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NUCLEAR REGULATORY COMMISSION

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485th MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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WEDNESDAY,

SEPTEMBER 5, 2001

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ROCKVILLE, MARYLAND

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The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, Rockville, Maryland, at 8:30 a.m., Dr. Mario V. Bonaca, Acting Chairman, presiding.

PRESENT:

MARIO V. BONACA, Acting Chairman

F. PETER FORD

THOMAS S. KRESS

DANA A. POWERS

STEPHEN L. ROSEN

WILLIAM J. ShACK

PRESENT (Continued):

JOHN D. SIEBER

GRAhAM B. WALLIS

ACRS STAFF PRESENT:

JOHN T. LARKINS, Executive Director

SHER BAHADUR

PAUL A. BOEHNERT

SAM DURAISWAMY

CAROL A. HARRIS

HOWARD J. LARSON

AMARJIT SINGH

C-O-N-T-E-N-T-S

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

(8:30 a.m.)

CHAIRMAN BONACA: Good morning. The meeting will now come to order.

This is the first day of the 485th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting the committee will consider the following:

Proposed resolution of genetic safety issue, GSI-191, assessment of debris accumulation on PWR sump pump performance;

EPRI report on resolution of generic letter 96-06, waterhammer issues;

Reconciliation of ACRS comments and recommendations;

Reactor oversight process;

Proposed ACRS reports.

A portion of this meeting may be closed to discuss EPRI, information applicable to EPRI report and resolution of waterhammer issues.

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

We have received no written comments or 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. First of all, a list of topics for the meeting with the Commissioner Merrifield tomorrow morning has been distributed to you and also has been E-mailed to you. The expectation is that the subcommittee chairmen responsible for the individual items which are in the list will take the lead in the discussion during the meeting with the Commissioner.

A second item, I'm sorry to announce the death of an ex-ACRS member, Mr. Jeremiah Ray. He was an ACRS member between 1978 and 1983. He served as Vice Chairman in 1982, and as Chairman in 1983. He retired in 1984 due to health reasons. He passed away on August 2001.

We will, I think, prepare a card and circulate it for signature from individual members and then mail it to his wife.

With regard to the items we have in front of us, the first presentation is going to be on the proposed resolution of GSI-191. The staff does not have yet the proposed resolution. So the intent here is to listen to the presentations and then make a decision on our part whether or not we want to write a report at this time.

Okay. So we'll decided after the meeting.

Another item, you have in front of you items of interest. In the first page you'll see there is a list of five Commissioners' speeches, and also under miscellaneous items, you'll see the last item is the announcement of the 29th Nuclear Safety Research Conference in October 22nd-24th, 2001, and the result of the registration form are attached.

I also believe that there is an introduction we want to make, and for that I turn to John.

DR. LARKINS: Yes. I'd like to introduce our latest member to the staff, Scott Sunn, and Scott is a senior computer science major at the University of Maryland. He's going to be co-oping with the ACRS ACNW staff for the next four or five months. Hopefully he'll have an opportunity to learn something, but if anybody needs any help in the computer or ADP area, Scott --

(Laughter.)

DR. LARKINS: -- is more than willing and quite capable of helping out. So I'd like to introduce him.

Thank you.

CHAIRMAN BONACA: Welcome aboard.

With that we'll move to the first item on the agenda is the proposed resolution of the generic safety issue, GSI-191. Steve Rosen is responsible for that.

DR. ROSEN: Thank you, Mario.

It's an important issue that we heard a briefing on in July, and I understand this briefing will follow onto that perhaps with a slightly different slant.

Please go ahead.

MR. MAYFIELD: Mr. Rosen, if I might, I'm Mike Mayfield from staff.

I just wanted to touch on a couple of points before we started. Since the July meeting, staff has been fairly busy trying to finalize the parametric evaluation that we briefed you on in July and completing the risk and cost benefit analyses.

And Art Buslik is with us this morning to describe those analyses.

The other thing that we did since the July meeting was reached a management decision to transition this GSI from the old process under a particular office letter to the Management Directive 6.4 process.

The committee has been briefed previously on that process, and we felt like this was a good time since the staff is getting ready to make 6.4 the accepted process for handling genetic safety issues. We're at a point in the management of GSI-191 where the old process and the new process most closely align. So instead of the resolution step, this is now the technical assessment step, but it's fundamentally the same thing, although there are some substantive differences.

One of the things Mike is going to describe for you today is the difference between those two processes and the benefits, such as they are, in making the transition at this time.

This was a management decision that we reached in August, and we apologize for not having gotten this to you sooner, but it was something that we felt like this was the appropriate time to make the transition.

Now, under Management Directive 6.4, there isn't an explicit request for a letter from the committee at this juncture. However, that is an issue, as we discussed this with Mr. Thadani yesterday. this is an issue that he feels like needs to be revisited in the management directive. He doesn't think that it is in the best interests of the staff, the committee, or the public to move forward from the technical assessment step to the -- I've forgotten what they're called.

MR. MARShALL: The regulatory guidance.

MR. MAYFIELD: The regulatory guidance step without having some explicit feedback from the ACRS on whether or not you believe the proposed approach, as this moves from research to NRR. He feels like it is appropriate to request a letter from the ACRS at this juncture.

So that's a step in the management directive we are going to be revisiting in the very near future, but it is something that we would request a letter from the committee if you're so inclined to write one at this juncture.

With that, I'd like to turn the presentation over to Mike Marshall and Art Buslik.

MR. MARShALL: Good morning. My name is

Michael Marshall. I'm the project manager for Generic Safety Issue 191, and Art Buslik and I will be making a presentation today.

I will be talking about the change from the old process to the new process: how does it affect Generic Safety Issue 191? I'll describe the proposed recommendation we'll be sending to NRR for resolution of Generic Safety Issue 191.

And Art will build on our technical basis for that, for our recommendation, and at the July meeting we talked about the work that LANL did for us with the parametric evaluation.

Here in Research, we had Sid Feld do our cost estimates for us. Art did our benefits estimates and the core damage frequency contribution estimates, and he'll be covering that at the latter of the presentation today.

And this is just to reiterate. Almost everybody is familiar with Generic Safety Issue 191 since we are looking to see if debris accumulation on sump screen strainers causes problems for long-term recirculation. From our last briefing we've concluded, yes, there's a possibility. Well, yes, that's a credible concern.

But because of the variations, large

numbers of variations from plant to plant, we can't say specifically if a particular plant has a problem. So our recommendation -- I'll give a little bit of it away -- is that plant specific analyses are required to make that determination.

But before going on to our recommendation, talk about the change in the generic safety issue process. Under the old process, and the status of new process essentially is the management directive administration essentially are checking to make sure it's in the right format, and so it should become final very soon.

And under the old process, the first three stages of both processes line up very nicely, and after the third stage they don't line up as nicely again, and so we thought this was a fine time to move Generic Safety Issue 191 from the old process to the new process for a couple of reasons.

Because Management Directive 6.4 has been receiving a lot of circulation within our office reviews and such, a lot of managers and staff actually might seem a little bit more familiar with the process that we're about to implement than the older process, and some of the discussions we're having between the offices we found out we would end up losing a number of time because we're talking one process and the other parties, assuming this management directive is what is going to be guiding the agency's generic issue process.

And so we found out we were talking past each other even though we agreed on technical details and how things should follow after that, and so that was one reason for switching processes, was just clarity internally.

Another reason is Generic Safety Issue 191, at this point we are not going to close it with no new actions or no new requirements with saying that there's no additional actions. So it's going to go on for another couple of years possibly, and under the old process, at this point we would have resolved Generic Safety Issue 191 and officially on the books it would have been closed.

In reality, we would have still been working sump block, again, for maybe a couple of years, where under the new process -- and this is one of the things we think we're taking advantage of -- is that they'll be tracking all the way through the verification so that it will be clear that the safety concern, the concern 191, was addressed then from outside the stakeholder's point of view. They can look at it and track 191 to see how it was fully implemented.

DR. WALLIS: You mentioned the word "closed." Now, when is the issue closed? It used to be closed around the resolution point in the old process.

MR. MARShALL: Right. Under the old process, it would have been closed under the resolution, at the resolution process. Now an issue is closed when we determine that no further action is required.

For instance, we went through our analysis and determined that there's nothing here. There's no need for backfit. There's no safety benefit with this issue, and we'll close it with that finding.

For issues that at the end of the technical assessment stage, where we say, "Hey, there's something here. There's something that needs to be addressed," we won't close it at that point because it was truly before never closed, and then we'll keep working the issue.

And if you're interested in the Generic Safety Issue 191, you won't have to grope around for finding what's the new identifier.

DR. WALLIS: Would you then close it at

the verification stage if you had to take action?

MR. MARShALL: Well, any point along -- it will be closed any point along here if it was discovered. For instance, let's say NEI and the Westinghouse Owners Group, they do additional work and decide, hey, we've found out that this isn't as big of a concern as you thought. We don't need to do any additional action, and they provide that to us.

And we might close it saying, "Hey, the industry says, has proven to us that this isn't a legitimate concern," or we begin. It goes all the way through where there's hardware modifications, and at that point it would be at the verification where we go back and check either through inspections or audits of selected utilities that it was implemented as we expected.

CHAIRMAN BONACA: But, you know, if I compare those two tables, I could be drawn to conclude that before you reached a resolution without performing a technical assessment, of course, you need to perform a technical assessment, right? I mean, a technical assessment was part of the resolution process.

MR. MARShALL: Yes.

CHAIRMAN BONACA: And all you did, you

expanded. I'm still confused about what is new about the new process, I mean.

MR. MARShALL: Well, what's new if we go to the next page, the key differences between the new process and the old process is not giving the perception that something has been closed when it's actually still being worked.

CHAIRMAN BONACA: Okay.

MR. MARShALL: That's the biggest difference, and I believe that was probably rooted more as a public confidence type of concern.

CHAIRMAN BONACA: Okay.

MR. MARShALL: Another one is just, again, for ease of tracking. The generic safety issue designation will live on with the issue all the way through verification, where in the current process at the end of the resolution stage, the generic safety issue designation is no longer used as it goes through the remaining stages of imposition, implementation, and verification.

In the past usually that was turned into what's termed a multi-plan action.

CHAIRMAN BONACA: Okay.

MR. MARShALL: Now, the practical impact on us from moving from the old process to the new process, and it boils down to two things. At the end of the technical assessment stage we won't have a resolution that's the agency position on this is what' going to be done.

What happens here is Research will send a recommendation to NRR with our proposed recommendation for resolution, and that will be the next slide. So instead of the consensus that we're sending to the EDO saying, "Hey, this is how Generic Safety Issue 191 will be resolved," or sending a recommendation over to NRR, and so instead of -- and the couple I'd already mentioned it -- there's no longer a memo to the EDO at the end of the stage. It's an interoffice memo.

DR. WALLIS: What is the driving force for finishing the job? These things in the past have hung around.

MR. MARShALL: Right now the driving force, I would say, for finishing the job is a couple. There's a lot of oversight for generic safety issues. Internally there's a lot of office level attention given to our deadlines.

Working these, there's a lot of emphasis on finishing them in a timely manner.

DR. WALLIS: So there's some incentive for some manager to say it's being done or there's some --

what's the --

MR. MAYFIELD: If I might, this is Mike Mayfield from the staff.

There is a congressional oversight group. Senator Dominici receives a monthly report on the status of each and every generic safety issue, and this is something that at very senior levels in the agency has taken quite seriously.

So there is significant impetus to continue and not lose momentum on pursuing these issues.

MR. MARShALL: And by going to the new process, it keep sit in that. It keeps that visibility on this generic safety issue.

Okay. I just want to cover the last bullet on page 5. I think we've addressed the first two already, and so at the end of this month, by the end of September, we plan on sending our recommendation via memo to the office director of NRR, and at that point, in addition to closing the technical assessment stage, we will also be transferring the lead for Generic Safety Issue 191 from the Office of Research to the Office of Nuclear Reactor Regulation.

And the proposed recommendation we plan on sending to NRR is on page 6, and there's two parts to our recommendation.

There's two parts to our recommendation. The first part is to conduct the plant specific analysis, determine whether debris accumulation will impede or prevent ECCS operation during long-term cooling, during recirculation.

And the second part is if you discover a vulnerability during that assessment is to implement appropriate corrective actions.

DR. KRESS: Now, since the staff was unable to actually do this on its own, do you think the licensees have the capability to make this determination?

MR. MARShALL: Well, we think they have the capability. Yes, we do think they have the capability.

DR. KRESS: Do you think they can actually track, determine the source of this debris and track its transport and end up with how much and what the characteristics of the debris is that reaches their sump? Do you think they have that capability?

MR. MARShALL: Yes, I do.

DR. KRESS: Is there guidance that is given to --

MR. MARShALL: Not specifically for PWRs. We had issued guidance for BWRs, and there's quite a bit of overlap in the guidance, considering it's usually done at a performance base level.

And essentially the guidance boils down to identify the debris, estimate how much transports, and then estimate what the head loss would be.

DR. KRESS: Yes, of course.

MR. MARShALL: And that's more or less it. Now, the specifics of what particular debris they have in there is something we would leave up to the licensees to determine or whoever is conducting that analysis would determine.

DR. KRESS: That's probably a plant specific issue anyway.

MR. MARShALL: Right. That's true.

DR. KRESS: When each licensee makes this look to see if they're vulnerable, what happens then? Do they come back to you with a report or do they fix it and you review the fix or what is the next step?

MR. MARShALL: That hasn't been decided yet. That's where NRR will enter in the next stage of the process. They'll map out how it's implemented.

DR. KRESS: Okay. That's up to NRR to do.

MR. MARShALL: So that's still to be done.

DR. POWERS: Let me ask more about this debris, and some aspects of it certainly could be plant specific, I imagine. Different types of insulation get torn off in the blow-down process, but I would suspect that some of it is very generic in nature.

Do we have guidance on what that generic component of it is?

MR. MARShALL: Let me answer your question slightly differently. I think we would look at the debris from the way it's created, not at a specific material. For instance, debris would be created by direct impact from the jet. The possibility debris would be created by the environment in the containment, and that will include chemical reactions possibly.

And that's where we would direct probably our guidance if we started assembling guidance. That's what we would probably recommend. Then we could say specifically what jet impact would have to look at different types of materials.

The main one we focus on a lot because it's a large source is thermal insulation. Then, again, we would recommend fire barriers possibly, especially if there's any fibrous content with that.

And then we could point out what would be the more problematic debris types. Again, that would be a fibroblast, your calcium silicate. So be very careful when you're doing your assessment of sources that you identify these types of debris because they tend to be the worst actors.

And coupled with that would be particulates. Again, that would be generated possibly from the environment of the containment. During normal operation you might have some of that material generated and also with the jet impact.

DR. POWERS: There's been within this general field a lot of discussion of gelatinous material. Do you give them any guidance on that?

MR. MARShALL: Yeah. Well, specifically, we would recommend that people look at right now -- this is Michael Marshall if I'm sitting taking notes back from the guidance.

DR. POWERS: Okay.

MR. MARShALL: Again, point out chemical reactions, then give examples of where this has been seen, and then again, leave it up for licensees in case we miss something to look for similar type of debris generation, or whoever is doing the analysis.

DR. POWERS: Gee, I wonder how you look

for that. I mean, can you go to the Journal of Chemical Phenomena during reactor accidents and say --

(Laughter.)

MR. MARShALL: What we did was we did our literature search, and we started looking for just chemistry following a LOCA, and there was a number of things we found, such as zinc precipitates, and we started collecting that information.

So there's some things that wasn't done specifically for debris clogging, and again, if you just start out with a broad literature search, you start finding work, and we found work that the Finnish regulators had done in this area that was very beneficial. We shared that with industry on the 26th and 27th of July of some of the sources that you can look at.

And again, some of it when we went through it, we didn't use everything we discovered during our literature searches and our reviews, and so that's another area where we'll probably have to do a little more documentation than we planned to so that people will be fully aware what we learned during this process.

Because as we mentioned in the July meeting, we didn't use everything we learned to prove our case that this is a concern that we need to worry about. So we know we might have collected a few more bits of information that we haven't shared, and that's one of the major comments we get from industry is, "Please tell us what you know. Please tell us what you know. Please tell us what you know."

And so in order to facilitate that, we've accelerated our documentation of the work we've done, and we right pretty much have tried by the end of November to distribute everything we've collected.

DR. POWERS: Rain dump.

MR. MARShALL: Yes.

CHAIRMAN BONACA: Now, one thing I remember when this issue was raised in 1995, '96, or whatever, a number of plants did a calculation which were plant specific, and one of the findings was that they really had marginal NPSH and was not an uncommon condition to have the situation, which tells me if you have any degree of blockage, you could have no NPSH at all.

So isn't there some sense of urgency behind this resolution of this issue?

MR. MARShALL: Well, I speak for the Office of Research. There's a strong urgency from my office director down with regards to this issue. Yes, there is a sense of urgency.

DR. WALLIS: Now, thinking back to your presentation last time and the report that your consultants did, there seemed to be a lot of assumptions made about how the debris got to the sump. I mean, you can get a sense of understanding of how jets affect -- steam jets and so on -- affect fibrous insulation.

But then the transport mechanism, I think there was a lot of almost hand waving, UI mean, sort of assumptions and so on. So there's a lot of potential here for some licensees to hire some smart consultants who will do some other kind of an analysis with fancy transport equations and solving and proving that never gets to the sump because we don't really have a very good basis for knowing how the material is transported to the sump.

So there's going to be a lot of debate perhaps, and I'm wondering how that gets resolved.

MR. MARShALL: Well, after the last presentation, I was taken aside by my colleagues and lectured that I didn't give enough credit for the amount of work we did with transport. There are certain areas of transport we're pretty sure once we've published our results, especially once the material gets in water. There's a very strong case that it will make it to the sump spring if it's of a particular size.

We've also done work in trying to estimate what that size is, and we believe we're going to get debris of that size, and then we rely a little bit on our work we did with BWRs on estimating how debris transports in a dry well to the wet well, and we use that to estimate how much would actually get into the water.

So there's enough work we've done out there not just on this study, but when we're working on BWRs which demonstrates that the plausibility of debris getting into the pool of water on the containment floor, then transporting to the sump spring, and in this analysis we made it even easier on ourselves by we essentially at the very beginning excluded debris that could transport and just focused on the smallest debris that would accumulate uniformly on the sump screen.

So, again, some of the stuff that would transport sliding on the floor we didn't include in our analysis to make it simple, but even without that debris, with the stuff that's more transportable because it's very fine and accumulation formally on the screen.

So in our analysis we didn't actually include all the different debris.

DR. WALLIS: So you don't anticipate some real technical issues coming up where the licensees have a different analysis. You think your technical basis is so sound that they will essentially do the same thing.

MR. MARShALL: I'm not going to assume they're going to do the same thing. Some licensees, for instance, the plant that we got some of our cost estimates from, they did things differently because they had different licensing constraints that they weren't willing to change, and so they made assumptions that whatever was destroyed got there.

And as a regulator, I don't think we would argue with that, and the same thing with the BWRs. There's a whole different range of ways that individual plants handle this. I doubt there will be a lot of uniformity as this goes forward. There might be three, four, maybe five different approaches, and then there will be variance on those approaches, but for a BWR experience, everybody kind of did it based on a little bit of what they thought was right and what was their licensing basis and how much did they want to deviate or try to request changes from that.

It's the only fixed increase in the screen area?

MR. MARShALL: No, there's a combination. One reason we picked the increase in the screen area as a fix that's one not only with regards to the BWRs, but through other countries, that was the favorite solution. Other solutions were minimizing your debris, and there's a couple ways to do that.

When we're doing debris generation testing with the Canadians, with Ontario Power Generation, one thing they started considering was essentially put another sheet of jacket over top of some of their insulations, and that significantly in our testing reduced the amount of debris generated.

Another approach is to switch from -- and this was an approach used, I think, by the Finns a good bit -- was they looked at the fiberglass and the more problematic materials, and they decided, let's switch to the RMI.

One thing from our parametric evaluation, the cases that were predominantly RMI, they didn't show up as -- they weren't ones labeled very likely. They were mostly either unlikely or at the most possible for a large LOCA. So changing your debris, minimizing your debris is one solution.

Other things I would expect that seem reasonable measures to take is to reevaluate your net positive suction head margins. I would assume people would do that, see if they have credit for containment over pressure, if that's allowed or if they think that's defensible.

Another one might be operational changes. There's a couple of things. You've got your debris, and then you have the flow rate, and so if you were to use flow rate, you actually would decrease the head loss across the screen, but some people might not want to attach that because it attaches a strong philosophy with regards to how to respond to an accident. You probably don't want to start off by cutting off pumps.

CHAIRMAN BONACA: Are we looking at some scenarios that might be more likely than others? For example, the CRDM housing breaking and debris from the location and could happen, just understand. You know, obviously later on in the presentation there are evaluations of initiating event frequencies and so on and so forth, and they would be interesting to understand. For example, debris generation from an event of that type, there may be something more likely than others.

MR. MARShALL: During the study we didn't consider the CRDMs, and I think the bulletin that went out, they were asking for the type of materials in that area. So at least we would have a feel for what type of materials we would consider.

CHAIRMAN BONACA: Yeah, that's what I was looking for. I mean the kind of debris that you would get from the kind of break.

MR. MARShALL: Just to go back to the presentation for a moment, our technical basis boils down to two things: the presentation we gave you last July, which is the parametric evaluation, and the work that Art will be presenting today on the risk and cost benefit considerations.

Now, we've shared all of this work, except for the cost estimate, with the industry on July 26th and 27th. Actually over two days we were able to get a lot more detail, and unfortunately -- not unfortunately -- we actually covered more detail than we actually had published in the report we released earlier.

That was one of the comments that we got back from NEI, the industry in general through NEI, and they provided several other comments we plan to address.

But if you're interested, I could cover the first -- just recap the parametric evaluation or we could jump straight into the benefit and cost estimates. I would recommend doing that.

DR. WALLIS: Well, let me ask you. Is there agreement from the industry with your conclusions? You made this presentation. Did they say, "Gee, whiz, you're right," or, "no, you're wrong," or what?

MR. MARShALL: They haven't told us we're wrong. I think that's a fair statement.

With regards to whether we're right or not, they would like, again -- their major comment would be, "We know you did more than you shared with us in writing so far. Please give us the rest of it so we could make a better determination if we agree with you or disagree with you."

So their position -- well, I'm going to speak for them -- their position right now is we probably don't have enough information to say if we agree with you or disagree with you. We don't see anything on the surface that seems obviously wrong, but again, we don't have all of the information.

I think that Kurt Cozens is coming up to answer us.

MR. COZENS: This is Kurt Cozens, from NEI.

In all fairness to Mike, was it just Friday that we sent you the letter with the comments?

MR. MARShALL: Yes, right.

MR. COZENS: So he's just received those probably about the time he was wrapping up his presentation material here, and we would be happy to provide a copy of this letter to the staff.

Mike has properly characterized our overall findings that we do not have enough of the specific data to agree or disagree with the findings that the staff has done. They have provided us a lot more information in the meetings that we had at the end of July that were not in the draft report that they had put together, and you know, we are continuing to look at that, and we'll do that once that's publicly available.

And we would be happy to provide ACRS a copy of that letter today.

Mike, do you have a copy that they could have?

MR. MARShALL: I have a copy with me if you'd like to.

MR. COZENS: Okay. So that will help you

guys, and you can see the full range.

DR. WALLIS: So that means that you folks didn't have an assessment of your own to compare with the NRC assessment?

MR. COZENS: We do not have the technical details that the staff has, and we were asked to comment on the --

DR. WALLIS: You must have some technical evaluation from your engineers as to whether or not this is a problem.

MR. COZENS: We are still in the process of seeing the data. We have not seen the data yet. So it would be inappropriate for us --

DR. WALLIS: You haven't seen anybody's data but your own. You must have some sort of a position as to whether or not you think it's a problem, or has it just been something that no one has worried about at all?

MR. COZENS: We are continuing to look at it, and we've had questions about it, but we have not finalized it to make a formal industry position.

DR. WALLIS: Well, that's a little disconcerting if this is a real technical problem and industry has no position.

MR. COZENS: There is an industry group

working on this, but until we have the technical data, we are not able to finalize our conclusions.

MR. BUSLIK: Okay. I'll start on the --

DR. KRESS: Well, before you start, Michael if we wanted any more information on the parametric study since we had previously reviewed it. I'd like to have you refresh my memory on just what parameters were varied and why -- not the actual ranges of those, but why -- what was the basis of choosing the ranges of the parametric variations?

MR. MARShALL: Well, I'll go ahead and leave that up.

In the parametric evaluation, we varied a number of things, and usually the basis for the range we chose was the industry survey we collected. NEI helped us with collecting information on, let's see, sumps, sump screen area size, height of debris curves in containment, times that licensed plants would expect to switch from RWST to the sump.

Sump water height was another factor we considered, and again, that was all based on responses to the survey.

DR. KRESS: Did you vary the -- does your parametric variation include the source of debris?

MR. MARShALL: The only variation we had

with the source of debris was usually the amount of debris, and we varied the combinations of debris depending on how we -- on the varieties we saw at different plants, but we didn't vary the debris types beyond fiberglass, reflective metallic insulation, and calcium silica.

And then we had a reasonable amount of particulate debris, but the amount of those varied from different cases, and so we had cases that were mostly RMI, which again would show up as -- in most of the cases showed up as not being a -- showed up as being unlikely.

Then we had cases where the plants were cases where 100 percent fiberblast, and again, depending on the net positive suction and margin, size of the sump screen area, that ranged from probably possible to very likely.

DR. KRESS: So you took plant specific information.

MR. MARShALL: We took plant specific information. We coupled that --

DR. KRESS: And then coupled that with --

MR. MARShALL: We coupled that with information we collected from two volunteer plants. So from the volunteer plants we got the piping configurations, and so we assumed for all 69 cases they had one of these two piping configuration.

Now, both of those configurations were four-loop Westinghouse units. Again, so when you look at a two loop, as far as the capacity of the screen to accumulate debris, we did a really, really good job there, and that's something I would recommend industry take because it doesn't require you to know how much is just transported and how much is generated.

You can sit down and do a calculation of if you have this type of material in your containment and you assume how much of it do you need to get on your sump screen to exceed your net positive suction margin. That's one thing I liked about the approach we used, is regardless of transport amount of generation, you can always go back and look at what we call the threshold value.

And is that threshold value 100 cubic feet or is it just two cubic feet? And I would say those of us that worked on the evaluation are very confident with that point of the evaluation.

And then, of course, there's the box. I'm assuming people remember the presentation from last time when I referred to the box.

Then there's that box where we had the

unfavorable and favorable assumptions, and that sort of gave a feel for how much we actually thought would get transported to the sump screen, how much would be generated, and then we compared that to the minimum threshold.

DR. KRESS: Thank you. That helps.

DR. ROSEN: Mike, do I understand that in this transition to NRR that's coming up, that NRR will make a determination at that point or after they get it and study the issue for some time as to whether or not they're going to issue a bulletin? Did you say something about an NRR bulletin that I didn't understand?

MR. MARShALL: No, I was referring to the bulletins on CRDMs that went out.

DR. ROSEN: Okay. So there is no bulletin planned on this yet.

MR. MARShALL: No. Right now what -- and I'll speak for NRR, and please correct me if I'm wrong -- right now we're going to send over our technical basis in this information, and NRR wants time to consider again input from other industry groups with regards to our work, and then they'll decide on what's the appropriate regulatory path to take.

Is it a generic communication? If it's a generic community, is it a bulletin generic letter? Is the industry going to step up and propose something which would, again, that the agency might not have to issue a formal -- take formal regulatory action?

DR. ROSEN: Okay. I understand that. That will be decisions made by NRR.

MR. MARShALL: Right.

DR. ROSEN: Now, let me just ask again about the approach of not issuing detailed guidance. I know this is a little early, but that was probed a moment ago by some of the members, and your response was, no, we would not issue detailed guidance on how to do the analysis, the plant specific analyses.

MR. MARShALL: What we would avoid doing is issuing prescriptive guidance. It would probably be performance, and as a debate of whether how quickly we can get guidance out there.

MR. MAYFIELD: This is Mike Mayfield.

The issue of guidance, do you issue a reg. guide or is there some other vehicle? A reg. guide, regulatory guidance, that specific kind of document takes about two years to get out the door in a final form, and there was some, I think, a question earlier about some sense of urgency on this.

We think it's not in anybody's best

interest for the staff to take two more years to promulgate a regulatory guide. So if we set aside a regulatory guide is something that we're probably not going to pursue at this stage.

What kind of guidance would the staff do presumably if we were going to issue some sort of generic communication? That would provide some information , the collection of reports and analyses that Mike and his colleagues have worked on would be available and could be -- we could point to that as one method that could be followed.

So it's not to just go out to the industry with a suggestion they might go do something. We have some -- you know, a fairly specific set of analyses and approaches that will be published and in the public domain and that could be used, and I think in that body of reports, there's a lot of information and a lot of guidance on what -- at least how we did the analysis.

So we're not asking people to just embark on something in a blind fashion. As the same time, we don't see publishing a regulatory guide, at least not in a time frame that would support the industry going off and doing something on this issue.

DR. ROSEN: Well, there clearly is a need for prompt action on this. I think everybody thinks that there is some urgency here.

There is also a need for putting out enough guidance so that you don't get apples and oranges responses that are not into comparable.

MR. MAYFIELD: Yes, we agree. And, again, if the staff chose to go down a path of some sort of generic communication, a combination of information that would be included in that document as well as references to the reports that Mike and his colleagues are getting ready to put out would provide the level of guidance to provide the kind of consistency you're talking about.

DR. WALLIS: Sorry to go back to this, but I've just read this NEI letter which we see here which was sent on August 31st, and all of the comments are critical. It seems to me that we've been talking here as if your conclusions are acceptable, but it's not at all clear that that is the industry position.

I think you may have quite a fight on your hands, in which case it's not clear that things are going to be quite as smooth as has just been discussed. You just sort of go ahead, and now I was going to accept your conclusions, and you know, some regulatory action will be taken. You may have quite a debate going on in the next year or so.

That's my sense of the NEI letter.

MR. MAYFIELD: This is Mike Mayfield.

Based on some other dialogue we have had with members of the industry and some of the staff at NEI, we think that while there are many questions and, indeed, the comments you see in the letter tend to the critical or questioning side of the spectrum, we weren't surprised by those. In fact, that's pretty much what we would have anticipated. I think that's what we were looking for is where they saw soft spots or areas that they thought should be expanded.

This is an issue that will require, I suspect, some extensive dialogue and a fair bit of interaction. It is -- the piece of work we did is not all that conclusive. It was a parametric evaluation. It was a scoping evaluation to decide if there's something there that should be pursued. We think that the piece of work makes that case.

We will have some discussions with the NRR staff and management as we go forward. If we were all in complete lock step on this, then I'm not quite sure what presentation we'd be making to the committee or how it would differ, but the fact is there's a process, and we've embarked on it.

To suggest to you that, like I say, everyone is in lock step would be incorrect. At the same time, we think there is a good case that's been made to pursue the activity.

MR. COZENS: This is Kurt Cozens from NEI.

With regards to the letter that we provided staff, the letter was provided in response to a specific request that we provide them comments on a draft research report that had been written. The draft research report had been accelerated, and it appeared that many of the assumptions that were taken in it and the analyses that were performed to provide the more conclusions and the underpinnings of that were not provided in that particular report.

The letter that we submitted identified specific areas where we wanted to see more detail as to how those were arrived and the logic behind those selections. We had the process of very thorough evaluation and have not been able to go over those in detail as of yet.

However, I will note that on the was it July 26-7th meeting we had with the staff? Many of those details were, indeed, discussed at that meeting, but they are not in the report at this point in time, nor are they in a format that we can actually review them.

So, you know, I would like to compliment staff on its efforts to coordinate its activities with industry. We've gotten a lot of benefit out of that. We have provided the staff with a great deal of information to make this study possible, everything from the basic survey of where industry is through the effort of identifying volunteer plants to give very explicit detail which made the study even possible.

So we have been an active participant in this. You know, we are still evaluating the data, however.

MR. BUSLIK: Concerning the risk and cost-benefit analysis, the work that I did had to do with calculating the decrease in the core damage frequency, and doing the benefit analysis as per the reg. analysis guidelines. Sid Feld did the costs associated with fixing the problem, and there was an uncertainty analysis.

An outline of the approach, I'm going to calculate the difference in the core damage frequency given before the fix and after the fix, and basically you would have to look at the event sequences on an event tree where it matters whether the sump clogs or not.

And these basically are given as follows. You have a LOCA. You're not able to cool down and depressurize and use your RHR system as you would in a normal shutdown. The sump clogs to the point where you fail emergency coolant recirculation, and emergency contingency action type recovery actions fail. These are, for example, in the emergency response guidelines of Westinghouse, ECA-1.1.

There are various size LOCAs. There are also very small LOCAs and stuck open pressurizer safety valves which are not considered here because, as I'll indicate later, they don't contribute.

The initiating event frequencies I used came from NUREG CR-5750, and the large LOCA frequency comes from assuming that from taking the number of leaks in large piping that have occurred and estimating the probability of going to a rupture from a leak.

The means and the five percent/95 percent bounds are given there. For the reactor coolant pump seal LOCA basically there's an error factor of three so that the lower bound is 5.60 minus four and the upper bound is 5.4 E minus three, according to the table in NUREG CR-6750.

As far as the control rod drive mechanism, whether it would be important or not would depend on the kind of plant and how big a LOCA would be.

Also, the type of insulation may tend to be more reflective metal, metallic insulation in most plants. That would be the most benign, but you would have to look at each plant.

I did look at the seismic contribution to the initiating event frequencies for Surry using fragilities from the old NUREG 1150 study and also using the revised Lawrence Livermore hazard curves. They were smaller than the initiating event frequency listings, although there was some contribution for large LOCA.

However, since we have arrived at the conclusion that it's cost beneficial without seismic, it won't make any difference if we include it.

For recirculation and nonrecovery, basically you're going to have to go to sump recirculation for large and medium LOCAs as I indicate later. So these are only important for small break LOCAs and reactor coolant pump seal LOCAs.

And it depends -- how successful you'll be will depend on the kind of plant you have. If you have a large, dry containment, emergency fan coolers, and large refueling water storage tanks, then the chances of being able to cool down and depressurize before you've exhausted your -- you've gotten to the point on the refueling water storage tank level where you're forced to switch is fairly good.

For a subatmospheric plant, the RHR at least at Surry, it's inside containment, and it's not environmentally qualified. So there would be questions as to whether you could actually go on residual heat removal there.

And plants with ice condensers, the containment spray goes on at a very low pressure, and you would exhaust the refueling water storage tanks. So again, there's no chance.

Some of this material in the next slide I've already covered. For medium and large LOCAs you have to go to sump recirculation. For very small break LOCAs, the chances of needing to go to recirculation was negligible.

I mean, it was pointed out to me that, for example, if all your charging pumps failed, then you probably would be forced to, but that's a low probability event, and I just didn't consider it.

CHAIRMAN BONACA: And I want to let you go. You know, you're presenting us with the cost-benefit analysis, and I'll be very interested in seeing this, but I'm trying to understand the whole logic now.

The FSARs or these power plants state that you have high pressure injection and low pressure injection. You run through half of your RWST. Then you switch to recirculation and you depend on that recirculation for preventing core damage.

Now, it is a commitment of the FSAR. Now we have doubt that the analysis provided in the FSAR is adequate, I mean, and there is reasonable -- there are reasons to doubt because the analysis does not address sufficiently debris or because we find that in some cases MPSH was very marginal, and so on and so forth.

So there is a reasonable position that the NRC is raising here that is basis from the analysis done at some plants that there is a concern. I'm trying to understand why would you need a cost-benefit.

MR. BUSLIK: The reason is, and I can't quote the exact document, but even for issues of compliance, which is what you're talking about --

CHAIRMAN BONACA: Yes.

MR. BUSLIK: -- compliance with regulations, we're supposed to do a cost-benefit analysis.

CHAIRMAN BONACA: Okay.

MR. BUSLIK: This has been for a couple of years now. I think there was some SECY paper where it was mentioned, and there was an agreement with industry, the idea being that if the issue really doesn't have any safety significance, that you may want to avoid -- you may want to basically have a waiver of some sort.

CHAIRMAN BONACA: Okay. Thank you.

DR. WALLIS: It's a way of risk informing the regulations.

MR. BUSLIK: Yes.

DR. WALLIS: Without definitely changing them, you know; modifying them.

MR. BUSLIK: That's right.

CHAIRMAN BONACA: But in any case you would perform a cost-benefit.

MR. BUSLIK: Yes. I don't think it has to be as elaborate as a cost-benefits analysis for a backfit.

Now, stuck open pressurizer safety valves are a special case because the discharge from a safety valve would be routed to the quench tank, and if it got into containment, it would be through a rupture valve there, and I am told that because of the location of a quench tank and other things, there's very little likelihood that that would cause a clogging of the sump. So that was neglected.

Now, as far as the probability of some clogging is concerned, the LANL draft report, which you've has a presentation on, assigned -- I believe you did -- assigned qualitative, very likely, likely, possible, and unlikely designations for whether the sump would clog on various size LOCAs, separate for different size LOCAs.

After consulting with Mike Marshall and D.V. Rao at Los Alamos, I assigned these probabilities. More recent probabilities are possible as .4 instead of .3. It will not make any difference, and the direction that it would go, it's small, but the direction that it would go would be to make it even more cost beneficial.

I considered three aggregates of the plant. The idea here is for any individual plant there may be uncertainties because of lack of plant specific information, but you consider the fact that if you consider an aggregate of plants, these uncertainties will somewhat cancel.

So we consider a case which at that time had 23 plants, and according to more recent information has 25. There are some clogs on all size LOCAs, and there are 18 large drives and five subatmospherics there.

The 32 plant case --

DR. WALLIS: Excuse me. That means that they clog with any kind of a LOCA?

MR. BUSLIK: Even the reactor coolant pump seal LOCA, yes.

DR. WALLIS: The reactor pump seal actually --

MR. BUSLIK: I mean, they're relatively large.

DR. WALLIS: -- actually produces jets which remove enough material?

MR. BUSLIK: That was the question which Westinghouse asked, and I don't really know.

PARTICIPANT: We're still collecting marketing.

MR. BUSLIK: Yeah. I mean, it will come out the top of the shaft, I guess, and so the 32 plant case, there are some clogs with fuzzy certainty for large LOCA and medium LOCA, and it can or cannot clog with various probabilities for small break, and in the 40 plant case, it had a probability of one for large

LOCAs and either one or .6 for medium LOCAs.

Now, the change in the core damage frequency, the mean change in the core damage frequency associated with the 23 plant item is all about one E minus four, and that indicates that there's a substantial safety benefit, but we still go on with the cost-benefit analysis.

DR. WALLIS: But it seems to me that industry could easily come back with numbers which instead of probability one, one, and one were probability .2, .2, .2, and it would turn out that nothing matters at all.

MR. BUSLIK: Yeah, I know, but if you look at -- I mean, you need really D.V. Rao or somebody to answer that, but if you look at some of the curves, you have a little box which has the range of particulates, and you have a place where if you're on the right side there's failure and on the left side there's not.

In some cases there's such an extreme difference that --

DR. WALLIS: There's one or nothing?

MR. BUSLIK: Yeah, in that case for that plant it would be the one.

DR. WALLIS: Okay.

CHAIRMAN BONACA: I mean, certainly an argument could be that, you know, a large LOCA, it's clear it can break and it is unlikely and so on and so forth. So you would want to have some realistic estimation of debris accumulation for break sizes that are not going to be in contention. It would be interesting to have some.

So it would probably have some sensitivity as a function of break size.

MR. BUSLIK: Well, the --

CHAIRMAN BONACA: You have a meeting.

MR. BUSLIK: These probabilities are by break size. That came from the report.

CHAIRMAN BONACA: Yeah, I understand.

MR. BUSLIK: So I didn't do any sensitivity on the probability of some clogging, except for you'll see later that it's easy to see that it's cost beneficial even if for the ones where it wasn't one, it was zero instead of .6 and .3.

CHAIRMAN BONACA: Okay.

MR. MAYFIELD: Art, excuse me, if I could. Just to pursue that point, the break frequencies that Art used came out of the NUREG 5750. One of the points that we've talked about, without trying to insult my colleagues that did that piece of work, I don't think there's any question they did their sums properly.

The problem with those frequencies is they can only capture experience up to the point in time when they did the analysis. It can't capture new degradation phenomena. It doesn't capture new aging phenomena that we haven't seen yet, and there's no way it could.

So the frequencies that Art has used, they reflect service data up to a point what, four or five years ago?

He noted on the one slide that they made an attempt to include the recent V.C. Summer experience and just a one crack in a largish pipe made a significant difference in that break frequency, but there's a lot of additional analysis that goes into that. So we wouldn't want to put forward these break frequencies as the definitive statement the staff is making on break frequency, but it's something to work with for this kind of analysis, and it reflects service experience, perhaps except the most recent events.

MR. BUSLIK: And, of course, if we used higher numbers like I've been using in the past in PRAs, it would be even more cost beneficial.

DR. WALLIS: So you are not using those PRA numbers?

MR. BUSLIK: For the initiating event frequencies. Instead I was using these, the initiating event frequencies from NUREG CR-5750, which are smaller basically.

DR. WALLIS: One would expect PRAs which are evolving to be more reliable.

MR. BUSLIK: But the initiating event frequencies, my guess is that they're originally from -- for LOCAs, originally came from expert judgment. It hasn't been changed that much.

Okay. So to go into the monetized benefits, the kinds of things you have to consider according to our regulatory guidance are expected averted population dose to 15 miles, monetized at $2,000 per person-rem, expected averted off-site financial cost, expected averted on-site cost, and expected averted on-site occupational dose.

The largest contributor is the on-site cost, clean-up and decontamination and replacement power. It's about 80 percent of the benefits.

The expected averted population dose to 15 miles is about 17 percent. If you look at -- if I -- it would not be cost beneficial if this were a backfit, now, if we only consider the expected averted population dose, but it's not a -- I mean, that's not what our guidance is.

And of course, in a sense, the expected averted on-site costs should be subtracted from the cost that the utility has to make anyway, even if you have to consider it.

DR. WALLIS: This simply gives you dollars per CDF, doesn't it?

MR. BUSLIK: This --

DR. WALLIS: Average plant.

Do you have to do this calculation every time? Don't you have a sort of rule of thumb of dollars per CDF?

MR. BUSLIK: What I did was dollars per person-rem.

DR. WALLIS: Yeah, but eventually you're going to relate it to CDF.

MR. BUSLIK: Oh, yes, yes. The CDF is included there.

DR. WALLIS: So it is dollars per CDF.

MR. BUSLIK: That's right.

DR. WALLIS: What is the dollars per CDF number, just so that I can sort of --

MR. BUSLIK: Well --

DR. WALLIS: Do you have it? If you don't have it, it doesn't matter, but it seems that's what eventually --

MR. BUSLIK: Yeah, I have it.

DR. WALLIS: -- it comes down to, doesn't it?

MR. BUSLIK: Well, first of all, it would depend, in general, whether it's a core damage frequency, which has a large contribution, a large early release fraction or not, but early containment failure basically.

But for this study 23 plants gave a benefit -- I mean, I don't have the numbers right in front of me. I think maybe I do, as a matter of fact, but --

DR. WALLIS: It's just very useful for the future when we're making these assessments if we have a rule of thumb that we can think about.

MR. BUSLIK: Okay.

DR. WALLIS: Maybe at the end of the talk or something.

MR. BUSLIK: Yeah. I mean, I have a slide that I could compute it from, but --

MR. MAYFIELD: Why don't we take that as something that we can get back to you on, Professor

Wallis, if that's acceptable?

DR. WALLIS: All right, and there's no need to do it now.

MR. BUSLIK: Yeah, okay. Because the numbers I have depend on the number of years of operation of the plant and things like that.

We can skip this slide, I think.

The cost analysis, the data, of course, that's used are given on this slide, and the cost elements consisted of three parts: up front analytical activities; the physical modification; and other cost elements.

The up front analytical activities, each plant would have to do them. So it's independent of the number of plants that have to make the fix.

Physical modifications are proportional to the number of plants that have to make the fix, and it was assumed that audits and inspections were also independent of the number of plants that had to make the fix.

So that --

DR. WALLIS: How big are the up front activities as a fraction of the cost?

MR. BUSLIK: Okay. You'll see it on the next --

DR. WALLIS: It will come?

MR. BUSLIK: -- the next slide.

DR. WALLIS: I was wondering if the analysis doesn't cost more than the --

MR. BUSLIK: Well, it depends. If no plant had to make fixes, then obviously it would, but it's a linear function, and this is taken down to 2001 dollars. The assumption is made that the analysis is done in two years from now and the fix is made in three years from now, and it's discounted to the present at a seven percent discount rate, which is the value we're supposed to use.

And so you have six times ten to the fifth dollars, in other words, $612,000, for making the fix at each plant, and an up front cost of $9 million.

DR. ROSEN: That's aggregate for the whole industry or is it per plant?

MR. BUSLIK: The aggregate for the whole -- the nine million is an aggregate for the whole industry, but you get an idea here. When this was done, it was assumed that 50 percent of the plants would go to license renewal, and there were some rough assumptions. Really the way you should do it is you should look at every plant, know how many more years left, and make some decisions as to whether it is going to go to license renewal or not, and do that.

But we did it in a rough way, which is probably okay, but I'm told that industry may plan to have much more than 50 percent of plants go to license renewal. That would make it even more cost beneficial because there would be more years with the fix in place.

DR. ROSEN: So the hardware fixes are about 600,000 per unit.

MR. BUSLIK: Per unit, that's right.

DR. ROSEN: And the aggregate analysis costs for the industry are about $9 million.

MR. BUSLIK: That's right.

DR. ROSEN: And what are you expecting that $600,000 to buy in the plants? Is there a specific fix that that is supposed to be the cost estimate of?

MR. MARShALL: What we assume is that the fix would be is increasing your sump screen area, and the costs were based on estimates of one utility that already did that. Then estimates we got from other vendors on how much they would charge the utility for doing that type of work.

MR. BUSLIK: Yeah. What was the plant that was -- Diablo Canyon?

MR. MARShALL: Yes.

MR. BUSLIK: Yeah, Diablo Canyon had actually done such a fix.

What you get is for the 23 plants where there was a probability of one of the LOCA on every -- for every size LOCA, the benefits were about $50 million, and the costs, 23 million. You can see that if I considered only those 23 plants in a sense, that has enough benefit to take care of the 32 plant case and, in fact, the 40 plant case using mean values.

So basically even if every case where it is possible or likely for the sump to clog, you set it equal to zero, you would still be cost beneficial for all of the three cases.

DR. WALLIS: But if I'm NEI, I'm going to come back and say you've made conservative assumptions. The benefit is really, you know, half of that and the cost really twice that. So it's not worth doing.

MR. BUSLIK: Well, right. And it all hinges on the probability of the sump clogging and whether they can argue --

DR. WALLIS: Except I wonder if it's really -- any prediction is within a factor of two. So it's going to be --

MR. BUSLIK: Aside from that probability of the sump clogging, and I think probably for some plants the probability of the sump clogging being one is fairly robust just because of where the little box is compared to the failure line, and that's my own opinion, but --

DR. WALLIS: Probably nothing in nuclear is ever one, is it?

MR. BUSLIK: No, it isn't one, but if it's .99 it doesn't matter.

DR. WALLIS: Well, it seems to me a bit surprising that these things have operated all this time and engineers have looked at things and now you're coming up with something with a probability of one which hasn't been considered before.

MR. BUSLIK: Well --

DR. POWERS: It must have been considered or it wouldn't have been screened.

DR. WALLIS: Well, if it's been considered before, then we must consider the probability to be very small. Otherwise they would have done something about it.

DR. POWERS: Well, I think the discovery was that that at Barseback they could produce a lot of debris from the process itself.

MR. BUSLIK: That's right.

DR. POWERS: I mean, I think it's the magnitude of the debris.

DR. WALLIS: So it's a new piece of knowledge which changed this assessment from negligible to one.

MR. MARShALL: Yes. When it was considered before, there's a few changes. Barseback -- well, yeah, there's a few things we knew from Barseback that we didn't know back in 19 -- actually the agency addressed this explicitly back in 1980, 1985, that time frame.

And what Barseback showed us was that our amount of transport, the type of debris we were considering, not the type, but the shape and size of it was in error.

And so when we went back from what we knew with Barseback and applied it and a few more things we learned along the way, such as filtering of particulate debris, we end up with drastically different --

DR. WALLIS: Was Barseback some event that actually happened?

MR. MARShALL: Yes.

DR. WALLIS: When did it happen?

MR. MARShALL: A Swedish BWR in 1992.

DR. WALLIS: '92?

MR. MARShALL: yes.

DR. WALLIS: So it's going to take ten years before anything is done?

DR. POWERS: It'll take more than that.

DR. WALLIS: Well, there are going to be no hardware modifications.

DR. POWERS: I understand you're talking about --

MR. MARShALL: Well, actually the NRC did this in two steps. We addressed our BWRs first, and all those had made modifications. The agency has audited those modifications, have closed out, essentially went through -- if the BWRs was handled as a GSI, that would have been concluded probably beginning of this year.

So we took it in two steps. We took the BWRs first, and then we went back and looked at the PWRs, and so we've been active sine Barseback, and we've addressed our BWR population, and we're in the process now of addressing our RPEs.

DR. WALLIS: Thank you.

MR. BUSLIK: I guess it was less clear that there was a problem with BWRs, and yes, there are some screens, but the assumption was that they would get to be clogged only 50 percent, and in some cases it's much more than that.

DR. POWERS: Also in fairness, Graham, the first four years that I was on this committee, I got to listen to just about every meeting a request from Mr. Carroll on when was the staff going to do something about the Barseback incident.

DR. WALLIS: So you're seeing in back in person again.

MR. BUSLIK: Okay. These are the uncertainties of the large and medium LOCA frequencies here. They were on an earlier slide as well, except for the median values, which are given there.

The values for the reactor cool pump from sealed LOCA are not there. They were given. The upper bound is 5.3 minus three. The lower bound is 5.6 E minus four, and I think the error factor is three. So that the difference between the mean and the median for reactor cool pump sealed LOCA would be about 25 percent.

Okay. In some cases the probability of the sump clogging may be conservative. I mean, they use the licensing criteria for loss of net positive suction, but in some cases it probably wouldn't make any difference at all, but I don't know on the average how it would affect it.

DR. WALLIS: Excuse me. There's one screen or something? Are the screens in different places? There are several intakes for pumps, aren't there? There isn't just one.

MR. MARShALL: It depends on the plant. There's one plant that has three distinctly separate sump screen -- sumps with three separate sump screens. More typical would be two sumps per plant, and then that will vary between two distinctly separate sump screens or two sumps that share a sump screen area.

I don't believe there's any -- no, there's no single sump plant. So most of them have two, and it's whether they have two physically separate sump screens or --

DR. WALLIS: Doesn't it help you -- isn't there a preference for debris from a particular accident to be in a particular place, or is it everywhere?

MR. MARShALL: Again, this would be one of the plant specific things. Depending on the break, it could be preferential in one location versus another, and also depending on --

DR. WALLIS: Does that come into your

analysis, the LANL analysis, or do they just assume it goes everywhere?

MR. MARShALL: We pretty much assume it goes everywhere.

MR. RAO: My name is D.V. Rao. I work at Los Alamos. I'm the principal investigator.

Actually sump screens changed quite -- sump screen designs are unique to each plant, I guess. They vary quite much.

In our analysis we did take into consideration sump screen location as relates to how close it would be to the pipe locations where the insulation is. In some plants it's in the remote as packed away in some parts, and in some it could be feet away from, literally under a recirculation line.

So we tried to take that into consideration.

Also, another aspect that we took into consideration is whether the sump screen is above the floor or below the floor. In some plants, the sump screen just looks like a storm drain of such where it's in a pit in which the sump screen is. So the debris actually tends to go into the pit and, therefore, deposit, and in some plants, on the other hand, it is a vertical screen located on the floor.

Therefore, the debris had to go up and build.

We tried to take some of these factors into consideration and be very -- and we still have some other experimentation and others going on on those issues, but I do believe we tried to address that.

DR. WALLIS: Thank you.

MR. MARShALL: I didn't go into that kind of detail, but there's essentially no two sumps alike between different sites.

DR. WALLIS: Which indicates that every plant is going to have to do its own analysis and someone is going to have to review that for technical credibility.

MR. MARShALL: And that led us to our recommendation of plant specific.

DR. ROSEN: I think that's absolutely true, Graham, and my comments earlier were about every plant has to do its own analysis, and every plant is different. Then the need for guidance, it seems to me, is absolutely clear in the sense that you will get analyses that you won't -- that will look -- the answers will be very different, and the configurations may be the same. And then what do you do with that?

MR. RAO: Actually, may I say one other

point? It is true that every plant may have to do separate analysis, but depending on the fix, you know, a lot of our discussions that I've been seeing here are going on what the status is right now.

It is, in fact, true that the sumps are designed differently, but that doesn't necessarily mean that the new sumps that are to be replacing the present ones, as in the screens and others, could not be generic or could not be more -- they share features common to different plants, in which case it is not necessary that you have to do analysis to that level for each plant.

We need to think about that, that is, that at the present time they're different from each site or each plant, doesn't necessarily mean in the future analysis that they have to do will have to be the same either.

I don't know if I made my point clear.

CHAIRMAN BONACA: Just a note. We have less than ten minutes left. So we should --

MR. MARShALL: If you don't mind, I would like to skip to just --

CHAIRMAN BONACA: Okay.

MR. MARShALL: Just finish a couple of slides there.

MR. BUSLIK: All right. I did an uncertainty analysis, and using Sapphire (phonetic), and to get some idea on the core damage frequency, this was only for large, dry plants. And you get 6.7 E minus five per year for the mean and 1.8 E minus four per year for the upper bound.

And if you go to -- now, this is for one plant, one large dry. Presumably if you're considering the average core damage frequency for a set of, say, the 18 large dry -- this, by the way, was for a case where the sump clogged in all size LOCAs -- presumably there the uncertainties would tend to cancel out. The uncertainty in an average is less than the uncertainty in an individual sample.

And that's to be indicated here. So it looks like it's very highly likely that it's cost effective. The only problem is, of course, if the probability of some clogging instead of one is .2 or something like that.

CHAIRMAN BONACA: I just want to ask you a question about it. You know, when I look at the cost-benefit analysis here, the benefit is all coming from averted costs. Assume that for the case where you have sump blockage and you give the probability of one. That means that all the money that is going now in supporting high pressure injections, sit tanks (phonetic), testing, everything that a tech. spec. requires and everything else; so much is driven by the requirements of LOCA in the power plant.

All of these costs are totally lost, is being wasted today because you're saying that --

MR. BUSLIK: It is all plant protection.

CHAIRMAN BONACA: Yeah. So wouldn't the costs also have to be considered or it's just simply simplification you don't consider that?

I mean, it seems to me that that's --

MR. BUSLIK: I don't understand what you're saying.

CHAIRMAN BONACA: What I am saying is that there is a lot of cost associated with running all of the other ECCS systems in the expectations that they will be successful. If you are telling me that when you go to recirculation, you will not have success, then why bother with everything else you have for LOCA?

And I'm saying that all that is being invested there, which is --

MR. BUSLIK: Well, in a sense, this is included in the -- in the -- well, I'm not sure how that's included. It's the plant which makes power, and if you lose the plant, you lose the replacement power. I mean you need to replace the power.

CHAIRMAN BONACA: Sure, I understand.

MR. BUSLIK: And there's decontamination. I'm not quite sure how you --

DR. WALLIS: Well, that cost has already been --

CHAIRMAN BONACA: I'm only saying --

DR. WALLIS: -- is gone. You've spent it already. If you had to build the LOCA system today and you had to figure that in, then you might well figure out it wasn't worth doing it.

CHAIRMAN BONACA: Well, that's --

MR. BUSLIK: Well, at least for -- yes, you might figure that for large break LOCAs you don't need as elaborate a system or something like that.

DR. ROSEN: You know, Mario, I'm a little troubled by the emphasis both in the analysis and in the committee's time on the cost-benefit analysis. If a plant has a high likelihood of sump clogging, it would seem to me to be irrelevant whether or not, you know, there's a two to one cost-benefit ratio or three to one cost-benefit ratio.

They should simply verify that they do and take appropriate measures to fix it.

CHAIRMAN BONACA: I agree with you, and I think actually, you know, I recognize we have had previous presentation here that was quite informative on the generic analysis done. So but you're right. I mean the focus today has been on cost-benefit, and I agree with you that if there is a problem, the issue of compliance is significant in that case.

MR. BUSLIK: Yes. I think as long as you know there's a significant safety benefit, you don't really -- they've figured that that's sufficient.

DR. ROSEN: Well, I take it even one step further than you do, Mario, and you brought to the issue of compliance, and I bring it to the issue of responsibility for the nuclear --

CHAIRMAN BONACA: Of course.

DR. ROSEN: -- safety of the public and the plant workers and the investment. Responsible management faced with the finding that their plant has a high likelihood of sump blockage, I think would take prompt action to remedy the situation.

CHAIRMAN BONACA: Sure. That's why I spoke before of urgency. I mean, there is some urgency here, and --

MR. MARShALL: One reason we presented the risk and the cost-benefit considerations is even though this would have been very important for safety enhancement, even if this was treated as a safety enhancement, it still bolsters the case that this is something that merits attention.

Even based, if this was a safety enhancement, we would still have a case of moving forward with it, and again, as Art pointed out, we're required to consider or at least prepare the cost estimate for the decision makers to look at also.

So we're presenting all of the information we're going to be presenting to NRR as they take action on our recommendation.

DR. ROSEN: Don't take my comments that this work was not required, but I think we look at it and then we get past it.

MR. MARShALL: Okay.

DR. WALLIS: Well, I like your sentiment. It seems to me that responsible plant management ought to figure out what to do no matter what the NRC does. Now that there's a problem that seems to be there, they ought to respond with the appropriate action no matter the NRC may be doing in the meantime.

And it may be that their response will be to show that it's not a problem, but no matter what it is, they can't do nothing.

CHAIRMAN BONACA: And even -- I mean, I think the lack of specific guidance should not be an obstacle either. They know what the configuration of the plant is. They know what the installation is, and they have AEs that have done the original analysis. They can be repeated with certain considerations.

And so I think that I agree with you.

MR. ELLIOTT: Can I mention something from past experience?

My name is Rob Elliott, and I had the lead for the Bulletin 96-03, which was issued to implement the modifications to resolve the issue for BWRs.

At the time we issued the bulletin, there wasn't detailed guidance out for the BWRs either. The BWR owners group took the lead, prepared that guidance. We reviewed and approved it after the bulletin had been issued.

And licensees managed to implement all of their hardware modifications within two and a half years of the bulletin being issued.

So, I mean, if we get everybody working on the issue, we can be working on the detailed guidance, you know, almost immediately if there's agreement that we need to address the issue. That's what we need to get to.

MR. MARShALL: The important thing I think Rob mentioned was the detail guidance was actually prepared by the BWR's owners group. It wasn't prepared by the NRC. We prepared, again, like a very performance type guidance, but some people didn't feel that was detailed enough to work from, and so they took it upon themselves to provide their members detailed guidance to follow, and it provided options on A, B, C, D, on how to address debris generation.

MR. ELLIOTT: And transport.

MR. MARShALL: And they submitted that to our office for NRC review, got an SER on it. So the individual utilities had confidence if they followed this and submitted it to the NRC, it would be acceptable.

Just in closing because I think I ran out of time a minute ago --

CHAIRMAN BONACA: That's okay.

MR. MARShALL: -- I just want to reiterate our proposed recommendation: again, plant specific analysis, and if a problem or vulnerability is determined, implement an appropriate corrective action.

And that's what we'll be sending to NRR during this month.

DR. ROSEN: And for the committee's point of view, what I understand from this is that you do want an ACRS letter --

MR. MAYFIELD: That is correct.

DR. ROSEN: -- on the basis of what we've heard today.

MR. MAYFIELD: That is correct, sir.

CHAIRMAN BONACA: What's the sense of the membership? I think we should have one.

DR. WALLIS: Well, I'm a little concerned because we only have one side of this. We have this one report which does have assumptions in it. So we don't have any kind of other view that says -- it seems to have a vague statement that these assumptions are conservative. We don't have a basis for knowing what's really realistic. We just have to either believe that LANL report or we have nothing to go on.

CHAIRMAN BONACA: Well, we received the presentation here and read a report. It was quite detailed and had a generic treatment of the issue. There were representations of certain types of sumps, one that would flush and then stepped up and different heights of those, and they were pretty detailed insofar as the generic representation of sumps.

I was left at the time with the sense that all that could be done generically was done, and we had to move into plant specific already. That's why today I was surprised at the beginning that we were not facing that kind of recommendation immediately.

Then I saw it coming through, but it seems to me that we know enough to justify this recommendation. Now, you had a different sense from it, Graham?

DR. WALLIS: No, I just am saying I'm anticipating that there will be another view of the problem when eventually industry gets around to it. It may look rather different.

CHAIRMAN BONACA: And on a plant specific you might find that there are no problems or there are problems, and that will be --

DR. WALLIS: And then it will come to us again presumably. We may have to arbitrate between --

CHAIRMAN BONACA: I think we'll have to go away from genericity and go to specificity for the plants.

DR. ROSEN: Well, I think we clearly have to make a choice. I think anything we write now would have to be an interim letter. It will not be our final word on it.

So we have to choose whether we want to

say something on the interim, on the basis of the interim work we've heard about and seen so far or hold off.

DR. KRESS: There's not much chance this committee will get a chance to look at all of the individual plant specific analyses that come in. We need probably to make this our final letter, probably.

CHAIRMAN BONACA: Yeah, I think so, too. I mean, do we believe that this is an issue that would deserve, in fact, this recommendation?

DR. KRESS: That's the issue, I think.

CHAIRMAN BONACA: That's the issue, and you know, I personally believe that. So I'm supporting of a letter that will recommend that.

But I accept that the studies that we've done to date may have limitations and you know.

DR. KRESS: Yeah, I think I would support that conclusion also. I think the point of debate for our letter might revolve around the need for guidance and what that might take.

DR. ROSEN: Certainly that will be a point of debate and how clear we come out on that point will be important. But I think also, as Graham suggests, we haven't heard the industry reaction yet, and we may get some important input that could cause us to revise what we might say this week.

DR. KRESS: If we get such input. We're quite often faced with that situation though, and we go ahead and make our judgments based on what we know, and that's more likely to be the case here, I think. We've got the final work probably before we write a letter.

So I suspect we ought to resolve ourselves to making our judgment based on what we've already heard.

MR. MAYFIELD: If I could, this is Mike Mayfield.

As part of the generic communication process, there are opportunities for the committee to be briefed on and comment on generic communications that might issue from this.

DR. KRESS: Yes.

MR. MAYFIELD: So as the process proceeds, there will be another look at this potentially.

CHAIRMAN BONACA: Any other comments from members or points of view?

(No response.)

CHAIRMAN BONACA: Okay. If not, I think we are done. So we will recess the meeting for 15 minutes and take a break until 10:20.

(Whereupon, the foregoing matter went off the record at 10:03 a.m. and went back on the record at 10:21 a.m.)

CHAIRMAN BONACA: Okay. Let's resume the meeting now with the next item on the agenda. That's the EPRI report of resolution of generic letter 96-06, waterhammer issue. I believe Dr. Kress is the responsible individual.

Dr. Kress.

DR. KRESS: Thank you, Mr. Chairman.

We had a Thermal Hydraulic Phenomena Subcommittee meeting on this issue August 22nd and 23rd of this year. Not many members were there. So we have quite a bit of time on today's agenda to try to cover the issue.

To refresh your memory, there is a report on the subcommittee meeting, handout 311, that you may have already read, but to refresh your memory anyway, this is a compliance issue for a design basis event. A large break LOCA combined with the loss of off-site power or a main steam line break combined with the loss of off-site power sets up a condition in which you're likely to get a waterhammer event in the fan cooler units of containments.

And such an event could give you the loss of the function for the cooling and might even set up a bypass path from the containment.

So the generic letter in 96-06 requested that plants evaluate their vulnerability to this issue, and the work that was done by EPRI and industry in a collaborative effort was to provide guidance to licensees to do an individual plant evaluation or a specific plant evaluation of their vulnerability to this issue.

And the work they did was to develop a methodology for making the determination, and this methodology has in it a component of determining the amount of air and steam that makes a pocket in this event, and it's very important to know how much, what size this pocket is, and what its constituents are because it's a major factor in ameliorating the intensity of the waterhammer.

So we previously had a subcommittee meeting on this in which we looked at their methodology, and we had basically three issues with it.

One of them was the determination of our release fraction that made this void region as the event occurred. We felt the experiments that the release fraction was based on was apparatus dependent and might be difficult to scale to the FCUs that are actually in the plant.

The other one is --

DR. POWERS: Can I ask -- I sent you an E-mail asking some specific questions about the details of the experiment on that air release fraction. Did we ever get any clarification on that?

DR. KRESS: I was hoping we could ask that question at this meeting and get it clarified. I've not --

DR. POWERS: And there's a lot of problems of nucleation and whatnot in trying to get gases out of water in dynamic events.

DR. KRESS: Yeah.

DR. POWERS: There just didn't seem to be enough discussion on that to me.

DR. KRESS: Yeah. I definitely think when we get to the discussion of the termination of the release fraction that you need to bring that up again, Dana.

The other problem that we had previously was to determine the amount of steam that gets condensed and its effect on the amelioration. It was experiments to determine an hA term for condensation where condensation was hA delta T, and so we thought that might also lack enough technical basis to be scalable, and in general, scalable for the test data to the full size was our problem.

So at the subcommittee meeting, the EPRI group attempted to address these issues, and I think they will also address them further in this meeting.

So with that as a preliminary, I guess I'll turn it over to Jim Tatum of NRR.

MR. HUBBARD: This is George Hubbard, Acting Branch Chief for Plant Systems Branch.

Before Jim gets up or Jim can go ahead and start going forward, just Dr. Kress mentioned this methodology. I wanted to bring in focus a couple of things is this is not for the entire industry, as Jim will point out in his slide. This is for about 24 plants.

I think most of the other plants have addressed this issue, and they have satisfactorily accepted their resolution of the issue, but for these plants that EPRI is focusing on is they decided to go into a group to develop this methodology.

The other thing that I'd like to point out is that this is a low pressure system. It's probably up to about 100 psi so that we're not dealing with the high pressure waterhammers that we generally think of with the, you know, 800,000 or, you know, high pressures.

So I wanted to bring those two points out, and then I'll turn it over to Jim, and he'll bring us up to speed on the issues, a brief introduction, and then EPRI.

Thank you.

MR. TATUM: Good morning. My name is Jim Tatum. I'm from the Plant Systems Branch.

What I'd like to do, I think, just to make sure everyone is on the same page here on this issue is to provide a brief introduction as far as what the issue is, and then defer to EPRI. I think they have additional explanation that they would like to give us, and upon completion of that, go ahead and discuss the staff perspective on this thing.

Let's see. Now, in the way of introductions, Generic Letter 96-06 was issued just about five years ago.

DR. WALLIS: Excuse me. Do we have copies of your presentation?

MR. BOEHNERT: You should have it in front of you there.

MR. TATUM: Hopefully.

MR. BOEHNERT: It's a single page. If you don't, I have copies for you here.

MR. TATUM: Okay. About five years ago we issued the generic letter in response to some work that was done at Diablo Canyon and Westinghouse in looking at the fan cooler system and an issue that was identified.

The specific scenario that we're talking about has to do with a LOCA, large enough LOCA to provide significant heat input into containment and transfer that heat to the cooling water system.

Typical fan cooler units, this is a pretty good schematic I borrowed from the EPRI document. I think it came from Volume 2, but typically what happens is you have a loss of power. You lose the service water pumps or the cooling water pumps, whatever the case may be, that is providing flow through the fan cooler system, and at the same time, the fans that are blowing air through the fan coolers are winding down.

There is a timing difference, however. The pumps will coast down much more rapidly than the fans will coast down, and so what you have is a situation in the containment where you have the heat from the LOCA that's released rather quickly, and you have the fans continuing to wind down, transferring that heat into the fan coolers through the fan coolers, which are very efficient heat exchangers. They're designed to transfer heat, typically have copper tubes that have fins on them, and so you get a rather rapid, immediate heat transfer into the fan coolers themselves.

As you get the heat transfer in there, the concern was whether or not you would have a significant amount of steam formation, and if that steam formation could lead to some significant condensation induced waterhammer event, thinking back to the days when we were looking at the waterhammer events associated with steam systems, steam generators, feed rings, that sort of thing.

And not knowing a whole lot about the response of low pressure systems and whatnot, we thought for a level of comfort, make sure that these systems wouldn't be compromised during the event, that licensees really should take a look and see if their systems were robust enough to be able to handle the event.

DR. WALLIS: Jim, this is a very idealized picture, and in reality, as we've said before, these fan coolers are connected with all sorts of piping that goes up and down. It goes into big headers, and each plant has very specific piping.

MR. TATUM: That's true.

DR. WALLIS: Very specific connections, very specific ups and down, and this sort of gets lost in all this work and the connection between this reality and some idealized view is being lost to some extent throughout this work.

MR. TATUM: That's true, and I think EPRI can talk a little bit about what they've done in the way of the participating utilities. I mean, they have surveyed and tried to get a pretty good feel for what the specific piping arrangements are for the plants that are involves with this particular study that's been done.

But you're right. I mean, the plant designs are very plant specific. There's not a standard design. You can have the fan coolers at a high point. You can have them at a low point.

Typically I think it's more common that you see them at a high point in the system. You do have headers that feed into the fan coolers, and off of those headers then you have small tubes that form the majority of the fan cooler itself where the heat is transferred.

But you're right. There are different

turns, maybe different systems that are cooled by the cooling water system in containment. It may not just be the fan cooler. So there are some complications that have to be considered in all of this.

MR. SIEBER: Let me ask a question. When you have a LOCA, the containment temperature and pressure changes pretty rapidly, but not instantaneously. Did you take into account the profile of containment temperature with time and compare it to the time that that the service water is not flowing?

MR. TATUM: Yes. Typically what the plants have done is they have looked at their containment profiles for the design basis LOCA, and based on those profiles, they've maximized the heat input typically to get the maximum steam volume that you might be able to get from the heat that's in containment.

That's a little bit idealized because obviously there's difficulties in determining where in containment the heat is being disbursed. You know, there's going to be some complications with just getting down to how rapidly it is going to be transferred through the fan cooler.

So the process that utilities have

typically used is to look at worst case type conditions, take a look at the profile, assume that heat is there available to the fan coolers, transfer the heat into the cooling water systems just kind of as an approach to try to get past, well, yeah, you have the LOCA. How is that heat being conveyed through the containment? How long does it take to get to the fan coolers?

I mean, there are questions that can be asked that we really didn't go -- it wasn't the purpose of this generic letter really.

Our feeling when we issued the generic letter was that the bounding case, the limiting case would be maximum steam formation with the potential for a condensate induced waterhammer event. That's really what our concern was going into the generic letter, this aspect of it.

MR. SIEBER: Well, if the licensee would respond to the generic letter by doing an analysis that's time dependent, I presume you would accept that kind of analysis.

MR. TATUM: If it were justified. I mean, from the staff's perspective though, it would be difficult because we look at design basis scenarios, and so as design basis we look at the temperature profile, and we go by, well, at this point in time you have this temperature in containment, and we assume that it's disbursed uniformly throughout containment.

So you know, we don't get, and I think it would be very difficult to try to model exactly where that heat would be at any point in time. So we have to make some simplifications.

I put up another diagram here to --

MR. HUBBARD: Jim, let me add one comment on that. This is George Hubbard.

I think part of the reason the utilities went together is they all realized that for their situation, that there would be this input, and they could have the problem, and therefore, they went to form this group to address it.

So from their own evaluation they felt they had the problem, and they, you know, wanted to, you know, approach it with this methodology.

MR. TATUM: I've put this slide up to illustrate a little bit more of what Dr. Wallis was speaking to. The header configuration that you could expect to see for a fan cooler unit, you have the pipes, the main pipes that bring the water into the fan coolers, but then those pipes transition into individual unit boxes that make up the cooler, and the cooler itself is composed of copper tubing typically with fins and very long lengths and winding, making several paths through each box.

That's kind of the arrangement that we were looking at.

DR. WALLIS: Even this figure is a bit strange because your left-hand one shows a supply coming in presumably on the left, going out on the right, both at the bottom. But on the right-hand picture the return is at the top.

Now, where is the return? Is it at the top or the bottom in the fan cooler?

MR. TATUM: Well, typically I believe this is -- if you look at the diagram, I think the larger diagram over on the side there, you have a header that comes in, and this is very plant specific. I mean, this isn't meant to be generally applicable to all plants, but for this particular case, I mean, it's showing the return coming in at the bottom and going out at the top.

I wouldn't say that that's the case --

DR. WALLIS: They both go out at the bottom on the left, right?

MR. TATUM: Well, if you look on the left side --

DR. WALLIS: They both go out at the bottom.

MR. TATUM: -- it's probably hard to tell.

DR. WALLIS: They come in and go out at the bottom, don't they, on the left?

MR. TATUM: Well, I mean it's hard to tell from the isometric, I think, really, but it should be showing it coming in similar to what you have here. I mean, coming in at the bottom, going out at the top.

DR. WALLIS: And in the EPRI experiment, they have a pipe, and then it all comes out and bubbles up into something.

MR. TATUM: Yeah, well, they show -- and I'll defer comments on that. I think EPRI --

DR. WALLIS: Maybe they will tell us how their experiment is related to this sort of picture.

MR. TATUM: Right. I think they'll be prepared to discuss the experiment and how it relates to the actual header configuration and that sort of thing.

But I just wanted to make sure everyone is familiar at least generally with the system that we're talking about.

DR. WALLIS: The headers, the big headers that go around containment are at about the same level. So that return if it's up has to come down again to go into the header.

MR. TATUM: That's correct. That's correct. If it's in a high point, typically the piping will come back down to where the main header is.

DR. WALLIS: It comes down. It doesn't go up.

MR. TATUM: Right. Now, in those cases, and I think there may be a couple where you have the fan coolers at the low point in which case the piping would go up to go back to the header.

DR. WALLIS: All right.

MR. TATUM: So it can be very plant specific that way.

DR. FORD: Could I just ask another question?

MR. TATUM: Sure.

DR. FORD: I'm assuming SS is stainless steel. Stainless steel tubes with copper fins; does it change from plant to plant? Do you have copper all the time -- sorry -- stainless steel tubes all the time, or do you have carbon steel headers?

MR. TATUM: Well, no, the piping -- the headers themselves would typically be some sort of carbon steel.

DR. FORD: Okay.

MR. TATUM: Typically. Service water system, that kind of an arrangement. The tubing itself typically, they would be what you'd find in a heat exchanger, copper tubing, possibly fin.

This one, this particular example from the EPRI manual is for a particular plant, and in this case, they're talking about stainless steel, but it varies from plant to plant.

DR. FORD: Okay. So you could have just plain carbon steel tubes.

MR. TATUM: Well, not the tubes so much. The header that goes into the fan cooler.

The fan coolers themselves, I think, are typically originally commercial type units for transferring heat. There wasn't anything special about the design of the fan cooler itself.

DR. FORD: Okay.

DR. WALLIS: Now, while this release is occurring, is there flow through the system or is it stagnant pretty well?

MR. TATUM: Well, typically what we're looking at for the Generic Letter 96-06 scenario is that you have a stagnant cooling water system. The pumps stop, loss of power, and you have the air continuing the containment atmosphere continuing to blow through the heat exchanger as the fans wind down.

DR. WALLIS: But in this part, in the water supply here --

MR. TATUM: Right.

DR. WALLIS: -- there's no flow through there during this event or the pumps are coasting down. So there is a flow through here.

MR. TATUM: Well, they coast down very rapidly. So essentially it's no flow, yeah, no flow through on the water side. And so you may have column separation, you know, if you have a system that's high in the containment and, you know, would expect boiling to occur rather rapidly, that sort of thing.

DR. KRESS: Now, what's the general source of this water supply?

MR. TATUM: Well, it varies. I mean, the open loop systems, you can have the source from a reservoir. It can be from a river, a lake. You know, the pump service water system basically, it's that kind of a system. It would take a suction from a body of water, whatever is available.

DR. KRESS: So it very well could be fairly dirty water. It's not --

MR. TATUM: It could be fairly dirty water, and in fact, we've acknowledged that and recognized that previously by issuing Generic Letter 89-13. So there are -- you know, problems with dirty water systems have been addressed. I don't expect that to be a complication for this issue per se as far as degrading the system, aging, and that sort of thing.

DR. KRESS: Yeah. Well, I had in mind how that might affect the higher release fraction.

MR. TATUM: The heat transfer and whatnot.

DR. KRESS: Yeah, and the heat transfer.

MR. TATUM: Right. Yeah, the quality of water varies, and you can have silting and different things going on there with the water supply or marine growth, organisms, that sort of thing. But those issues for the most part I think we've addressed with Generic Letter 89-13.

Getting back here to just basically introductory comments, let's see. I wanted to just back up now with the EPRI initiative that was proposed in August of '98. As George has already mentioned, there were a group of utilities that were interested in trying to come up with a less conservative methodology than what was suggested by Generic Letter

96-06, that being NUREG CR-5220. That's a very bounding approach that was offered in that NUREG. Typically it goes straight from Joukowski, does not credit air or recognize air and cushioning, that sort of thing.

The industry felt like they could take advantage of some of the margins and conservatisms and maybe reduce the amount of modifications that would have to be done to address the issue, saving the industry money and whatnot and still providing confidence to the staff that they had adequately addressed the issue.

And, of course, we were very interested in proceeding with that effort. It was really a cooperative effort with the NRC. We observed much of the testing that was done.

We've had discussions with them at many of the meetings. We were involved with the development of the PIRT analysis that was done and whatnot. So we've provided guidance and suggestions along the way, but the work that was done, the analysis and whatnot, that's strictly EPRI's, and we're going to defer to them to discuss that part of it.

DR. WALLIS: Did you ask the kind of technical questions that we've been asking?

MR. TATUM: Yes, we have been asking those kind of technical questions. Unfortunately the staff has evolved. You know, this has been kind of a long-term project, and originally we had Al Serkiz who was working with us, and of course, he was a key player from our side, making sure the right issues were being addressed at least from his perspective for waterhammer, and he was our expert at the time for waterhammer.

Now we have Walt Jensen in Reactor Systems Branch and Gary Hammer doing the review. So we've transitioned in personnel, but we've tried to maintain continuity.

We've all looked at the same documents, and we have asked the technical questions. And I would say that in the meetings with the subcommittee, obviously the questions that have been asked have been good and helped us focus also on some areas, some I think that we were also aware of even at the time you were asking some of the questions as well.

So we're trying to move on with this thing at this point, but there are about 24 plants involved with this initiative, and these are for the most part the plants that have not really addressed the waterhammer issue.

The other plants for the most part are those that do not credit the fan coolers, and they're able to take alternative measures. For example, they can put in the procedures, restrictions on using the fan coolers so that they don't have to worry about the waterhammer event, and they've been able to address it that way.

There are a few, handful of plants that aren't involved with this initiative, a couple that have tried to apply RELAP. We're still reviewing those. We have not come to a conclusion on those other plants yet.

MR. SIEBER: Just a question, I guess. A lot of plants can't use the fan coolers after a LOCA because the containment atmosphere density is too high and it's too big a load on the fans. So when you get a containment isolation, the fans usually trip and, except for a smaller number of PWRs, they don't restart.

So the real issue is if you have the waterhammer and you rupture part of the piping, do you bypass containment?

I think to answer that you have to know what kind of a rupture you have. For example, if you just split a seam someplace, service water pressure is higher than containment pressure. So leakage is in rather than out.

Has that been taken into account, any of these factors?

MR. TATUM: Well, we have considered that. There are many different kinds of scenarios. The containment bypass is one, and that can be very complicated because depending on the plant design, you may have to have more than one rupture in the system to get a containment bypass.

Typically service water systems are easily isolated from outside the containment. So there are different mitigating factors to consider here.

Also, the service water system, what you mentioned with the load on the fan coolers and whatnot, that's true. It's kind of plant specific that way, but in fact, what many of the plants do is they will operate the fan coolers in the plants involved with this particular initiative, typically will shift to a low speed on the fans in order to be able to handle the load.

And so they credit those fan coolers in some fashion. It may be just for long-term cooling of containment. If it's a small containment, maybe it's in clipping the peak pressure a little bit. It varies from plant to plant, and you have to get into the details of each specific plant in order to see to what extent they're crediting the fan cooler.

MR. SIEBER: Well, the containment atmospheric pressure can triple during a large LOCA, and that really changes the load on the fans, and so typically you don't put fan coolers on at all until after the first hour to get the spray down and deep pressurization. I think that makes a difference.

MR. TATUM: Well, it does, and for some plants that the case, and for those plants, in particular, it wouldn't be an issue, and those would be among the group that we've already closed.

MR. SIEBER: And I guess another comment is that a lot of things happen during the first minute or so of a large LOCA, and even though you probably have a radiation detector on the outlet of the service water, I think that's pretty far down on the list of things to look at, and so isolation is, you know, maybe it happens; maybe it doesn't.

MR. TATUM: Well, it would be late on. The question is, you know, if you're looking at the severity of the event, how long do you have? And if you're talking about a split in the seam somewhere where it's not a major thing, you've got a lot of time, whereas if you're talking about a major rupture of the piping system and a direct path, maybe it's more significant.

So there are a lot of variables that go into this, and I think that's one of the points I think that needs to be appreciated here, is just the complexity and the number of variables we're talking about, but that's pretty much all I have in the way of introduction.

I'd like to turn it over to Vaughn Wagoner.

DR. WALLIS: Does the staff have a position on this work? Are you accepting it?

MR. TATUM: Yes, we do have a position, and I'd like to defer discussion of that until we hear from EPRI because they're going to attempt to provide additional information, and I think for continuity of the discussions here it would be good to have what they intend to say here available to the other members, and then we can go on to the staff perspective on this.

MR. WAGONER: I guess I get the honors now. Is there a microphone? Am I hot?

Okay. Good morning. I'm Vaughn Wagoner with Carolina Power & Light Company, and I chair the

Utility Advisory Committee that is composed of the members of the utilities that have been supporting this project with EPRI, and let's see. Well, I'm here this morning and joining with me are Tom Esselman and Greg Zisk from Altran Corporation and Tim Brown from Duke Energy, and Peter Griffith was going to be here with us this morning, but unfortunately could not make it at the 11th hour. So we'll have to try our best to fill in if questions get to that level.

So I just want to give a brief introduction here. Let's see, Tom. What do I do?

MR. ESSELMAN: Page down.

MR. WAGONER: Page down. Oh, that's why. I paged up, and it wouldn't work. Okay.

Okay. Very briefly this morning, what we want to do with you is go through an overall description of what we've done in this thing just to be sure everybody is on the same page, and then get into some specifics that we've been talking with with the Thermal Hydraulic Subcommittee, particularly in the areas of air release and heat transfer and the scaling issues. These seem to be continuing questions, and we want to try to get at those and address them for you this morning.

First, I just want to give you a little

bit of background. When we started out in this thing, as you've heard, there were utilities or plants generally fell into two or three groups: those that just flat didn't have the problem because of whatever, over pressure in their systems or whatever. They didn't have a problem and didn't have to address it.

Others that had some facet of the program, but could address it in terms of either operational changes or other changes to the plant.

And then a third grouping of plants that had -- that appear to have the issue, create the steam voids, et cetera, but whose piping systems were very close to being qualified in using classic systems with the theoretical loads that you could calculate.

So then the question became is there some mechanism or is there some activity because these are aerated systems for the most part and there's boiling going on; is there something going on there that we could take advantage of?

DR. WALLIS: Well, let's ask you. You're assuming these are aerated systems. Do you monitor how much air is in the water in these plants or do you just assume it's there?

MR. WAGONER: Well, there's fish that live in the pond and they don't die. So there's got to be some oxygen in there.

(Laughter.)

DR. WALLIS: But they aren't all like that. Don't some of them have a storage tank and they recirculate and so on?

Do they all bring in water from the outside?

MR. WAGONER: The open systems that I'm familiar with --

DR. WALLIS: Are all open?

MR. WAGONER: -- as far as I know, all participating in this study are all --

DR. WALLIS: Are all open systems?

MR. WAGONER: They're either open or they are closed systems, but we treat a closed system differently with respect to the potential for gaseous release.

DR. WALLIS: So are we talking only about open systems here or are we talking also about --

MR. WAGONER: Yes, sir. We're talking about both open systems and closed systems, but in the technical basis report and the user's manual, there are differences.

DR. WALLIS: So in the closed system we don't have an idea of how much air is in there?

MR. WAGONER: Well, we do have an idea.

DR. WALLIS: But we don't have a measurement or something?

MR. WAGONER: Well, you've got -- you know there's air in the water that's put in. Then typically there's some kind of oxygen scavaging added to the -- because it's a closed loop to prevent rust and stuff like that. So what you're left with then is the other.

DR. WALLIS: So you're taking oxygen out.

MR. WAGONER: Right. So what you're left with are things like nitrogen and what other small constituents of things that aren't removed by oxygen scavaging chemicals.

DR. POWERS: So when you say, "Okay. I've got this water" -- do you say you have some idea how much dissolved gas there is? How do you come up with that idea?

MR. WAGONER: Typically you would -- we don't typically take measurements of it on a routine basis, but then again, it's large bodies of water, surface area exposed to air. So you --

DR. POWERS: Yeah, I know, but now I still need a number.

MR. WAGONER: Okay.

DR. POWERS: How do I get that number?

MR. WAGONER: And that number is that we would look in a textbooks and see what the typical dissolved gas would be.

DR. POWERS: Okay, and I look in those textbooks and they give me the number for pure distilled, 23 meg water. Okay? And that's a number.

Now, if I looked farther in the textbooks, they would tell me there are section now coefficients that will tell me how dissolved salts will reduce that number. Do you take that into account?

MR. WAGONER: Dissolved salts?

DR. POWERS: Un-huh.

MR. WAGONER: Do you mean things that might be dissolved in the water?

DR. POWERS: Right.

MR. WAGONER: Not necessarily. I guess the question would be, you know, how much effect is it. Does it take it all out or a little bit?

DR. POWERS: Well, I guess I'm asking you what the effect is.

MR. WAGONER: And I guess I can't answer that.

DR. POWERS: Oh,

DR. WALLIS: When these pumps pump the

stuff around, there are regions of low pressure where maybe you get air bubbles coming out and so on. So there are mechanisms that influence the air content of the water. It's not as if you just take the figure 6.7, solubility of air and oxygen at one atmosphere in distilled water and use that. I mean, there are other things going on.

MR. WAGONER: I'll acknowledge that. I guess I would disagree that there are pockets of low pressure between the pump and discharge.

DR. WALLIS: Well, it's just the thing that so surprises me is that you just sort of take this curve and it's assumed it applies without further discussion.

MR. WAGONER: Let me ask. Have there been any measurements that you guys are aware of that have actually been made in water or any other thing?

MR. ESSELMAN: Vaughn, this is Tom Esselman.

The specific amount of gas, whether it be nitrogen or air, that's in a plant dependent situation depends on the plant, depends on whether you have a bond or a cooling tower or a closed loop system with a tank, whether it's a nitrogen blanketed tank or not, and all of those things will enter into -- and what the temperature is of the lake. That's clearly different in Minnesota than Texas; what the pressure is, whether you're taking it from the bottom of the lake or the top of the lake.

All of those details are not dealt with by us. What we're providing is a general recommendation that says you need to determine how much dissolved gas, whether it be air or nitrogen or whatever, is in your plant at the beginning of the event.

And the kind of factors that we're talking about are plant specific, and many of the things that we're talking about are going to depend on the details of the tower or the pond, and that has to be determined, and it's clearly identified as needing to be determined by the utility that's using this information.

DR. KRESS: Your experiments determine the fraction of the air that's in the water that gets released, but they started out using clean, saturated water.

MR. ESSELMAN: We use --

DR. KRESS: Water saturated with air. Do you think that fraction that you determined experimentally might have some dependence on the initial concentration of air in the water or --

MR. ESSELMAN: We looked at the way that air and nitrogen would come out of solution with an increase in temperature. We saw that the behavior of the different gases that could be in there is similar, and that the representation or the using oxygen, because we had a normally aerated water system; we used tap water. We measured the oxygen and used oxygen as an indicator of what was being released as a percentage.

I think given the -- we will discuss this in more detail, but given the way that we did the test and the range of data, we believe that it applies to a highly aerated or a moderately aerated or a highly nitrogenated or a moderately nitrogenated system.

So the steps is, number one, the plant needs to determine what they start with, and then they need to determine how much water is affected, and then they can calculate how much air would be released from that, how much gas, noncondensable gas would be released.

DR. WALLIS: You use oxygen as the indicator. I'm not clear that you ever measured air. You used oxygen.

MR. ESSELMAN: We didn't. We used oxygen as an indicator. That's correct.

DR. WALLIS: And the assumption is that nitrogen behaves exactly the same way.

MR. ESSELMAN: We don't presume that it behaves exactly the same way. We know that it behaves differently. We looked at how nitrogen and air and oxygen behave, and their behavior is similar enough that we were confident that using oxygen as an indicator was representative.

But we jump ahead.

MR. WAGONER: So I guess the correct answer to your question was that it is a plant specific determination.

Thank you, Tom.

And that is in the user's manual.

DR. POWERS: But, I mean, I guess what's distressing is you don't tell the user that he needs to worry a little bit about things other than handbook values. Pure water solubility just isn't going to cut it for most of these. Most of these external water sources are going to have a certain amount of dissolved material in them. It's going to affect the activity of oxygen strongly and nitrogen more moderately.

MR. WAGONER: But is it not true that within the tech. manual or within the user's manual it does say that on a plant specific basis you need to look at the --

DR. KRESS: If we assume the extraction of the air during the process of the event, the boiling event and so forth, was a stripping mechanism, which is generally described in mass transfer texts as a product of some sort of mass transfer coefficient and a surface area and a driving force, the driving force being the concentration in the difference between the liquid and what's in the --

DR. POWERS: Activity.

DR. KRESS: -- activity. Okay. But --

DR. POWERS: Activities count in this.

DR. KRESS: Yeah, okay. But my point is it seems to me like that activity is concentration dependent. It depends on the concentration in there, and you're saying --

DR. POWERS: But, I mean, the subtlety of water is it's not dependent on the concentration of oxygen. It's dependent on the concentration of everything else.

DR. KRESS: Yeah, yeah.

DR. POWERS: I mean that's why water is different than usual solutions.

MR. WAGONER: So I guess the question then would be whether or not in your minds or our minds that if, given the conditions that exist within the fan coolers during this transient event, is there, other than the total amount, is there anything that's going to preferentially act on or not act on the ability of oxygen, nitrogen, and whatever else is in there to get out of the water?

And when you're taking it down to darn near zero pounds absolute and then boiling the heck out of it, I'm not sure that was -- I guess the question is: is there any significant differences in what's going to happen with the ability to --

DR. WALLIS: Well, it's not zero pound -- it's about half an atmosphere, isn't it?

MR. WAGONER: Well, it eventually gets up to half an atmosphere, but it --

DR. WALLIS: Well, it goes through something lower before that?

MR. WAGONER: Well, as the pumps fall away and as the steaming starts, you have a pressure decrease as nature is taking the water column down to its normal 32 or what --

DR. WALLIS: So it goes down to about zero?

MR. WAGONER: So it's headed down, and

then the steaming process starts, and then the pressurization starts chasing the depressurization.

DR. WALLIS: And so all of your experiments are done at half an atmosphere. Isn't that the case?

MR. WAGONER: I believe that's correct.

DR. WALLIS: Which was chosen for some reason?

MR. WAGONER: Somewhere between the starting point of zero and roughly atmospheric that some of these systems go to. So we tried to pick a point that didn't give too much credit to just degasification.

DR. WALLIS: But this is plant specific, isn't it? I mean, this pressure history is plant specific.

MR. WAGONER: Generally, yes.

DR. WALLIS: And so you're claiming that your experiments all are operating at one half an atmosphere are somewhat typical of all plants no matter what the history of the pressure in that plant?

MR. WAGONER: Because of the fact that the pressures are not -- we're not talking about hundreds of pounds of difference. We're talking about, you know, three to five pounds difference absolute, across the range of plants. Because generally there's various elevation differences, and you only go to zero on the depressurization side, and then the repressurization side is generally around an atmosphere or less.

DR. WALLIS: Well, you're saying this, and I'm not sure this is in the report. I mean, you read the report. Someone did experiments at half an atmosphere, and it's never really -- maybe it is. I didn't find it -- sort of explained why this is representative of what you're talking about here, which is a history of pressure which can be quite variable from plant to plant.

MR. WAGONER: I thought that we had discussed that in the original reports. Perhaps I'm --

MR. ESSELMAN: I would comment briefly that we have looked at both the effect of depressurizing a system and the effect of boiling a system, and there are papers and references that deal with how water behaves when it's depressurized and agitated. The amount of gas that's given off within this time period, which is about 30 seconds, is very small in comparison to what we measured from the results of boiling.

This material, including that pressure, we will go through when we deal with the boiling test, which is on the agenda. I guess we might defer the details until we get --

DR. WALLIS: You're saying something which sounds credible. If you had done the experiment at, say, one atmosphere and a half an atmosphere and got the same amount of air because the boiling process dominates, that would be convincing. It would be nice to see it. I mean, you're sort of assuming there.

MR. ESSELMAN: We ran at a half an atmosphere because we wanted to remove the air in the system prior to the start of the test, and we did that by running steam through it and then closing and allowing that to condense. So we started with an air free system that was at a half an atmosphere.

We also researched the release that we would have expected by pressure beforehand and concluded that whether we ran it half an atmosphere or one atmosphere would be immaterial, and we ran the test on that basis and --

DR. WALLIS: This is on a theoretical basis.

MR. ESSELMAN: Well, based upon testing that had been performed by others, yes, not by the testing that we had performed. But yet we looked at that; we referenced that work in the technical basis report.

MR. WAGONER: Okay. Let me move on through what we're trying to accomplish in the program, and four things that we were trying to do.

One was understand the behavior of the system, and you heard the overviews of what went on. And we wanted to understand in general how that worked, what happens in terms of coast-down. Did flow ever really quit? What happens in terms of fan coast-down? Did fans die rapidly or did they die away slowly such that it really was an issue?

And then where did water go? Is steam created? Where does it go? How far does the bubble go, and those kinds of things, and how we go about tracking those?

We wanted to determine the safety significance of the issue. Frankly, as you heard, there was a lot of data around on high pressure waterhammers. There wasn't much around on low pressure waterhammers and what happens here.

And so we wanted to try to understand that, and basically there's three things we had to deal with. One is retaining cooling capability of the fan coolers at whatever post accident requirements that are there; maintaining containment integrity, such that it didn't set up a bypass for containment; and then maintaining or not flooding the containment, not creating a flooding path for containment.

So that was the three things that we try to deal with, and then we wanted to provide a methodology to assure that we do maintain these pressure boundaries and also, again, as you heard mentioned, we want to minimize modifications that we didn't have to make. We were willing to do anything that we needed to do, but if we didn't have to, then we wanted to try to pursue that.

And frankly, as we worked through that, and that was the reason that a bunch of us utilities got together, even though that we determined -- had the potential for the problem; when we looked at it, even using some Joukowski type loading, we were close. It got down to trying to qualify the steel in the pipe supports, and we were darn close. So we were just looking for a little bit.

And you've heard the numbers, 20, 30 percent in load interaction with the piping support system, and if that was possible, then we wouldn't need to make modifications to the plant, and frankly, the intuitive feeling is, and my experience with waterhammers up to about 300 pounds or so, the stiffer you make the system, the more trouble you get into.

I spent two years chasing one in the wrong direction, and we went back and chased it in the other direction and put rod hangers on the pipe, and it's been banging for 15 years, and we don't have a problem. The more steel I put in it, the more concrete we tore out of the wall.

Okay. But moving along -- I'm sorry? Oh, I'm sorry. I thought I heard someone.

Anyway, we put -- in order from an industry perspective, we got Altran Corporation together and assembled an expert panel to provide us an independent perspective of what it was we're doing. We wanted to get the very best in the industry that we could, but unfortunately you're all on the ACRS. So we had to go with --

DR. POWERS: Flattery, sir, will get you anywhere you want to go.

(Laughter.)

MR. WAGONER: So we did assemble these folks with a lot of experience, and I can tell you, and I think most of you have had interaction with them, they are independent. It didn't matter who was paying the bill. We had some quite informative and lively discussions on what it was we were trying to do and acknowledged right off that we don't know everything about the science and the details of the interaction, but what we think we have done is provide a reasonable approach that helps us to adjudicate the loading, and that's what we're really working at.

And we had this utilities steering committee. I chaired it, and we were active in it, and our focus was to be sure that we were looking at that stuff that would help us where the rubber meets the road, if you will, and look at safety significance and then look at applicability of the results to the power plant.

Let me drop down two slides in your handout, and I'll come back.

DR. WALLIS: Well, the one that you didn't show us.

MR. WAGONER: Well, I was going to come back to that one, if you'll -

DR. WALLIS: You're going to come back to it?

MR. WAGONER: Yes, sir, I will. Okay? Only because it's -- well, I'll get to it here.

I want to wrap up my part with just a

perspective on where I think we are in this situation. First off, we're dealing with a very low probability event, and the combination of LOOP-LOCA or LOOP-main steam line break, when you sum them all up, for all the plants that are participating, it's less than ten to the minus six. Actually it's much less than ten to the minus six because this ten to the minus six on frequency is over a 24 hour period.

This thing is over in 60 seconds, and when you do that, you take it down another couple order of magnitude. So we're dealing with something at ten to the minus eight, ten to the minus nine probability of even happening, and in fact, as you know, there are efforts underway to eliminate simultaneous LOOP-LOCA as a design basis event. So --

DR. POWERS: I mean, I think what you're saying is that the mean value of the probability is very low, but if I asked my blacksmith friends if they are very certain about that number, they say, "Well, no." And so when I ask them about 95 percentiles, those probabilities come up fairly dramatically, don't they?

MR. WAGONER: Come up to -- bring them up to -- bring them up two orders of magnitude, but then take it down to the real time of the event, which is

60 seconds, and you add back three orders of magnitude. So I think realistically any way you cut it, the initiating event is pretty low probability.

DR. WALLIS: But you're not asking us to evaluate the risk. You're asking us to evaluate a technical report on waterhammer.

MR. WAGONER: Yes, sir, I am, but what I'm asking you to do is look at a perspective that is at a reasonable judgment to use to mitigate the theoretical loading versus understanding everything that's happening right at the interface. That's where I'm coming from from a risk perspective.

DR. ROSEN: What you're saying is that if you don't have a loss of off-site power, you have a LOCA, but you don't have a loss of off-site power; you don't have this event.

MR. WAGONER: The event never happens. That's right.

DR. ROSEN: And I think it's generally understood and believed that loss of coolant accidents don't cause losses of off-site power. Generally plants, even when they trip, as they would in a loss of coolant accident, the grid is typically unaffected by that. The plants continue to receive off-site power, and in that case, this event wouldn't happen because the fans would never coast down. They would be starting if they weren't running, and the component cooling water or whatever service water would never stop.

DR. POWERS: Isn't there a lower bound on this just given by the seismic hazard? You can never go lower than the seismic hazard on this one?

DR. ROSEN: I think that's fair because losses of off-site power would occur during a major seismic event that was strong enough to cause a LOCA.

MR. WAGONER: So anyway, I think we're starting with a low probability event. We looked at the risk of pipe failure, again, looking at our three safety functions, maintaining coolant capability, bypassing containment or flooding containment. Those last two require you to do something to the integrity of the system.

And we think there are significant margin, and that's why I go back to the slide that you thought I was going to skip over, relative to the structural integrity. If we looked at a typical tubing or typical typing material, steel --

DR. POWERS: People never do that though, do they?

MR. WAGONER: Huh?

DR. POWERS: I mean when we go through ASME codes and things like that, we never look at typical. We look at lower bound numbers, don't we?

MR. WAGONER: I've lost you. What's -- this is typical piping that's used, is carbon steel, standard wall, .375 thickness. It might be eight, ten, 12, 14 inch. So that's why I say this is typical.

DR. POWERS: Well, you're going to go through these various stresses numbers here. Are those typical values or are they lower bound values?

MR. WAGONER: Well, these numbers are right out of the code.

DR. POWERS: Okay.

DR. WALLIS: Well, it doesn't say use S^{ult}. It says use S allow, isn't it, which their number doesn't become 3,000? It becomes less than 1,000.

MR. WAGONER: Okay, and that's true, but you can use ultimate if you're looking at an operability issue or looking at a real world behavior of the pipe.

MR. BROWN: Vaughn, this is Tim Brown, Duke Energy.

That's a faulted event. So ASME lets you use 2.4 SH, which is very close to S-ultimate.

DR. WALLIS: It lets you use S^{ult}?

MR. BROWN: It's very close to S-ultimate.

MR. WAGONER: Thank you, Tim.

But anyway, there's some margin. These numbers you'd have a factor of about six. Take it down a little bit and you've got a factor of two, three, four, five.

DR. WALLIS: Now, this 600 -- sorry.

DR. FORD: I was about to say is B-280 as a copper?

MR. WAGONER: That's right.

DR. FORD: Copper, copper-nickel?

MR. WAGONER: Yeah, that's typical copper-nickel tubing, which in fact is typically what's in the heat exchanger. Some of them have been changed to a stainless steel.

DR. FORD: Have any of these analyses been done on degraded piping?

MR. WAGONER: These are always -- these are done -- well, this is a typical wall thickness. All of these systems are monitored for degradation, but through Section 11 of ASME code. So heat exchangers, the tubes are monitored for degradation. The piping systems are monitored for degradation.

DR. FORD: Is there not concern though,

Vaughn, that, for instance, B-280 -- when it goes through that U bend, there will be erosion presumably at that U bend. So at that point that's the thing that's going to be hit by the waterhammer.

MR. WAGONER: Un-huh.

DR. FORD: So at that degraded U bend, which is presumably eroded, after 20 years or thereabouts in 8 ppm oxygenated water, what is the safety issue then? Did not that degraded U bend be now exposed to that waterhammer pressure? Would it stand it?

MR. WAGONER: It could be, but again, we're monitoring these systems. We run eddy current (phonetic) probes through those heat exchangers to see what the tubes look like.

DR. FORD: And that has been done?

MR. WAGONER: Yes.

DR. FORD: And there is no degradation at that U bend?

MR. WAGONER: If there is, you have to -- you have to address it.

DR. FORD: How often is it inspected?

MR. WAGONER: Well, that depends on what you find. If you've gone ten years and haven't seen anything, then you -- through ASME, you're allowed to

-- through the code you're allowed certain inspection intervals, you know, based on your findings.

DR. FORD: Presumably the -- okay, and the same applies to the carbon steel header which is essentially a closed tube?

MR. WAGONER: Closed with respect to the loop that it's in, yes.

DR. FORD: And it would be a welded closed end.

MR. WAGONER: Right, typically, yes.

DR. FORD: Okay. And that is inspected also?

MR. WAGONER: Yes.

DR. FORD: Because that will degrade.

MR. WAGONER: Yep. And there have been replacement programs that you heard last time. Some folks have had to replace sections of piping due to monitoring and indications of degradation, and that's typical of the whole steam system.

DR. FORD: Just assume that what with the ISI inspection periodicity you had a waterhammer effect and it hadn't been inspected and it hadn't been replaced. How would that affect the whole safety evaluation?

MR. WAGONER: Well, actually --

DR. FORD: Could a degraded pipe, whether it be the piping, the A-106 header, or the copper-nickel tubing -- it was degraded, hadn't been replaced -- could that withstand that water pressure?

MR. WAGONER: And, yes, it would be a multi-degradation scenario, but in fact, from a personal perspective, I talked with some of our operations folks at one of the plants and said, "Okay. What if?"

And there's a couple of things that happen. One is our emergency operating procedures are all symptom based. So a couple of things could happen. You could have a containment bypass that would be harder to detect, but it would be indirectly indicated because you'd have to also have a loss of a service water flow in order to get a containment bypass.

Then the other possibility would be containment flooding, and that's right in the EOPs because those are all symptom based, and you would be looking at, you know, your levels and things that are already going on.

So the symptom based EOPs don't care where the water is coming from. They just address it from a flooding issue if need be.

MR. SIEBER: It seems to me that degradation in those systems was mostly through mic. attack, microbiologic --

MR. WAGONER: Yeah, there has been. I think mic. has shown up in stainless steel systems on occasion.

MR. SIEBER: It really shows up in carbon steel piping.

MR. WAGONER: Oh, okay.

MR. SIEBER: And the ISI program uses an ultrasonic thickness gauge, which is a spot measurement.

MR. WAGONER: Yes.

MR. SIEBER: Those numbers there are min. wall numbers, okay, for typically that's Schedule 80 piping, and so when you measure the thickness in the manufacture, there's a corrosion allowance built into it.

MR. WAGONER: Okay.

MR. SIEBER: And all of the stress allowances are based on min. wall. Okay? So that's how you get a service life out of it. You could actually calculate the degradation and the bursting pressure if you're below min. wall, but the code says you've got to replace it when you hit min. wall or below it.

MR. WAGONER: Okay.

MR. SIEBER: And you have to measure at more places if you find one place that's below min. wall.

MR. ESSELMAN: The 600, is this with air in the lines or is that without air in the lines?

MR. WAGONER: No, that's just an assumption at 20 feet per --

DR. WALLIS: That's just an assumption?

MR. WAGONER: Well, it's at a 20 foot per second --

DR. WALLIS: Is this the Joukowski pressure or is this with air?

MR. ESSELMAN: This is Tom Esselman again.

That is uncushioned. It's without air. That's just the straight Joukowski --

DR. WALLIS: Then why do we worry?

MR. ESSELMAN: The purpose of this is to say that a failure mechanism that we need to address is not one that is frequent in waterhammers of much larger pressure which causes the tube or a pipe to burst. And in these systems, 600 psi waterhammer is greater than any of the waterhammers we expect to see because we have a controlled velocity of closure.

The closure velocity is determined by the pumping characteristics. So that this is the largest pressure that we can see from this event that we're talking about here, again. The burst pressure which does have to -- which has to be augmented clearly by satisfying all of the ASME code requirements not only for burst, but for bending, but that burst pressure just is shown to indicate the margin that we have been the pressure that we will see in this event and what it takes to burst the pipe.

Now, bursting the pipe is one of the mechanisms that have to be considered. The other is a traveling wave that has pulled supports out of the wall for other kinds of waterhammer, and even for this waterhammer at those magnitudes, it has the potential to do that.

But yet from an integrity point of view, a piping integrity point of view, what we would like to -- what we're trying to point out here is that we're not concerned -- obviously we have to be concerned, but yet this waterhammer cannot challenge the burst pressure of the typical components. What we are focusing on is the traveling wave, the conversion of those waves into support forces, which is Vaughn's second bullet, if I may, that says that we are focusing on support failure and subsequent deformation of the piping system that would be required to challenge the pressure boundary integrity.

We have to evaluate for burst pressure, but we're so far away in this case that we are focusing much more on how to track this pressure wave through the system and get to the point where we can calculate support forces because that's the line of defense.

Before pressure boundary integrity can be challenged, you have to cause the support to fail, and then you can subsequently challenge the pressure boundary integrity. That's a much more difficult failure mechanism to occur.

DR. WALLIS: This is very interesting to me. We spent about two thirds of our time, and we have yet to get to the EPRI report, which is the whole focus of our meeting, isn't it?

Are you up here to take all of the shots before we get to EPRI?

MR. WAGONER: I was going to give a brief introduction. Let me just make one more point and I'll quit, and that is I think to why are we worried. Dr. Wallis, frankly, I have the same question. Why are we worried?

Because we're really down to dealing with a compliance issue. We're trying to make the mathematics work in our piping analysis system. That's where we are.

I don't believe -- we've got a low probability event. I don't think we have a safety significant issue, and we're down to trying to make the mathematics work so that we can say that we have a system that is our piping support system meets design basis so that we're in compliance with our design basis. I think that's all we're dealing with, frankly, and we need a little bit to do that, 20, 30 percent, and that's what we're trying to get out of this cushioning thing.

And with that I'll move on. Thank you.

Tom, you're up.

MR. BOEHNERT: Now, I understand we have to go into closed session; is that correct?

MR. WAGONER: Yes, the next slides do contain proprietary information.

(Whereupon, at 11:25 a.m., the meeting was adjourned into closed session, to reconvene at 12:32 p.m. in open session.)

MR. TATUM: Okay. Jim Tatum again from Plant Systems Branch.

Staff perspective on this, first of all, we would agree with the points that were raised by the subcommittee. Obviously when you take a look at it, there are shortcomings in the testing apparatus. The hA is a very difficult value to come up with. Even if full scale testing were done, the correct analytical approach for calculating and coming up with a value that would be applicable to other pipe sizes would be questionable no matter what.

So there's uncertainty, and there's going to continue to be uncertainty from that perspective. But I do want to acknowledge that points raised by the subcommittee are valid. We agree, and where do we go from there?

And basically in looking at generic letter 9606 and resolution and whatnot, there are other factors that we need to consider, I think, from a perspective of regulation, public health and safety and whatnot. We really need to try to put this in perspective in trying to determine where do you want to go from here.

Now, in looking at the other factors, the other factors that come to bear here, first of all, we do recognize and appreciate that this is a complex phenomenon. It's very difficult to model. There's going to be uncertainty, and we need to be able to deal with that somehow.

We believe it's important to appreciate, I guess, the work that EPRI has done, the involvement of the expert panel and that's gone into it. I think by and large they've done a pretty good job with the resources that have been available, and the effort that they've put into it.

They're kind of at the end of the rope -- end of the road on this. We understand their --

DR. POWERS: Or the end of the rope, either one.

MR. TATUM: Yeah.

(Laughter.)

MR. TATUM: They're as limited in resources was we are.

DR. WALLIS: Which end of the rope are they on?

MR. TATUM: Yeah. Maybe that was a Freudian slip. I don't know.

(Laughter.)

MR. TATUM: Anyway, they're limited on resources. They're having difficulty getting additional funds from participating utilities. We can appreciate that. We hear that on our end as well.

The NUREG CR-5220 waterhammer loads, if you'll look at what's calculated in that approach, which is a bounding approach, the Joukowski approach, what EPRI is proposing in their methodology gives you a reduction by a factor of 1.2 to possibly 1.6. If you look at the NUREG, it talks about the fact that the evaluation by NUREG CR-5220 could be a factor of two to ten conservatively, depending on what's going on, air cushioning, steam condensation, that sort of thing.

Unfortunately it doesn't qualify how much reduction to expect for different facets of the waterhammer event. However, I think what EPRI is proposing is certainly reasonable, and it's within the expectations at least that I would have in looking at what is said in NUREG CR-5220 and what they're proposing. I don't think it's out of line.

LOOP events, I think in the testing and analyses that have been done, the waterhammer group here has shown rather convincingly that the LOOP event, LOOP only without steam, would be bounding.

Okay. If we take a look at just the LOOP event, that takes us back to USI A-1 basically. That was reviewed previously, and we considered that part of the resolution. I think it was 927, Rev. 1, talks about resolution in there, and we acknowledge that plants have during start-up phases experienced those waterhammers due to LOOP, due to LOOP testing.

Any plant design weaknesses or vulnerabilities due to LOOP have been identified during early start-up days and whatnot, and those problems have been corrected. So at least in my mind the situation with steam in the piping is a step removed really in significance from just the loop event.

And if we were going back to resolution of USI A-1, I'd just remind you we really didn't go out to the plants and have them do anything to address this issue, and I don't think it is our purpose, nor was it our purpose, in issuing Generic Letter 96-06 to have plants go and address this issue. It was really the concern relative condensate induced waterhammer that drove the waterhammer issue in Generic Letter 96-06.

So we have sort of transitioned here in the work that's been going on from what our concern was to a different aspect of the concern, something I think that is a little removed from what our real concern was to begin with. We were thinking that condensate induced waterhammer would be the real severe issue that needed to be addressed, and I think what we've learned based on the work that EPRI has done is that, no, for low pressure systems we really don't have to be so concerned about that. It's really the loop event, and that brings us back to USI A-1, and I don't think we want to try to force the industry into doing something that we didn't ask them to do originally and really wasn't part of the generic letter consideration. So we do have to be a little bit sensitive to that.

Again, I'd emphasize cooling water systems are maintained not only for in-service testing and ASME code or other standard requirements, but also Generic Letter 89-13 was issued in recognition of the problems that we were seeing, reports that were made, LERs and whatnot with degradation and vulnerabilities that were being identified by utilities over the years with service water systems and cooling water systems.

So we have asked utilities, and we have done inspections to confirm that they are implementing programs to satisfy those concerns to make sure they know what the vulnerabilities are, what the degradation mechanisms are.

If it's mic, they're identifying that, and they have established programs to address that. Obviously those degradation mechanisms are very plant specific. It depends on the water quality, et cetera, but the plants are responsible to know what's going on in their system and to implement programs to maintain the quality of the system and the integrity of the system.

And we're confident that they are at a point where they're doing that. We've performed inspections to satisfy ourselves of that.

Also, we would agree with what Vaughn Wagoner and EPRI have said. We believe that this is of low safety significance, primarily just looking at the numbers for LOOP plus LOCA.

But if you go beyond that, if you had a problem with service water in containment, we've had other evaluations, other initiatives where you look at, well, what is the robustness of containment, how much can it take during, for example, maybe a hydrogen explosion, and the containments can take more typically than what we give them credit for, which tells us that, well, okay; you do have some margin there to heat up containment. If you did have a break in the service water system, in the cooling water system, typically those are isolatable from outside containment. I wouldn't expect that to be a problem.

So there are actions that can be taken should the event occur, which also helps to put this in a different kind of a risk perspective, and early on we were hoping to be able to address it from that perspective.

Unfortunately, it becomes such a plant specific evaluation that it's not something that our staff, that the Risk Assessment staff could handle on a generic level, and so we deferred to industry and asked that they consider risk, and that's why, partly why, I think, Vaughn mentioned that, was because it was requested by the staff to see if they could handle that or deal with that more handily than we could. That was the reason for that.

MR. SIEBER: Let me ask a simple question. If condensation induced waterhammer is just a small fraction of the forces that pump driven waterhammer has, and since start-up testing for every plant that I know, which isn't all of them, for sure, has already tested pump driven waterhammer and all of the deficiencies corrected, why can't the issue be resolved just on the basis of that logic?

MR. TATUM: Well, that's certainly a

possibility and something that could be considered. It's not something the industry has proposed, but it is something that I think is within the realm of possibility.

We're still reviewing the issue and trying to see how it fits together, but it's our expectation that for LOOP, the plants, in fact, are able to handle those events.

MR. SIEBER: That's right.

MR. TATUM: They have shown that during the start-up testing and whatnot.

The complication maybe that you get into there is the combined loads and what's required by the FSAR design basis. Would you require plants to combine those loads somehow?

So you get into the design basis base and FSAR requirements and being able to address that. And it's a possibility it's something that certainly the industry can suggest. We have discussed it, but not really gone into detail on that.

MR. SIEBER: Thank you.

MR. TATUM: So having considered these other factors, I'll just put up my last slide here, which would give you our preliminary conclusions. As I've said, we haven't completed our review. We do have a number of open items. One has to do with air content.

We believe that for the work that has been done, that the proposed amount of air is conservative. However, we're looking at differences in plant arrangement, for example, that maybe would explain or argue that, well, maybe the amount of air for one arrangement versus another may not -- maybe you wouldn't credit that much, and we just need to think through in our evaluation the different plant arrangements that we would expect to see and whether or not the proposed amount of air release would be conservative.

At least we believe it would be conservative for the different plant arrangements. So we're looking really at that kind of a level or that type of a review for air.

However, for the testing that was done and for the limited scope testing, you know, representing basically a stagnant tube, but without the continued flow and whatnot, we do believe rather convincingly that it is conservative, and it may not be the right number, but part of what we're considering is, well, is it a conservative approach and do we believe that it would give us confidence that if the utility used this approach, that they would give us an answer or come up with a load that is conservative with respect to the waterhammer condition.

It's not just is it the right number, but is it a conservative number, and I think the subcommittee has pointed out very well that it may not be the right number, probably is not the right number, certainly not exact,b ut we're tending to look more on whether or not it's conservative and whether or not we can base our evaluation on the work that was done and use that in resolving or closing out this issue for these plants.

DR. ROSEN: Jim, I only have one remaining residual, remaining concern, and that is that post LOCA-LOOP emergency operating procedures are specific enough to assure that plant staffs will isolate faulted fan coolers if that should happen, even though these analyses say it probably won't.

Is that something you're thinking about?

MR. TATUM: Well, it's not something -- you know, the emergency response was touched on a little bit by EPRI, and you do get into the symptoms based or symptoms driven response, and to the extent the operators are able to identify the reason for the symptom, they can address it.

But you get into real complications with operator response and human error and human factors and whatnot, and we really haven't gone into that level of detail. We have not involved emergency response people.

I don't know. Our feeling is that it's relatively low safety significance. We don't know that it really warrants that level of review at this point. That's kind of where we are on that.

CHAIRMAN BONACA: I had a question. Do you expect us to write a report on this issue? I mean, at the end you're telling us these are preliminary conclusions. You told us that there are a number of open issues, and I think you have some judgment you're making regarding conclusions, and I am left, you know, with a question in my mind. Are we ready to write a report of this or should we?

MR. TATUM: Well, obviously the conclusions I'm giving you here are the staff's views on what we've seen, our understanding of the work that's been done and the report as it has been presented in our review to date.

We do have, as I say, some open issues, but we do not think that the shortcomings of the analytical derivations or the experimentation and the issues that have been raised by the subcommittee, we do not believe that those shortcoming really are show stoppers with respect to being able to use that report and credit it for analyzing waterhammer events at these plants.

We think that to the extent we do identify significant issues during our evaluation, and like I say, the air is one. We have pulse rise time, I think. We're considering single pulse, multiple pulse. You know, getting back to our review of the document itself, we may find the need to impose certain restrictions on how the report is used.

One restriction that we know we would impose is that the report would only be used -- we would only accept it for resolution of 96-06 waterhammer. It would be allowed for any other application because the testing is pretty specific to 96-06 for fan cooler systems. It would not be applicable to RHR or other systems that typically experience waterhammer.

So we're going to be very specific on where we allow it. It's only this limited use application, but we think that industry has provided sufficient argument. It's convincing, I believe, to provide reasonable assurance to us that if the utilities use that methodology, they can at least come up with a value for support loads and whatnot that's realistic, credible, and something that we can use to resolve the issue.

CHAIRMAN BONACA: Okay.

MR. HUBBARD: This is George Hubbard.

I'd just like to reemphasize that; that I think really the question is: is the user manual that they will be providing to industry -- does it provide a reasonable method for a plant to take, do plant specific analysis, and use this methodology to determine their waterhammer loads? Does that provide a reasonable method for them to use and considering, in particular, the low safety significance of this event?

And I think, you know, if you were to write a letter, we would be looking for the ACRS to tell us yes or no, that the use of this user manual is reasonable.

DR. WALLIS: Usually what happens is the staff takes a position and we see something written from the staff, and then we write a letter saying we agree with the staff or whatever.

In the absence of this final statement from the staff, you're sort of asking us to be the staff and to write a review of the document. It's not really our job.

MR. HUBBARD: Okay. I guess the point is, I think, from the management perspective we're seeing that this with maybe some limited -- being limited to the containment fan coolers from a management standpoint; we're seeing that this does provide a reasonable approach, and that any restrictions we would be putting in our safety evaluation on how they apply it.

But basically, considering the safety significance of this issue, I think they've got a reasonable approach for dealing with this.

DR. ROSEN: In fact, we do have your final conclusions on this.

DR. WALLIS: I have another question. This document, this EPRI report, is this going to eventually be a public document?

MR. TATUM: Yes, it is.

DR. WALLIS: So that means that in the presentation we kept being promised improvements to the report, and I think that the real driving force for that is that eventually it's going to be out there in the public. So it's got to be a convincing document.

MR. TATUM: Well, it will be proprietary, and there will be a non-proprietary version. We also have editorial comments that we've found and we will be sharing with EPRI, corrections that need to be made. They will prepare a final version, and also, I think, put their own corrections and also add the additional detail that they've promised the subcommittee.

But once they've put that final version together, then they will also prepare the nonproprietary version and made that submittal.

DR. WALLIS: So I think there are sort of two issues here. One is is this a safety issue and is this good enough to resolve the safety issue. The other one is is this the sort of report you want to see out in public as typical of what the NRC accepts.

They're sort of different questions.

MR. TATUM: Yeah, and as I say, I mean, the staff really doesn't have a problem accepting the report for the specific limited application. We would have a problem obviously accepting it as a way to evaluate waterhammer in general

MR. SIEBER: Maybe I can ask one more question. Is there a list of plants that have resolved this issue outside of the methodology of the

EPRI process?

MR. TATUM: I do have a listing of plants. I can't tell you off the top of my head what they are, but there have been quite a number of more plants that have resolved it outside this process.

MR. SIEBER: Okay, and of course, there's a list of the members of the group who would intend to resolve it this way. If I take those two lists, does that include all of the plants subject to the generic letter?

MR. TATUM: All except I'd say maybe about half a dozen.

MR. SIEBER: What happens to them? You know, what are they doing?

MR. TATUM: Now, the half a dozen that are left, a couple of them have submittals in house that we're reviewing. They have used RELAP and were not comfortable with their use of RELAP, and so we need to take a close look at it. So those are in process.

Others that we're looking at, I think your concern is, well, what if they wanted to use this EPRI methodology.

MR. SIEBER: Well, that would be one concern, or what happens after this group has spent maybe a million bucks or whatever to do this, and then somebody else devises some, you know, very simplistic approach. What is the criteria by which you would accept all of these various methods?

MR. TATUM: Well, a particular utility is always free to propose an approach, and we obviously are obligated to review that. And, in fact, that's what brought us here to begin with. Utilities were trying to make submittals on their evaluations that we felt were just not adequate, and we asked the questions. We would ask the same questions that we asked in the beginning about the evaluation. What were the assumptions and considerations that went into it, whether or not they followed Joukowski, if they were proposing some other approach and what was the justification; that's what drove this group of utilities together to form the working group and to develop this methodology.

It wouldn't be a trivial matter for a single utility to come in on their own and say, "Well, we'd like to use this other approach." We'd expect the same kind of effort and expense, I would expect, to justify that approach.

MR. SIEBER: Okay. Thank you.

MR. TATUM: Any other questions?

(No response.)

MR. TATUM: Okay. Well, thank you very much.

DR. KRESS: Thank you.

And I turn the floor back to you, Mr. Chairman.

CHAIRMAN BONACA: Yeah, I think we should postpone any further discussion to the afternoon.

DR. KRESS: Yeah, I think that's correct.

CHAIRMAN BONACA: And with that I think we'll recess for lunch now. Well, we do have some discretion because the two meetings we have in the afternoon, the first two are just internal matters. One is reconciliation of ACRS comments.

I would propose that we do that when we reconvene, say, at 1:45, and then after that -- and we will do the subcommittee report at 4:00 p.m., at the conclusion of the reactor oversight process.

Okay. With that, then the meeting is recessed until 1:45.

(Whereupon, at 12:55 p.m., the meeting was recessed for lunch, to reconvene at 1:45 p.m., the same day.)

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

(2:30 p.m.)

CHAIRMAN BONACA: Let's resume the meeting now. The meeting will come to order again.

And we're going to review the reactor oversight process. We have presentations by the NRC staff, and I'll turn the meeting to the Chairman of the subcommittee, Jack Sieber.

MR. SIEBER: Okay. I'll be very brief. Actually we have had four previous meetings on this subject where we have looked at various components of 03-05 and how it fits together, and today is a review, which is necessary for us because we have an SRN that we need to answer, dated April 5th, 2000.

And you'll notice on the board that it's rated A plus, which means get it done or stay here forever, and so what I'd like to do is we will discuss performance indicators, initial implementation, significance determination process, and the technical adequacy of the significance determination process to contribute to the reactor oversight process.

And since we are going to put out a report at this meeting some time, I would encourage members to ask the pertinent questions that they feel are matters of concern to them so that we can have the advantage of the staff's response.

And with that, Mike.

MR. JOHNSON: Thank you.

My name is Michael Johnson from the Inspection Program Branch, and I'm joined at the table by Mark Satorius, who is the Chief of the Performance Assessment Section, and Doug Coe, who is the Chief of the Inspection Program Section.

And as was indicated, we are here to talk about the reactor oversight process. I ought to mention that also at the side table we have Don Hickman, who is, as you are aware, our performance indicator lead. Chris Nolan is here representing the Office of Enforcement, and in fact, throughout the room are a number of folks from my branch and who serve in various capacities, and also Steve Mays from the Office of Research.

So we've got a pretty good spectrum of folks in the room to listen in on and possibly contribute on the discussion of reactor oversight process.

As was mentioned, we have had several briefings throughout the first year of initial implementation for the ACRS, and those briefings have focused on areas, I think of key importance to the

ACRS in preparing for this letter writing opportunity that you have for the Commission.

And we focused in on the important areas, I think, that are of interest to you. We focused in on performance indicators, significance determination process. We went through a fairly exhaustive presentation, I think, and tried to demonstrate for you the use of the SDP.

We talked about in a session, I think, in July the action matrix and tried to respond to your questions and provide you a good overview of what we intended to do with respect to the action matrix and the reactor oversight process.

At our last meeting in July, we also took the opportunity to try to forecast for you what we were going to -- then, at that time, we were previewing what we were going to tell the Commission, that we ended up telling the Commission in fact on the 20th of July about the reactor oversight process.

At that time we really used some of the high level slides that captured the results that we documented in the Commission paper and the fact that we, again, did, in fact, discuss with the Commission.

Those overall results, and I'll just repeat them briefly, right now is that based on the input that we got from internal stakeholders and external stakeholders, based on a very, very thorough, I think, use of self-assessment metrics and internal feedback through a Federal Register notice and an internal survey, reached the conclusion that the reactor oversight process, while not perfect, does do what we intended it to do, in that it makes steps in the direction of improving its ability to be more risk informed, understandable, predictable and objective, and in fact, goes towards meeting the agency's NRC performance goals, maintaining safety, efficiency, and effectiveness, those goals that you're well aware of.

Having said that, we did learn lessons throughout the first year. We tried to characterize those lessons for you, and in fat, we had planned actions that we described in the Commission paper, and we talked about those planned actions in July.

And so the point that we tried to leave with in July, and I want to start off with perhaps today, is, again, while we know the process isn't perfect, we believe and have told the Commission and I think the Commission recognizes that the ROP is a step in the right direction. It does represent an improvement over the previous process, and we ought to go forward and make improvements, and that's our mantra, the mantra that we carry for the staff, with the staff, is that we are going to continue to improve the ROP in this next year, in fact, the year that we're already in, the second year of implementation of the ROP.

I ought to also mention by way of background that in addition to, you know, talking about the status in that last briefing, we did something that I thought was very useful, that is, the ACRS subcommittee did something that was very useful for us, and that was that we went around the table, and each of you told us, each of the subcommittee members told us what their primary concerns were with respect to the ROP, and we wrote those down, and we listened to those concerns.

And they dealt with things like confusion. There's confusion with respect to, for example, what is meant by a green PI and how that differs from a green inspection finding and how we treat those consistently through use of the action matrix.

We talked about, the ACRS subcommittee talked about the consistency of the treatment of issues in various cornerstones, if you will. In fact, we talked about the ALARA cornerstone, the occupational safety cornerstone, and the ALARA SDP and where that gets you with respect to the significance of issues and whether or not that's equivalent when you look at the reactor safety SDP and where you come out with respect to that. That was an issue.

We talked about the treatment of safety conscious work environment and all of the cross-cutting issues and the concern on the part of the subcommittee members at that time with respect to those issues in the ROP.

We talked about the plant specific thresholds for performance indicators or the fact that we ought to be moving in the direction of plant specific PIs or plant specific thresholds, I should say, associated with performance indicators.

There was a concern about rewarding the good performance in this process, and really a concept, I think, on at least some participants' minds that the old process, the SALP process used to provide something in terms of incentive for licensees to improve their performance, and in fact, the ROP, the existing ROP that we've gone to, does not.

There was a concern late in the meeting about the consistency of ROP implementation, the issue being that are we, in fact, at the threshold for documentation level at the identification of green issues and white issues. Are we consistent among the very regions in terms of how we implement the ROP?

So we talked about those issues. Those were among the issues that we raised, and, in fact, there are other issues that we're aware that the ACRS has continued to raise and that we've continued to take action on.

In fact, one of the things I wanted to tell you is that as you'll hear in a few minutes we have taken or are taking action and moving in the direction to address many of the concerns that you've raised in the past, and in fact, I feel very positive with respect to the role of the ACRS in terms of shaping the direction of the staff with respect to improving the implementation of the --

Has the word gotten out that we're easily swayed by flattery?

MR. JOHNSON: The flattery is almost over. So let me --

(Laughter.)

MR. JOHNSON: The last point I would make, and then I'll shut up and let Mark talk, is that I do want to tell you that we are prepared today to talk at a very high level with respect to the ROP, and we'll touch on all of the areas that are of interest to you, and we'll do our best to answer your questions.

I do want to tell you though that we did not bring the cast that I would have brought if we had the time to do the very detailed reenactment of some of the earlier presentations that we had for the ACRS, for example, the SDP discussions and those kinds of things.

So I simply tell you that to say that welcome your questions. We'll do our best to address your questions, although I don't think the time is going to allow us to delve into a lot of detail on any of the issues that we've talked about in the past.

Having said that, let me turn it over to Mark, and Mark will start off the discussion, a very brief presentation, I might add, on lessons learned and actions that we're going to take on the major areas of the ROP, and then we'll be quiet and entertain your questions.

MR. SATORIUS: Thanks, Mike.

I'm going to talk about both performance indicators and also assessment. But like Mike indicated, we're here to do our very best to answer your questions as they develop and to give you a good briefing on where we've come thus far.

I would like to point out that unlike Mike and Doug and the majority of the folks in the Inspection Program Branch, I'm a relatively newcomer and been in the branch for three months. So I don't have, I guess, the bench strength in my memory that some of my colleagues do. So like I said --

MR. SIEBER: Which probably won't help you here.

(Laughter.)

MR. SATORIUS: I suspected as much.

I thought I'd start on performance indicators with just a very brief background just to kind of frame the performance indicator issues, and that is we put together some guidance with NEI in a working group that we had empaneled to develop some reporting guidance, and that was NEI 99-02, and that first revision was then revised again based on input from the working group, and also our stakeholders in the spring of 2001 after the first year of initial implementation.

The working group primarily was put together to provide resolution on PI issues as they developed, insights as to where problems existed with the PIs, and also as an avenue to develop any needed replacement PIs should it become evident that they were necessary.

With respect to the first bullet, that was a replacement scram PI indicator that at the onset of the ROP and initial implementation there was an issue involving whether we had identified the appropriate scram performance indicator, and that was the first performance indicator that we took on to conduct a six month pilot.

We performed that six month pilot in the spring of this year, came to a conclusion that the proposed pilot PI did not contain any advantages to the original PI, and it was the staff's view that we would retain the original PI for use.

Due primarily to some industry senior executives' interest in this matter, we have drafted a letter that would address our position on how this PI should be retained, and that letter is at the Commission right now for their review and consultation prior to issuance.

Once that's issued, it would be our intent to go ahead and inform the industry via a regulatory information summary that would indicate that we will retain the PI that was originally put into place.

MR. SIEBER: And I guess the difference between the original industry position and your current position relates to whether manual scrams are included or not.

MR. SATORIUS: That's exactly right, and the replacement PI proposed to do away with what's termed unintended consequences that develop as a result of manual scrams counting. There were some positions that there would be unintended consequences as a result of potentially an operator hesitating or possibly not inserting the manual scram, and the replacement scram we concluded to a large extent did not remove the potential for unintended consequences. There were unintended consequences that were developed as a result of that new replacement PI, and that was the conclusion.

MR. SIEBER: Well, as a former operator, I think that when you count automatics and manual scrams just as a scram, the operator doesn't care one way or another.

MR. SATORIUS: We got that.

MR. SIEBER: The difference is if you don't count manual scrams and the operator is more likely to manually scram the plant where the automatic set both takes it off.

So I don't know whether that's good or bad, but that's what the original argument was.

MR. SATORIUS: Some of the feedback we got from pros was that the operators would do the right thing irrespective of whether they were counted or not.

MR. SIEBER: I think that's true.

MR. SATORIUS: And we got that indication from a lot of operations managers in direct contact with various licensee staffs during the first year of initial implementation.

MR. SIEBER: With regard to that indicator though I think that one thing that I note is that the threshold between green and white is such that it's not particular risk significant. Okay? You know, a plant is designed to deal with an automatic or a manual scram so that you actually have -- before it becomes risk significant to any appreciable extent, you have to get into the more serious thresholds.

Another indicator that's like that is the loss of heat sink. For example, you have to lose heat sink to get to a red indicator three times a day every day for three years, and boy, if your plant is in that bad a shape, you know, I would say that indicator doesn't tell me much

MR. JOHNSON: Yeah, and, Don, you're welcome to jump in at this point or you can wait if you want to a more opportune moment.

MR. HICKMAN: Okay.

MR. JOHNSON: But let me just say a couple of words before you do, Don.

One clarification is that we're going to count -- both indicators count manual scrams. If you look at the primary change in the replacement PI, you won't find the word "scram" at all. You'll find a shutdown, and then we've gone though the effort to try to define a shutdown that is a rapid shutdown like a scram without saying the word "scram."

And if you look at --

MR. SATORIUS: And it introduces a 15 minute period in there, in other words, a rapid shutdown within 15 minutes, and I think our view was when all is said and done, the potential for unintended consequences associated with that 15 minutes is probably more than the operator -- and like you say, you haven't been an operator. In the heat of battle in the control room, he's going to reach up and do the right thing.

MR. JOHNSON: So I guess the point I was making was that we're going to count manual scrams. We think it's important to count manual scrams.

Now, your point is well taken with respect to the thresholds. Typically what we find is if a plant is going to begin to have problems with scrams, we'll see performance problems showing up that are reflected in other indicators, and in fact, for example, there's a special inspection going on right now where the plant had a scram and then had some other complications.

And so we'll do an event follow-up type inspection to look into that issue. So we're not -- that takes me into a good point, and that is to say that the performance indicators are a part of the indication that we have about the overall performance of the plan, but it's not the sole indication.

MR. SATORIUS: I'll go now to just the unplanned power change PI. The original PI read the number of unplanned power changes in reactor power greater than 20 percent within 7,000 critical hours, and there were a number of questions within our working group on that.

The industry and NEI had proposed a different unplanned power change PI that they intended to bring to the table to be piloted at some time this summer or fall.

We had also developed one ourselves and had entertained whether it might be useful to pilot both of them at the same time. Through our working group NEI has taken those, our proposed, their proposed and, I guess, they're framing them or they're collecting data and seeing as to where those would all fall out, and they haven't gotten back to us with their proposed unplanned power change PI.

We've gone ahead and developed ours and would propose that at the next meeting that we have with them, to go ahead and pilot that at some point in the fall and early winter.

The last issue involves improving the safety system unavailability PI. We've established a separate working group to work on that specifically. Part of the problem that we have with this one is the fault exposure hours associated with an unknown as to when the initiating event was.

In other words, for example, you may have an 18 month surveillance where the previous time you might have had an opportunity to identify that you had a problem would have been 18 months ago, and it's -- using the standard T over two gives you nine months of fault exposure time, and on any diesel that's going to put you into rad.

And the consistency issue that we have here, and we discussed this with the subcommittee before, was a lot of times if you look at this demand failure, in other words, during the surveillance and you plug that into an SDP because of the chance for operator successes, because of the chance or opportunities for off-site power to be restored, you'll oftentimes get a green SDP finding on a red PI finding, and we recognize that as a consistency problem.

Industry also has identified that, and this safety system unavailability group is working to develop a pilot PI that we would intend to begin piloting. I believe it's in January, isn't it, Don? Yes, January.

In the interim though, recognizing that there are some challenges, especially from a consistency standpoint, we're going to take interim steps where for any demand failure, such as the example I just gave, the diesel, that we would, in fact, use the SDP to determine the actual significance because it more closely ties it to risk significance as opposed to the counting of hours and the use of T over two, although T over 2 is pretty consistent from PRA and also in the ASP analysis.

But that is an interim step that we plan on taking until we can get -- and that interim step would continue throughout the piloting of the PI and until we would be able to develop a PI that would more accurately measure this unavailability issue.

MR. SIEBER: If you continue to use T over two in the SDP process, would you --

MR. SATORIUS: Yes.

MR. SIEBER: -- not come up with the same result that you come up with out of the PI?

MR. SATORIUS: No, you don't, and the reason is that the SDP takes a look at, and then Doug probably can talk to this better than I, but the SDP takes a look at other matters outside the simple counting of hours. It looks at the ease or the ability of an operator to take compensatory action and how likely that is to be successful. It takes a look at, for example, if you were to have a diesel that would fail 12 hours into its full power run. If you were to have an actual scenario with a loss of off-site power, the chances for the recovery of off-site power within 12 hours are relatively high.

So you take that, coupled with the potential for operators to take -- it gives you a better scenario and the SDP more accurately categorizes it or addresses it from a risk perspective.

MR. JOHNSON: This is just another one of those advertisements that I'll try to throw in. This, I think is one of the most substantial improvements to the ROP in the area of performance indicators that goes a long ways towards addressing a number of the concerns and the recommendations of the ACRS in the past in that I think at the end of the day what we will have in this revised SSU is something that is clearer, that does provide consistency in the use of the definition of unavailability.

We've got all of the right folks in this working group. We're talking to the PRA folks. We've got Research participating. We've got the maintenance rule folks participating. We've got a representative from INPO/WANO.

And so we'll have a standard definition of unavailability that will be used for this performance indicator. And so when you apply this performance indicator, again, you'll have consistency. It'll be easier for the operators, and it will get us to the right result.

And when you go to run through an SDP, a finding that would reflect an unavailability for the PI, you'll end up at the same spot. So that scratches a lot of itches, and so we think that's a very good change.

CHAIRMAN BONACA: Yeah, sine you have performance indicators and you're moving to other issues, I would like to just ask a question regarding, again, one issue that has been brought up by this committee many times and our Chairman who is not here has raised this issue and I somewhat am representing his thoughts, too.

The fact that this PI is a known plant specific; they are generic. Okay? And you know, we went through an exercise yesterday, just some chatting about it, and for example, take the high pressure injection system, which is a significant system in all power plants because it's an element of LOCA mitigation.

And you know, I can think of specifically a group of early C plants out there, like St. Lucie and Calvert Cliffs, known things, that have two high head pumps in that system, 50 gpm each, that provide very little floor, high head. Therefore, those plants are vulnerable more than others to small break LOCAs because the pressure may hang up there, and you may not be able to add water in it.

I mean, that's a known thing technically, and in fact, the PRAs reflect the importance of that scenario in the risk, as well as the importance of that system for the plant. Okay?

They also happen to be pretty limited in auxiliary feedwater. So, therefore, you know, if you look at the PRA, it shows a very significant contribution, and you know, so here I have some very specific insight on the safety aspects of that plant tied to that system.

I also have the latest generation of Westinghouse plants like CBER. With five I had injection pumps that provide, I believe, 375 gpm each, at the 2,300 psi. Two of them are charging pumps. Two of them are self-injection pumps. One of them is a back-up. They're interchangeable.

Tremendous capability up there, and clearly that shows in that the fact that small break LOCA is not a dominant sequence in those plants. You know, these are the specifics.

Now, so if I really looked at getting insights from PRAs and from risk regarding these two things, I would treat the self-injection very differently for the St. Lucie type plant than I would call for this Westinghouse type plant. They're telling me very different things.

I would set probably the thresholds in different locations.

I would also even put a multiplier maybe on the C type plant, given that the system is so fundamental, important for the plant, and yet if I look at the PIs, the way they are defined right now, they don't discriminate at all in that sense.

I mean we discussed this issue to death already, and they're not plant specific, and by the way, when I look at the question, number one, from the Commission that says if the PIs provide meaningful insight into aspects of plant operation that are important to safety, they don't provide insight at all.

And yet the PRAs are providing that insight right now that there is this strength for the Westinghouse type plants, and there is this weakness. Let me call it that way.

And I wanted to provide this example simply because I think it's poignant in indicating how much more one could get from existing risk information from these plants that is not present in the current PIs.

DR. ROSEN: let me before you answer that, Mark, take the same point from a slightly different angle. What we really want to measure in these indicators is the overall risk of plant operation.