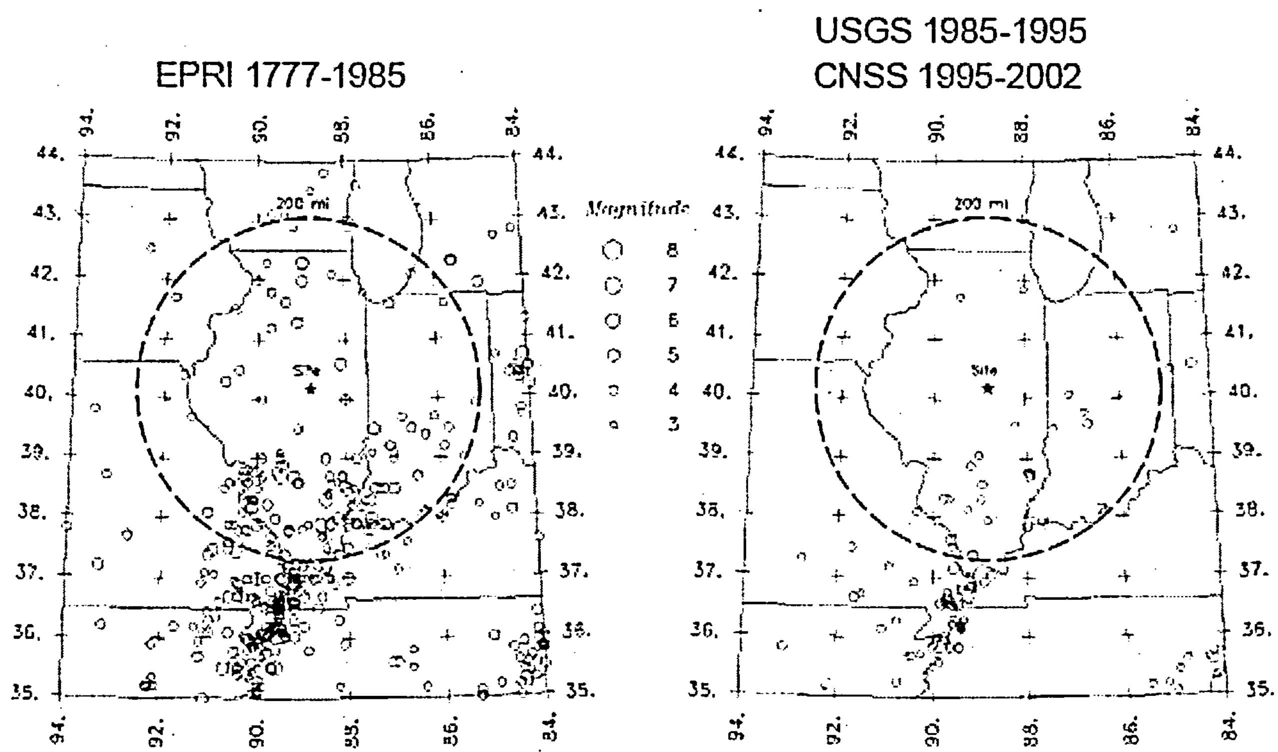
Exelon. Nuclear

Seismic Evaluation (cont'd)

SSE Ground Motion Determination (cont'd)

RG 1.165 Methodology	*EGC ESP Application*
➢ De-aggregate to identify controlling earthquakes	➢ Same
➢ Account for site effects	➢ Same [NUREG/CR-6728]

Seismic Evaluation (cont'd)

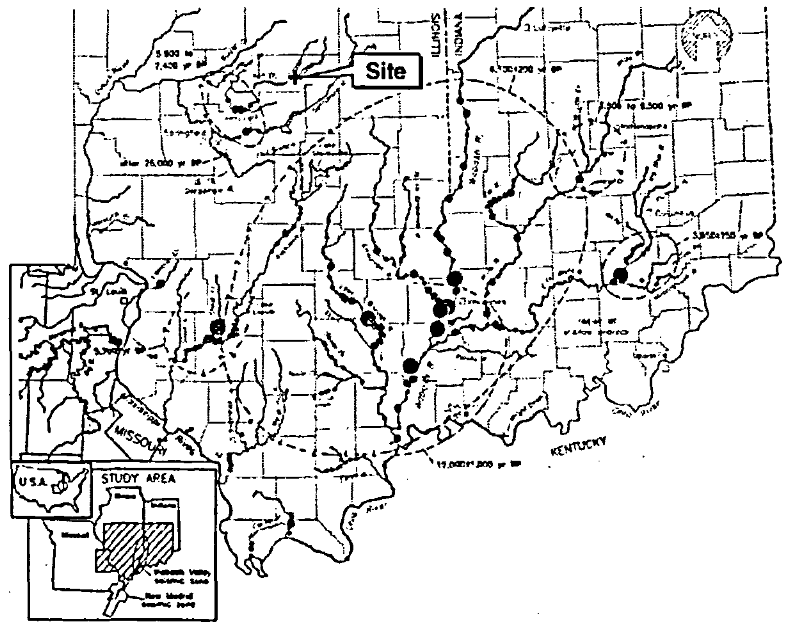


Seismic Hazards Report for the EGC ESP Site
Updates to Seismicity Catalog

Figure 2.1-11

Seismic Evaluation (cont'd)

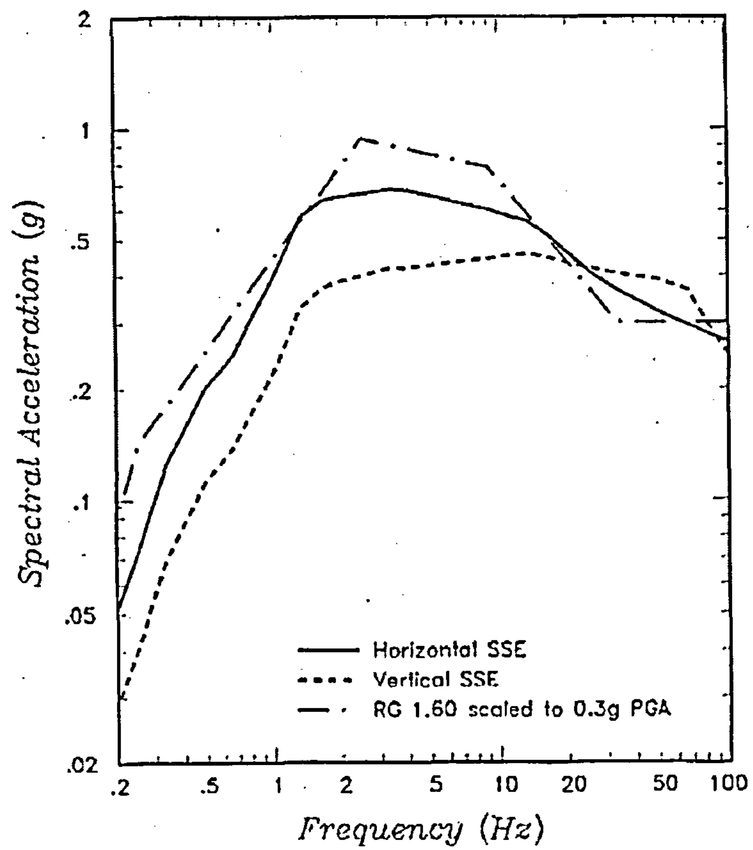
➢ Major new information
- Repeated large events in New Madrid seismic zone in past 2,000 years
- Large events in Wabash Valley/ Southern Illinois in past 12,000 years
- One moderate event with energy center ~40 miles SW of site at Springfield ~6,000 years ago



Exelon. Nuclear

Seismic Evaluation (cont'd)

- Performance-Based EGC ESP SSE Ground Motion Spectra
  - Horizontal DRS
  - Vertical DRS
  - RG 1.60 0.3g PGA (for reference only)
  - Acceptable to NRC Staff
  - Compared to Design Spectra at COL stage



Exelon. Nuclear

Supp. DSER Issue Closure

- Open Items (7) - Resolved
  - 2.5.1-1, New Madrid magnitude estimates
  - 2.5.2-1, Distance-conversion in EPRI '03 Ground Motion Model
  - 2.5.2-2, Site velocity model for response analysis
  - 2.5.2-3, Site dynamic response analysis
  - 2.5.2-4, SSE ground motion adequately represents local prehistoric earthquakes
  - 2.5.2-5, Performance-based method clarification
  - 2.5.4-1, Additional borings

Exelon Nuclear

Summary

- All Open Items Closed
- All Confirmatory Items Completed
- SSE Ground Motion Spectra Accepted

Exelon Early Site Permit
Safety Review Status

March 9, 2006

Advisory Committee on Reactor Safeguards
Full Committee Meeting

John Segala, Senior Project Manager
Office of Nuclear Reactor Regulation

Purpose

- To provide the ACRS an overview of the Exelon early site permit (ESP) application safety review
- Answer the ACRS's questions

Meeting Agenda

- Project Milestones
- Exelon ESP Safety Review
- Key Review Areas
- Open Items
- Permit Conditions/COL Action Items
- FSER Conclusions
- Seismic Review
- Questions or Comments

03/09/2006 3

Completed Milestones

- Received Exelon ESP application - September 25, 2003
- FRN published announcing acceptance – October 31, 2003
- FRN published for mandatory hearing – December 12, 2003
- RAIs issued to the Applicant – July, 27, 2004
- Draft SER issued – February 10, 2005
- Applicant responds to Draft SER open items – April 26, 2005
- Supplemental Draft SER issued – August 26, 2005
- ACRS Full Committee Meeting - September 8, 2005
- ACRS interim letter – September 22, 2005
- Staff provided Final SER to ACRS – February 9, 2006
- **Staff issued Final SER – February 17, 2006**
- ACRS Subcommittee Meeting – March 8, 2006

03/09/2006 4

Remaining Milestones

- ACRS letter assumed – March 30, 2006
- Staff issue Final SER as NUREG – May 1, 2006
- Mandatory hearings begin Fall 2006
- Commission decision assumed mid 2007

03/09/2006 5

Exelon ESP Safety Review

- Final SER documents the staff's technical review of the applicant's site safety analysis report and emergency planning information
- Exelon requests ESP site be approved for total core thermal power rating between 2400 and 6800 MWt
- Exelon has chosen not to submit specific design but instead has submitted a plant parameter envelope (PPE) based on a number of current and future reactor designs

03/09/2006 6

Key Review Areas

- Exclusion Area Authority and Control
- Nearby Industrial, Transportation, and Military Facilities
- Meteorology
- Hydrology
- Seismology and Geology
- Radiological Effluents
- Thermal Discharges
- Radiological Consequences of Accidents
- Physical Security
- Aircraft Hazards
- Emergency Planning
- Quality Assurance

Principal Contributors

Brad Harvey - Meteorology

Goutam Bagchi – Hydrology

- Contract support from PNNL

Kazimieras Campe - Site Hazards

- Contract support from PNNL

Clifford Munson and Tom Cheng – Geology, Seismology, and Geotechnical

- Support from U.S. Geologic Survey and BNL

Jay Lee – Demography, Geography, and Radiological Consequence Analysis

Robert Moody - Emergency Planning

- Consultation with FEMA

Paul Prescott - Quality Assurance

Al Tardiff - Physical Security

Open Items

Review Area	Open Items
Exclusion Area Authority and Control	1
Meteorology	3
Hydrology	21
Seismology and Geology	7
Radiological Consequences of Accidents	1
Emergency Planning	6
Quality Assurance	1
Total:	40

Proposed Permit Conditions and COL Action Items

- There are 6 proposed Permit Conditions (15 in the Draft SER)
- There are 32 proposed COL Action Items (17 in the Draft SER)

FSER Conclusions

Overall:

- Site safety and emergency planning is acceptable and meets the regulations

Seismology and Geology:

- Site is acceptable from a geologic and seismologic standpoint and meets the requirements of 10 CFR 100.23

03/09/2006 11

NRC Experience with the Performance-Based Methodology

- Use of a performance-based approach for determining the SSE first identified in Exelon's application in September 2003
- NRC formed a Seismic Technical Advisory Group
  - Seismic & Civil Engineers from NRR, NMSS, and RES
  - Served in an advisory role to NRR for review of performance-based approach

03/09/2006 12

Exelon's Performance-Based (PB) Safe Shutdown Earthquake (SSE)

NRC staff concluded:

1. PB method based on sound technical approach
2. Seismic design using PB SSE achieves safety level generally higher than operating plants
3. PB SSE adequately reflects local ground motion hazard

03/09/2006 13

Conclusion 1

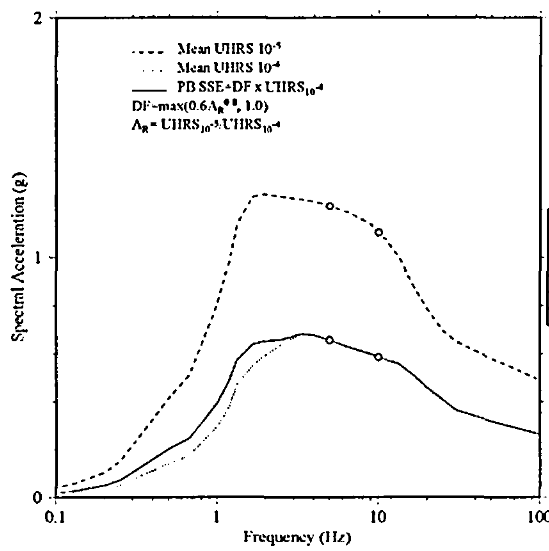
PB method based on sound technical approach

- PB approach is risk-based
- PB approach requires structures be designed to achieve target performance goal
- PB SSE determined by two approaches:
  - Design Factor Method (ASCE 43-05)
  - Direct Integration of Risk Equation

03/09/2006 14

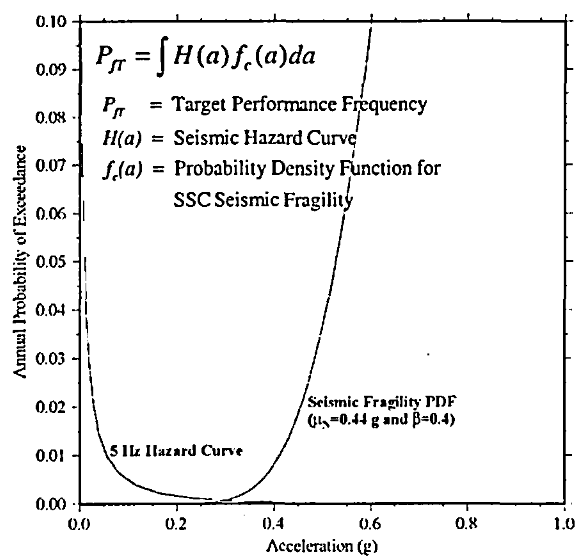
Conclusion 1 (Cont.)

Exelon Performance Based SSE



Spectral Frequency (Hz)	10-4 Mean UHRS (g)	10-5 Mean UHRS (g)	AR	DF	Horiz. SSE (g)
1	0.297	0 802	2.700	1.328	0.395
2.5	0.638	1.256	1.968	1 031	0 658
5	0 657	1.215	1 849	1 000	0 657
10	0.586	1.107	1.887	1 000	0 586

Conclusion 1 (Cont.)



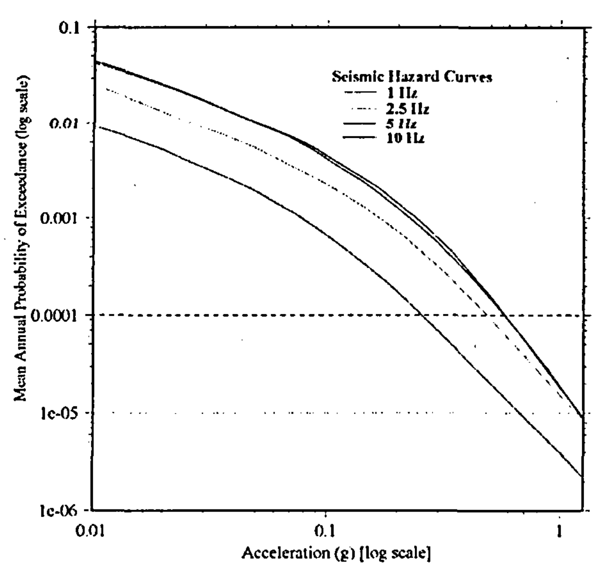
Conclusion 1 (Cont.)

Parameter/Model Assumptions:

- Performance Target (P_{FT}) is $1x10^{-5}$ per year
  - P_{FT} corresponds to most stringent seismic design class
- ASCE 43-05 assumes a linear hazard curve between 10^{-4} and 10^{-5}
- SSC seismic fragility modeled using lognormal distribution
  - $\beta = 0.4$
  - Seismic Margin = 1

03/09/2006 17

Conclusion 1 (Cont.)



03/09/2006 18

Conclusion 1 (Cont.)

Summary of Conclusion 1:

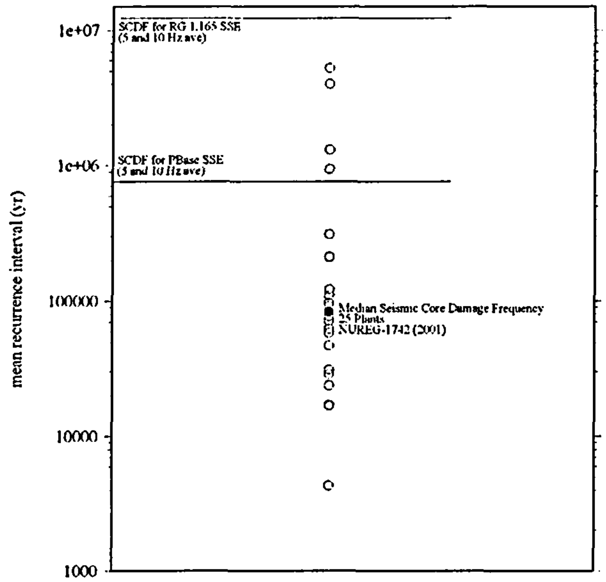
- PB Approach
  - Achieves both high and consistent level of seismic safety
  - No credit for seismic margin
  - Conservative performance target
  - Based on conservative parameter and modeling assumptions

Conclusion 2

PB SSE achieves safety level generally higher than operating NPPs

- Using Clinton PB SSE values and HCLPF seismic margin of 1.67 (SECY 93-087)
  - What are SCDF values?
  - How do Clinton PB SCDF values compare to current NPPs?

Conclusion 2 (Cont.)



03/09/2006 21

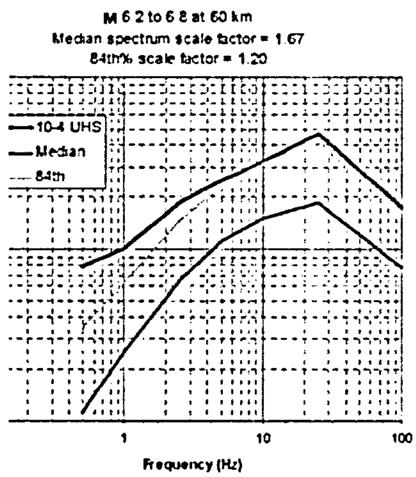
Conclusion 3

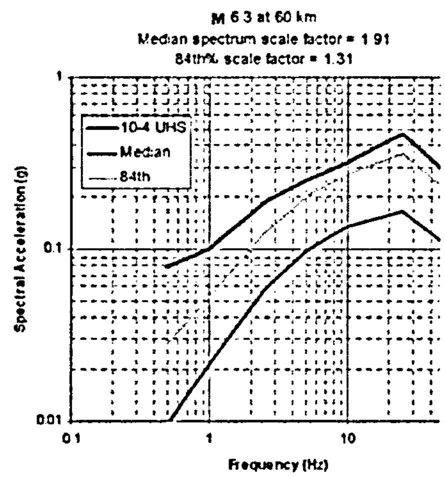
PB SSE adequately reflects local ground motion hazard

- Greatest local seismic hazard for central Illinois from Springfield earthquake
  - Prehistoric earthquake (5900 to 7400 years ago)
  - Near Springfield (60 km SW of ESP site)
  - Magnitude estimates (6.2 to 6.8)

03/09/2006 22

Conclusion 3 (Cont.)





03/09/2006 23

Summary

- All open items resolved
- Looking forward to receiving the interim ACRS letter
- Questions or comments?

03/09/2006 24

Overview of NRC-Sponsored Research Supporting GL2004-02 Resolution

Mark Cunningham
Robert L. Tregoning
Office of Nuclear Regulatory Research

Advisory Committee on Reactor Safeguards
March 9, 2006

Research Questions Investigated in Support of GL 2004-02 Resolution

- Does the post-LOCA environment generate chemical byproducts which may contribute to sump clogging?
- Can chemical byproducts cause head loss during post-LOCA recirculation scenarios?
- What variables affect debris penetration through sump screens? Will such debris clog surrogate throttle valves?
- Can debris head-loss data be used to develop predictive correlations?
- Can coatings debris transport within containment to the sump screen?

General Research Philosophy

- **Motivation**: Recognized that research was necessary in important technical areas to ensure adequate resolution of GL 2004-02
- **Broad Objectives**
  - Focus on technical areas having highest uncertainty (ACRS, staff, industry) and where generic evaluation provides the most impact
  - Conduct parametric and/or scoping studies to evaluate important variables over ranges of representative conditions
  - Interact with regulatory staff and industry to inform testing approach & conditions
- **Goals**
  - **Integrated Chemical Effects Testing (ICET) Program:** Provide basic technical knowledge to industry and staff on formation of chemical byproducts
  - **Other Programs**
    - Conduct confirmatory research for staff use in conducting an independent review and assessment of licensee GL 2004-02 evaluations
    - Make important results publicly available to inform ongoing industry activities

Technical Areas of Study

- **Chemical effects**: Investigate contributions to sump screen head loss
  1. Determine potential for chemical by-product formation within containment pool environments.
  2. Characterize, predict, and investigate head loss for significant by-products.

- **Particulate head loss**: Integrate testing results with analytical model to develop correlations for evaluating head loss of PWR insulation materials

- **Downstream effects**: Identify significant variables for consideration in ECCS performance evaluation.
  1. Quantity of ingested insulation debris
  2. Clogging within HPSI throttle valves

- **Coatings transport**: Evaluate the transportability of coating chips to the sump screen

Chemical Effects: Objectives

- Determine, characterize, and quantify the chemical reaction products that may develop in representative PWR containment pool environments
  - Integrated chemical Effects Testing (ICET) Program: Los Alamos National Laboratory (LANL).
- Investigate potential for chemical products to contribute to sump screen head loss
  - Argonne National Laboratory
- Evaluate accuracy of thermodynamic predictions on the quantities and species of chemical products which form
  - Center for Nuclear Waste Regulatory Analyses (CNWRA) @ Southwest Research Institute

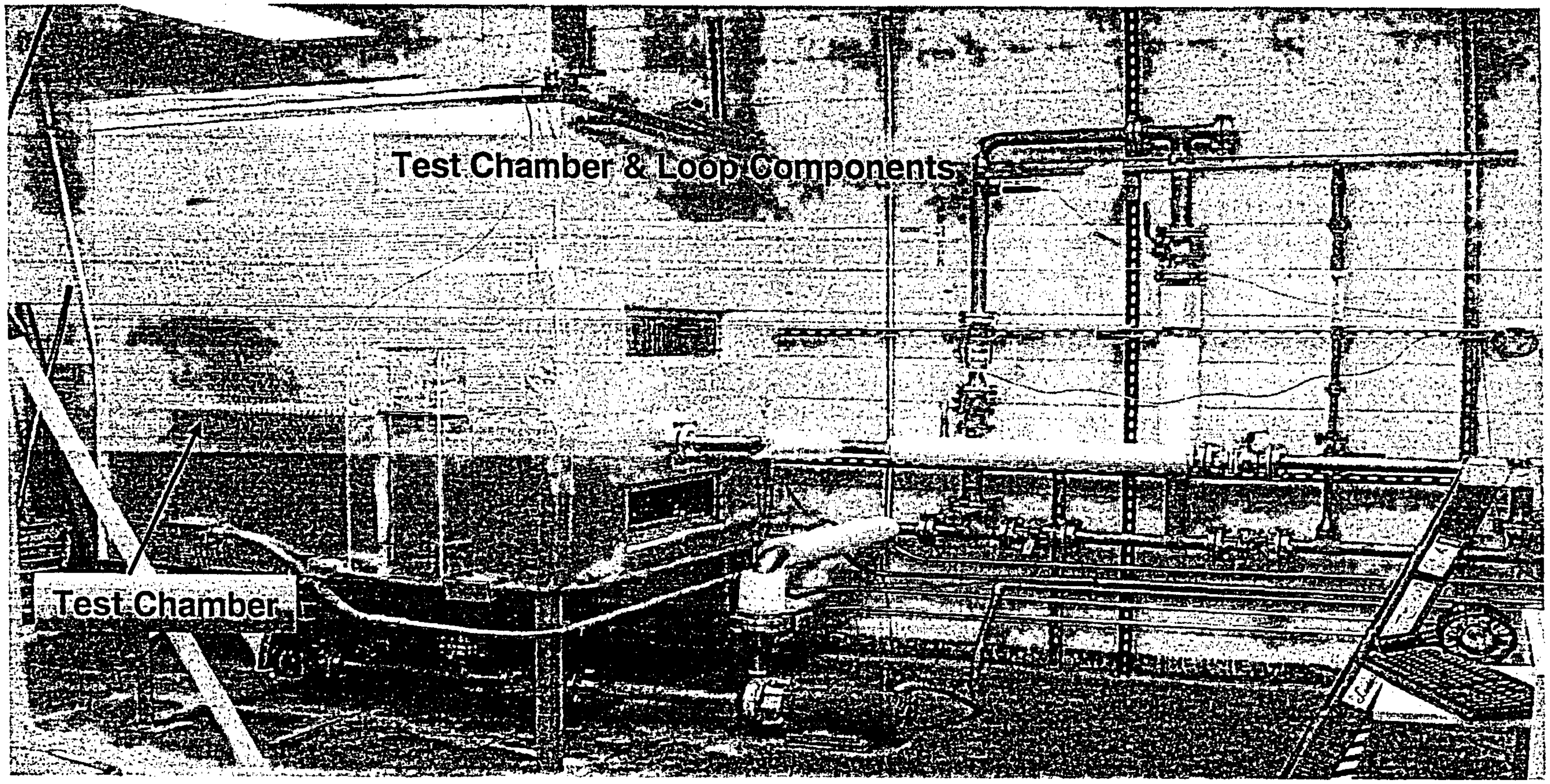
ICET Approach

- Evaluate chemical by-product formation over 30 day mission time
- Choose representative test parameters using industry surveys
- Consider contribution from submerged and un-submerged materials: Al, Cu, Zn, GS, concrete, fiberglass and calcium silicate insulation
- Simulate plant conditions using scaling constant: ratio of surface area of coupon material (or weight/volume of insulation) to water volume

Test	Temp (C)	Buffering Agent	Initial pH	Boron (ppm)	Insulation Mixture	Corresponding Plants*
1	60	NaOH	10	2800	100% fiberglass	25
2	60	Na_3PO_4	7	2800	100% fiberglass	20
3	60	Na_3PO_4	7	2800	80% cal-sil 20% fiberglass	6
4	60	NaOH	10	2800	80% cal-sil 20% fiberglass	9
5	60	$Na_2B_4O_7$	8	2400	100% fiberglass	9

* ICET environment most similar to plant. Some plants fit multiple environments.

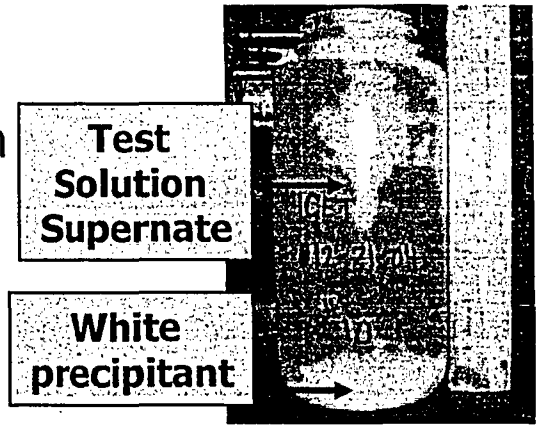
ICET Test Loop

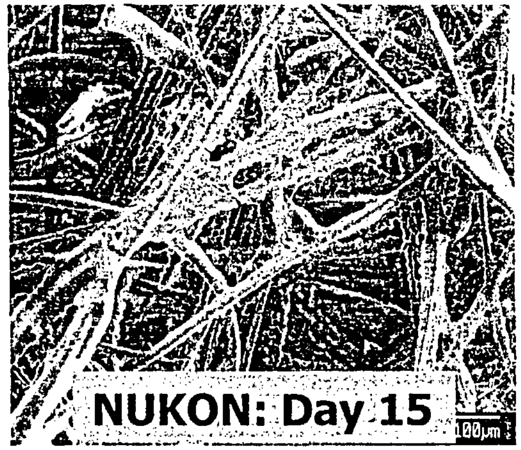


ICET: Significant Results

Test #1: NaOH & NUKON

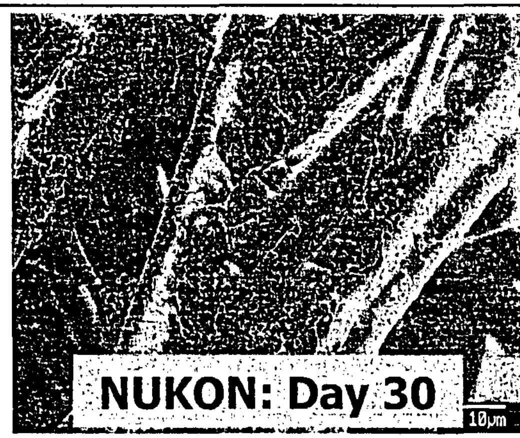
- White precipitate (aluminum oxyhydroxide)
- Insulation deposits
- Significant Al weight loss





Test #2: Na_3PO_4 & NUKON

- Insulation deposits



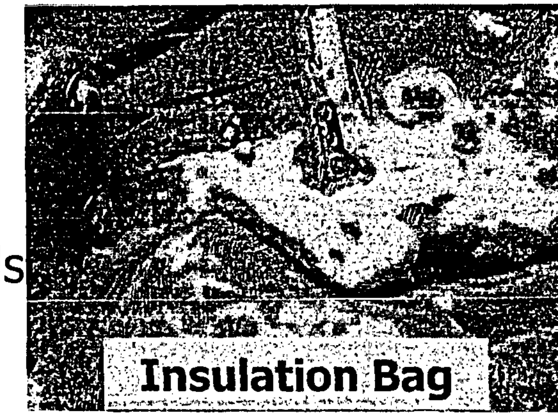
Test #5: $Na_2B_4O_7$ & NUKON

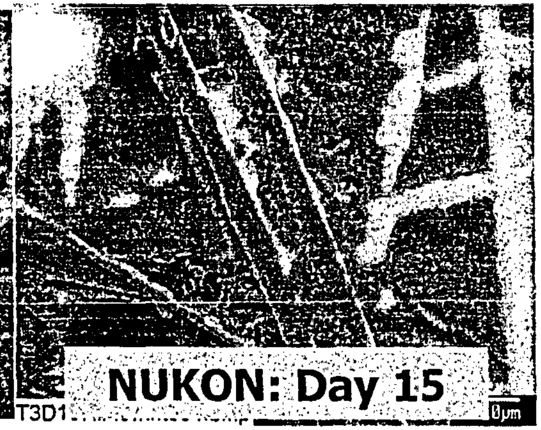
- Similar products as Test #1
- Less quantity and slower to form at lower temps

ICET: Significant Results

Test #3: Na_3PO_4 & Cal-Sil/NUKON

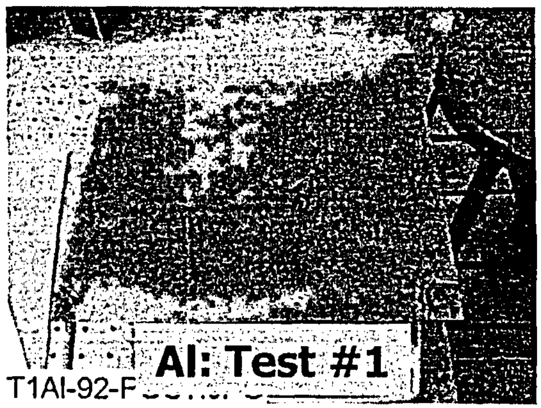
- During test: White flocculent material observed
- Post-Test:
  - White substance $\{Ca_3(PO_4)_2\}$ coating test chamber materials
  - Insulation deposits

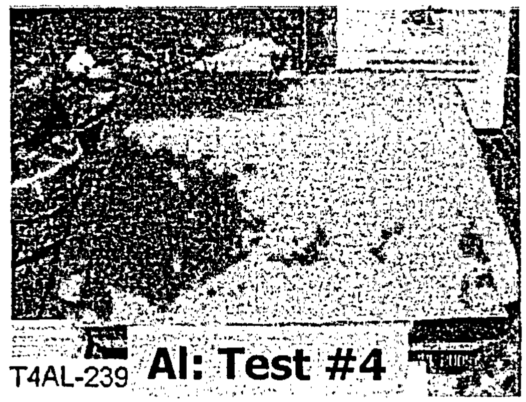




Test #4: NaOH & Cal-Sil/NUKON

- Much less insulation deposits
- Minimal aluminum weight loss
- Thin white coating ($CaCO_3$) on Al specimens

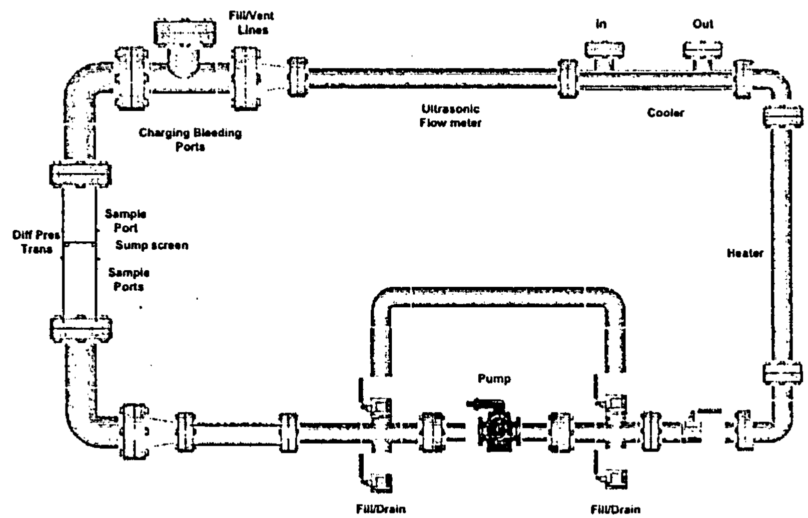




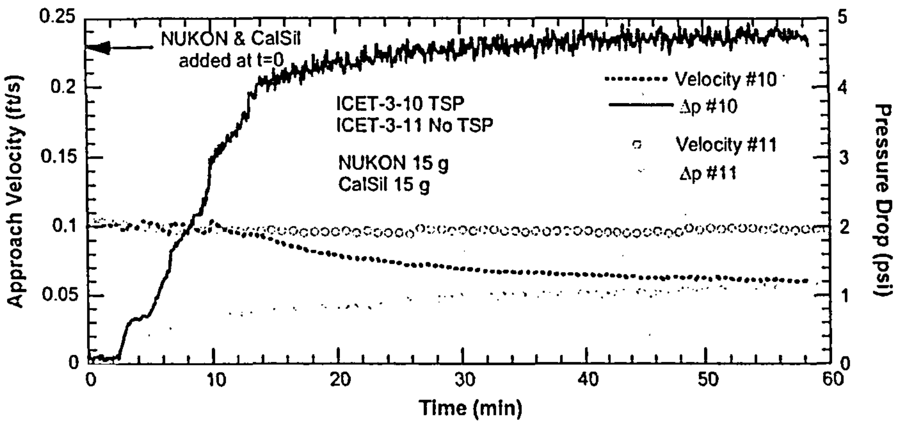
Chemical Head Loss Testing: Approach

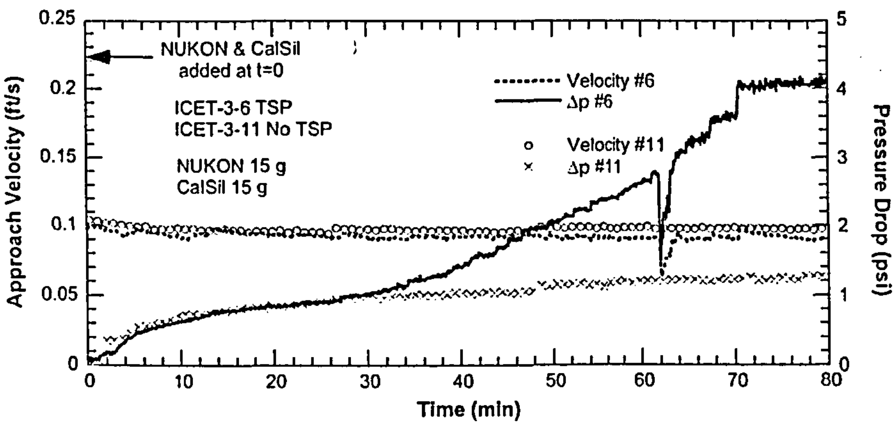
- Simulate chemical products observed in ICET
- Examine effects over a broad, representative range of environmental variables (time, temperature, concentrations, etc.)
- Conduct single effects tests in closed vertical loop instead of integrated tests
- Evaluate plant-relevance using scaling parameters
  - Head loss: mass of chemical product & debris per sump screen area
  - Product formation: mass of chemical product per containment volume

Chemical Effects Head Loss Test Loop



Chemical Head Loss Testing: Significant Results





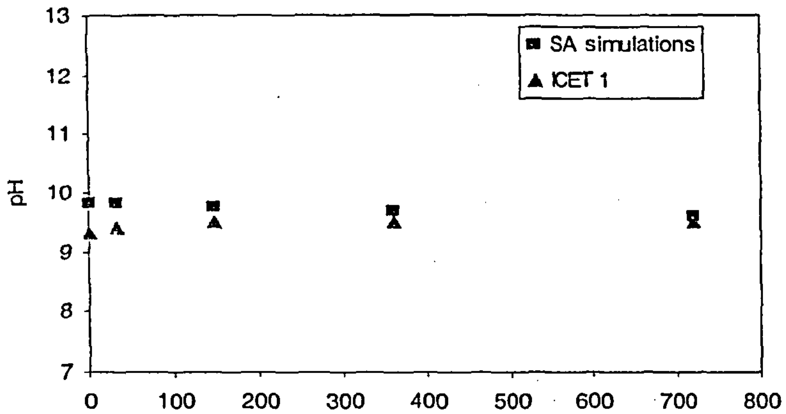
Head Loss in Na_3PO_4 Environments

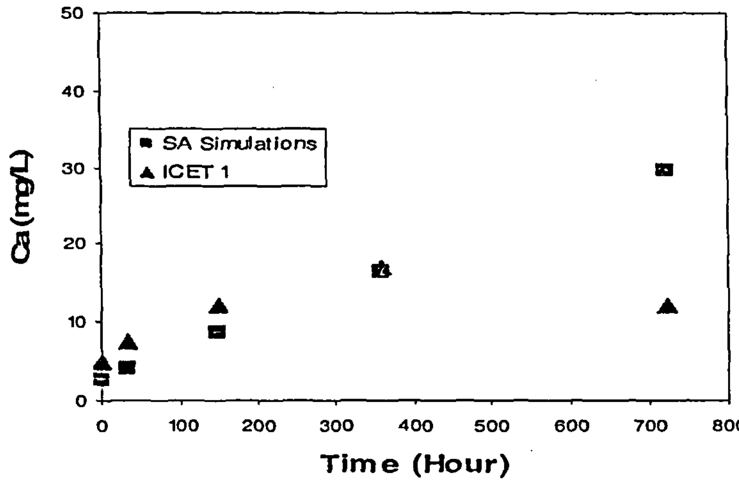
- Head losses with chemical products can be greater than with an corresponding amount of cal–sil
- No significant difference in maximum head loss apparent as a function of cal-sil/Na_3PO_4 dissolution rates
- Relative contribution of $Ca_3(PO_4)_2$ to head loss depends strongly on the debris loading
  - Biggest contribution: Fiber bed saturated with chemical product
  - Similar behavior observed as with particulate loading

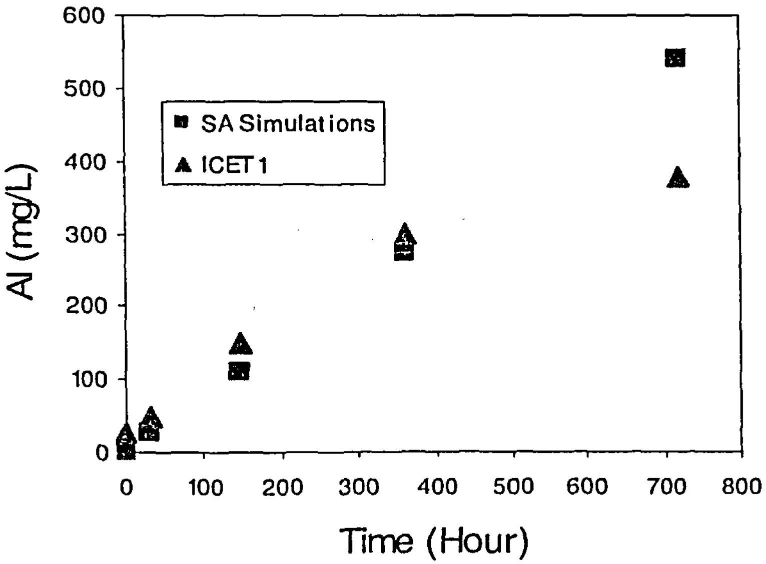
Chemical Speciation Prediction: Approach

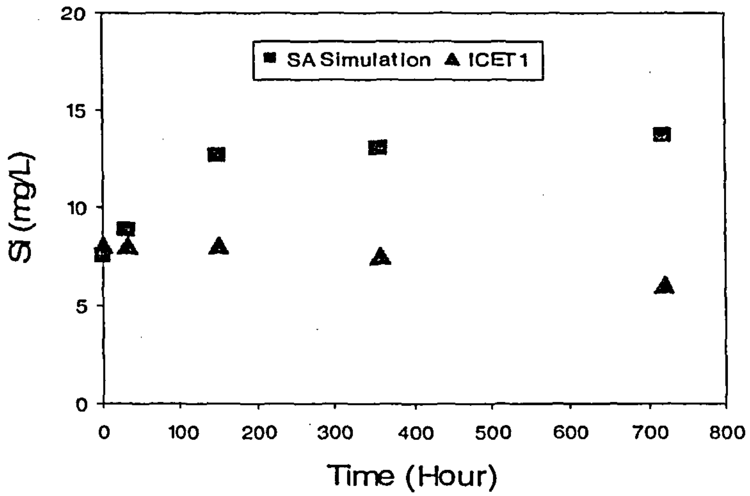
- Evaluate the feasibility of utilizing commercially-available thermodynamic simulation codes for predicting chemical species formation in plant-specific environments
- Measure corrosion rates of important materials: Al, Cu, Zn (galvanized steel), fiberglass, cal-sil, carbon steel, concrete
- Perform initial blind predictions of the ICET experiments to compare the quantity and type of solid species which form
- Conduct follow-on calibrated simulations to omit species not observed in ICET testing

Chemical Speciation Prediction: Calibrated Simulation of ICET #1









Chemical Effects: Initial Conclusions

- Chemical products, precipitants and gelatinous-like materials can form in a representative PWR containment pool.
- Relatively small changes to important variables (e.g., pH, insulation) can significantly affect the quantity, types, and nature of chemical by-products that form.
- Chemical products in the environments examined thus far can contribute significantly to sump screen head loss.
- In Na_3PO_4 environments, small inventories of dissolved Ca may significantly contribute to head loss.
  - Greater than 25 ppm dissolved Ca
  - Depending on fiber loading, greater than 0.5 kg/m^2 of cal-sil screen loading
- Blind predictions using only input corrosion data were not successful.
- Most accurate results achieved by suppressing thermodynamically species not observed in ICET testing.

Particulate Head Loss: Testing & Modeling

- Contractor: Pacific Northwest National Laboratory
- RES Investigator: William Krotiuk
- Objectives
  - Develop improved model to conservatively predict pressure drop across and compression of a debris bed on a sump screen
  - Utilize test data to support model development of empirical constants and independently validate applicability
  - Experimentally investigate important mechanistic parameters affecting head loss in mixed debris beds

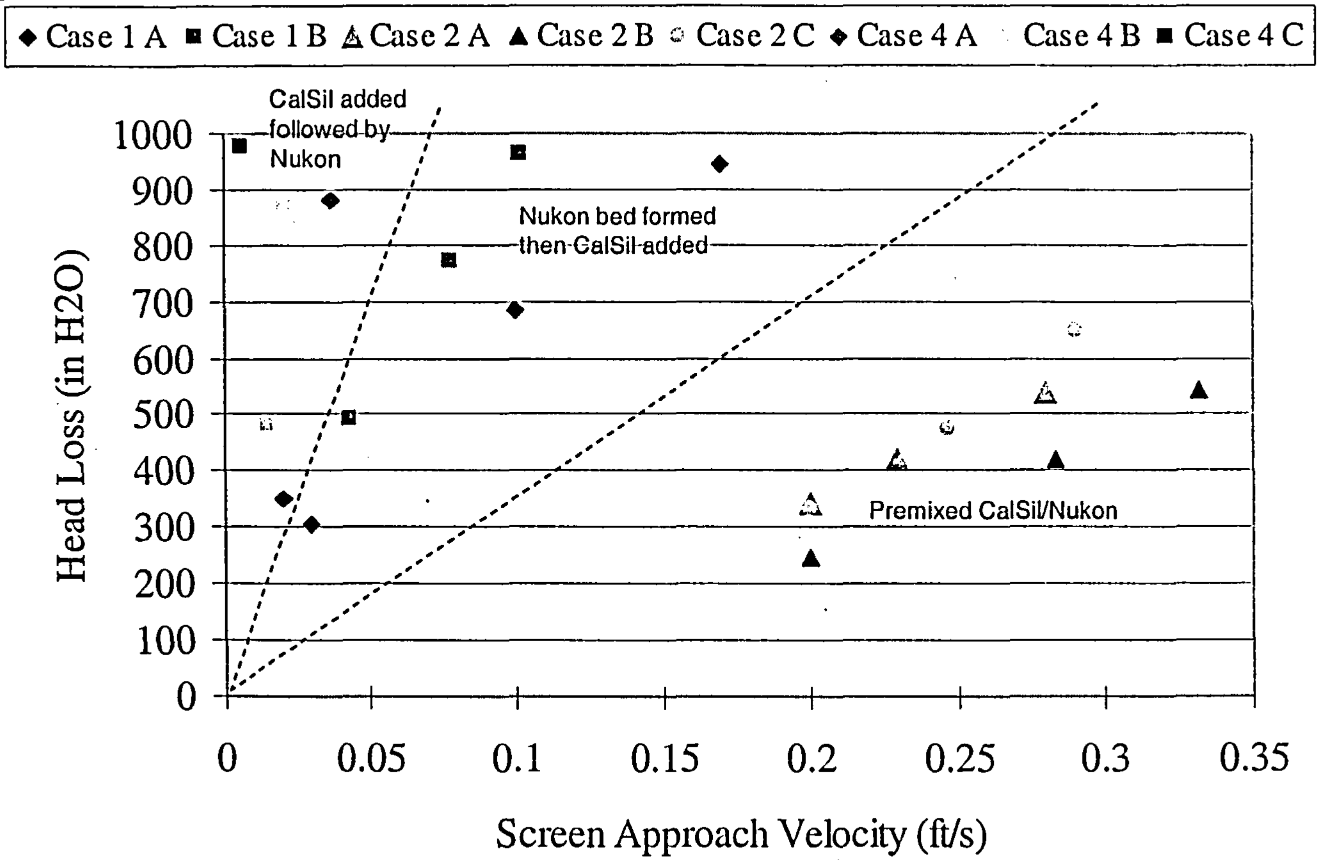
Particulate Head Loss: Modeling Approach

- Base model on classical form of porous medium flow equation (Ergun Equation) accounting for viscous and kinetic flow components
  - Develop improved method to predict debris bed compressibility
  - Develop particulate "saturation" relation for mixed fibrous (NUKON), particulate (cal-sil) debris beds
  - Identify the limiting particulate concentration as a function of NUKON bed characteristics
- Model formulation
  - One homogeneous control volume
  - two homogeneous control volumes through debris bed thickness, each with independent debris concentration distribution
- Evaluate model assumptions and validity with head loss test data from variety of test programs (PNNL, LANL, ANL)

Particulate Head Loss: Testing Approach

- Design closed-loop facility to control of test parameters over a range of relevant conditions
  - Pressurize loop to eliminate gas and two-phase flow conditions
  - Measure bed height in situ
  - Permit separate filtering of suspended particles
- Develop standardized debris preparation so that material with repeatable characteristics can be produced by independent operators.
- Characterize the debris bed after the test
  - Measure mass of individual constituents in bed.
  - Evaluate through-thickness particulate concentration within the debris bed .
- Principal test variables
  - Debris bed mass and relative composition
  - Particulate distribution within bed
  - Debris arrival sequence
  - fluid temperature
  - flow velocity

Particulate Head Loss: Significant Test Results



Target test conditions

- NUKON: 1.01 kg/m^2
- Cal-sil: 0.51 kg/m^2
- Total: 1.52 kg/m^2

- Debris arrival sequence can significantly affect measured head loss
  - Localized bed saturation is likely important contributor
  - Debris bed sectioning being used to investigate bed homogeneity and particulate distribution within the bed

Particulate Head Loss: Initial Conclusions

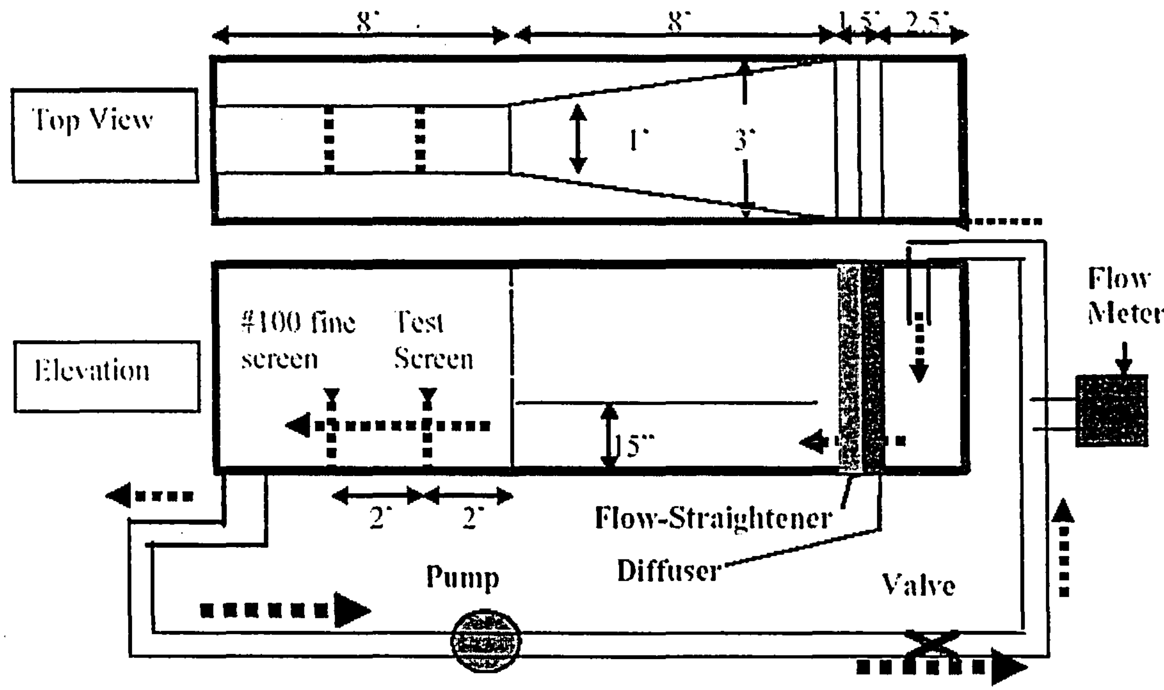
- Significant head loss increases occur when a fibrous debris bed become saturated with small particles either uniformly or locally
- Fibrous debris is required initially to trap finer particulates
- Debris entrapment at the test screen is a function of debris type
  - Most fibrous insulation added accumulates in the debris bed
  - Depending on particulate mass added, significant (as much as 50%) particulate remains suspended during testing

Downstream Effects

- Contractor: Los Alamos National Laboratory
- Objectives
  - Debris Ingestion (Phase I): Examine variables that affect the amount of insulation debris that can pass through a sump strainer screen and become ingested within the ECCS system (NUREG/CR-6885).
  - Throttle Valve Blockage (Phase II): Evaluate effect of ingested insulation debris on blockage of surrogate high-pressure safety-injection (HPSI) throttle valves.

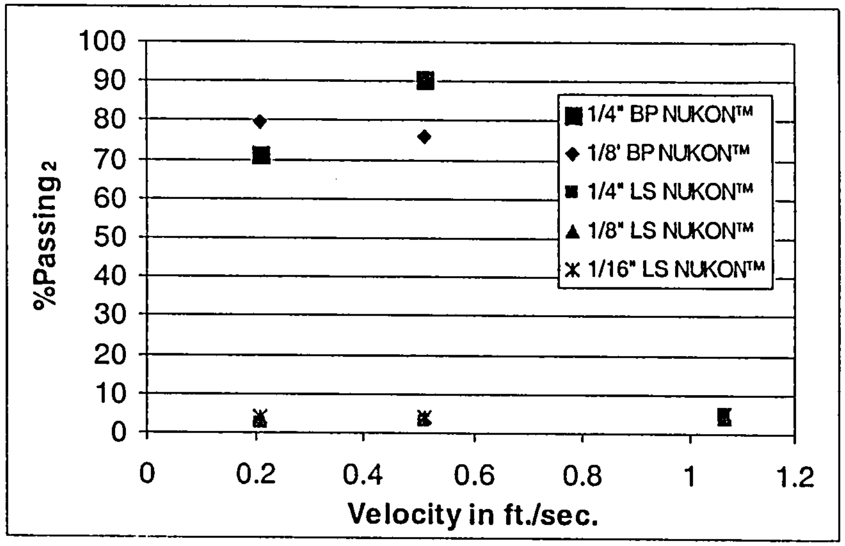
Downstream Effects: Debris Ingestion

- Approach: Phase I
  - Evaluate fiberglass (NUKON), cal-sil, and reflective metal insulation (RMI) debris
  - Conduct constant velocity testing within linear flume
  - Pass individual debris types through clean test screens
- Principal test variables
  - Debris size
  - Debris agglomeration
  - Debris location: floor or within flow
  - Flow velocity

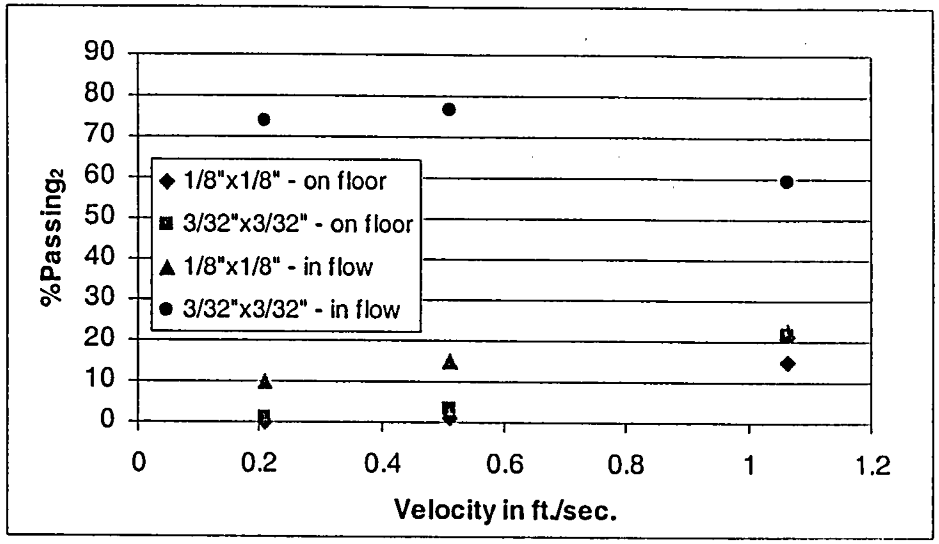


Debris Ingestion: Significant Results

NUKON: 1/16", 1/8", & 1/4" screens



RMI: 1/8" screen

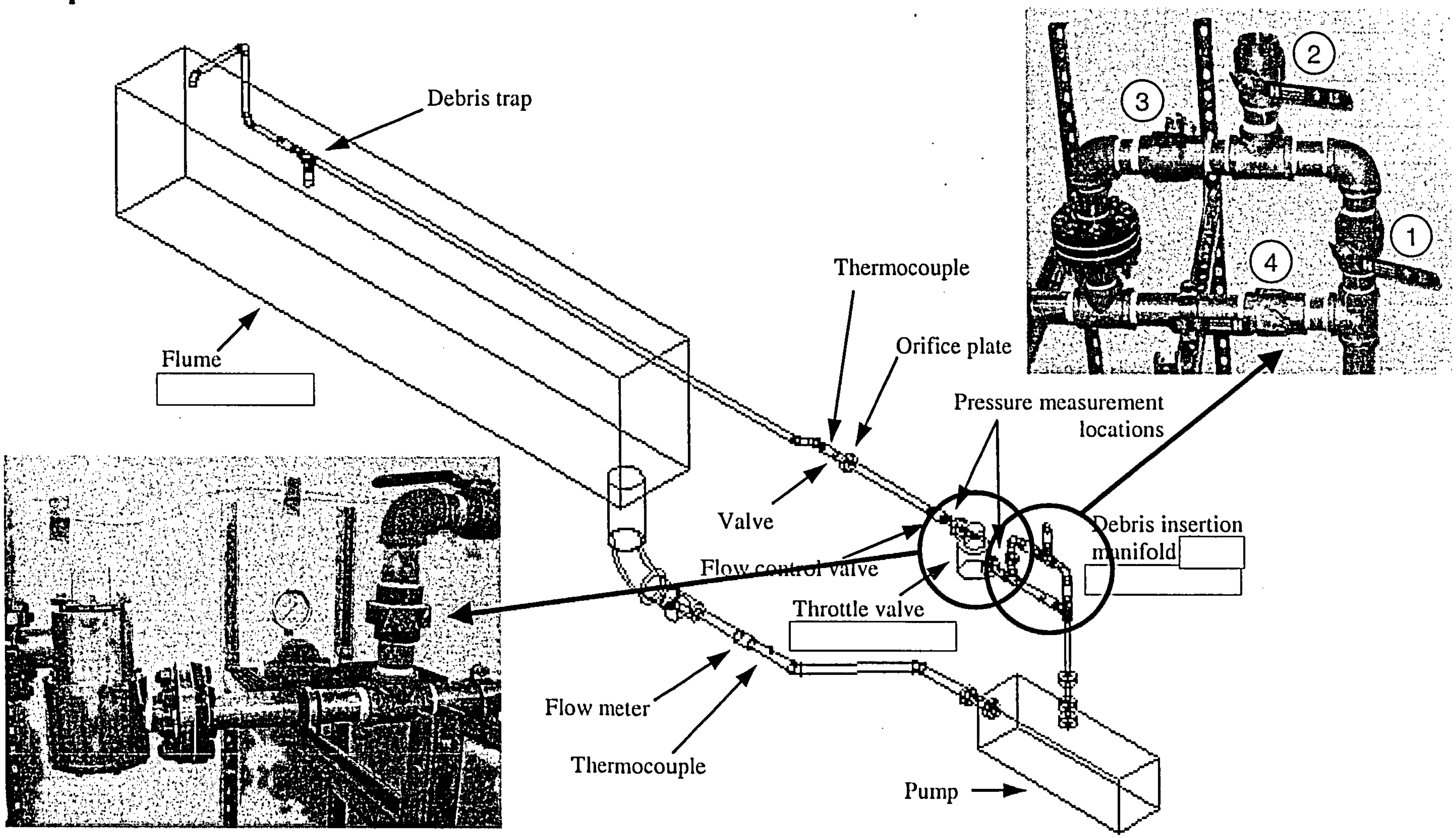


- A significant amount of NUKON debris arriving in finely separated fibers (BP) passed through the test screens while larger, agglomerated pieces (LS) did not.
- Significant percentages (up to 75%) of RMI debris passed through the test screens when the debris was smaller than the screen opening and was introduced directly into the flow at these velocities.
- Virtually all cal-sil insulation particulates passed through any size test screen.

Downstream Effects: Throttle Valve Blockage

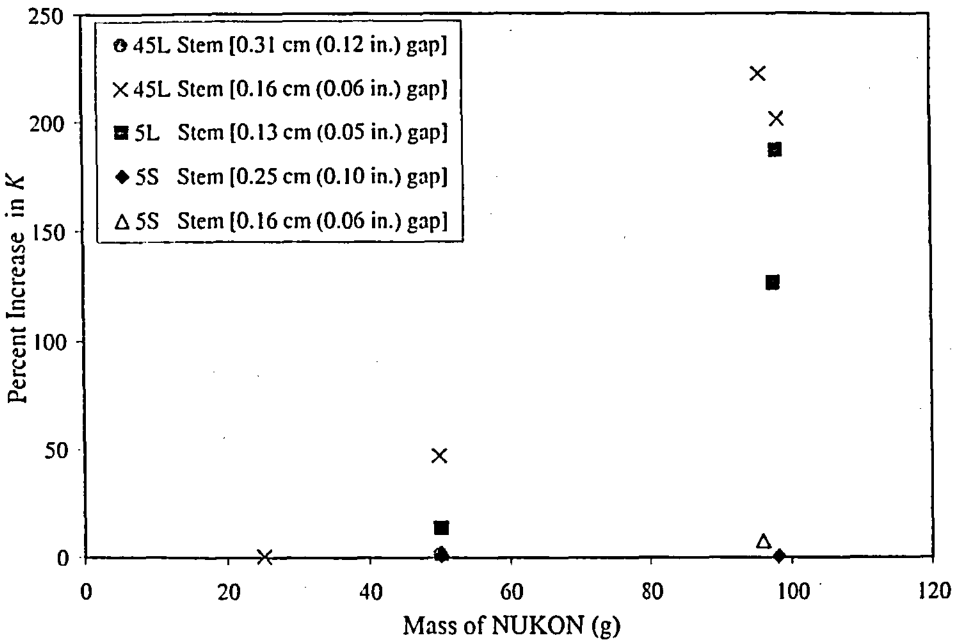
- Approach: Phase II
  - Select ingested debris characteristics for RMI, NUKON, cal-sil based on the phase I study
  - Test a surrogate valve chamber with flexible geometry: 3 configurations with different contact angles and seat diameters
  - Parametrically study important variables to identify plausible debris retention mechanisms
  - Determine relationship between flow area and valve loss coefficient
  - Infer debris retention based on increases in valve loss coefficient
- Principal test variables
  - Valve geometry
  - Debris type and size
  - Valve gap height setting
  - Single input vs. accumulated debris
  - Single vs. mixed debris

Throttle Valve Blockage: Test Apparatus Schematic

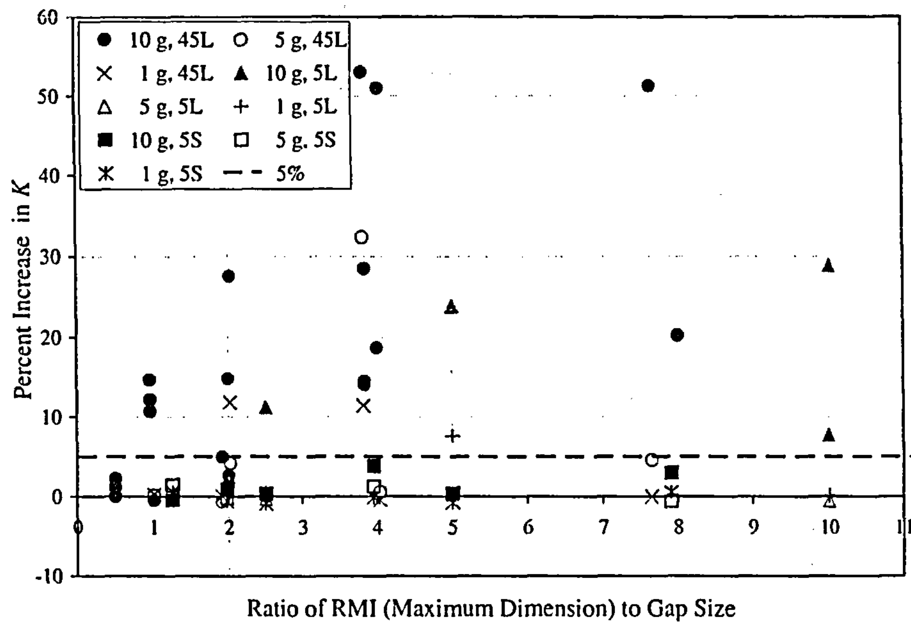


Throttle Valve Blockage: Significant Results

NUKON Retention in Valves



RMI Retention in Valves



- Greatest loss coefficient increases resulted from NUKON loading
- Valve loss coefficient increased as the RMI debris size relative to the gap setting increased
- Measured loss coefficient is a function of valve geometry
- Considerable variability was apparent in results

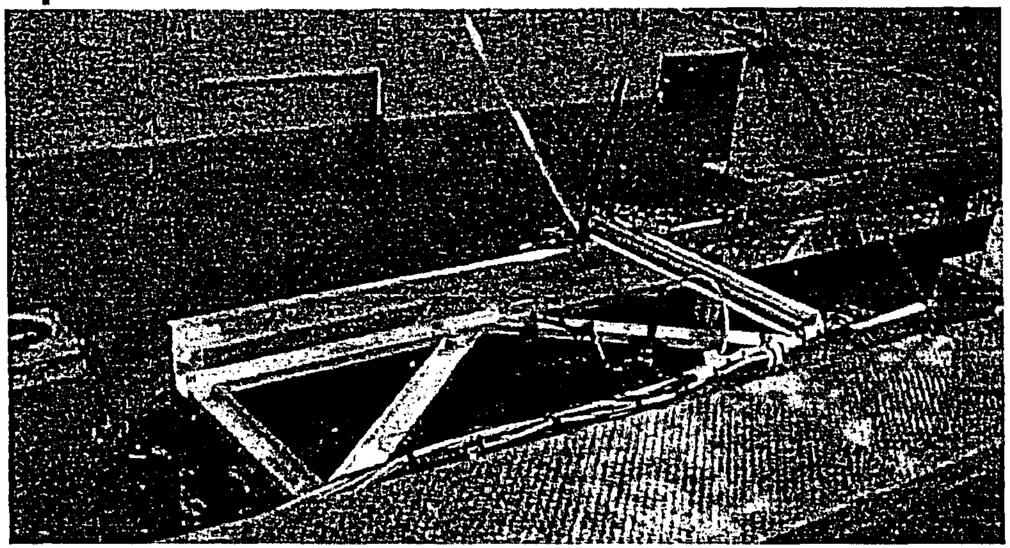
Downstream Effects Testing: Conclusions

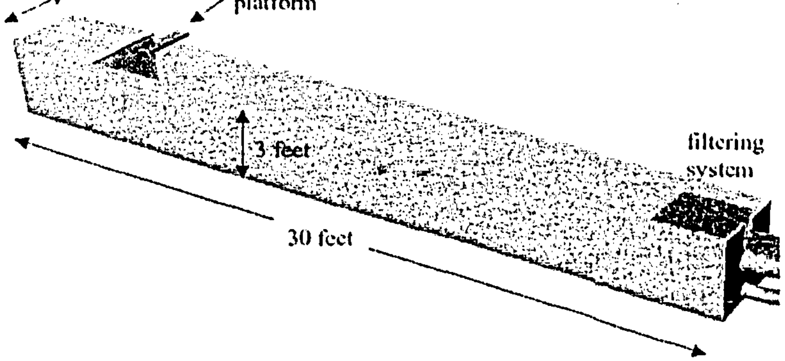
- A significant percentage of finely-divided, suspended debris (NUKON, RMI, cal-sil) can pass through clean screens
- It is important to understand size distribution and timing of debris arriving at screen to determine percentage of debris ingestion
- All debris types (except for finely divided cal-sil) and combinations resulted in valve loss coefficient increases for a surrogate HPSI throttle valve
- Some tests demonstrated that finer debris (cal-sil) could be retained if blockage is initially established with coarser debris (NUKON, RMI)
- Debris accumulation over time was observed, but the effects were not monotonic and self-clearing was observed at certain points

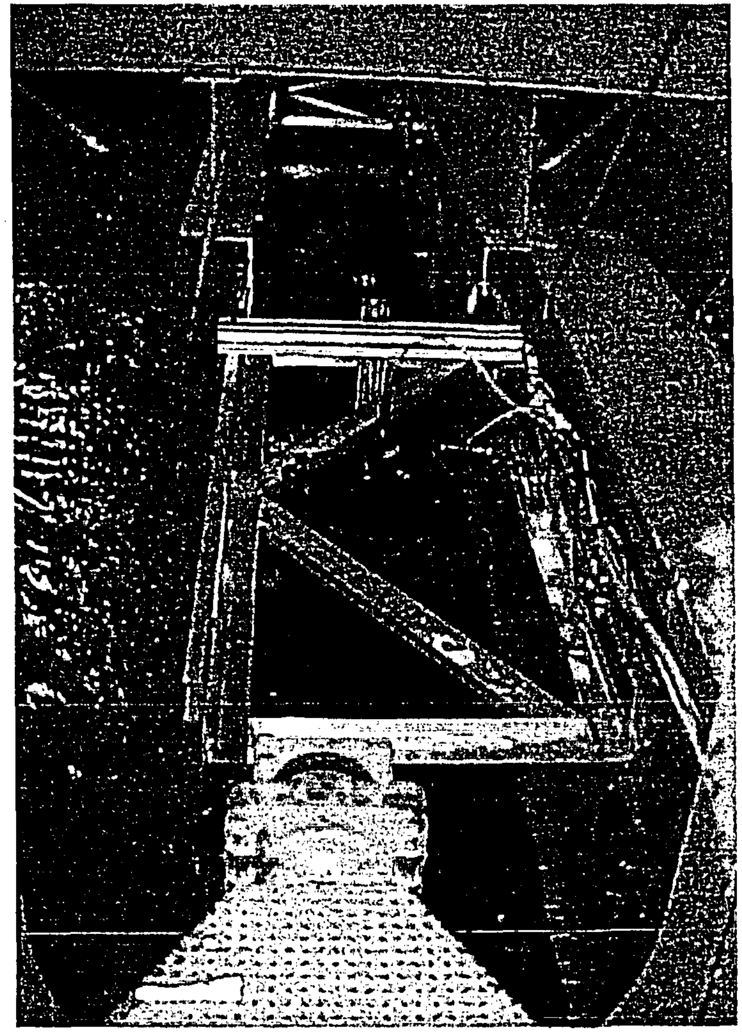
Coatings Transport Testing

- Contractor: Naval Surface Warfare Center, Carderock Division
- Objective: Characterize the transport behavior of coatings debris in water under stagnant and flow conditions.
- Approach
  - Study 5 coating systems representing a range of representative physical characteristics (e. g., specific gravity, thickness, surface roughness)
  - Perform quiescent settling tests: terminal velocity and time-to-sink.
  - Conduct uniform flow transport testing: tumbling steady-state velocity.
- Principal test variables
  - Debris size: 1/64 inch to 2 inch
  - Debris shape: flat and curled
  - Flow velocity

Coatings Transport Testing: Transport Test Apparatus







Coatings Transport Testing: Preliminary Observations

- Time-to-sink is significantly influenced by specific gravity (SG)
  - Alkyd coatings (SG = 1.05) did not sink
  - Heavier coatings typically sank within 1 second
- Transport velocities were influenced primarily by SG and chip shape
  - Alkyd coating (SG = 1.05) injected into the flow transported at 0.2 ft/s
  - Heavier coatings had higher transport and tumbling velocities
  - Curled chips generally had lower tumbling velocities than flat chips

Important Messages

1. NRC's research program is designed to provide basic conceptual understanding about several important technical issues which impact ECCS functionality
2. NRC's primary research role is to provide confirmatory information so the staff can independently evaluate whether licensees satisfy regulatory requirements
3. Several important research findings have been discussed that should be considered in reaching an acceptable resolution of the technical issues raised in Generic Letter 2004-02
4. Thorough understanding and consideration of plant-specific issues is required to assess the implications of research findings and develop acceptable resolution strategies

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

Presented by:
Jon Hopkins
Thomas Hafera
Michael Scott
Office of Nuclear Reactor Regulation

Presented to: Advisory Committee on Reactor Safeguards
March 9, 2006

Purpose of Presentation

- Update the Committee on progress to date in addressing GSI-191, challenges and issues that remain, and plans for addressing the challenges and closing the GSI

Presentation Topics

- Background
- Chemical Effects
- Coatings Issues
- Downstream Effects
- Path Forward

GSI-191

- Objective: Ensure that post-accident debris blockage will not impede or prevent operation of PWR emergency core cooling system (ECCS) and containment spray system (CSS) in recirculation mode

UNITED STATES NUCLEAR REGULATORY COMMISSION

GSI-191 Milestones to Date

- Bulletin 2003-01 issued June 2003
- NEI methodology guidance document submitted May 2004
- Generic Letter 2004-02 issued September 2004
- NRC Safety Evaluation issued December 2004
- Licensee detailed responses to GL 2004-02, September 2005
- Information Notice 2005-26 issued September 2005
- IN 2005-26 Supplement 1 issued January 2006

Generic Letter 2004-02

- Requests addressees to 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
- Requests licensees to implement, by end of 2007, any plant modifications that the above evaluation identifies as being necessary to ensure system functionality
- By Sep 1, 2005, addressees were to provide:
  - Results of the evaluation
  - Modification implementation schedule
  - License amendments and/or exemption requests (if needed)

Generic Letter 2004-02 Responses

- Responses were due September 1, 2005
- All plants are upgrading or have recently upgraded their sump strainers
- While the responses were not complete, industry continues to make progress toward resolving this issue
  - Industry will provide updates to their September responses as information becomes available
  - Industry will meet with the staff periodically to keep the staff informed of the industry efforts to resolve this issue
- The staff issued requests for additional information in February 2006. Industry will respond in supplements to September 2005 GL responses
- Five units have requested additional time beyond 2007 to complete their corrective actions

Chemical Effects

- Corrosion products, gelatinous material, or other chemical reaction products that result from interaction between containment materials and the containment environment after a loss-of-coolant accident

- May affect head loss across sump strainers and downstream components

Chemical Effects Approach

Industry

- ICET (LANL)
- Bench Top Testing (WOG)
- Plant Specific Testing/Analysis

↓

Plant Specific Chemical Effects Evaluation →

NRC

- ICET (LANL)
- Bench Top Testing (Various)
- Head Loss (ANL)
- Speciation Modeling (SwRI)

↓

NRC Review

UNITED STATES NUCLEAR REGULATORY COMMISSION

Path Forward - Chemical Effects Evaluations

- Staff will receive and comment on Westinghouse Owners Group (WOG) report that proposes guidance for industry chemical effects evaluations
- Staff will continue interactions with screen vendors to resolve technical issues with plant-specific testing
- Staff will use information from confirmatory Office of Nuclear Regulatory Research work to perform independent evaluation of licensee chemical effect evaluations

Coatings Issues

- NRC adopted conservative positions for coatings zone of influence, coatings debris characterization, non-qualified coatings failure, and coatings debris transport

- Plants could deviate from these positions with an adequate technical justification (test data)

- Staff will evaluate testing that licensees provide to ensure that it is technically sound and applicable

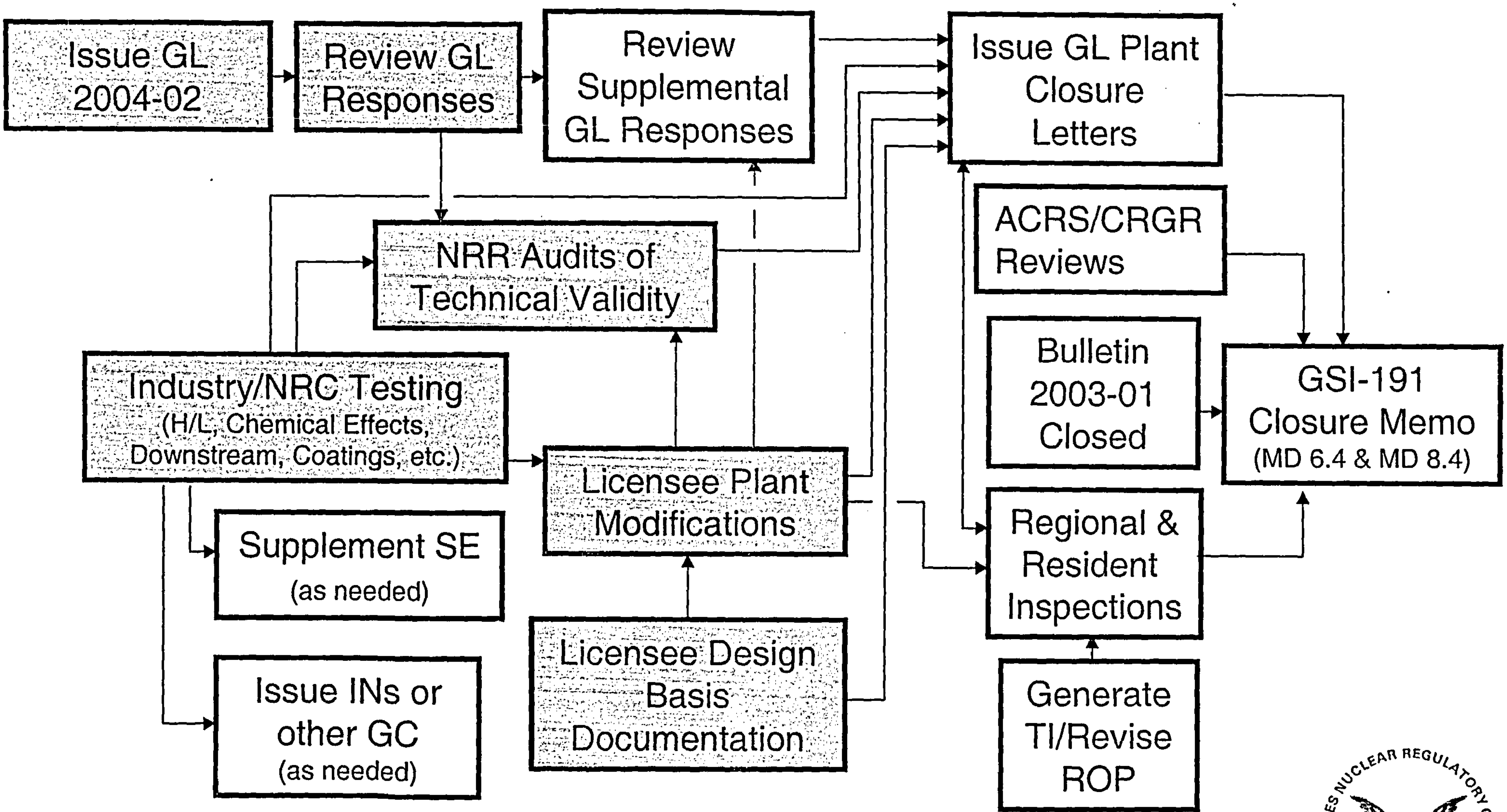
Downstream Effects

- Design of systems for handling debris-laden fluids is a mature science
- Almost all licensees are using the Westinghouse Owners Group (WOG) report WCAP-16406P for their evaluation methodology
- Staff reviewed WCAP and provided comments to the WOG in October 2005

Path Forward - Downstream Effects

- Staff has draft review guidance for fuel and reactor vessel issues
- Staff will continue to work with the WOG and licensees on WCAP issues, site-specific issues, and responses to staff's requests for additional information
- Staff will review licensee modifications and industry tests for downstream issues, including in-vessel issues
- Staff will run confirmatory computer analysis of effects of potential flow blockage in the vessel

GSI-191 Resolution Path Forward



Regulatory Approach to Issue Closure

- High confidence that enlarging strainers will enhance safety – staff expects modifications by end of 2007
- Additional measures may be identified as a result of ongoing testing
- NRC has provided an approved resolution methodology and will verify adequacy of implementation through inspections and audits
- Licensees are responsible for resolving sump issues at their plants
- Industry developing additional guidance, on which staff will comment
- Solutions are largely plant specific
- Issue closure based on reasonable assurance plants compliant with 10 CFR 50.46 and other applicable regulations

Acronyms for Figures

ANL	Argonne National Laboratory
GC	generic communications
H/L	head loss
ICET	Integrated Chemical Effects Test
IN	Information Notice
LANL	Los Alamos National Laboratory
MD	Management Directive
ROP	Reactor Oversight Process
SE	safety evaluation
SwRI	Southwest Research Institute
TI	Temporary Instruction

UNITED STATES NUCLEAR REGULATORY COMMISSION

Generic Safety Issue 191

Brian W. Sheron
Office of Nuclear Reactor Regulation

Advisory Committee on Reactor Safeguards
March 9, 2006

Background

- Chemical effects testing raised additional concerns about debris loading on screens. Industry initially did not aggressively pursue issue

- Many licensees approached the issue by planning significantly larger screens with excess margin to account for areas of uncertainty, in some cases literally the largest screens that the containment can accommodate

- A few licensees are pursuing an active strainer design

Status

- Staff has recently confirmed its expectation to licensees that modifications to address sump issues should be in place by end of 2007

- Both staff and industry believe that installing modified strainers at this time is correct thing to do. Downstream effects can be accommodated through engineering evaluation and component modification, as necessary

- Industry has said that a nominal amount of time (i.e., 6 months to a year) for additional analysis would not affect modified strainer installation plans, because modified strainers have already been designed, procured, and scheduled for installation

Path Forward

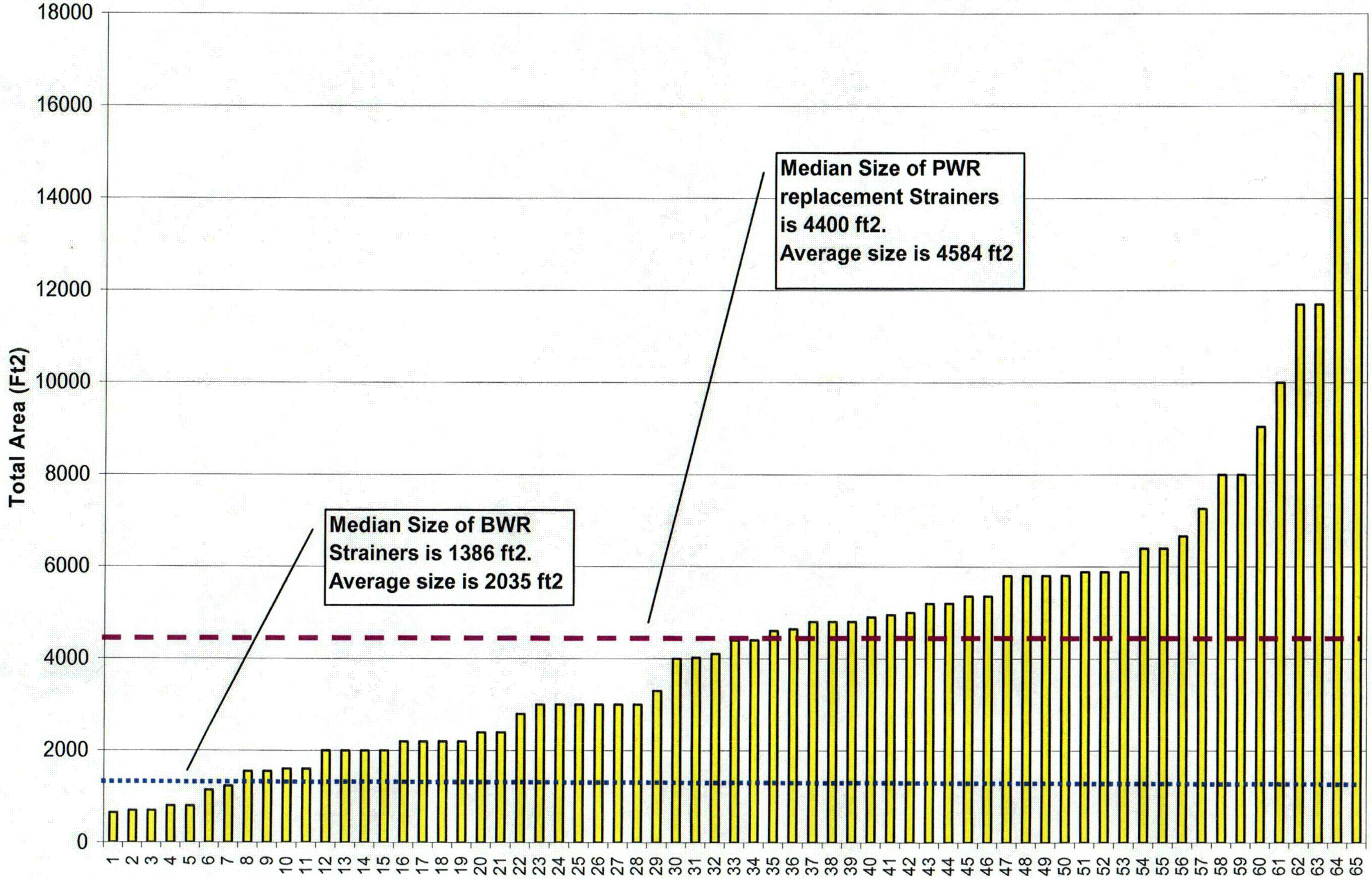
- Waiting until all testing and analysis is completed would result in unacceptable modified strainer installation dates, and would likely not significantly affect the size of the installed strainers

- Moreover, if subsequent testing and/or analyses show modified strainers still don't provide adequate margin, likely resolution would be further reduction of debris loading on strainers (e.g, fibrous insulation removal, alternate buffering agent)

- Further testing and/or analyses will be done to confirm acceptability of margins

- Staff conclusion is that current schedule for modified strainer installation should be maintained and will provide significant improvement in safety compared to current strainers

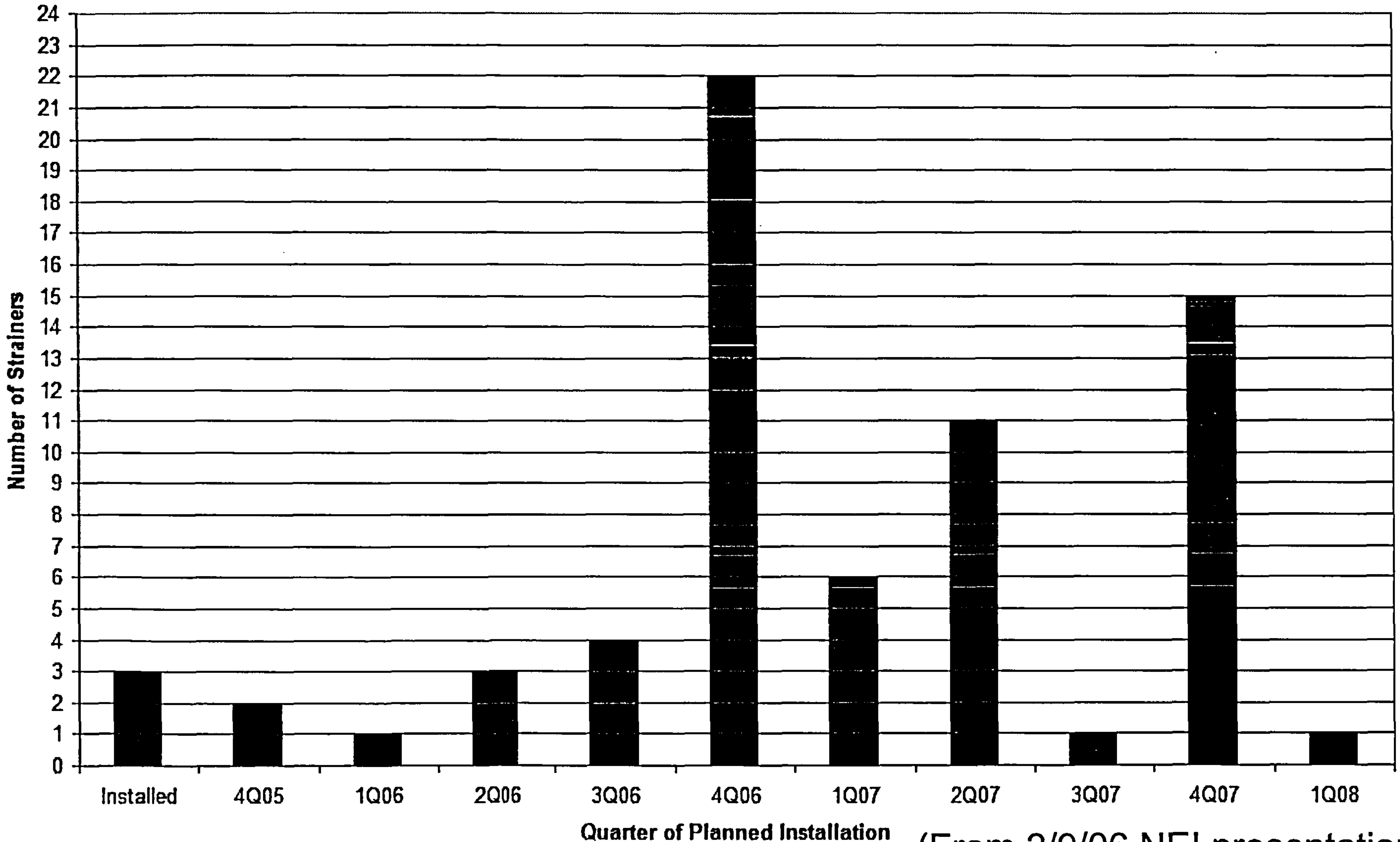
Estimated Size of PWR Replacement Strainers (Passive Strainers only) *



* (From 2/9/06 NEI presentation)

C01

Planned Strainer Installation



(From 2/9/06 NEI presentation)

Industry Activities to Address PWR ECCS Sump Performance

ACRS Meeting
March 9, 2006

John Butler
Senior Project Manager
Nuclear Energy Institute
(202)739-8108
jcb@nei.org

NEI

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 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 (development sponsored by WOG)
- Bulletin 2003-01, Potential Impact of Debris Blockage on Emergency Sump Recirculation at PWRs (2003) called for compensatory actions

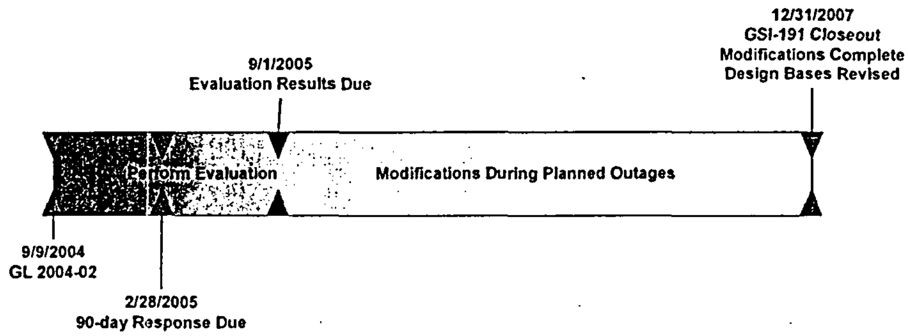
NEI

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

NEI

GL 2004-02 Schedule



NEI

Industry Guidance (NEI 04-07)

- Evaluation guidance, development led by WOG, issued December 2004
- Developed to provide a practical and realistically conservative set of methods
- Used to identify “problem areas” and focus on cost effective areas for refinement and resolution
- NRC issued SER, December 2004
  - SER added conservatism

NEI

Supplemental Guidance

- WOG guidance was prepared to support evaluation in two areas not addressed in NEI 04-07
  - Downstream Effects
  - Results from Joint Industry/NRC Chemical Effects tests and WOG Bench Top Chemical Tests

Downstream Effects

- WCAP 16406-P, *Evaluation of Downstream Sump Debris Effects in Support of GSI-191*
  - Provides methods to perform Downstream Effects Evaluations, issued June 2005
    - Addresses wear, abrasion and blockage impacts of sump screen bypass
  - NRC comments, October 2005
  - Submitted for NRC review in February 2006
  - Current WOG program to address NRC comments and obtain NRC approval

Integrated Chemical Effects Tests

- Jointly sponsored by Industry and NRC
  - WOG support included development of test plan
- Tests conducted between 11/2004 and 8/2005
  - Test reports published; compiling program information into NUREG document to be developed by March 2006

NEI

Bench Top Chemical Effects Tests

- WCAP-16530-NP, *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

Status of Industry Activities

- Survey conducted January 19th
- All 69 plants have completed evaluations necessary to assess need for strainer modifications
  - Three units have assessed that their current strainers are appropriately sized
  - Sixty-six units plan to replace their current strainers

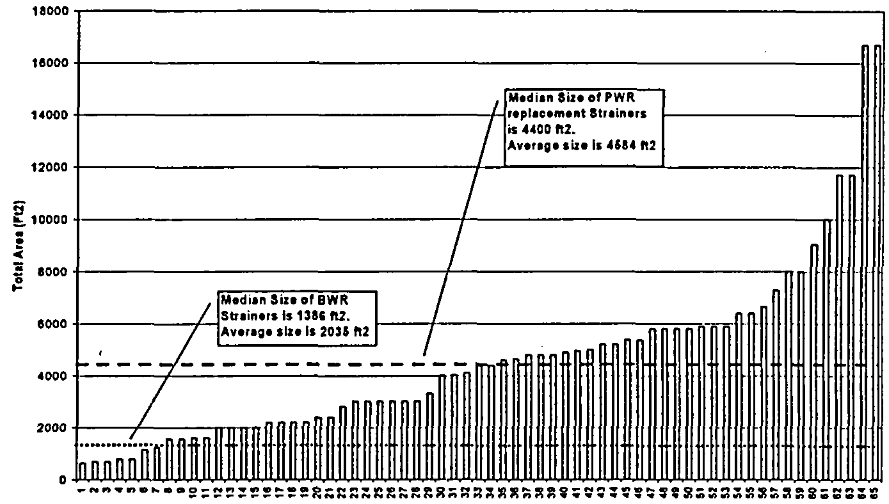
NEI

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
  - Four units intend to install active strainers

NEI

Estimated Size of PWR Replacement Strainers (Passive Strainers only)

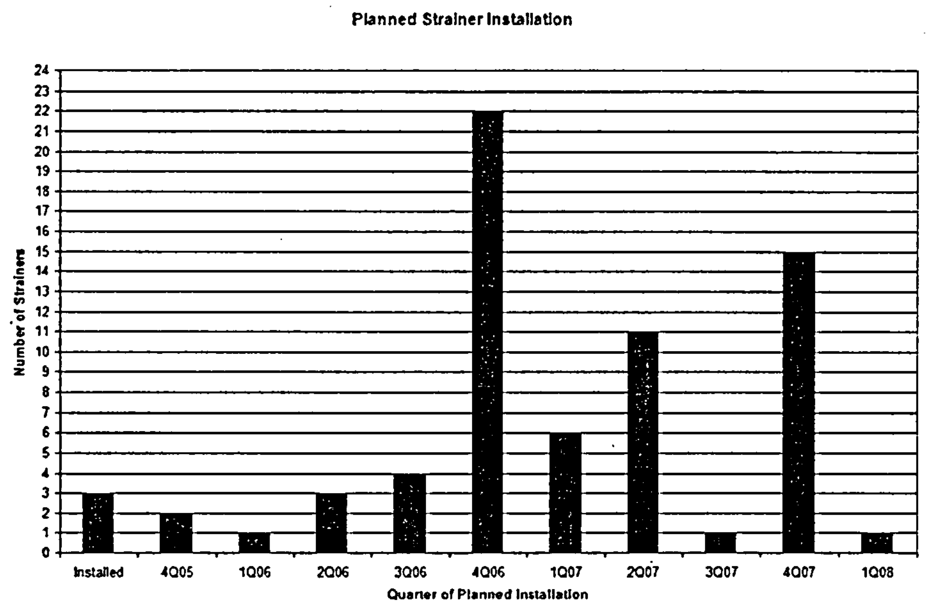


NEI

Factors Affecting Strainer Size

- The variability in sizes reflects a number of factors, including:
  - Plant design
  - Conservatism in methodology application
  - Retained Margin

NEI



Plant Specific Modifications

- 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

NEI

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

NEI

Industry Test Activities

- WOG Chemical Effects Testing
- Strainer Qualification Testing
- WOG Alternate Buffer Project
- STARS Coatings Tests
- FPL/AREVA NP Coatings Tests

NEI

Summary

- WOG, EPRI and NEI activities are directed toward addressing key areas of uncertainty and minimizing plant impacts
- Activities for plant-specific resolution of GSI-191 are continuing

NEI

Browns Ferry Nuclear Plant Units 1, 2, and 3 License Renewal Safety Evaluation Report

Staff Presentation to the ACRS Full Committee

Ram Subbaratnam, and
Yoira Diaz Sanabria, Project Managers
Office of Nuclear Reactor Regulation

March 9, 2006
3:15 - 5:15 PM (EST)

Review Highlights

- **License Extension Request – December 31, 2003**
  - Unit 1: December 20, 2013
  - Unit 2: June 28, 2014
  - Unit 3: July 2, 2016

- **SER with Open and Confirmatory Items issued on August 9, 2005**

- **Final SER issued on January 12, 2006**
  - Two (2) CIs and Four (4) OIs were resolved
  - March 6, 2006 letter - Applicant certified CLB differences in Unit 1 satisfied 10 CFR 50.59 criteria and ready for audit (TI 2509/001)
  - Supplemental SER will provide details/clarifications on Unit 1 Periodic Inspection Program and resolution of OI for Drywell Shell Corrosion

- **Open Items (OIs)**
  - **Two (2) OIs (Closed)**
    - Time-limited aging analysis: OI 4.7.7
    - Unit 1 Periodic Inspection: OI 3.0-3 LP (lay up)
  - **One (1) OI AMP Inspection**
    - RHRSW piping

- **Open Item 2.4-3: Drywell Shell Remains Unresolved**

ACRS Interim Report Letter

Highlights

- Interim Report Letter – October 19, 2005
- Response to Letter – November 28, 2005
- Four major recommendations
  - The final SER included:
    - Resolution of four OIs
    - Discussion of Units 2 and 3 operating experience and its applicability to Unit 1
    - Description of Unit 1 Periodic Inspection Program attributes
    - Evaluation of operating experience at up-rated power level that incorporates lessons learned into the AMP prior to the PEO

SER – OI 4.7.7 (Closed)

OI 4.7.7: Stress Relaxation Core Plate Hold-Down Bolts

- Applicant committed to perform plant specific analysis per BWRVIP-25
- Analysis will be submitted for staff's review and approval two years prior to entering the PEO

SER – OI 3.0-3 LP (Closed)

OI 3.0-3 LP (lay up): Unit 1 Periodic Inspection Program

- Staff requested and evaluated program that was included in final SER Section 3.0.3.3.5
  - Plant specific program to monitor latent aging effects of left in place / lay up components in Unit 1
  - Assures level of safety of Unit 1 left in place / lay up components equivalent from those components in Units 2 and 3
  - Staff's reviewed subsequent sampling methodology to confirm consistency with NUREG-1475

- The program will be fully developed and implemented prior to Unit 1 restart

RHRSW Piping Confirmatory Item

Inspection report – November 7, 2005

- RHRSW suction side: Three 24-inch diameter cast iron pipes, cast into concrete of the intake structure, have never been inspected
- On February 14, 2006 letter, the applicant committed to perform one-time inspection by using a remote method before entering the PEO
- Staff asked the applicant to confirm no blockage path through pipes by using the buried piping inspection program and tanks as recommended by GALL
- Applicant agrees with the staff and will provide this as a commitment
- Pending on formal submittal this is a confirmatory item
- No additional safety issues were identified, therefore aging management inspection is closed as documented in letter dated March 1, 2006.

SER – OI 2.4-3 (Open)

- Earlier, the applicant indicated that no significant degradation observed in normally in-accessible areas of the drywell
- Staff accepted a one-time UT inspection based on the understanding that the degradation is insignificant
- Inspection will be done prior to restart for Unit 1 and before entering the PEO for Units 2 and 3

SER – OI 2.4-3 (Continued)

On March 9, 2006 new information verbally provided by applicant on Unit 1 drywell UT data

- Found a small localized area of wall thinning
- Applicant is evaluating issue to provide impact on drywell integrity for all three units
- Evaluation will be provided to the staff for review
- Staff evaluation will be documented in Supplemental SER
- Therefore, OI 2.4-3 remains open

ACRS Interim Report Letter
Operating Experience Applicability

- Applicant claims:
  - Unit 1 Environment was maintained consistent with those of Units 2 and 3
  - Unit 1 experienced the same aging mechanisms and rates
  - Water chemistry within Unit 1 piping systems maintained in Service met operating purity requirements
  - Effective portions of certain systems in areas where OE from U 2 & 3 showed adverse effects from uncontrolled lay up were replaced for all three units
- Staff questions the applicant's statement of OE applicability
- Unit 1 Periodic Inspection Program will be an acceptable mitigating action for the lack of applicable OE

ACRS Interim Report Letter

AMR and AMP evaluated at EPU level

- Applicant to evaluate BFN operating experience at the up-rated power level and incorporate lessons learned into their aging management programs for the PEO

- Applicant committed to implement operating experience and aging management program reviews before entering PEO

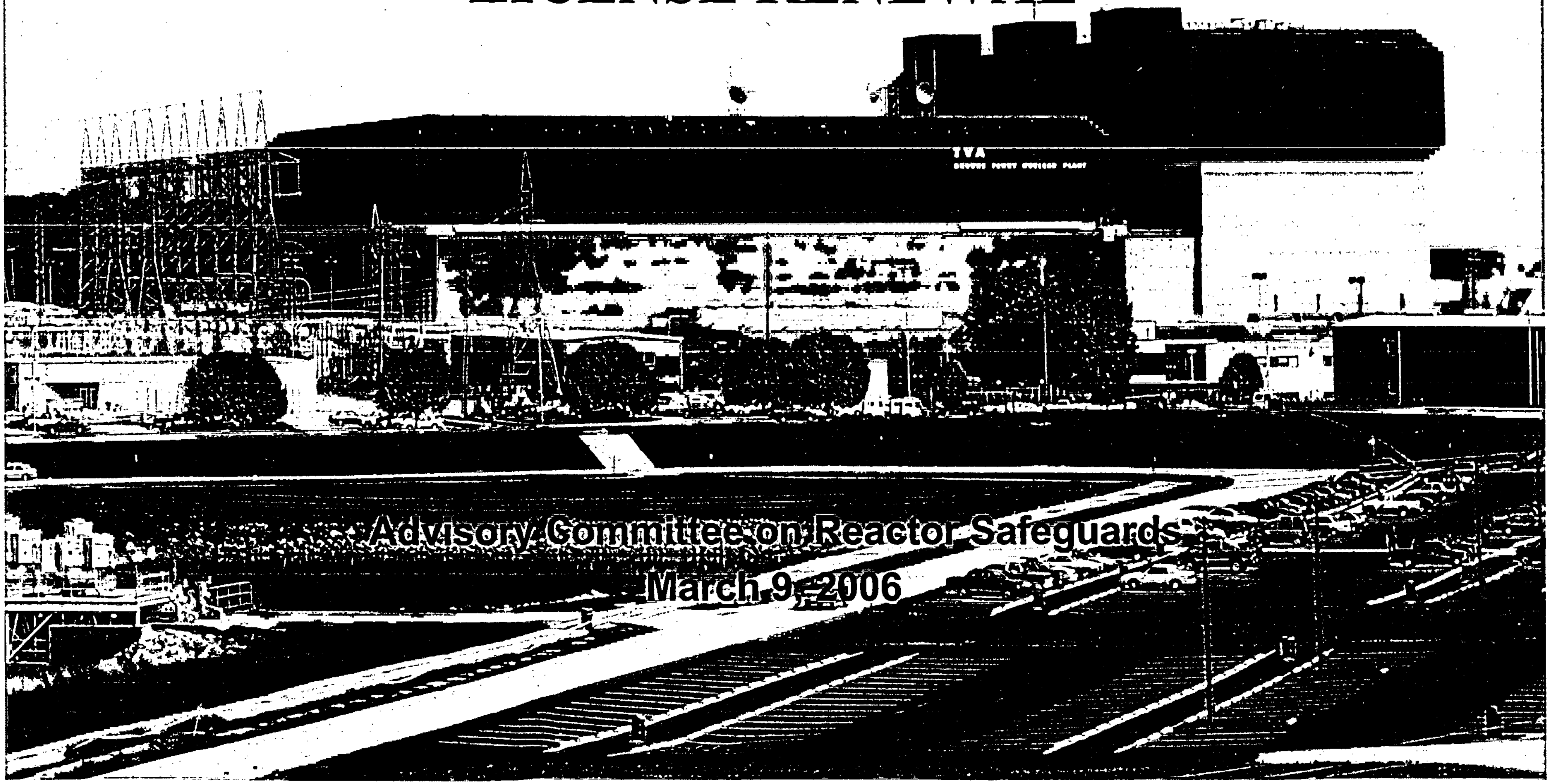
Conclusion

- On the basis of its evaluation of the license renewal application, the NRC staff concluded that the requirements of 10 CFR 54.29(a) have been met, pending resolution of OI 2.4-3.

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT

TVA

LICENSE RENEWAL



Agenda

• Opening Remarks	Masoud Bajestani
• Description of Browns Ferry	Bill Crouch
• BFN License Renewal Application	Bill Crouch
• Unit 1 Major Equipment Replacement / Repair	Joe Valente
• Operating Experience Applicable to Unit 1	Bill Crouch
• Unit 1 Periodic Inspection Program	Joe Valente
• Major Exceptions to GALL Report	Ken Brune
• Corrective Action Program	Rich DeLong
• License Renewal Commitments	Rich DeLong
• Status of AMP Implementation	Rich DeLong
• Unit 1 Maintenance Rule Implementation	Bill Crouch
• Summary	Bill Crouch

Description of Browns Ferry

- All Three BFN Units are General Electric BWR 4 Reactors with Mark I Containments
- Designed and Constructed Materially and Operationally Identical Including Systems, Components, Materials and Environments
- Approximate Years of Operation
  - Unit 1 – 10
  - Unit 2 – 23
  - Unit 3 – 18
- NRC Performance Indicators Green
  - Operating at High Capacity Factor
- Unit 1 on Schedule to Restart in May 2007
- Unit 2/3 Operating at 105% Original Licensed Thermal Power

BFN License Renewal Application

- Three-Unit Application Submitted December 31, 2003
- Original License Expiration
  - Unit 1 – December 20, 2013
  - Unit 2 – June 28, 2014
  - Unit 3 – July 2, 2016
- License Renewal Application at Current Licensed Thermal Power for each Unit (Unit 1 – 3293 MWt, Units 2 and 3 – 3458 MWt)
- Appendix F Describes the Current Licensing Basis Differences Between Unit 1 and Units 2/3
  - These Differences will be Eliminated Prior to Unit 1 Restart (May 2007)
  - Modification and Program Changes in Progress to Eliminate These Differences
  - Current Licensing Basis Same at Restart
- Prepared Using Generic Aging Lessons Learned Report (Rev. 0, 2001)

Unit 1 Major Equipment Replacement / Repair

- Reasons for Replacement / Repair – Examples Provided Below
  - Fidelity with Units 2/3 and Reliability
    - Recirculation Pump Variable Frequency Drives
    - Install Digital Feedwater Control System
    - New Drywell Coolers
    - RHR Heat Exchanger Floating Head
  - Regulatory Issues (Nuclear Performance Plan, GLs and Bulletins)
    - Replace piping subject to Intergrannular Stress Corrosion Cracking
    - Drywell structural steel and electrical penetrations
    - Environmental Qualification
  - Dose Reduction
    - Replace valves due to stellite content

Unit 1 Major Equipment Replacement / Repair

- Reasons for Replacement / Repair
  - Maintenance Reduction
    - Large pump and motor refurbishment
    - Turbine refurbishment
    - Valve replacement / refurbishment
  - Lessons Learned from Unit 3 Layup and Recovery
    - Residual Heat Removal Service Water Piping Replacement in the Reactor Building
    - Extraction Steam Piping (FAC) Replacement
    - Raw Cooling Water Piping Replacement
  - Extended Power Uprate
    - Feedwater Pump and Turbine Modifications
    - Additional Condensate Demineralizer

Unit 2/3 Operating Experience Applicable to Unit 1

- Identical GE BWR4 Reactors with Mark I Containments
- Designed and Constructed Materially and Operationally Identical Including Systems, Components, Materials and Environments
- Unit 3 Shutdown for 10 Years
  - All Units Used Same Layup Philosophy, Processes and Conditions
    - Aging Effects Monitored and Addressed Prior to Unit 3 Restart
    - No Layup Induced Aging Effects During 10 Years of Ensuing Operation
  - Extensive Layup Experience from Unit 3 Directly Applicable to Unit 1
    - Other than Duration, Same Effects
- Anticipated Piping Replacements as a Result of Layup Experience from Unit 3 Incorporated into Unit 1 Recovery Plan
  - RHR Service Water Piping Replacement (A and C Loops)
  - Raw Cooling Water Small Bore Piping

Unit 2/3 Operating Experience Applicable to Unit 1

- Planned Replacement of IGSCC Susceptible Piping in Reactor Recirculation, Residual Heat Removal, Reactor Water Cleanup and Core Spray Systems
- Did not Credit Unit 1 Layup Program as Sole Means to Establish Acceptability of Piping and Components for Restart or License Renewal
  - Visual and UT Inspections Performed to Establish Condition
  - Piping and Component Replacements
- Implementing Same Restart Programs and Modifications as were Completed on Unit 2 and 3
- Implementing Same Aging Management Programs for Duration of Original License Period and Period of Extended Operation
- Compensatory Periodic Inspection of Unit 1 Non-Replaced Piping

Unit 1 Periodic Inspection Program

- Periodic Inspections will be Performed to Verify No Latent Aging Effects are Occurring in Non-Replaced Piping
- Supplements Other Aging Management Programs
- Baseline Inspections Before Restart
- 95/95 Confidence Level Samples for each Group in Accordance with NUREG 1475
- Samples Grouped by Common Material Types and Environments
  - Stainless Steel/Treated Water
  - Stainless Steel/Raw Water
  - Carbon Steel/Treated Water
  - Carbon Steel/Raw Water
  - Carbon Steel/Treated Water Closed Cooling Water System

Unit 1 Periodic Inspection Program

- Sample Points
  - From Non-Replaced Piping In-Scope for License Renewal
  - From Piping not in Operation During Unit 1 Lay-up
  - Includes Areas Where There is Potential for Degradation as well as Areas Where Degradation is not Expected
- First Round of Periodic Inspections will be Performed After Several Years of Unit 1 Operation and Prior to Period of Extended Operation
- Additional Inspections will be Performed during the Period of Extended Operation Prior to Completion of 10 Years of Extended Operation
- Subsequent Inspection Frequency will be Determined Based on Inspection Results

Unit 1 Periodic Inspection Program

TVA

- The Periodic Inspection Sample Locations will be a Subset of Non-Replaced Piping Locations in
  - Residual Heat Removal Service Water (A and C loops)
  - Fire Protection
  - Emergency Equipment Cooling Water
  - Raw Cooling Water
  - Control Rod Drive
  - Core Spray
  - Feedwater
  - High Pressure Core Injection
  - Main Steam
  - Reactor Core Isolation Cooling
  - Residual Heat Removal
  - Reactor Building Closed Cooling Water
  - Turbine Drains and Miscellaneous Piping
  - Radiation Monitoring
  - Radwaste
  - Containment Inerting
  - Reactor Water Cleanup
  - Rector Recirculation
  - Containment
  - Standby Liquid Control
  - Sampling and Water Quality
  - Gland Seal
  - Reactor Vessel Vents and Drains
  - Heater Drains and Vents
  - Condensate and Demineralized Water

Major Exceptions to GALL Report

- No Major Exceptions to Generic Aging Lessons Learned Report
- 39 Aging Management Programs
- 8 Aging Management Programs Have Taken Minor Exceptions to GALL
- Each Aging Management Program is Adequate to Manage the Aging Effects for Which it is Credited.

Exceptions to GALL Report

- Aging Management Programs with Exceptions to GALL
  - Electrical Cables not Subject to 10 CFR 50.49 Environmental Qualification Requirements used in Instrumentation Circuits Program
    - LPRM cables use calibration results of surveillance program
  - Chemistry Control Program
    - Used updated EPRI guidelines for water chemistry
  - Bolting Integrity Program
    - Other AMPs were used for some bolting
  - Inspection of Overhead Heavy Load and Light Load Handling Systems Program
    - Crane fatigue was addressed by TLAA analysis
  - Fire Protection Program
    - CLB requirements used for inspection and testing
  - Fire Water System Program
    - CLB requirements used for inspection and testing
  - Fuel Oil Chemistry Program
    - Different industry standard used
  - ASME Section XI Subsection IWE Program
    - Some inspection and testing requirements based on approved relief requests

Corrective Action Program

TVA

- License Renewal Commitments Tracked with Onsite Commitment Tracking System and Corrective Action Program
- TVA Corrective Action Program Applies to all TVA Units
- Requires All Personnel to Promptly Document and Report Problems and Adverse Conditions for Evaluation and Corrective Action
- Ensures Immediate Action, Operability Evaluation, Reportability Determination, Determination of Severity for Root Cause and Extent of Condition (if required), Management Review, Evaluation, Corrective Action Tracking and Trending
- Condition Identified on any BFN Unit Reviewed for Generic Implications to Other Units and Other TVA Sites
- Internal and External Plant Operating Experience Incorporated into Corrective Action Program

License Renewal Commitments

- Commitments made Through Application and Requests for Additional Information
  - 110 Commitments made to Date
  - Revise Existing Aging Management Programs to Include License Renewal References
  - Enhance Existing Aging Management Programs
  - Implement New Aging Management Programs
  - Completion of Open Items from Draft SER
  - Unit 1 Specific - Appendix F Current Licensing Basis Differences Between Unit 1 and Units 2 and 3
- License Renewal Commitments Tracked Through Onsite Commitment Tracking System and Corrective Action Program

Status of AMP Implementation

- 39 Aging Management Programs Total
  - 11 Existing Aging Management Programs Revised Only to Include Unit 1
    - Complete Revisions in 2006
  - 11 Existing Aging Management Programs Requiring No Enhancement
    - Complete Revisions in 2007
  - 11 Existing Aging Management Programs Require Enhancement for all Units
    - Complete Revisions in 2008
  - 6 New Aging Management Programs
    - Develop by 2009
- Aging Management Program Implementation Packages Have Been Developed for All 39 Programs
- Implement Unit 1 Periodic Inspection Program Prior to Restart

Unit 1 Maintenance Rule Implementation

- Underlying Purpose of Maintenance Rule is to Ensure SSCs are Maintained so that they will Perform their Intended Function when Required
- Because of Defueled Condition Most Unit 1 Systems do not Perform Functions Required to be Monitored by Rule
- Because of Layup Status Most Unit 1 Systems cannot Perform Functions
- Unit 1 Systems that Perform Required Function in Defueled Status or Support U2/3 Operation are Operated and Maintained under Applicable Technical Specifications and Included in Maintenance Rule Program
- Temporary Exemption Created to Resolve Issue Raised in 1997 NRC Initial Maintenance Rule Inspection – Eliminated When System Required to be Operable by Technical Specifications

Summary

- Three-Unit Application at Current Licensed Thermal Power
- Prepared using Generic Aging Lessons Learned Report
- Unit 2/3 Operating Experience Applicable to Unit 1
- Unit 1 Periodic Inspection Program for Non-Replaced Piping to Verify No Latent Aging Effects are Occurring as a Result of Layup Duration
- Aging Management Programs Established to Manage the Effects of Aging so that BFN can be Operated Safely in Accordance with Current Licensing Basis for Period of Extended Operation
- License Renewal Commitments Tracked Through Onsite Commitment Tracking System and Corrective Action Program