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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

THERMAL HYDRAULICS SUBCOMMITTEE

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MEETING

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ROCKVILLE, MARYLAND

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TUESDAY

JUNE 22, 2004

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The Subcommittee met in Room T2B1 at Two White Flint North, 11555 Rockville Pike, Rockville, Maryland, at 8:30 a.m., Graham Wallis, Subcommittee Chairman, presiding.

PRESENT

GRAHAM WALLIS	Subcommittee Chair
F. PETER FORD	ACRS Member
THOMAS S. KRESS	ACRS Member
VICTOR H RANSOM	ACRS Member
RALPH CARUSO	Designated Federal Official

NRC STAFF

RALPH ARCHITZEL	NRR
MICHAEL JOHNSON	NRR
ANGIE LAVRETTA	NRR

ALSO PRESENT

TIM ANDREYCHEK	Westinghouse
P. BLOMART	Electricite de France
BOB BRYAN	TVI
JOHN BUTLER	NEI
JOHN CAVALO	
MO DINGLER	WCNOG/WOG
CHRIS HUTCHINS	Westinghouse
BRUCE LeTELLIER	Los Alamos National Lab
TONY PIETRANGELO	NEI
GILL ZIGLER	Aliva Science & Technology

C O N T E N T S

P R O C E E D I N G S

(8:30 a.m.)

CHAIRMAN WALLIS: The meeting will now come to order, please.

This is a meeting of the Advisory Committee on Reactor Safeguards, Subcommittee on Thermal Hydraulic Phenomena.

I am Graham Wallis, the Chairman of the Subcommittee. The subcommittee members in attendance are Tom Kress, Victor Ransom, and Peter Ford.

The purpose of this meeting is to discuss the staff's approach to resolution of several issues related to pressurized water reactor sump performance during a loss of coolant accident. The subcommittee will hear presentations by and hold discussions with representatives of the NRC Staff, the Nuclear Energy Institute, and other interested persons regarding this matter.

The subcommittee will gather information, analyze relevant facts and issues, and formally proposed positions and actions as appropriate for deliberation by the full committee.

Ralph Caruso is the designated federal official for this meeting.

The rules for participation in today's

meeting have been announced as part of the notice of this meeting previously published in the Federal Register on June 14, 2004. A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice.

It is requested that speakers first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

We have not received any requests from members of the public to make oral statements or written comments.

Now, usually I like to proceed directly with the meeting, but I do have a few introductory remarks.

This appears to be a significant issue which has been around for quite a long time, and it's not just the group in this room that's interested in it. There has been interest in the meatier and the broader section of the public as well, and the ACRS would like to do what it can to add value to the resolution of this issue and help the staff reach the right decision that can be clearly justified.

My understanding is that all we're asked to do at the moment is to advise on the issuance of a revised generic letter. There's nothing else which is ready for decision at this time. And I find that a little puzzling because the generic letter requests that calculations be made, analyses be made, and this would seem to depend upon proper guidance about what those calculations should be, how they should be conducted, and particularly it depends on the NEI guidance, which we're discussing today. We're getting some introduction to it, but we're not evaluating it, and we don't have any staff evaluation of that guidance to talk about.

So I don't quite see -- maybe it will be clear in the next couple of days -- how we can have a generic letter without proper guidance about how to make technical calculations, and we already stated that the reg. guide really is not technical guidance. We'll have a letter from the ACRS on that matter. It simply says thou shall calculate a lot of things without telling how to do it.

Now, this NEI guidance, I've had a look at it, but I haven't had time to review it fully, and it appears to be substantially changed since the last draft that we reviewed. And it claims to be very, very conservative, and so it would seem if it's very, very conservative, it's going to be more conservative than the Los Alamos study, which we already know predicted that quite a few plants would have to take some action.

Okay, and so it would appear that the result of all of this effort is going to be that many PWRs will find that they are unable to pass to 5046 criteria in light of the new research information, and it's quite clear if you read 5046 that some action is immediately required in that case.

Now, if we reach the situation a couple of years down the road, there's going to be a clamoring to adopt a risk informed solution, and it would seem to me that if that's going to be the solution to this problem, we had better start it today instead of spending a great deal of time on some deterministic compliance approach, finding that it has all been trumped by something else after we have done all of this work.

So I would like to know perfectly clearly very soon from the staff and NEI what is the future of this risk informed approach and how it's going to play into this overall game because the generic letter seems to be directed entirely at a deterministic compliance approach. At least it has changed to admit now that there might be some sort of a backfit implied.

There was something mysterious about the original generic letter. It's referred in this discussion of there being no backfit when it sort of was rather clear this could be quite a large backfit if the deterministic approach were applied.

Well, I'm sorry to take some of your time. I'm looking forward to what Tony Petrangelo has to tell us and invite him to address us.

MR. PETRANGELO: Good morning. I feel like at the start of two days' worth of meetings on sumps I need to say something like, "Are you ready for some sump performance information?"

Well, my purpose today, just to kick off the industry presentation on our evaluation guidance. As Dr. Wallis noted, we did send an early draft to the staff last October. There was a lot of work done in the interim to get the staff the draft we sent on May 28th.

We're going to go through that draft in some detail this morning. Let me at this point introduce my colleagues here.

First, Mo Dingler from Wolf Creek and representing the Westinghouse Owners Group. Mo is going to give you an overview of the industry evaluation guidance.

Next will be Tim Andreychek from Westinghouse. Tim is going to go over both the baseline and what we call analytical refinements in the evaluation methodology.

And then John Butler from NEI is going to talk a little bit about the risk informed approach.

The risk informed piece is not as well baked as the deterministic part at this point.

CHAIRMAN WALLIS: Not as well baked?

MR. PETRANGELO: Not as well baked.

CHAIRMAN WALLIS: You mean it's half-baked?

(Laughter.)

MR. PETRANGELO: I think we're still in the kitchen. We haven't put it in the oven yet.

We've only had a couple of discussions with the staff on this. There have been some different approaches on how to do this.

CHAIRMAN WALLIS: Okay, and there will be some time during all of this when we can take a break?

MR. PETRANGELO: Absolutely.

CHAIRMAN WALLIS: Okay.

MR. PETRANGELO: Absolutely. The other thing I want to say about the risk informed approach is that this is a very complex issue. We're doing a mechanistic evaluation where before we had a simple assumption; sump screen performance to 50 percent blockage that practically all licensees have in their licensing bases.

This is a complex issue, a lot of phenomena, difficult to model and understand, and a lot of uncertainty. So trying to do a probabilistic approach to this suffers from the same ills that our deterministic approach suffers from.

So I like what Dr. Wallis said in his introductory remarks, and I think at this stage of the game the ACRS can add great value to the resolution of this issue because even though our schedule is somewhat compressed and we're trying to meet the Commission's deadline on this, there's still time to make sure we do the right thing and work this smartly.

And the industry is committed to getting the resolution on the timetable of the Commission set forth, and we're working as hard as we can to try to meet those dates, but we look forward to your feedback and input to the evaluation guidance today and tomorrow.

CHAIRMAN WALLIS: What you just said, Tony, was that you are now asked to do a mechanistic analysis to replace the simple assumptions that we had in the past, which were presumably in the regulations, simple assumptions, where they were some acceptable way to calculate, which was --

MR. PETRANGELO: There was an assumption in the initial reg. guide.

CHAIRMAN WALLIS: In the initial reg. guide, right. And it seems to me this is an example of where some simple assumption is made because of a reluctance to do the analysis and the research, and then later on comes back to bite you when you find that if you had done the analysis your simple assumption wouldn't have been very good.

This is an example of where doing research ahead of time might have been a good idea.

MR. PETRANGELO: Well, I was in high school in the '70s when that assumption was made.

CHAIRMAN WALLIS: Yes.

MR. PETRANGELO: I can't speak for the people --

CHAIRMAN WALLIS: I think we might learn from that. These simple assumptions sometimes come back to bite you later on.

MR. PETRANGELO: They can, and I think at the time I'm sure it was thought to be a conservative assumption, okay, and it has taken years of research to, I think, raise the question again.

This was a USI before it was GSI and it was closed out. So we're a learning industry, and I think the NRC is a learning organization and we have to take new information into account and do the right thing. So that's where we're at today.

Now, let me get into my opening remarks here. My remarks are structured around the recommendations that were in the September 30th letter from the ACRS to the NRC, and I think at that time the context of this letter was you were reviewing Reg. Guide 182, and you said the staff should go ahead and issue it and work with us on our guidance. You noted the complex phenomena and need for plant specific assessments.

As I said before, we submitted a revised guidance document on May 28th, and our purpose today is to give you an overview of that guidance.

You acknowledged that the knowledge based report captures all of the research that has been done, but it was confusing and could not be used directly as sump evaluation guidance.

Part of our effort, I think, is to address the second part of this, trying to get an endorsement from the staff that our guide os am acceptable way to address the functional requirements.

You noted all of the sub-bullets down there and how hard this is to do. We've tried to address each of these areas in the guidance on the schedule laid out by the staff.

You're going to hear, I think, tomorrow about the chemical effects testing that's being planned. This is a large uncertainty in your sump evaluation.

CHAIRMAN WALLIS: This is not in your guidance document.

MR. PETRANGELO: Not at the present time.

CHAIRMAN WALLIS: So it's another one of these things which might come back to bite you.

MR. PETRANGELO: That's correct. But I would note that there has been a very cooperative effort between NRC Research, EPRI and the WOG to get this testing, the protocol location.

CHAIRMAN WALLIS: Well, I think there was a statement by either you or the authors of your guidance that they do not believe that chemical effects are important. It's one of these belief things, is it?

MR. PETRANGELO: We hope it's not important. We're optimistic that it's not important.

CHAIRMAN WALLIS: That was the problem initially.

MR. PETRANGELO: That's why we have to do the test.

MR. PETRANGELO: No, we have to do the test.

This was another recommendation about the uncertainties being so large that they could not care what evaluation methodology you use, probabilistic or deterministic. You could have wound up in the same boat. So we need to think of other means to look at this issue.

We structured our evaluation guidance and methodology, and you noted the high degree of conservatism in the baseline. It's really a way to try to direct you at what issues are going to be important for your plant, and then we'll talk about some of the analytical refinements and plant specific things one can put into that evaluation.

I think the risk informed cut also is one degree of resolution finer to try to get a solution that focuses on --

CHAIRMAN WALLIS: This question here which is up there about alternative methods of cooling really changes the risk, and if you just look at the sump blockage issue, that first report that Los Alamos put out, the risk could increase significantly.

But when you look at all of the things plants can do to cool the core and put that into their risk, it doesn't look so bad.

MR. PETRANGELO: No, it doesn't.

CHAIRMAN WALLIS: So this is an important question.

MR. PETRANGELO: Yeah, and early on in our discussions, we were considering, we though, some fairly innovative solutions to try to address this problem before you get to the sump screen. If you never get the recirculation this problem goes away for some of the more likely brinks.

Unfortunately we don't have enough time for the schedule to work all of that out, and perhaps later we can work on some of those issues, but at the current time to respond to the schedule of general letter, we just don't have enough time to work on some of those more innovative solutions.

And you noted that we had given all of these uncertainties a risk informed, more realistic, lead conservative approach may be warranted. So, again, we structured the guidance into kind of the Option A, which is your traditional deterministic/design basis methodology, worst case assumption on top of worst case assumption, and I think it compounds into a very, very grossly conservative evaluation methodology.

The risk informed approach tries to use realistic conservatism. Actually you'll hear about two different approaches that we believe are both risk informed. We don't think we have enough information on what's happening from debris generation to transport to the sumps to get our hands around this probabilistically. We're having a hard enough time doing it deterministically.

MEMBER KRESS: We thought we'd perhaps -- if you just look at the frequencies --

MR. PETRANGELO: Yes.

MEMBER KRESS: -- that you might just be able to skip that part of it.

MR. PETRANGELO: Well, that's kind of what we proposed.

MEMBER KRESS: Okay.

MR. PETRANGELO: Okay? Now, the staff has looked at another approach that is more geared towards mitigating sump screen clogging, the use of more active --

MEMBER KRESS: Well, if your frequencies

don't get you out of it and you go to the mitigation part.

MR. PETRANGELO: Right, right. But I'll call the industry approach the realistically conservative approach. We took the same framework that's in the deterministic methodology, with all of the analytical refinements that are in our supplemental guidance, and then looked at where we could make some of the assumptions, the key assumptions more realistically conservative. Okay? And John will go into that in great detail.

And we had a meeting with the staff on this last week. Again, we've only had a couple of meetings since March. Unfortunately, because of the expert elicitation on 5046 for pipe breaks and frequencies isn't complete, we kind of got at least one of our hands tied behind our back on this. I think in that effort there's a peer review that will be done of the expert elicitation, kind of the peer review of the peer review.

MEMBER KRESS: But you know, you couldn't just make a leap of faith and say, well, the frequencies that they developed might be the final ones we're going to come up with and tart from that.

MR. PETRANGELO: You could, and we do that to a certain extent with I think enough confidence that even in the final expert elicitation when the NUREG is published, that there will be some buffer there. I wouldn't even call it leap of faith. I think we can with reasonable certainty make a cut, right, and John will go into that in some detail.

And our discussions with the staff are ongoing.

MEMBER KRESS: And that's the only place you're going to get some frequencies that you can justified.

MR. PETRANGELO: I think so.

Okay. With that I want to turn it over to Mo Dingler for the overview of the guidance document.

MR. DINGLER: I'm going to have John help me because every time I touch a different computer I screw it up. So I lose all of the presentation. So my people after me will be hurt by that.

I'm Mo Dingler, and I represent WCNOC, Wolf Creed, and the WOG.

What I want to do in this presentation is give you an 80,000 foot level of what we submitted in May. We have presentations going on there with Tim and John. I'll give you more detail on that. So what I want to do is I'll go over our objective of methodology. We did submit one in October of last year. We revised it considerably when we submitted it in May.

What we want to do is provide a suggested consistent framework with plant specific inputs, which allow for plant specific applications. You'll see in an upcoming slide there's complications where the Ps at the boilers didn't have.

Also this allows for utilities to perform a conservative evaluation of the containment sump performance.

A little on the background. We wanted to get into multiple staff addressing. We wanted to address each phase we think is important to us to postulate a break, the size, the type, location dependent, what kind of termination of debris generation, how much is generated, the types, the size, evaluation of transport, what's holed up. This is where it's highly dependent on plant designs.

I think you've got 67 plants out there and probably 64 of them are totally different; makes some complications. Postulated scenarios, some plants have safety grip grand coolers so that they don't go to recirc. on the main steam and feedwater break.

So, I mean, sometimes you've got to worry about those.

Incorporation of contributor factors, latent debris. How much dirt or we call dust bunnies that are in containment starting out? Spray wash-down.

And then what we want to do with the bottom line is calculation of the screen deposits and resulting head losses to maintain the kind of margin•--

CHAIRMAN WALLIS: But this postulated break includes presumably the up-stream conditions, too, and the pressure and the enthalpies and all of that kind of stuff. So a steam line break is different from a main loop break.

MR. DINGLER: That's correct, and we get into that.

In other words, as I said, consideration as we looked into the methodology, a high degree of variable between plants. As I said, I think there's about 64 or 65 different brands out there on that. Some sumps are inside the crane wall, the bioshield. Some are outside, a whole variety of that.

We also looked at plants, the type insulation. Each plant would maybe have a different type, different quantities of insulation. So you had this variety.

We looked at the methodology and what we wanted to sue, and what we did was we built in the conservatives that account for these uncertainties that we have on plant specifics.

We also looked at developing Section 3, which is the baseline, and the Section 4 in the four major steps. We want to look at debris generation. We looked at break location, break size and break type, zone of influence or zone of destruction caused by the break, the re-characteristic. Latent debris is what we considered already in containment when we start.

CHAIRMAN WALLIS: Now, the number you have for that seemed to me small compared with the number which my colleague Jack Sieber had in his presentation to the Commission.

MR. DINGLER: I wasn't aware, Dr. Graham.

CHAIRMAN WALLIS: The number, the number for latent debris that you were assuming seemed to be small. It was one of the points that Dr. Sieber made about the possibility for latent debris being quite significant.

MR. DINGLER: What we did on this one, I don't know which one he looked at, the October one or the one in May. October we assumed 150 --

CHAIRMAN WALLIS: One hundred fifty sounded small to me compared with the number that Dr. Sieber had.

MEMBER KRESS: Yeah, I think he had what, 580?

CHAIRMAN WALLIS: He had several hundred.

MR. DINGLER: Several hundred? So what we did was we gave a pathology how to calculate that by taking swipes in that and calculate the surface area, both vertical, horizontal, and that to come up with that. So we have not really at this point given a maximum loading at this point because we saw the same thing.

CHAIRMAN WALLIS: Does this include transient stuff which is in there because of maintenance and so on?

MR. DINGLER: We looked at that, and we looked at the plant procedures. What we're looking at, they have FME requirements. So when they get done with the maintenance criteria, they make a log and make sure that stuff goes out.

So we're saying that's a short period of maintenance activity, and we're not considering those what we call transients, I think, Dr. Graham.

MEMBER KRESS: I take it from these four steps that you're looking at downstream effects in case it penetrates.

MR. DINGLER: That's a separate section, and that's Chapter 7, and I'll get into that in a minute.

MEMBER KRESS: Okay.

MR. DINGLER: What this was is the four steps to get your head loss, and that's what we started out and we added some other stuff based on comments from you guys and the staff and the industry.

MEMBER RANSOM: Are the containments periodically washed down?

MR. DINGLER: Some containments are washed down prior to start-up after an outage. I know all plants do a complete walk-down to make sure that FME or foreign materials are accounted for. With less attention there's more additional walk-downs going on now,b ut some plants do do a wash-down, but not all of them at this point.

MEMBER RANSOM: is there a question why all of them don't?

MR. DINGLER: I can't answer that. I know some plants don't want to do it and worry about the electricals and stuff like that and have water dripping. Other plants have done evaluations.

MR. PETRANGELO: When the bulletin came out last year, one of the interim actions one could take, given that we hadn't developed the guidance on the plant specific evaluations yet, there were several compensatory actions. One of them went to insure that your containment was very clean after an outage, and those responses were all back on the docket to the Commission.

So I think the staff is in a good position to know who's doing it and who's not. I'm pretty sure that the cleanliness in containment is, again, a higher priority than it was before.

MR. DINGLER: And I know for my sake in a couple of plants they did additional sweeps and not wash-down exactly, but actually went in, did some sweeping, and went in to areas that were very infrequently visited, an did clean-up and made sure the debris was out of those also.

MEMBER RANSOM: In cases where, you know, the recirs have been called into action, has the residual dirt or whatever you will, dust bunnies, been a factor in plugging?

MR. DINGLER: To my knowledge, no.

PARTICIPANT: They've never been called

into action.

MR. DINGLER: By themselves, no. It's like you put dirt on a filter for your furnace in that. It does collect. So we have to look at that in combination with other debris that's generated.

MR. ARCHITZEL: Ralph Architzel of the staff.

As far as we know, there's never been a recirculation demand.

MEMBER RANSOM: I though there were several plants where they've --

MR. ARCHITZEL: BWRs have been the precursors, but not for PWRs, where they've had these events that raise this issue, but not for pressurized water reactors.

MEMBER RANSOM: I see.

MR. ARCHITZEL: The only thing we've seen is inadvertent spray actuations of the Ps.

MEMBER FORD: Just looking forward on your presentation, I notice under debris generation, you don't discuss this category interactions in the formation of your --

MR. DINGLER: That's a separate slide, and I'll get into that. That's not --

MEMBER FORD: That does come later?

MR. DINGLER: That comes later. You need to go about five more slides down and I'll get to it.

MEMBER FORD: Okay.

MR. DINGLER: But you're right.

We broke it down in these four steps into two areas. The baseline, which you've heard some comments, is a common, conservative approach that plants may use. What we want to do with this one is completion of the baseline. The plants will either indicate adequate NPSH or look and see what's the driver that appropriate action is needed in the refinement area.

It may be an analyzed refinement or analytical refinements. It might be plant mods or a combination of both. A lot of plants will probably do both.

The analytical refinements, or at least some of you may have had in the October one, supplemental guidance, we interchanged those. We finally stuck on analytical refinements.

We want to use and give some options, but still more realistic there, but still conservative to accomplish and have a combination of inputs, both design and method revision.

I go over a little to the baseline Section

3. We've got a Section 3, 4, 5; 6 is risk informed, and 7, and I've got a slide for each one of those, and some of these questions on chemical effects will get me into that.

The section 3, what we want to do is we wanted, and this is the baseline, is pick the maximum debris generation location, the maximum debris that can be generated. We took the brake size or brake type any way up from a break of a small pipe all the way up to the main loop, double guillotine on the main loop.

Zone of influence, we want to look at spherical, the radius space on a minimum insulation destruction pressure. So if you have five different types of insulation and the destruction pressure goes -- I'll just make it up -- one to five, one being least, we assume that whole sphere radius is based on one, and so everything in that sphere is gone.

Debris characteristics in the baseline, we wanted to look at only two types of debris characteristics. So we've said we've got them large and small. Smaller is four by four, and below. Large is anything above four by four.

Latent debris. We're finding that at plants it may not be or are generally not considered a major contributor, but we've got to look at it. So we asked the man to talk the total laying debris in containment. Instead of coming up with a figure, we give them an example of how to calculate that.

We're setting some debris characteristics, and we tweaked it. RES is doing some additional research on that that is supposed to --

CHAIRMAN WALLIS: Can I ask you something generally about all of this? I mean, yes, you'd like to do all of this, but how much do you know about all of these things. Do you know the size of the debris? What's the knowledge base for determining the size of the debris? Is it good enough?

If you're making assumptions about these things, what's it based on?

MR. DINGLER: In the refinement, we actually had some test data of debris characteristics. So we're going to use that.

CHAIRMAN WALLIS: But in the baseline you used some extreme, worst case or something?

MR. DINGLER: That's correct, and what we did is looked at what kind of grating most places have.

CHAIRMAN WALLIS: So you take the worst size that the debris could possibly have and use that?

Is that what you do?

MR. DINGLER: We take --

PARTICIPANT: That's correct.

CHAIRMAN WALLIS: So it's all transported?

MR. DINGLER: We say all of the fines are transported.

CHAIRMAN WALLIS: All of them. Okay.

MR. DINGLER: All of the fines, four by four, goes and transports to the sump screen.

CHAIRMAN WALLIS: Okay.

MR. DINGLER: So you can see four by four --

CHAIRMAN WALLIS: So you're not really relying on research work. You're making the worst case assumption in every one of these categories?

MR. DINGLER: Yes, we're trying to make the worst case.

CHAIRMAN WALLIS: Okay.

MR. DINGLER: You can see how on the baseline.

MEMBER RANSOM: Well, in terms of latent debris, do you consider all of the paint eventually to --

MR. DINGLER: We're considering paint as a separate debris sources. So we're considering that, and we're looking at what's in the sphere of influence or what kind of debris is generated in the sphere of influence. For the baseline we're saying that all non-qualified, all non-DBA tested, acceptable -- those nice words -- all is --

MEMBER RANSOM: Is there a characterization of all these different types of waste that you're considering, you know, what they are specifically?

MR. DINGLER: We have a little section. Codeines are separate from -- we define latent debris, and we say codeine is another debris source like insulation is another debris source.

MEMBER FORD: Things like labels and stuff?

MR. DINGLER: Labels is part of -- labels is latent debris, and that's spelled out in our methodology. If we define what we consider latent debris, if I understand your question, sir. The only thing we've said not latent debris is coatings, insulation, and stuff like that, and we wanted to treat them separately.

MEMBER FORD: When that definitively, "generally not considered a major contributor," is there data to support that conclusion at this stage?

MR. DINGLER: We've had some plants that run. Some of it has done rough. The amount of quantities that we have, let's say it's even 200 or 300 pounds. When you're looking at a fiber plant that has maybe 100,000 square feet, and this is really in a small bug dust

MEMBER FORD: But if that's an area of poundage, that doesn't tell you anything about the blockage.

MR. DINGLER: It's piping insulation that goes. Like if you have an RR in my plant, latent debris may or may not drive for a pressure drop. If you have a fiber plant, a lot of latent debris may drive you to a pressure drop. In the fiber plant, a lot of latent debris may drive you to a pressure drop. In the thin benefacts and that, we're looking at that also.

What we're saying here is we've got to consider it, but it may not as we look at here are the insulations and the coatings. It may not be a driver for some plants. Some plants it may be. But with the extra degree of the bulletin coming out, our containments are getting cleaner and cleaner as we go on.

Does that answer your question, sir?

Debris transport. For the baseline we looked at use in transport logic trees, and Tim will have a slide showing what we consider the logic tree.

We want to quantify what's captured and on transport in the logic tree. We want to address washdown, erosion, and pulled transport.

We use NUREG CR-6224 for head loss correlation. We want to look at the effects of debris composition and materials properties, and we want to look at thin bed effect.

CHAIRMAN WALLIS: Does this NUREG take account of the newest Los Alamos work on combinations of different types of debris?

PARTICIPANT: In those, yes they do.

CHAIRMAN WALLIS: They had some really weird characteristics.

MR. ANDREYCHEK: But the correlation provides for the capability of taking into account whatever the different material characteristics are.

CHAIRMAN WALLIS: So it can be adapted?

MR. ANDREYCHEK: Yes, sir.

CHAIRMAN WALLIS: Fit the latest data?

MR. ANDREYCHEK: That is correct.

MR. DINGLER: And you look at it in the refinement that we have in initial correlations that come out for fiber only.

MEMBER FORD: But if this NUREG 6224 is the baseline for you making your case here, you technical case, just how sure are you that it is valid?

I mean, you're basing your whole analysis on that correlation; is that correct?

MR. ANDREYCHEK: Yes.

MEMBER FORD: So how sure are you that that correlation is correct. We're not seeing R squared value. I mean quantitatively how sure are you that it's a good correlation?

MR. DINGLER: We believe from the test that went into 6224 and the test at Los Alamos has proved that the correlations that we have in there are applicable to us.

MR. ANDREYCHEK: It is a semi-theoretical correlation that provides for inputting different material property characteristics, and even the most recent testing that was performed by Los Alamos for calcium silicate does indicate that the correlation can be used within limits of data that are typically representative of what we expect to see in our plants.

So we believe that that correlation is, indeed, valid for the purposes that we're attempting to use it for based on not only the data from the boiling water reactors, but also more recent, other databases that have been used in the development to provide input for the correlation and check it against major values.

MR. DINGLER: As Tim says, there's a correlation, let's say, for calcium silicate. We say that correlation falls apart by the 20 percent calcium silicate. So we say in the document we cannot use 6224 correlation for anything above a 20 percent contribution of calcium silicate.

So we put those restrictions to make sure it is applicable.

MEMBER FORD: The reason why I'm pushing this, I come from earlier the corrosion area, and invariably you have a Murphy's Law relationship that I think kills you in the end. You've got, "Oh, dear. That was an outlier."

And in terms in the long run it wasn't an outlier. so that's why I'm asking this question. How sure are you about that correlation in terms of the worst case scenario you might have, which invariably is going to occur some time or other.

MR. ANDREYCHEK: Well, there are limits of applicability in any correlation, and we try to establish what the elements of applicability are within the guidance so that the correlation is not misused.

CHAIRMAN WALLIS: Well, I think this is the correlation that Los Alamos said in their report. We quoted it in our letter: needs modification. Then you have taken account of those modifications?

MR. DINGLER: That's correct.

CHAIRMAN WALLIS: Okay.

MR. DINGLER: What we did in the refinement or supplemental guidance, we want to use more realistic, but still conservative break locations. We've had the document, used General Letter 8711. The break size, the break type was still going from small break bovines all the way up to the main loop, double guillotine break.

The zone of influence, instead of using the lowest destruction pressure, we'd give our option and let me them use material specific ZIOlize more work so that you had a break. You may have to have three different types of insulation. So you have three different types of ZOIs.

The directed jet is a free flowing expandage out of the break, use of ANSI and ANS 58.2, 1988 criteria.

This is one of the questions you gave me before, was to bring characteristics. We looked at what kind of test data was out there to find the debris characteristics. We're using that in there instead of just saying one is large, and that's fine.

Debris transport, we gave two alternatives in the nodal network model, which is open flow channels for the civil engineering people, and computation fluid dynamics. Computer analysis.

Head loss, we talked a little about that. It again uses NUREG 6224 and also uses some existing correlations which came out, which is the all fiber plants, which there are some plants out there and all reflect in Maryland installation plants.

MEMBER RANSOM: In their debris classification, do you classify them as to whether or not they're buoyant or nonbuoyant components?

MR. DINGLER: Yes.

Now, Section 5, it's a little from four and five, but Section 5 we give design and administrative controls. In other words, there is some test data out there. Our test data out there show if you put curbs in, it stops some flow on the floor. If you look at putting in trash racks, you can stop the debris getting to your sumps.

Now, you've got to look at this if you install those, and I'll get into Chapter 7 is upstream effect. You've got to worry about water being held up on those. So there's some pros nd cons to those.

We also look at consideration for sump screens. Plants may look at passive strainer designs, putting in larger passive; may look at backwash drainer design; and may look at an active sump screen on there. We show the pros and cons of each one, and those are plant specific evaluations. It's how much room do you have in containment. How much do you want to do and stuff like that? So each one has its plus and its negative to that.

The risk informed, Section 6, and John will get up and do that, but we wanted to find a maximum break size or break opening on that.

We also are looking at mitigative capacity analysis using modifications to the conservative design basis, methods, assumptions and success criteria. This will probably be the most discussion point right in here.

Now some of the other stuff in the additional Chapter 7, additional design criterias, what we're saying is, okay, you've got to look at your structural analysis of your sump. Can it handle that much debris against your sump so that it doesn't wash in and have all of the debris get into your pump immediately.

Upstream effects.

CHAIRMAN WALLIS: You're not looking at the physical integrity of the screen, I understand. Some screens getting overloaded will actually fail physically.

MR. DINGLER: Right. That's what this one is for. We're saying to this building your structural codes --

CHAIRMAN WALLIS: So you are going to look at that.

MR. DINGLER: And what we're saying is you have to evaluate that to make sure that doesn't have enough. Now, our guidance is pretty well saying, no, you're structural steel codes can do that.

Upstream effects. As I said, in other words, what kind of upstream effects? Do you have narrow openings in your bioshield or crane wall you have to dress for flows? Your sump areas that could get blocked, like a cavity seal, refueling canals and stuff like that, how much water is taken away. Also is you put in curbs and trash racks, you've got to look at that.

Downstream effects. What we're saying is you need to look at your obstructions to your containment spray nozzles, your throttle valves in that.

The chemical effects. As Tony said, we don't believe it's going to be a major contributor.

What we believe is not adequate. We want to do testing. So we're willing to do some testing, and we're working with RES to do testing to show that it is a problem or is not a problem, this gelapidus (phonetic) material form and not form.

MEMBER FORD: You mentioned earlier on that of the 67 reactors there 64 different variations.

MR. DINGLER: I just used that example. It might be 50.

MEMBER FORD: It's an interesting number because there will be a whole lot of ranges of various chemical combinations within that set. When you were coming up with your test program to evaluate whether or not the chemical effect was a big effect or ont, did you go into some sort of decision matrix as to these are the sort of chemical reactions tha we should be testing in this program.?

MR. DINGLER: Yes.

MEMBER FORD: You did?

MR. DINGLER: Well, we did, but there's a presentation tomorrow. I'll jump a little ahead.

MEMBER FORD: I'm a good straight man, huh?

MR. DINGLER: Yeah, you're a straight man. We looked at PSP. We looked at sodium hydroxide. We went out and surveyed what plants had material quantities of zinc, aluminum, copper and that, to try to look at that.

We looked at the interactions of those, I think, if that's what your question was.

MEMBER FORD: Yeah, and what sort of timing is that test program?

MR. DINGLER: I'm going to have to defer that to tomorrow.

MEMBER FORD: Okay.

MR. DINGLER: I'll let some other people more knowledgeable in that get up and bare themselves to you.

MEMBER FORD: Okay.

MR. DINGLER: That's my presentation on an 80,000 foot overview.

MEMBER RANSOM: You mentioned that active strainers were being considered, and there's a lot of experience with active trash racks and things in the hydroelectric industry, irrigation industries and on and on. What's the down size of active systems? Mainly the expense?

MR. DINGLER: The expense. If it's active and has a motor, you've got to worry about EQ qualifications, some surveillance, dual power supplies.

MEMBER RANSOM: Worried about on the pumps anyway though I assume.

MR. DINGLER: Definitely. I mean that's just the down side. Is it major for some plants? I doubt it. I know some plants some size don't even have electrical near their sump. So they'll have to do a lot of routing to that. What's the size in that they will met. So there's a call. Do you have two foot of water? Do you have 23 feet of water?

So some of those is considerations you've got to go into.

MR. ANDREYCHEK: Actually what's in the specific guidance. I wouldn't necessarily characterize it as cons, but here are a list of things you need to consider, and they may form the basis of a design review for an active sump screen.

So here's the considerations you need to take into account if this is the path you're going to choose with regards to the design.

MR. DINGLER: And let me say my definition of con is I've go to put in maybe a power supply. So that's my definition. Passive sump screen. One of the issues we've got to look at is do we have room to put a large passive sump screen in there.

Some containments are very small and very limited on space. I consider that a consideration or a con that I've got to look at.

So cons don't mean it's a negative. Cons are something you've got to consider.

Thank you. Did I answer your question, sir?

CHAIRMAN WALLIS: So this is the task that takes 10,000 manhours; is that it?

How long does it take to do all of this analysis if you're in a plant? An estimate that is being thrown around is 10,000 hours; is that right?

MR. ARCHITZEL: Then 10,000 comment is a comment from industry on the amount of effort it would take to respond to the generic letter.

CHAIRMAN WALLIS: Not to do the analysis, but just to respond to the generic letter itself?

MR. PETRANGELO: I think that probably includes everything.

CHAIRMAN WALLIS: It includes this, too

MR. ARCHITZEL: That was the comment we received. I guess Dave will talk about it tomorrow, but --

CHAIRMAN WALLIS: The estimate was ten times the staff's estimate, something like that. It sounds like a big job. That's all I'm trying --

MR. DINGLER: It is a big job, and if you look at it and go back and take the ZOIs, and that is very I consider, quote, labor intense. You do an iteration and you do another iteration. You do another iteration and do another iteration to make sure you get --

CHAIRMAN WALLIS: So it's several person-years per plant to do all of this?

MR. DINGLER: I would say at least, yes, sir.

MR. ANDREYCHEK: I think that 10,000 includes design, fabrication, installation if it's necessary. So that's the maximum it would be.

MR. BRYAN: It didn't include design, converting estimates. We have contractors who are constantly --

CHAIRMAN WALLIS: I think you have to identify yourself for the purpose of the record, please.

MR. BRYAN: Sure, sorry. My name is Bob Bryan. I'm the Tennessee Valley Authority.

Sop it's the analytical side in responding to the generic letter and all aspects of that. It does not include major modifications to the sump screen.

MR. DINGLER: Some if it is the CFD, did you have a model already in the computer or do you have to model it? So there is some of that stuff.

Any other? That's all I have, sir, or gentlemen.

CHAIRMAN WALLIS: Thank you very much.

MR. ANDREYCHEK: Good morning. Thank you for the opportunity to talk with you this morning.

I'd like to just go over briefly what I'm going to present. PWR methodology introduction I'm not going to repeat. Mo Dingler has done that very well, thank you.

We'll talk about our evaluation methodology approach and the baseline methodology which we've identified in the break selection.

The regeneration latent debris, transport head loss, and I'll summarize.

As was mentioned by Mo earlier, Section 3 is the baseline methodology in the report that was submitted to NRC on the 28th of May of this year. Section 4, which will b the subject of my next presentation, is the analytical refinements.

Section 3, the baseline methodology is a common conservative method that all plants may use. It uses plant specific inputs which allows for plant specific application of the conservative methodology.

We've also stated that if a plant determines that it meets NPSH requirements after using this baseline methodology, it documents it, and it's finished. It's done. It has addressed the issues associated with GSI 191 with regards to head loss.

With regards to break types, we are using a double ended guillotine break, and the double ended guillotine break applies to both primary system and the main steam line. It pertains to any event that gets you to recirculation from the sump for whatever the reason, whether it be for containment spray or containment spray and ECCS.

We believe this to be conservative, and it maximizes the reason for debris generation. The break locations, where are these breaks being taken at?

Considerations that we have are that we look for the maximum total debris generation. That's one consideration. What's the total maximum amount of debris we can generate?

The second consideration is what's the worst combination of debris? We're looking at both particulates and fiber. So what's the worst combination?

And we take the breaks at arbitrary intervals around the piping.

MEMBER RANSOM: Each of these would be plant specific?

MR. ANDREYCHEK: Each of these?

MEMBER RANSOM: If you apply this methodology.

MR. ANDREYCHEK: That's correct.

MEMBER RANSOM: Each plant would have different characteristics in the types of debris that would be generated and the amounts

MR. ANDREYCHEK: That's correct. It depends. As Mo Dingler mentioned earlier, each plant has different insulation systems.. They apply the insulation differently and, therefore, this particular valuation must, indeed, be plant specific.

You can look at the specific configuration of the plant and to relate this back, one of the things that we asked plants to do early on, NEIO0201 was to do a condition assessment to identify where the insulation was inside the plant and what insulation you had where, how much.

So this takes advantage of the work that was done in NEI0201.

MEMBER KRESS: Could you explain that third bullet under the second one? Break locations taken in arbitrary clear review?

Does that mean you pull them out of a hat?

MR. ANDREYCHEK: I'm sorry. Say that again, please.

MEMBER KRESS: What do you mean by arbitrary intervals?

MR. ANDREYCHEK: By arbitrary intervals we're looking at regular intervals along the pipe. For example, three foot intervals starting at one location, say, adjacent --

MEMBER KRESS: That's not arbitrary.

MR. ANDREYCHEK: Okay. Perhaps it was a bad choice of words, but it's regular intervals. Take them along and some plants may choose to do two foot intervals, okay, but it's --

MEMBER KRESS: The size may be off.

MR. ANDREYCHEK: That's correct, but they are regular intervals spaced along the pipeline.

MEMBER KRESS: Okay. Now I understand.

MR. ANDREYCHEK: Okay. Now, as you can see from the conversation we had, the calculation of debris generation is an iterative process. It's done at intervals as we lock along, and the purpose of that is to identify maximum debris generation and where do we get the worst case combination of debris.

MEMBER KRESS: That may be two different places.

MR. ANDREYCHEK: Exactly correct, sir. Exactly correct.

MEMBER FORD: Let me ask a somewhat similar question, and maybe it's covered in your next slide. As you remember we saw some data quite some time ago, maybe two years ago, where there were experiments of firing a jet at insulated -- insulation to see how much comes off.

MR. ANDREYCHEK: Okay.

MEMBER FORD: Is any account taken of the fact that over time, 30 years, that the paint will become degraded in terms of its sticking onto the surface of the containment? Or do you take the adherence forces to be as you designed it?

Do you understand the question?

MR. ANDREYCHEK: I think I understand the question. We're talking about --

MEMBER FORD: The kind of comes degraded in terms of its sticking on.

MR. ANDREYCHEK: Rather than me to try to answer that question directly, I see someone in the back of the room that might want to answer that.

John Cavala, do you want to answer that question?

MR. CAVALA: I'll give ia a quick try.

John Cavala with Corrosion Control Component Lab.

I don't agree with you that the coating become degraded past the point of testing. When we are talking about the EPA qualified or the pre-ANSI plans, acceptable coding, what we have done is artificially aged those coatings by the use of specifically baking them in an oven and put two leaks at 150 F and irradiating to one times ten to the let's say ninth rads before the polymerize the coating system itself on the substrate to approximate or to simulate, if you will, their full life aging process. In other words to fully polymerize the coating and then test them in a DBA environment.

MEMBER FORD: That is pretty expensive. If you are going to apply all of these calculations to such a degraded coating, that would be a pretty expensive experimental program.

MR. CAVALA: What we have said in the guideline now is we've looked at coatings in two areas. One inside the zone of influence, which is the break area, and we've done as one of your members suggested, we have done some physical testing to fill the void that we had in that area.

And in side the zone of influence what we are seeing in fact is that within that ZOI all coatings, regardless of their pedigree, will fail, and they will in fact degrade to the point of being the size of its finest particulates, ten to 50 microns.

It's an assumption. It's the only one we could make because it's the only --

MEMBER FORD: Okay. So you have taken into account degraded coatings.

MR. CAVALA: Exactly. Outside the zone of influence we are saying that the unqualified, non-DBA qualified, nonacceptable coatings all fail and all are available for --

MR. ANDREYCHEK: Right.

MEMBER KRESS: Thank you.

MR. ANDREYCHEK: And, again, the coating failures are at the point where they're very easy to transport, and we do calculate a zone of influence specific for coatings.

However, as Mo had mentioned earlier, and we'll talk about that in just a moment, about the zone of influence, how we're dealing with coatings for the baseline evaluation.

The other thing that I would suggest and advise you is that quake exclusion zones are not accounted for in the baseline evaluation results. And that is we looked at regular intervals, Tom, as you had asked. We don't take any break exclusion zones whatsoever in the baseline.

MEMBER KRESS: These were added in, the four break areas.

MR. ANDREYCHEK: That's correct.

MEMBER KRESS: You'll have them put those in.

MR. ANDREYCHEK: That is correct. So my primary system piping at two three, three feet, whatever the appropriate level is. That's when we mark down even though it may have LBB technology applied and had been acceptable by NRC as being LBB qualified pipe. That's correct.

Zone of influence. The philosophy we're using is very similar to what was used for the BWR debris generation methodology. We're using ANSI/ANS 58.2-1988. We're taking a free stent of a flashing jet from a subcooled reservoir and calculating what we've got.

We've equated insulation damage pressure to the static jet pressure. So we look at the boundary of whatever --

MEMBER FORD: Now, I don't understand that because if you expand the flashing jet to atmosphere pressure from 2000 psi, you get velocities of thousand of feet a second, and the pressure is atmospheric.

But what damage is to the insulation is the velocity which is then converted to stagnation pressure when it comes to rest. So it cannot possibly be that, gee, it's static pressure that destroys the insulation.

MR. ANDREYCHEK: We believe that that's a reasonable --

CHAIRMAN WALLIS: It doesn't make any sense at all. If you stand behind a jet engine of an aircraft, you're at atmospheric pressure. Okay. So you should feel anything.

That doesn't make any sense.

MEMBER KRESS: Let me throw out an alternative. the status pressure does vary along the jet centerline. It's not atmospheric, and if one used that --

CHAIRMAN WALLIS: It can be subatmospheric in places.

MEMBER KRESS: Yeah, but if one then had an experiment where you subjected some debris to this jet and calculated the amount generated and your correlation of the amount was to the status pressure, you could do that because I think the stagnation pressure is related to that static pressure.

CHAIRMAN WALLIS: But it's sort of absurd because one is --

MEMBER KRESS: I wouldn't have done it that way, but --

CHAIRMAN WALLIS: -- one is way above the other.

MEMBER KRESS: Yeah, I would have done it that way, but one could

MEMBER RANSOM: Well, it wouldn't be right. I mean if you blow down the stagnation pressure is decreasing. Static pressure can stay constant, and that does mean the velocity is decreasing.

MEMBER KRESS: Not in a preexpanding jet. The static pressure there is --

CHAIRMAN WALLIS: Yeah, but it's mixing.

MEMBER RANSOM: No. It depends on the stagnation pressure what kind of velocities will exist at a given static pressure within the job, and they are very coupled. It's well known from any supersonic flow analysis, you know. Hypersonic reentry is the same kind of problem, and the idea of using static pressure would be ridiculous.

MR. ANDREYCHEK: I stand corrected. I was talking to the follows who were going to work -- this should be stagnation, not static pressure.

CHAIRMAN WALLIS: Makes more sense.

MR. ANDREYCHEK: I stand corrected.

CHAIRMAN WALLIS: I hope you're very clear to examine this zone of influence because --

MR. ANDREYCHEK: Say that again, please.

CHAIRMAN WALLIS: I hope you have critically examined the zone of influence models, and I think the one which is at the bottom here, the 83, is the one that in our ledger. It seemed to be based on some misunderstanding, and I think it is also being discredited by the Barsebek event. I'm trying to remember which model is, but some of these models just don't fit to some of the data cited by Los Alamos in their sort of knowledge basis report.

So you can't just take something and say it's in a NUREG that's 20 years old and we're going to use it, if it has already been discredited by somebody else's experiments.

MR. ANDREYCHEK: We have looked at it, and I don't believe it has been discredited by --

CHAIRMAN WALLIS: But you will be in real trouble if you do that because then someone will come and say, "Look. You're using something. It's in the NUREG. Okay. The government has blessed it."

But it's technically wrong because it doesn't fit data. So you've got to be sure that you're standing on firm ground here. You don't want to do a surface and then find out that you can be shot down by someone citing something from I'm saying the Los Alamos report. It says it has already been discredited because of, you know, some event or some experiment.

MR. ANDREYCHEK: I understand the point.

CHAIRMAN WALLIS: So be very careful about just quoting something.

MR. ANDREYCHEK: Okay.

CHAIRMAN WALLIS: Especially if it's 20 years old because I think you might have trouble with it. As I recall, one of our problems with the Los

Alamos technical basis report was that they gave conflicting models of ZOIs which just were not consistent.

MR. ANDREYCHEK: Okay.

CHAIRMAN WALLIS: Anyway, we'll look at that, I guess, in August. Are we going to look at the details of this in August?

MR. ANDREYCHEK: I'm not sure what August.

MR. ARCHITZEL: That's correct. There's a subcommittee meeting in August. We're going to have our SER and industry would come to defend in detail.

CHAIRMAN WALLIS: Okay. Thank you.

MR. ARCHITZEL: August 17th.

CHAIRMAN WALLIS: And this ten times the breakdown, I thought 12 times was the one that we --

MR. ANDREYCHEK: You have to bear with me. I think you're jumping ahead just a little bit.

CHAIRMAN WALLIS: Well, I am because I've read it.

MR. ANDREYCHEK: Well, allow me just the privilege of going through a couple of bullets here and we'll get to that point.

CHAIRMAN WALLIS: Okay.

MR. ANDREYCHEK: Again, as Mo had mentioned earlier if you have several different materials within the zone of influence you select the material with the worst or with the lowest damage pressure. That sets the zone of influence for the baseline, which is very large and conservatively predicts the total amount of debris that's generated, as well as the mix of debris.

And we calculate the equivalent sphere assuming the double ended break. So we take the freely expanded jet from both ends. That becomes the spherical zone of influence. It's a very large region.

We believe to be very conservative. We picked the thermal hydraulic values for the working fluid to maximize the jet volume, again, looking for a maximum.

This is beyond certain licensing bases, and the ten time the diameter of the break is what's used for jet impingement calculations from NUREG CR 90-2013. We're looking at impact of jet impingement on equipment inside containment.

CHAIRMAN WALLIS: Why was it 12?

MR. ANDREYCHEK: Twelve is what we're using. Again, depending upon the material, it could vary anywhere from 12 to maybe 17, 18 times the break diameter for very weak materials, but 10D is what is used for jet impingement in calculations based on this particular NUREG.

So the purpose in showing you this is that we are at least consistent, if not much more conservative than what we're doing here.

CHAIRMAN WALLIS: What's the basis for attenuating this jet? If it expands isentropically (phonetic), there's no attenuation at all. I mean it never loses its energy. It goes on until it hits something whether it's one diameter or 50 diameters. What's the basis for this jet getting tired?

MR. ANDREYCHEK: Well, the stagnation pressure becomes smaller and smaller.

CHAIRMAN WALLIS: Well, what makes it get lower?

MEMBER KRESS: If it entrains.

CHAIRMAN WALLIS: Why does it get lower?

MR. ANDREYCHEK: It get lower because the jet as it expands, the expansion itself is taking up energy.

CHAIRMAN WALLIS: It's not isentropic?

MR. ANDREYCHEK: I don't believe it's isentropic.

CHAIRMAN WALLIS: What's the mechanism for decreasing the stagnation pressure?

MR. ANDREYCHEK: I need to take a look at the model and see that.

CHAIRMAN WALLIS: Because, I mean, some of these models are isentropic and stagnation pressure is constant forever until it hits something.

MEMBER KRESS: Unless it's entraining out.

MR. ANDREYCHEK: I think Chris Hutchins can answer that question for you.

MR. HUTCHINS: I'm Chris Hutchins from Westinghouse Electric Company.

Based on some information that I read in doing the injection calculations using this standard, it appears that the model is a polytropic expansion rather than an isotropic expansion. I don't have further information to add to that, but that was based on some technical papers.

CHAIRMAN WALLIS: But it's a model.

MR. HUTCHINS: It's a model.

CHAIRMAN WALLIS: And one of the classic experiments -- I think it was a Los Alamos experience or something, or Sandia experiments. Sandia Experiments were very well correlated with an isotropic expansion, with a shock wave. That's the only analysis they have. That's one of the classic documents in the knowledge bases records if you study that.

The only mechanism for decreasing the stagnation pressure is the shock wave in their analysis, and yet this is another one. These are all theoretical things. The Sandia one actually fit data.

So again, I would be very suspicious of any of these which don't relate to some experiment.

MR. ANDREYCHEK: Okay. Point well taken.

The other thing I would mention is about two weeks ago I was talking with Pete Griffith, and he offered some insights that he thought what we were doing was extremely conservative and suggested a couple of papers, and I'm pulling the tape on what that --

CHAIRMAN WALLIS: It might be. It might be.

MR. ANDREYCHEK: The use of the data is well taken, and we're following up on that.

CHAIRMAN WALLIS: Okay.

MR. ANDREYCHEK: Any further discussion on this, gentlemen?

Debris characterization, as Mo mentioned earlier, we're looking at two debris sizes for the purpose of the baseline: four inch by four inch and smaller, and anything larger than four inch by four inch.

MEMBER KRESS: Is that the grid size that stuff has to eventually fall down through?

MR. ANDREYCHEK: Yes, it's based on grating size, yes. And the idea, if it can fit through the grate, we're going to consider transportable. If it can't fit through the grate, it's going to be held up. A very simplistic approach.

MEMBER KRESS: How do you characterize something that's skinny and long?

PARTICIPANT: Skinny and long.

(Laughter.)

CHAIRMAN WALLIS: Vibrant.

MEMBER KRESS: One dimension is less informed and the other one is bigger.

MR. ANDREYCHEK: Yeah, that's a good question. I think we need to use some judgment on that because now you're talking about orientation. What's the orientation of Debris when it hits the grid?

And we need to think about that one a little bit, but from what I've seen I haven't seen a lot of examples of long, skinny debris. I tend to see it in chunks, from even like a steam line break. So the four by four seems to be a reasonable representation based on --

CHAIRMAN WALLIS: This is four by four by what? By one micron?

MR. ANDREYCHEK: Well, whatever the thickness of the debris is.

CHAIRMAN WALLIS: It's a thin piece of plastic?

MR. ANDREYCHEK: Whatever the thickness of the debris is. We don't assume that.

CHAIRMAN WALLIS: How do you know? You're making an assumption.

MR. ANDREYCHEK: It's an assumption.

CHAIRMAN WALLIS: So you take different thicknesses. Is it a trick or is it a sheet or what is it?

MR. ANDREYCHEK: Well, if it's fibrous insulation --

CHAIRMAN WALLIS: You break some into fibers then?

MR. ANDREYCHEK: Yes. If it's smaller than four by four, for all practical purposes in terms of the surface area, it is transportable, and we assume that eventually it will come into very small pieces of fiber, erode away into smaller pieces that will form a bed on the sump screen.

CHAIRMAN WALLIS: Okay.

MR. ANDREYCHEK: And again, erosion is implicitly addressed by assuming the non-jacket insulation is erosion. It become smaller pieces, even if it starts out as a, quote, large piece, greater than four by four. If you've got water flow over top of it, over an extended period of time, it will erose, then become more transportable debris.

Reflecting the pallet, the insulation doesn't erode, and therefore, once it has been generated it stays whatever size it is.

MEMBER KRESS: That's the one I thought might be long and skinny.

MR. ANDREYCHEK: I understand. Particularly from the inside foil wraps and things like that.

Now, that also has a tendency to have a fairly high density, which means it's going to want to settle. Unless you've got extremely high velocity, it's not going to want to move. It's also very easily captured by curbs and things like that.

MEMBER RANSOM: Just one further comment on stagnation pressure.

MR. ANDREYCHEK: Yes, sir.

MEMBER RANSOM: A common force variable

for use in variable force calculations is the dynamic pressure. which is somewhat less than stagnation pressure, depending on the mock number in the region. And that would seem like using stagnation pressure you should get a conservative result, but it may be somewhat overly conservative.

Dynamic pressure, for example, is used in a drag correlation or any lift, whatever force that a flow induces on a structure.

MR. ANDREYCHEK: We concur, and in fact, the use of the stagnation pressure we thought provided a very conservative approach. That was the reasoning and the rationale for it.

We haven't looked at refining it even more and looking at dynamic pressure, which I think would be more appropriate, but the stagnation pressure, we believe, is very conservative, and provides us with a large volume to estimate the regeneration with.

CHAIRMAN WALLIS: With all of this talk about conservative, it would seem to me you'd have to test it. You'd have to have some sort of realistic configuration of pipes and insulation, and you'd have to take a jet and expand it and get some data, and there is data.

The University of New Mexico, they have

actually directed jets at pipes with insulation, have they not? So there is a basis of data.

MR. ANDREYCHEK: At the University of New Mexico, I don't believe that was the case.

CHAIRMAN WALLIS: New Mexico.

MR. ANDREYCHEK: There may be other data.

CHAIRMAN WALLIS: But I would be very suspicious if it's all theory.

MR. ANDREYCHEK: Okay. We'll take it.

MEMBER RANSOM: In fact, we saw some movies, didn't we of that type of thing?

MR. ANDREYCHEK: There were some movies where the pipe actually broke.

CHAIRMAN WALLIS: Yes.

MR. ANDREYCHEK: And there was some limited amount of data of jet impaction data.

MEMBER RANSOM: On insulation.

MR. ANDREYCHEK: On insulation, particularly from the boiling water reactor.

CHAIRMAN WALLIS: There's some very dramatic pictures from not long ago of concrete erosion and all kinds of stuff.

MR. ANDREYCHEK: Right.

MEMBER RANSOM: Also that was just along the centerline of the jet.

MR. ANDREYCHEK: Correct.

MEMBER RANSOM: That would, again produce rather the worst case. As the jet expands off to the side it becomes less dense, and the pressure crops off.

MR. ANDREYCHEK: That's correct and we concur.

Any other comments?

Latent debris as Mo earlier mentioned earlier, we can certainly estimate the total latent debris in containment by either calculating or estimating the amount of surface area, both horizontal and vertical.

We took some samples and swiped some various areas to estimate the quantity of latent debris, given the areas, and we set the debris characteristics.

Now, it was mentioned earlier in Mo's presentation what characteristics are you using. For particulates we're using dirt, and dirt is a very fine particulate which has a tendency to build up on a filter very quickly and create a large pressure drop. So it's in a conservative nature.

MEMBER KRESS: That bullet struck me as being more realistic than conservative. Like you have an estimate of the surface area and you take swipes and you'll put that amount on that area, and the debris characteristics are probably more like dust and dirt. So it sounds like a realistic calculation.

MR. ANDREYCHEK: It's a reasonable calculation. And, again, when you're estimating surface, you've got to get some surface you may not be able to get to in the plant because of other considerations, but we're looking at what's a reasonable way to approach this.

And by taking swipes it does provide an opportunity to take into account plant specific debris loading that you might get from whatever happens to be in containment at the time.

CHAIRMAN WALLIS: Containment has filters in it, doesn't it, as being clean all the time?

MR. ANDREYCHEK: There is an air filter on the containment fan coolers.

CHAIRMAN WALLIS: Right, and this is one of the things that happened at Davis-Besse, Those filters kept getting clogged, and presumably if the filters keep getting clogged, this is evidence that there's a lot of latent debris around.

PARTICIPANT: Erosion.

MR. ANDREYCHEK: I would suggest that what

I understand of Davis Besse, the filters, typically during normal operation in some plants that I'm aware of they didn't necessarily have fiber filters in the air flow path for PWRS, for normal containment and cooling operation. So that HEPA filters in the emergency operation mode, they would pull in and take radionucleides out of containment.

CHAIRMAN WALLIS: But they had to replace that filter because they were getting rust and all kinds of stuff in the filters. Just like on you vacuum cleaner all the time, can't you work back from how often you have to change the filter to how much dirt that must be generated? You must be able to do that.

MR. ANDREYCHEK: If I remember Davis-Besse -- Bob, do you have something you'd like to add?

MR. BRYAN: Yeah, this is Bob Bryan.

The way we run, and this is just for TVA. I'm not saying it's necessarily typical, but when our fan cooler is in containment, we put filters on there when we go into outages, when people are in there generating dust. We take them out when we come out of the outage, and so we don't operate the plant with them in there.

We did a lot of looking at our fan coolers because we ran them during construction, and we got about 50 percent of the air flow we expected because of construction dust and things like that, and we dismantled the coils and actually inspected them. So we knew what was in them and why it was in them.

But since we replaced them and we used these filters during outages but not in place during operation, we don't see any plugging of the coolers.

So I think what you expect to see is you get a lot of dust and dirt when people are in there moving around, but when you lean it up and you go out and there's nobody in there, you don't see too much.

MR. ANDREYCHEK: Dr. Wallis, I believe -- and I may be wrong on this -- but I believe that what Davis-Besse experienced was clogging of the coils during normal operation. They didn't have filters in front of the coils They actually had plating out on the coals of materials that were inside the can.

They did have power washer equipment inside containment to actually clean the coils as I recall in reading one of the reports.

CHAIRMAN WALLIS: Well, that was one of the symptoms they had of debris generation, let's say, originating from boric acid. So if there were something like this going on, I'm just saying the fact that debris is being filtered out or collected is an indication of how much debris there is, and you might be able to work back to the source of debris from that.

I'm just suggesting that you have a measure of this debris that way.

MR. ANDREYCHEK: In terms of an indication that there is a problem and what to do for the problem that's true; we were looking at here were plants that didn't necessarily have problems like that, but they did have resident debris inside the containment just because the containment is open during outages and you're going to get dustballing in, and no matter how clean you are, you're going to get some resident debris on walls and so on.

So we were looking at that, but you're correct. You can certainly look backwards and say, "Okay. I'm getting more debris than I expect. Is that an indication of a problem and where do I begin to look for the problems?"

And again, as Mo mentioned we generally, don't consider resident debris as a major contributor, but we do account for it. We do provide a method of doing.

And I agree with you, Dr. Kress. A

reasonable estimate of what you have inside the can.

The conservatism comes in in what we said is debris characteristics, which are find dirt and fiber.

Any further discussion?

CHAIRMAN WALLIS: I'd be interested in the number that Dr. Sieber had for this. It seems to me it was an expressive number.

MEMBER KRESS: Yeah, I've forgotten.

CHAIRMAN WALLIS: So we'll look at up.

MR. ANDREYCHEK: There is a sample calculation of what we use in the -- how to go about doing this in the guidance of 52804.

Baseline degree transport, again, there are four modes that we account for in the baseline model: blowdown transport, the original dispersion about the containment, spray wash-down after containment sprays come on. Where does he get the wash?

As the pool fills up, there's a potential for some degree transport as the pool rises up off the floor and begins to fill to its normal level.

And then the recirculation. Once the ECCS and containment sprays are realigned to draw suction from the containment sump, from the refueling water restorage tank with the BWST for the BWR plants.

MEMBER RANSOM: How mechanistic is the transport model when you consider things like buoyancy and whether it floats away with the flow or whether it's the flow is too old and lost this crane non-buoyant material.

MR. ANDREYCHEK: There is specific guidance on buoyant material that's accounted for in the guidance. I couldn't recite it right offhand at this point, but we do provide specific guidance for buoyant materials. The buoyant you typically would look at would be cassettes of RMI that are encased, encapsulated, that don't become water saturated.

Typically from what we've seen, we believe that the fiber glass insulation due to the expansion of the jet and the washdown of the containment spray, that's going to be thoroughly saturated.

MEMBER RANSOM: That's assumed to be entrained, I guess.

MR. ANDREYCHEK: That's correct.

MEMBER RANSOM: And would flow wherever the liquid goes.

MR. ANDREYCHEK: We would expect that to be the case, yes.

MR. DINGLER: But to answer your question, Section 4 which was after the break, we do look at velocities for vulcan, velocities in the flue stream to look at the transport of debris, both buoyant and at more. Here we assume 100 percent of the fines transport by decree.

MR. ANDREYCHEK: And we'll talk about that in Section 4 in more detail, but right now if it's less than four by four it transports to the sump screen. If it's greater than four by four, it doesn't immediately transport, but it does erode if it's an unjacketed fiberglass.

MEMBER KRESS: I hate to go back, but let me ask you another question at the latent debris.

MEMBER RANSOM: Yes, sir.

MEMBER KRESS: The impression is that's a process that's a good one, but it's a snapshot in time, and my feeling is that debris, latent type debris, dust and dirt and stuff on areas builds up in time. So if you have one snapshot in time, and the question is how fast did it get there and is it still going there and some later time is it going to be more?

Have you thought about how to do with that question?

MR. ANDREYCHEK: That's a good question,

and it's certainly beyond the guidance, but one of the things that we've suggested in looking at any IO-201 is that forms the baseline for your input to your sump evaluation, and one of the things the plant would need to do is to confirm that that baseline is still valid.

MEMBER KRESS: You know, if they're cracked in sand, it's generally a no never mind. It probably doesn't matter. It's still probably a no never mind.

MR. ANDREYCHEK: That doesn't mean you can back a dump truck of dirt back up into the containment.

MEMBER KRESS: Of course you control that sort of thing.

MR. ANDREYCHEK: That's right. So, I mean, normal cleanliness practices keeps the debris level at about the same, but you need to make sure that that's the case from time to time.

MEMBER KRESS: Yeah, most of that is on the floors and walls.

MR. ANDREYCHEK: That's correct.

As Mo had mentioned for the baseline, we use the logic tree, a similar method used for the BWRs in NUREG 6369, and it quantifies the debris capture and nontransport as well as transport. It also includes for latent or resident containment debris; identifies insulation as contained and where it's retained; what insulation is transported to the sump. It addresses the final distribution of insulation about the containment or debris about the containment, and it provides for a conservative estimate of debris distribution and transport.

Now, within the baseline there are three types of logic trees or three sets of logic trees that are given, and one of them is for an ice condenser plant and one of them is for a large, dry containment, and one of them is for a small, dry containment, such as might be in a two-loop or three-loop PWR.

CHAIRMAN WALLIS: It seems to me a very messy problem. It's like trying to figure out where the leaves go after a major thunder storm in some city. I mean, you've got these chunks of stuff which may be built up somewhere and make a dam and build up some water, and then the dam breaks and the stuff cascades down the stairs and material which was previously hung up on the stairs gets freed by this temporary waterfall. There are so many things going on that it's a bit mind boggling to figure out that you can calculate anything.

MR. ANDREYCHEK: Well, we don't disagree

that it's a very complex phenomenon. We've stated that. What we are looking at is based on best engineering judgment that we have available to us. What does it look like? Where does it look like it goes? And here's the log tree.

CHAIRMAN WALLIS: A logic tree is nice in terms of a sketch, but in terms of realistically, mechanistically modeling, it must be very difficult.

MR. ANDREYCHEK: We think it is, yes. We think it is.

MEMBER KRESS: Are these probabilities on there?

MR. ANDREYCHEK: No.

MEMBER KRESS: The percentage, a fraction of the --

MR. ANDREYCHEK: Of the debris that's actually transported. For example, what we're suggesting for this particular type of insulation, Nukon, is that 60 percent of the debris that's generated in the zone of influence is small fines and it's transportable to the sump, and 40 percent are large pieces.

MEMBER KRESS: So at that point in the logic tree you change sizes for the rest of the tree.

MR. ANDREYCHEK: That's correct. Actually at this point on the logic tree, that's where the break occurs. That's when the break occurs. At that point 40 percent remains large pieces jacketed, and therefore it does not find its way to the sump.

We get approximately 60 percent fines that are transported from the sump, and we get the 75-25 split between the lower containment and the upper containment. Seventy-five percent of the debris stays in a lower containment. Twenty-five percent finds its way to the upper containment.

In the lower containment, you get about 70 percent of it stays in the active pool. You get 30 percent that goes into inactive volumes like the reactor cavity, places that don't participate, that don't participate in the overall flow, and so basically following the logic train through, we identify what finds itself into the sump and what finds itself not in the sump.

CHAIRMAN WALLIS: So you get 12. 3.

MR. ANDREYCHEK: That's correct.

CHAIRMAN WALLIS: And you're not quite sure. You say you'll have a factor of safety of two. You get .86. You might as well assume one. It seems to me it's pretty iffy. These numbers are subject to uncertainty.

MEMBER KRESS: This is the part we were hoping we could bypass.

CHAIRMAN WALLIS: Does it make any difference whether it's .5 or one? Is the screen so sensitive that it makes a difference?

MR. ANDREYCHEK: It depends on the size of the screen how sensitive it is.

CHAIRMAN WALLIS: Well, I guess the NRC has a ticklish job here if you can get -- can stand .5 and you're predicting .43. Is that going to be acceptable?

MR. ANDREYCHEK: I'm going to have to defer to the NRC to answer that.

CHAIRMAN WALLIS: Well, I think they have a tough job.

MR. ANDREYCHEK: Certainly I think the responsibility of industry is to identify why these numbers are reasonable and appropriate to use.

CHAIRMAN WALLIS: You're going to put uncertainties on all of these?

MR. ANDREYCHEK: These numbers are conservative already.

Gil, would you like to offer a comment on these numbers?

MR. ZIGLER: Sure. My name is Gil Zigler.

I'm with Align Science, and you probably know me from a different thing. I' m not wearing my ASME hat today. I'm wearing my symbology hat on.

The logic trees, the numbers that we selected were the worst cases that we could find from the experimental data. Take a look, for example, for this one, the Nukon, the small fines and the large size. There's one data point from the BWR orange group air jet impact test that shows that.

Most of us in the BWR world when we did the BWR analysis actually used a flip. We used 600 percent large, 40 percent small.

We further compounded by assuming that the small fines are at the essence of debris, that is, individual fibers, which again is a further compounding of the conservatism because the data indicates that in the small fine size, it costs you less than by four; that they are actually clusters, not individual fines.

The split of the upper containment to the lower containment is based on an area of a highly compartmentalized steam generator on it where you basically have or you really have less than 25 percent of area that can be jetted up.

So here we just took an upper bound of the amount that can go up and conservatively assumed that most of it stays in the lower containment. There's the small fines which are easily transportable.

The stuff that now goes up on the dome side of it, which then can be washed down from the upper containment, we conservatively assume that everything that went up on fines comes back down, which is a very, very highly conservative assumption, and the reason behind it is because this is for the baseline. You don't really background the individual prime considerations.

Now, on the active pool and the inactive pool split, that is an actual number from the plant. So each one of the plants will have a different split. Those are the total volumes that are under the water that are not participating in the research flow. So this is a typical representative. We did an analysis of about a half a dozen to a dozen plants already, and they show that's a typical representative number, which was used in the sample calculation for the baseline calculation.

And finally when you get over to the total transport, the recirculation transport, since we assume them to be completely individual fibers, we transported 100 percent that's in the pool that's not sequestered in the inactive pool goes to the sump.

So as you can see, you know, you start off with a very conservative zone of influence, the size of the zone of influence. You do a conservative size distribution. You do a conservative split of where it comes up and down. You transport everything that went up. It comes back down.

It is more realistic of what's captured and not captured in the inactive sumps, and then you do a conservative transport and non-transport.

So again, as we keep saying, the baseline is compounding conservatism on conservatism, again, to minimize any of the uncertainties associated with it.

CHAIRMAN WALLIS: Did you take this and apply it to something which happened like the Barsebek event and predict what happened?

MR. ZIGLER: We did that in the BWR world when we were doing the analysis in 6224. We took very careful look at the Barsebek then, and this basically tracks the Barsebek.

CHAIRMAN WALLIS: So we plot conservative. It's realistic on the Barsebek?

MR. ZIGLER: No, no, no. This is conservative with respect to the Barsebek. It bounds, significantly bounds the Barsebek.

CHAIRMAN WALLIS: Thank you.

MEMBER RANSOM: One thing I didn't understand, is this fraction of the total potential debris in the containment, or only that within the zone of --

MR. ANDREYCHEK: If the zone of influence for Nukon alone, okay? Now, you'll find that there's another logic tree like this for reflective metallic insulation for the same plant design that has slightly different numbers perhaps based on what's generated as large and small fines.

MEMBER KRESS: So you add up all of the logic tree.

MR. ANDREYCHEK: Yes, sir. To use Mo's example earlier, if you have five insulations, five different types of insulation with the zone of influence, you would have five logic trees like this, one for each insulation pipe.

CHAIRMAN WALLIS: Now, who is going to do this calculation? Are the individual plants going to do it or are they going to hire a consultant who knows what he's doing?

MR. ZIGLER: Sir, this afternoon, you will see from our colleagues from EDF a typical example of a logic tree application for plant specific, which is a little bit more complicated than this, and you will see --

CHAIRMAN WALLIS: It's going to be done by engineers at the plant or is it going to be done by some consultant who knows this inside and out?

MR. ANDREYCHEK: This particular methodology, the direction I was given was make it in such a way that the engineer could plan, pick up and read it, and use it.

CHAIRMAN WALLIS: The purpose is to make it understandable, usable by the people at the plant.

MR. ANDREYCHEK: That's correct.

CHAIRMAN WALLIS: Okay. Thank you.

MEMBER FORD: But my understanding was that the analysis that you talked about was done by an expert panel.

MR. ZIGLER: No, sir. I don't know what analysis you're addressing.

MEMBER FORD: When you're coming to using worst case and best estimate as you go across this event tree, you are making specific judgments.

MR. ZIGLER: Yes.

MEMBER FORD: And my question to Professor's Wallis' question: who is making those judgments? Is it an expert panel or is it a youth?

MR. ZIGLER: For the baseline document, it was a group of experienced engineers --

MEMBER FORD: Okay.

MR. ZIGLER: -- looking at the available data in previous analysis, and dividing this whole spectra over which we have plans, where we see three basic categories.

That is, the ice condenser transport logic tree for the baseline, and what we call the highly compartmentalized plants which Tim addresses as the early generation plants, and then the non-highly compartmentalized plans which are the latter generation plans on it.

Analysis have been performed at one level, and based in our experience then, those are bounding numbers that were presented in the baseline for the industry to use.

MR. ANDREYCHEK: And these are designed so that the plants can actually take the guidance and use it.

MEMBER KRESS: Will these numbers depend on your selection of where the worst break is, depending on where you end up deciding that worst break is?

MR. ANDREYCHEK: It could. People are at

the plant to make the decisions about how they're developing and applying this methodology are going to make some decisions, and they're going to have to justify why they choose certain things.

We chose these numbers because. . . .

CHAIRMAN WALLIS: But this is again -- the question is how well equipped the staff is going to be to evaluate these assumptions and judgments.

MR. ANDREYCHEK: And the judgments should be clearly defined when the information is presented to the staff.

CHAIRMAN WALLIS: I'm wondering how well equipped the staff is going to be to critically assess all of these assumptions and adjustments. Maybe the staff can tell us tomorrow.

MR. ARCHITZEL: Dr. Wallis, we have a presentation this afternoon, but we're not going into a lot of detail for our current review, but we do have a presentation this afternoon, and we have some alternatives we're working on that we might present, but I don't know that we'll present them today, but for the baseline it's a different case.

CHAIRMAN WALLIS: Okay.

MR. ANDREYCHEK: Any further questions or comments?

(No response.)

MR. ANDREYCHEK: Head loss, we are using NUREG CR-6224, head loss correlation. As I mentioned earlier, it is somewhat theoretical and does account for degree characteristics, such as thickness, porosity, surface to volume ratio and compressibility of the material.

It also accounts for working characteristics, specifically velocity and temperature properties, density and viscosity.

We treat as a flat pledged correlation, which has been demonstrated through comparison to data is conservative. The debris quantities are specifically counted for based on what we evaluate through the logic trees, and does provide for a very conservative head loss calculation. I feel comfortable with that.

MEMBER RANSOM: What do you mean by flat fee application?

MR. ANDREYCHEK: Well, we treat it as a flat plate that flows perpendicular to it as opposed to a slant or any other orientation. And it's a flat plate correlation.

MEMBER RANSOM: So it's just normal flow through this plat.

MR. ANDREYCHEK: That's correct.

CHAIRMAN WALLIS: What is the thin bed effect?

MR. ANDREYCHEK: The thin bed effective is when approximately an eighth of an inch of fiber forms in the surface of the screen and particulates come behind it. The eighth of an inch appears to be a number that says you get a rather contiguous fiber bed that the particulates can form on the back side of yes.

CHAIRMAN WALLIS: This was discovered after this last correlation, but it is somehow being fed back into the correlation?

MR. ANDREYCHEK: Well, this correlation will predict, depending upon the particulate loading, the thin bed effect. It will calculate the pressure drop.

CHAIRMAN WALLIS: It will predict the thin bed effect?

MR. ANDREYCHEK: Yes, it will. Given a particular fiber bed thickness and then the various particulate leads on that, you can calculate the thin bed effect which is the pressure increase, and then drop down again and back up.

Yes, sir, and in fact, I believe that this was used to calculate the thin bed effects that we're seeing on the boilers.

MEMBER FORD: Going back to the event tree and thinking about it, is there a database to show -- you mentioned the Barsebek was bounded by this analysis. Is there more of a database?

I mean there's been quite a few such incidents. Is there a database?

MR. ZIGLER: There was a considerable amount of study done for the BWR on the sponsorship of the NRC which is summarized in NUREG 6339, where actual pieces of fibers were blown in highly controlled air tunnel tests and seen how it accumulated on gratings and how different structures and I beams trapped.

Then the NRC went to the same facility where the BWR Owners Group did the air jet impact test, and I was in the tail end of that experience with my experience with the NRC, but anyway, we designed a number of obstructions of I beams and gradings, et cetera, et cetera. that were associated with it.

And they actually blasted intentionally Nukon blankets, fiberglass blankets and observed the properties of how the debris would accumulate, impinge on the structures, whether the structures were wet, whether the structures were dry and calculated numbers came out of that.

So there's a good database associated with the transport in simulated air blasts, what structures, dry structures, that kind of stuff.

CHAIRMAN WALLIS: There's also from the plant experienced. You mentioned Barsebek, but there are other plants where there have been similar --

MR. ZIGLER: There hasn't been any intentional plant experiences in the sense of fortunately we have not had any actual pipe breaks in containments or anything like that.

There has been a few interesting data points from the DDR 1000 worked, where they actually went ahead and spread a number of -- they simulated a break by spreading the fiberglass on the floor of the compartment and actually turning on the sprays and observing the transport of those fiberglass components from the compartment level down through the multiple levels and how it transported to the sump.

And modeling that phenomena show that what we are doing over here is basically bounding that,b ut actual turning on sprays, if you please, it's not something that people have intentionally done.

CHAIRMAN WALLIS: So does your report or your guidance, when it presents a recommended calculation method, does it list the evidence behind that method in some consistent way so that it can be assessed as to how well this is understood?

MR. ANDREYCHEK: References are provided for --

CHAIRMAN WALLIS: Do we then have to look up all the references or is there some evidence actually provided in the report itself or do we have to go dig into the literature?

MR. ANDREYCHEK: I'm not sure I understand what you mean by "evidence."

CHAIRMAN WALLIS: Well, if we read your guidance now and you're claiming, "Use this method," how do we know it's any good? Do we have to then dig into the references and find out what the evidence for this is?

I'm trying to figure out how on earth we're going to assess the validity of this guidance.

PARTICIPANT: Does the documentation contain comparisons?

CHAIRMAN WALLIS: Does the document contain the evidence in the guidance itself?

MR. ANDREYCHEK: Okay. There are no

comparisons to other forms of data, with the exception ofa couple of head loss comparisons that are included in later sections of the document.

This is an approach that we felt was based on --

CHAIRMAN WALLIS: So how do we know it's any good? It may be a wonderful approach, but how does the evaluator reading this thing get convinced that this is the right way to do it?

MR. ANDREYCHEK: It's a good question. As a matter of fact, one of the things that we're attempting to do is respond to questions that the evaluators have and try to provide additional information, which I believe is consistent with your question.

CHAIRMAN WALLIS: So there may be quite a long period of the staff asking questions, not the ACRS because it's not our job to do all of that work, but saying why do you use this correlation; what's the evidence for it; how do you know it's conservative; how conservative is it; all of those kinds of things.

They're going to be asked and there's going to be a whole train of documentation somewhere which can be looked at which is going to give the answers to those questions?

MR. ANDREYCHEK: To date the two correlations that the people have asked about have use of ANSI/ANS 1998 58.2, 1998, and the use of the head loss correlation at NUREG CR-6224. And we've attempted to address those in the latest round of REIs we've provided information for.

Everything else is based on data that is drawn from either experience and we identify why we believe this to be conservative, or it refers back to when we talk about Section 4 in the next presentation where the data is drawn from and out of industry report and the knowledge based document, NUREG CR-6808.

So we're not trying to hide or make it difficult to get that information. We believe in the process we identify this to be conservative because; we believe this to be applicable because.

And when we do get REIs from the NRC, we try to respond as directly as we can to them without --

CHAIRMAN WALLIS: If you had a presentation where you said, "We recommend this equation, and it's conservative. Here's the evidence. Here's a figure. Here's the line and here's all of the evidence. Here's all the data, and, gee whiz, all of the data is below the line."

Then we can say, 'Ah, ha, yeah. We sort of believe that's conservative because we see the evidence."

MR. ANDREYCHEK: All right. That's a fair point.

CHAIRMAN WALLIS: It would be useful if that could be summarized somehow. Maybe next time we see you you can talk about this in some detail, I believe.

MR. ANDREYCHEK: That's a fair comment.

CHAIRMAN WALLIS: You could present not just words, but curves and data and explain why this curve is conservative.

MR. ANDREYCHEK: Okay. Fair comment.

CHAIRMAN WALLIS: Are you near the end now so we can take a break?

MR. ANDREYCHEK: Well, I appreciate that straight line. Here's the summary. I'm done.

No, actually we do believe we have evaluated a baseline method for evaluating post accident sump performance. It does count the five steps we're looking at: break selection, break regeneration, late debris, transport, and head loss.

The method is applicable to all plants

with plant specific input and provides for an application of compounded conservatism since we had talked about in this presentation in the evaluation of the sump screen head loss.

CHAIRMAN WALLIS: Now, let me go back to what I said at the beginning. Los Alamos did a parametric study, and they started the ball rolling by saying that a significant number of plants would have problems.

You have now got a method which essentially does what they did, it seems to me, doesn't it? Are you going to retain different conclusions from what they did?

MR. ANDREYCHEK: We may.

CHAIRMAN WALLIS: But yours seem to be conservative. I'm not sure theirs was all that conservative.

MR. ANDREYCHEK: Well, I think theirs had some conservatisms in it. However, one of the obvious differences are that what we have provided for is more plant specific input, whereas the Los Alamos generic study blended some things in order to get the -- and their purpose of their study was to say is this a generic problem that we need to worry now about or not.

We're now saying let's take a look at the very specific plant inputs we need. Here is a specific methodology.

CHAIRMAN WALLIS: There's no reason to suppose the results will be significantly different from this. You haven't debunked their approach in any way by your studies, have you?

MR. ANDREYCHEK: I believe the September 2001 --

CHAIRMAN WALLIS: Where are we going to be at the end of all this is similar to where we are today, is it?

MR. PETRANGELO: This is the plant specific evaluation that they couldn't do generically. We don't know what the outcome is going to be.

CHAIRMAN WALLIS: One would expect it would be kind of similar. They're doing logical things. You're doing logical things.

MR. ANDREYCHEK: But the difference, and there is a difference, and the difference has to do with the plants, but the amount of plant specific input that's used in the evaluation.

And, yes, there are some strong similarities between what --

CHAIRMAN WALLIS: This approach seems to

be we can't do anything until we know the plant specific results. We can't do anything. I know the agency could have taken a much harder line and said, "Oh, we believe Los Alamos."

You guys are going to have to fix it. It seems this sort of puts it in a few more years of being more certain about what we're doing before we do anything at all. Is that what's happening here?

MR. PETRANGELO: To know what to do though, how do you know what to do without doing the evaluation?

CHAIRMAN WALLIS: There are some very Draconian things you could do I won't even mention. I'm just interested in the process here. We'll come back to it, I'm sure with the staff.

MR. JOHNSON: This is Mike Johnson.

We might be able to talk to that a little bit this afternoon.

CHAIRMAN WALLIS: Yeah, let's do that this afternoon. It's really questions for the staff more than for you.

Is it time to take a break?

MEMBER KRESS: I wanted to ask one more question and I want to hear what the Los Alamos guy has to say, too.

MR. BUTLER: John Butler, NEI.

I want to put in perspective what the baseline is serving a key role. We're using the baseline in part as a scoping analysis, not to at the end result in the baseline, but to use it to identify where a plant can then put its resources in time to get the right answer that they need, whether that's a design modification or actually doing a more detailed analytical refinement of their analysis.

The baseline is conservative. If you can live with that, you're fine, but if you can't, it then will guide you as to what the appropriate step is.

CHAIRMAN WALLIS: The public reaction if it turns out that you do all of this and you reach a worse conclusion than Los Alamos, you conclude that 90 percent of the plants need a major fix. That's a significantly nasty conclusion to reach after all this time.

MR. BUTLER: It would not be my desire that everyone provide the preliminary results which the baseline results are to the NRC, but they should provide their end results.

CHAIRMAN WALLIS: Somebody must have thought through the process. If we do this and we find that, what do we do next? And if we do this and we do that, what do we do next, maybe we have to ask the staff that. I'm trying to see how this whole thing is going to evolve, and I'm wondering whether we're going about it the right way.

We'll take a break.

MEMBER KRESS: I had one more question.

CHAIRMAN WALLIS: Right.

MEMBER KRESS: In one of your split fractions is an inactive part of the pool and active part.

MR. ANDREYCHEK: That's correct.

MEMBER KRESS: Could you clarify what that is for me and how you determine it?

MR. ANDREYCHEK: An active part of the pool is a dead ended volume that once it fills it doesn't react or interact with the rest of the pool. For example, the reactor cavity.

MEMBER KRESS: Do you have to do a flow analysis to determine what goes in there?

MR. ANDREYCHEK: Well, you don't necessarily have to do a flow analysis. You know it's a dead volume. It's a dead ended volume. It's going to fill and --

MEMBER KRESS: So it falls down from the top and goes in that volume. It's never going to get out.

MR. ANDREYCHEK: That's correct.

MEMBER KRESS: Okay.

MR. ANDREYCHEK: Once it goes in, it never comes back out.

MEMBER KRESS: I understand what you're saying there.

CHAIRMAN WALLIS: Okay. We'll take a break until 25 to 11.

(Whereupon, the foregoing matter went off the record at 10:19 a.m. and went back on the record at 10:37 a.m.)

CHAIRMAN WALLIS: Looking forward to getting more refined?

MR. ANDREYCHEK: Yes, we are.

Okay. Welcome back after the break. We'll talk about refinements, do a brief introduction of refinements, and we'll talk about what the specific refinements in the methodology are. Specifically, we're looking at break size or break types, break locations, selection of zone of influence, debris generation, refinement of latent debris, refinement of debris transport, and refinement of head loss.

The analytical refinements are refinements or options provided for more realistic but still conservative evaluation of post-accident containment sump performance. That's the definition we are using -- more realistic, but still conservative.

The definition of analytical refinement is an analysis option that builds on approach taken in the baseline methodology. And, again, the objective is to provide for a more realistic, but still conservative, evaluation.

With regards to the break types, we're still using a double-ended guillotine break. We're not changing anything in refinements. We're still looking at the large --

CHAIRMAN WALLIS: That's of any pipe size.

MR. ANDREYCHEK: That's correct.

With regards to break location, it is suggested to use Generic Letter 87-11, Relaxation and Arbitrary Intermediate Pipe Rupture Requirements. This document suggests the dynamic effects, resulting arbitrary intermediate pipe ruptures, are eliminated from consideration consistent with the plant's licensing basis.

Now, it does identify specific locations you need to look at -- high stress and high fatigue locations, such as the terminal ends of piping, systems at connections to components. The consideration of maximum debris and worst-case combination debris are still retained.

We believe that the reason for that is that the steam generators -- and the area has a lot of insulation -- typically, if you're going to have multiple types of insulation on your equipment, the steam generator is where you're likely to have it.

So the use of this particular guidance to select specific break locations is a conservative approach to taking a look at light. It also makes it a little bit easier and you're not necessarily looking at three-point increments all the way down the pipe for two-point increments. You're looking at those areas where the break is most likely as defined in Generic Letter 87-11.

CHAIRMAN WALLIS: But you're still considering the hot leg.

MR. ANDREYCHEK: Hot log and cold leg.

CHAIRMAN WALLIS: But you might consider it to be more likely where it attaches to the vessel than --

MR. ANDREYCHEK: Correct.

CHAIRMAN WALLIS: -- elsewhere.

MR. ANDREYCHEK: Correct. That's correct. So you're still retaining those most likely locations

-- at the nozzles, at the safe ends, high stress areas, as defined in the Generic Letter.

Victor, you looked a little puzzled.

MEMBER RANSOM: How much does this eliminate?

MR. ANDREYCHEK: It eliminates a lot of bookkeeping, repetitive work. You're focusing now on more limited locations.

MEMBER RANSOM: It's not a matter of changing the amount of debris you're going to calculate or --

MR. ANDREYCHEK: No.

MEMBER RANSOM: It's only reducing the amount of work they have to do to comply?

MR. ANDREYCHEK: That's correct. You're focusing on, how many times do I need to do this calculation? How intense is my bookkeeping operation? You know, the comment -- I believe someone mentioned the comment about 10,000 hours. Okay. This helps cut down some of that time.

MEMBER FORD: Well, it seems very reasonable. But what about other things such as erosion/corrosion? I'm thinking of, for instance, the Surry event where you had a large leakage but not due to the classical fatigue or I think -- well, how much is your risk increased in --

MR. ANDREYCHEK: The Surry event was which event? Please refresh my memory.

MR. DINGLER: The erosion/corrosion may be only on your feed or your steam line, main steam line. And that will be slightly different than using 87-11, because I think that's your class 1 piping that --

MR. ANDREYCHEK: Yes. Well --

MR. BRYAN: This is Bob Bryan again. This piping is not subject to erosion and corrosion. That's typically in the --

MEMBER FORD: I know. I recognize that.

MR. BRYAN: And for that matter, I'm not aware of any in the main steam line piping inside containment that has erosion/corrosion issues. You might have a fatigue issue at steam -- at feedwater nozzles.

MEMBER FORD: I was thinking off the cuff.

MR. BRYAN: Right. I understand, but I --

MEMBER FORD: Just looking at what risk are you -- by just confining yourself to --

MR. BRYAN: This basically is building on what we have learned the four years that -- in primary loop piping, you're going to have your breaks occurring at well locations, typically at terminal ends and high stress locations, where the analysis tells you it did. And it has been built into the regulations that you don't need to go look at arbitrary intermediate breaks. You just want to take advantage of that based on what we've learned.

MR. ANDREYCHEK: Well, and as Bob mentioned, with regards to corrosion, if there isn't any on the primary system piping --

MR. BRYAN: As for the Surry event, you would pick up that break in this event with this -- the crack that they found with the hot let nozzle. So that would be one of the terminal ends that we'd be looking at here.

MR. DINGLER: But i think you are also talking about the Surry steam line break, too, which I think you were --

MR. BRYAN: Let me correct that. That's Summer, not Surry. The Surry event was --

MEMBER FORD: Summer was the nozzle.

MR. BRYAN: -- balance of plant.

MR. ANDREYCHEK: Quite frankly, if it's not in the balance of plant, it's beyond consideration. We're only looking at breaks inside the cam, because those are the only ones that get us into recirculation.

MEMBER FORD: All I'm asking is: did someone go through the "what if" analysis? And you did. Summer, of course, had a large boron stalactite, which would have become debris.

MR. ANDREYCHEK: I'm sorry. Say that again.

MEMBER FORD: Summer had a large boron stalactite hanging from its crack, and presumably that would have become boric acid. That would have become debris in the event of a break.

MR. ANDREYCHEK: In the event of a break?

MEMBER FORD: Yes. I mean, that stuff would have presumably shattered and become debris.

MR. ANDREYCHEK: And also possibly might have gone back in the solution with warm water and --

MEMBER FORD: Right. Then you get all kinds of chemical effects, which we don't know about yet.

MR. ANDREYCHEK: We'll talk about chemical effects tomorrow.

MEMBER FORD: Okay. All right.

MR. ANDREYCHEK: Boric acid --

MEMBER FORD: But since you mentioned some, I was just going to say there was another piece of debris there which isn't probably in your design document. It's a large boric acid stalactite.

MR. DINGLER: Dr. Graham, you asked a question -- go back one slide.

MR. ANDREYCHEK: Sure.

MR. DINGLER: On the double guillotine -- we're assuming the double guillotine, where it's required, like mainly in the surge line but not on something where you don't have a double guillotine. I just wanted to make sure we understand that.

CHAIRMAN WALLIS: Okay.

MR. ANDREYCHEK: Any further questions on this one, or comments on this slide?

MR. LETELLIER: Tim?

MR. ANDREYCHEK: Yes.

MR. LETELLIER: This is Bruce Letellier from Los Alamos National Lab. You discussed this as a refinement. But it really looks more like an alternative, and I think that's the way it is outlined in the guidance in your flow chart, where it's a risk-informed option, because it comes to mind that if a baseline has already been performed, there is no savings in effort.

This is really an alternative approach, is it not?

MR. ANDREYCHEK: It may be considered as

an alternative, yes.

MR. BRYAN: With one correction. It isn't a risk-informed option. This is --

MR. ANDREYCHEK: Well, Bryan, TVA. Okay?

Selection of zones of influence. As you mentioned earlier, we take a look at the insulation material that is within the region we're looking at. We use the destruction pressure, the most weakest material, to define an overall zone, at the discretion of the plant. And they choose to use material-specific zones of influence.

For example, they have reflective metallic and Nukon insulation. The zone of influence associated with Nukon might be about 12 times the break diameter. The zone of influence for reflective metallic might be about one and a half times the break diameter.

And at their discretion, they can use the one and a half times break diameter for the reflective metallic to reduce the amount of debris that might be generated, and they would have to consider in their evaluation to maintain the 12 times the break diameter for the Nukon insulation.

Similarly, if they had something that was even less robust than Nukon, they would retain that particular zone of influence. It's a way of reducing the total amount of debris that they need -- that a plant would need to look at.

MEMBER RANSOM: There is a database for that based on experiments?

MR. ANDREYCHEK: There is a database for destruction pressures based on experiments, yes. And a lot of it is drawn from the air jet testing that was done for the boilers. That's correct, sir.

CHAIRMAN WALLIS: Air jets don't behave quite the same as two-phase steam jets?

MR. ANDREYCHEK: That is true. They do not behave quite exactly the same. In fact, the zone of influence associated with a steam jet tends to be a little larger than that for a two-phase jet.

CHAIRMAN WALLIS: And for an air jet similarly, is that right?

MR. ANDREYCHEK: I'm sorry. Say that again.

CHAIRMAN WALLIS: I said air -- you mentioned air jets.

MR. ANDREYCHEK: Yes.

CHAIRMAN WALLIS: So is the air jet zone of influence bigger or more directed?

MR. ANDREYCHEK: I don't have a good

answer for you. I can get that for you, though.

CHAIRMAN WALLIS: Well, you said it was based on air jet. That's why I asked.

MR. ANDREYCHEK: That's correct. I would have to get that information specifically, but I believe it is larger. But I don't have the comparisons to show you.

Again, we're taking a look at jets from the double-ended guillotine break assumed to be freely standing as we did previously, so we're looking at still calculating a considerably large zone of influence, even though it may be somewhat reduced, taking into account the material robustness or strength.

And, again, we can still get sometimes beyond 10 times the break diameter for jet impingement considerations, which we're looking at as part of the current licensing basis for NUREG/CR-2913. Sometimes it won't be.

For example, and I'll use the reflective metallic insulation. That has a zone of influence of about 1.5 times the break diameter, which is less than 10, but we're still looking at those less robust materials and keeping their larger diameter. And, again, the debris generation now becomes dependent upon the specific material properties.

MEMBER RANSOM: I'm wondering, is there any dependence on the size of the pipes that you're impinging on? Because generally the stainless steel or aluminum, or whatever it is, for containing the insulation is probably a constant thickness. It doesn't depend on pipe diameter. You know, it's more based on just being able to fabricate it.

I don't know what the thickness actually is, but certainly it's going to be more likely to be torn apart on a large pipe than it is on a small pipe, because of that.

MR. ANDREYCHEK: That's true. One would expect that to be the case, yes.

MEMBER RANSOM: Are those kind of effects taken into account?

MR. ANDREYCHEK: Actually, we're not taking that into account. We're taking a volume -- a representative volume that we feel is -- rather than trying to track where jets would go, we're saying we're taking the volume. Everything within that volume, regardless of the pipe size, is going to become debris. And we look at the data we have and say, "What's the distribution of debris sizes, given that it's within the volume? How much is going to be transported?"

MEMBER RANSOM: Well, the volume sounds a little small, actually, compared to supersonic jets, which don't decay all that rapidly.

MR. ANDREYCHEK: A little small. In what regard?

MEMBER RANSOM: Ten pipe diameters is a relatively small distance than a supersonic jet.

MR. ANDREYCHEK: If you're looking at a -- in a primary system, primary system piping, say it's 30 inches in diameter.

MEMBER RANSOM: Right.

MR. ANDREYCHEK: So the sphere is 10 times 30 inches in --

MEMBER RANSOM: Ten meters downstream.

MR. ANDREYCHEK: -- on radius. So you start looking at -- you're actually looking at 20.

MEMBER RANSOM: Sphere.

MR. ANDREYCHEK: Yes, 20. That covers a pretty good portion of containment. You're taking out a very large portion of the containment. So I'm not sure --

MEMBER RANSOM: Well, two comments. It's probably too large in diameter. You know, a jet doesn't diffuse that way under the kind of pressure issues you're talking about. But on the other hand, it extends for a lot greater distance axially. So I don't know. They may be compensating.

MR. ANDREYCHEK: We believe that they are. And, again, we chose the approach that was very similar to what was used in the BWR resolution issue, which used spherical sums to --

CHAIRMAN WALLIS: I think what happens here is your pressure ratio is humongous. You are going from 2,000 psi down to more or less atmospheric. And it's not as if it's just a supersonic jet. It's a very underexpanded jet, and it tends to open up.

MR. ANDREYCHEK: Right.

MEMBER RANSOM: Well, that angle can be predicted.

CHAIRMAN WALLIS: Right. It can be. It tends to open up to --

MEMBER RANSOM: Well, it --

CHAIRMAN WALLIS: And it also occurs at a lower pressure ratio. So it spreads out more, just by this huge pressure ratio.

MR. ANDREYCHEK: Right.

CHAIRMAN WALLIS: But, again, this has to be thoroughly based on technical analysis.

MEMBER RANSOM: Well, it's a very multidimensional phenomena. Even though it does spread out initially, it also curves back.

MR. ANDREYCHEK: That's correct. And you're right, it is multidimensional. And we have -- because we were trying to give the plant something that they can use as a basis for doing it. We've taken an approximation approach that gives us a -- what we consider to be a reasonably large volume, and we've applied that volume to -- rather than look at directed jets, which, by the way, happens to be the very next refinement that plants, if they choose to, can look at refinements.

Okay. So we are --

MEMBER RANSOM: There is evidence that these things have been looked at and more or less assessed that this model, then, is conservative?

MR. ANDREYCHEK: We have looked at it from the standpoint of what makes sense, and we have -- we believe it is a reasonable approach that gives us a very conservative approach. Now, I don't have data I can pull out and show you right now. It does provide for a very large volume, even the expanding -- as you noted, it flares out, and then it comes back again.

MEMBER RANSOM: It's like NASA people have a lot of data on this kind of thing, because they're very concerned with impingement of rocket engines, even, you know, in very low pressure situations, as well as high pressure. And, you know, they are generally concerned with heat transfer because of the temperature of their jet, which you're not so concerned with here. It's a different problem.

MR. ANDREYCHEK: That's correct.

MEMBER RANSOM: You'd like to see a database like that that could be used to verify that, indeed, this is a reasonable approach.

MR. ANDREYCHEK: That's a fair comment. We'll take it under advisement.

Any other comments?

CHAIRMAN WALLIS: Well, I guess the concern is that if you look at the jets from pictures of, say, the space shuttle, you see this sharp diamonds and all of that. And the jet goes an awful long way sort of straight behind the exhaust pipe. It doesn't spread out as a cone, so -- as a sphere.

So, again, this has to be suitably handled technically, and not just talked about. And we're going to look for the evidence that it is being properly handled technically I guess, or the staff is, when this report is reviewed.

MR. ANDREYCHEK: Okay.

MEMBER RANSOM: Well, then, I think two-phase actually complicates it even further, because the compressible part of the phase does expand that way. But the liquid primarily is going to flow along the axis. That's where the higher density material is, and one more likely to do damage.

CHAIRMAN WALLIS: Again, we want to look at the technical evidence behind your analysis.

MR. ANDREYCHEK: Okay. Any other comments?

MEMBER FORD: Well, I would like to followup on that remark. What is expected of us today when we're not seeing all the data in front of us?

MR. CARUSO: You're not here to evaluate the NEI methodology, because that hasn't been evaluated by the staff yet.

MEMBER FORD: Okay. So we're just being given a --

MR. CARUSO: This is an introduction --

MEMBER FORD: -- an approach.

MR. CARUSO: -- an introduction to their approach.

MEMBER FORD: Okay.

CHAIRMAN WALLIS: Well, I think what's expected from us is to give some indications of the kind of things we're going to look for.

MR. ANDREYCHEK: Okay. Feedback.

MEMBER FORD: So is what we're giving to you now in terms of feedback useful?

MR. ANDREYCHEK: I think it is, yes. I appreciate the insights and the concerns that are expressed.

Okay. The next refinement with regards to zone of influence is to look at a directed jet. Again, we're looking at an approach very similar to what is described in NUREG/CR-2913. And we're looking at the jet expansion as it goes down, and how far do you need to go dependent upon the material robustness.

Again, it yields a fairly large target-based region for debris generation of a specific material. And we assume that the jets form from both ends of the double-ended guillotine break, but they expand freely and don't interfere with one another. So you get the maximum effect of the jet opening up, the pipe breaks, it expands open this way without interference from the jet expanding in this direction.

And, again, it looks like you can be beyond the 10 times break diameter that was used in NUREG/CR-2913, based on the specific material properties of the insulation. You are talking about material properties specific to debris generation.

Any comment regarding the use of ANSI/ANS 58.2-1988 is still taken.

Debris evaluation -- we're taking advantage of the tabular -- the material debris characteristics that are provided in NUREG/CR-6808, which looks at different debris characteristics, different distributions, debris sizes, and other industry data where available.

We've been able to collect some information from some vendors of insulation that we're adding to the database to refine the two sizes fits all shoes -- the four by four and smaller and something greater than four by four. And that's provided as a way of looking at transportability of debris, which feeds into the next -- the transport items, which we'll talk about in just a moment.

With regards to latent debris, there is no general or analytical refinement that is offered by a specific environment, such as procedures. They justify changes to latent debris source term over what we calculate as a rough estimate. It has some elements of conservatism and some elements of realism in the baseline methodology.

If you've got some very specific plant

information, and you want to use it, you want to incorporate it, please go ahead and do it.

And, again, we don't consider this necessarily a major contributor to the overall head loss that has resulted. But we are accounting for it, we are -- we do want to consider it in all evaluations. It should be addressed.

MEMBER FORD: When you say "should be addressed," need it be addressed? Is it a question of nice to know or must know? Is it a driving factor? This is what I'm -- I'm trying to give advice to you. From my perspective, I'm having a problem finding out what's important and what's not important.

MR. ANDREYCHEK: Our methodology says incorporate it, make it a part of your evaluation. Experience to date has demonstrated that we haven't found it to be a major driver in the evaluations in plants that have looked at it so far. But account for it, because it may be important to your specific application. It is part of what we ask plants to do.

MR. PIETRANGELO: It means do it, and the staff is going to approve it in an SER with whatever exceptions. If you don't do it, then you have to take exception to it and justify it back to the NRC.

MEMBER RANSOM: This includes things like the different types of insulation that are utilized in different plants?

MR. ANDREYCHEK: That goes back to the debris generation aspect of it. That goes back to when you're evaluating debris source terms --

MEMBER RANSOM: You're talking about latent debris.

MR. ANDREYCHEK: Yes, sir. What's inside the cam just normally because people walk around inside. Do you have it open during an outage? And you do get some dust being blown in. For example --

MEMBER RANSOM: What's painted and what's not painted, that kind of thing.

MR. ANDREYCHEK: That's correct. That's correct.

Okay. Next question? Go on?

CHAIRMAN WALLIS: Move on.

MR. ANDREYCHEK: Okay. Debris transport. Two refinement options are identified -- a nodal network, which is based on open channel flow techniques. Basically, we're looking at bulk flow, what can get carried. It uses bulk flow velocities to calculate -- or evaluate debris transport.

CHAIRMAN WALLIS: Now, these open flow channels, these are based on a sort of quasi-steady flow that --

MR. ANDREYCHEK: That's correct.

CHAIRMAN WALLIS: Whereas if you watch what happens to leaves after a major storm, is there a buildup in place? And then they wash away, and then they build up again, and pools form and then they drain. It's a very non-steady sort of thing.

MR. ANDREYCHEK: Okay. I'm just wondering how well a steady flow models that. When you get a -- throw a leaf down, but then it breaks away, and then there's a lot of flow, and then it builds up again. I just don't know. I'm just wondering how well you can model what really happens.

MR. ANDREYCHEK: Material glomerates and then it --

CHAIRMAN WALLIS: It glomerates and then it washes away, and then it glomerates and breaks and --

MR. ANDREYCHEK: That question I think is applicable, regardless of whether you're talking about an open channel flow calculation or a CFD calculation.

CHAIRMAN WALLIS: I'm just wondering how well these open channel flow experiments model what really happens in a debris -- you know, in a similar situation. That's all.

MR. ANDREYCHEK: Well, I would suggest that that is -- that question is applicable to any analytical technique where you're looking at a loss of distribution.

CHAIRMAN WALLIS: You're going to say it's conservative, and all of that? What's the basis if you don't know what really happened?

MR. ANDREYCHEK: Well, what we're suggesting with the open channel flow and with the computational fluid dynamics is we're looking at, what can actually move? Where can it move? And with regards to bulk fluid velocities, there is data that's available that dates back to the early '50s that says if you have a velocity that's running in the horizontal direction, it's about seven times what the settling velocity is, you'll keep the debris in suspension. It's based on coal slurry data.

And that's one of the ways that we would look at, will debris stay, or will it actually transport? With regards to building up of debris in clumps as it were, the different locations, you're right, that's a very interesting question. I don't know how to do that. I'll be very honest with you.

And the way that I would treat it conservatively is to see that it doesn't build up. It either moves or it doesn't move. If it doesn't move, it's out of the equation. I don't need to consider it. If it moves, it's going to move towards the sump, and I need to look at what the local velocities are along the path.

And if I lose enough -- if the path opens up so that I lose the velocity to keep it in suspension, can I actually get it to settle to the floor before it goes back into another narrow channel and the velocity picks up again?

That's the type of an evaluation that I would look at and I would do. That's my thought process today. I would do the same type of an evaluation looking for computational fluid dynamics.

CHAIRMAN WALLIS: Do we have any sort of integral tests where sort of the whole thing is being looked at in some sort of semi-realistic way where you actually look at the transient phenomena of the four by four things, whether they go, and do they build up in one place and then wash out again, and all that stuff? I mean, is there any kind of -- I mean, this is all theory, it seems to me, based on little pieces.

Now, is there any kind of synthesis of it in terms of a large experiment that is being performed?

MR. ANDREYCHEK: Okay. There has been some experimental evidence that has been performed by Los Alamos at the University of New Mexico where they did look at a tank, because I believe at one time it was about a tenth the size of a full-size containment.

Bruce, is that correct?

MR. LETELLIER: Yes.

MR. ANDREYCHEK: Okay. And they did look at a variety of different types of flow patterns, putting the debris in different locations and seeing what happens to it. So there is some data that --

CHAIRMAN WALLIS: So all of this is taken into account in evaluating your methods.

MR. ANDREYCHEK: Yes.

CHAIRMAN WALLIS: Okay. We'll look at it, then, and --

MEMBER RANSOM: And it would be interesting to see those experiments, because it would be interesting to know if some of the internal geometry and pipe maze and that kind of thing were simulated.

MR. BARKSDALE: None of us stuff is -- you actually had a presentation on that material about a year and a half ago. I guess we could get the slides back and --

MEMBER RANSOM: I recall seeing some jet impingement experiments.

CHAIRMAN WALLIS: We also had some CFD, some modeling of that tank.

MR. ANDREYCHEK: That's correct.

CHAIRMAN WALLIS: I remember that.

MR. ANDREYCHEK: That's correct. But in terms of the jet impingement, I don't know that - and correct me if I'm wrong, Bruce -- UNM did not do jet impingement testing. They did look at -- they got the pool buildup, where does it go. I believe they even looked at pool buildup at some point in some manner, and that is --

CHAIRMAN WALLIS: So, anyway, the point is the realism of your analysis is not just based on the sort of conceptual model here. It's based on relating this to some real experiments and checking out if it works.

MR. ANDREYCHEK: Yes.

CHAIRMAN WALLIS: Okay. We're going to -- someone is going to check that out. And ACRS doesn't do all of the work, but presumably someone is going to check that out.

MR. ANDREYCHEK: Okay. Good.

MEMBER KRESS: Help me out a little bit.

On this typical blowdown for pipe break, it takes about, what, 20 minutes?

MR. ANDREYCHEK: Blowdown? Actually, until you get to the point where you're refilling the reactors, approximately 40 seconds until you start to recover the core, blowdown for a large break LOCA.

MEMBER KRESS: So that's when you're getting the high velocities and the stuff spreading around in containment?

MR. ANDREYCHEK: That's the initial distribution. Yes.

MEMBER KRESS: Then, when you're transporting the stuff to the sump, that part is over with.

MR. ANDREYCHEK: That's correct.

MEMBER KRESS: And you've just got the induced flow due to the sump suction?

MR. ANDREYCHEK: No, not at all. Let me explain the process. Initially, during the initial blowdown for large break LOCAs, approximately 40 seconds you eliminate the inventory of the primary system, along with the accumulators that are dumped in. And that is all bypass flow. That is thrown out the break. Okay?

Once you've depressurized the system and the ECCS aligns to the system, you begin to fill the reactor vessel. What you get --

MEMBER KRESS: It's blowing steam out.

MR. ANDREYCHEK: Well, it depends on the break, if it's a hot leg or a cold leg break. Okay? If you have a cold leg break, once you fill the downcomer, whatever excess flow you have drops out the cold leg break. And you fill the core based on the gravity head associated with what's in the downcomer.

If you have a hot leg break, then you build up water in the primary system piping in the cold legs and perhaps up into the steam generator such that you're driving all of the water that you pumped in through the core and out through the upper plenum and out the break in the hot leg.

MEMBER KRESS: But these are relatively low flow velocities, right?

MR. ANDREYCHEK: Not necessarily. Okay? If you've got two trains of RHR pumps that have been realigned to certain ECCS pumps, you are looking at approximately 9,000 -- as much as 9,000 gpm. So while they are not the same as your full flow reactor coolant pumps, they are not, you know, just small little tap water dribbling. It is some pretty good flow.

MEMBER RANSOM: And those flows are coming from the sump?

MR. DINGLER: The flows at your sumps are maybe less than one feet per second, .5, depending on your sump screen. I think that's your question. Yes, it's closed there. There may be higher flows if you go through the compartment, and the bioshields or the openings may have higher flows. And I think that's what --

MEMBER KRESS: I was trying to address Dr. Wallis' question about the clumping and the debris thing. I don't think you have the velocities to do that.

MR. ANDREYCHEK: I don't think you do going around overall.

MEMBER KRESS: Yes. I'll let you address that issue.

MR. ANDREYCHEK: Okay. Now, there is other flows that you have. We talked about debris being brought up onto the upper regions of containment. And containment spray will tend to wash some of that. And, again, containment spray pumps have about the same capacity as your ECCS pumps, and about 70 percent of containment spray lands on the operating deck, the upper flow.

So you're going to get 70 percent of 9,000 gpm that's landing on the floor, and you will tend to move whatever insulation, particularly if it's fiber, around on the operating deck. But you also have curves typically around the refueling water storage -- or the refueling canal where water would tend to drain to or down steps. There tends to be grading.

There are some open steps that you might have, but typically the water velocities are much lower because you only get about 70 percent of the flow and you're talking maybe half an inch or a quarter of an inch of water on the operating deck, even at containment spray flow rates.

CHAIRMAN WALLIS: Well, let me say, you have a violent thunderstorm, and you take all of the leaves off the trees, and then it rains for a long time afterwards. That's the containment spray and all of that stuff.

MR. ANDREYCHEK: Yes.

CHAIRMAN WALLIS: And what concerned me was that in the original violence you throw out this stuff, and you make sort of piles and dams here and there.

MR. ANDREYCHEK: Okay.

CHAIRMAN WALLIS: And then it rains and it makes pools behind these dams, and sometime later the dams break. I mean, it's not clear to me that your steady flow analysis of events is going to duplicate that sort of thing. That was I think the gist of my question.

MR. ANDREYCHEK: Okay. That's a fair question. But in the long term, I'm not sure that that really matters, because what we're looking at is not what happens in the half an hour or an hour or two hours, but what happens long term, and do we get enough debris to the sump before it actually blocks. So the transient behavior I'm not sure is that important.

CHAIRMAN WALLIS: But anyway, you guys are going to be right on top of that when we ask you the question in August.

(Laughter.)

MR. ANDREYCHEK: I guess I've been put on notice, haven't I?

(Laughter.)

Refinement of head losses, as mentioned by Mo in his presentation -- NUREG/CR-6224 is the head loss correlation of choice that we are using, and we use it for evaluation of thin bed effects. We're not offering any refinements for those. However, we are offering additional information, background on the development of the head loss correlations in general for the use of just understanding what it is we're trying to do, a summary of head loss tests.

Here is the database. Alternate head loss correlations, and the two that we now have mentioned are an all-hybrid plant, all RMI plant, because those are a little different in form from NUREG/CR-6224, and a discussion of possible analytical refinements that people may choose to use if their plant-specific conditions warrant it.

And also, there's a discussion on what head loss correlations should be looked -- you should look for head loss correlations for alternate strainer designs, alternate sump screen designs. That's what we have.

MEMBER RANSOM: I wanted to ask you a question on the previous slide. You had CFD, and I was just wondering if you're using that exclusively for the flow in a containment, the water drainback, or do you use it also to model the jet --

MR. ANDREYCHEK: We're not using it to model the jets. It's strictly for water distribution, water flow, about the base of the containment.

Two-phase jets -- modeling and computational fluid dynamics, very, very challenging, even today.

In summary, we have a set of analytical refinements to the baseline methodology. We treat them as analysis options. The analytical refinements provide for a more realistic, but we believe still conservative, evaluation of post-accident sump performance. And there's a standing option that we provide for to use plant- or vendor-specific data if it's available and applicable.

There is better data than what we have available to us in the guidance. And if the plant has access to it and wishes to use it, please go ahead and use it. We certainly have done our best at putting everything we know of into the document, but there might be information out there that we're unaware of.

CHAIRMAN WALLIS: Is this mostly flow over large flat surfaces? Or is it cascading down as it comes down from compartment to compartment? Or are there channels through which this stuff tends to flow?

MR. ANDREYCHEK: After the containment spray is secured, four to six hours into the transient, it is primarily flow over the containment floor that issues from the break location where the

ECCS flow is coming out of the break. So it becomes over -- an over --

CHAIRMAN WALLIS: So it spreads out over a large area.

MR. ANDREYCHEK: That's correct, sir.

CHAIRMAN WALLIS: Because everywhere in channels there's a -- rivers with trees in them make logjams and --

MR. ANDREYCHEK: That's correct.

CHAIRMAN WALLIS: -- rivers with ice in them make ice dams.

MR. ANDREYCHEK: That's correct.

CHAIRMAN WALLIS: They build up, and then they go. And the transients associated with those are very different from what you'd assume if you assume uniform flow of ice down the river. That's why I'm asking these kind of questions. I don't know whether what happens in a containment is anything like that. And maybe if it's large flat surfaces, these kinds of things don't happen.

But when you have channels with debris in them, there tend to be transient phenomena build up and discharge of debris. But I'm wondering if that's likely to happen here or not.

There are drain channels, presumably, and things like that, which can clog and then free up?

MR. ANDREYCHEK: Well, the drain channels typically are designed, from the plants that I have seen, that they won't necessarily clog. They're six-inch diameter drains or larger. Okay? And they're in areas that are protected or guarded from direct debris coming on to the drains. So there is that to protect and allow for drainage from upper elevations.

And typically what we're looking at when we talk about drainage from upper elevations is containment spray, and then there is some condensation that occurs as a consequence long after the plant -- okay. If you have the containment fan coolers that are running post-accident, the containment fan coolers are taking steam in that would result from cooling of the core and condensing it, and it condenses and it drops down onto the operating deck and then flows towards --

CHAIRMAN WALLIS: Yes. Well, if this sump recycling -- presumably, it's recycling. It has to go through the whole cycle --

MR. ANDREYCHEK: Correct.

CHAIRMAN WALLIS: -- and wash down and --

MR. ANDREYCHEK: Well, the wash down -- again, if it comes out of the break, it's relatively close, comparatively speaking, to the containment floor. Okay? And it's hitting the containment floor. It's not cascading down multiple steps. So it tends to be operating -- after we can secure containment sprays, it tends to be on a single level.

CHAIRMAN WALLIS: Only at one place.

MR. ANDREYCHEK: That's correct. It's on a single elevation, a single level.

CHAIRMAN WALLIS: Okay. Have you caught us up in time? I think you have.

MR. ANDREYCHEK: I was trying hard.

Thank you very much for your attention and --

CHAIRMAN WALLIS: Thank you very much.

MR. ANDREYCHEK: -- your questions.

CHAIRMAN WALLIS: Does the committee have any other questions at this time?

(Pause.)

Go ahead.

MR. BUTLER: All right. Good morning. I'm John Butler. I'm with NEI. And what I'll try to address is the risk-informed option that we're trying to have as an available option in the evaluation methodology.

It would be our -- is currently Section 6 of the evaluation methodology. But as will become apparent in the presentation, we are not at a point where we can say we have a final methodology that has agreement with the staff.

We have had discussions with the staff, different proposals have been put forward, and what I will spend my time in this presentation is kind of explaining the different proposals and points of view that have been expressed in those meetings and kind of give you a status where that stands.

As a general outline of the presentation, what I'll do is first start off with what our objectives are with having a risk-informed option available for licensees to utilize, talk a little bit -- or talk primarily about the proposals that have been put forward by both industry and NRC, and the different aspects of those proposals, where we agree, where we are not quite in a level of agreement yet, and then tell you what the status is of that and where we need to be in order to have this as an available option.

CHAIRMAN WALLIS: Go back -- if you go back to 50.46 as written in the regulations, it doesn't allow for much compromise. It simply says if your analytical techniques show that the ECCS won't work, you've got to fix it. That's essentially what it says.

MR. PIETRANGELO: This isn't about --

CHAIRMAN WALLIS: There's no latitude at all.

MR. PIETRANGELO: This is not -- this presentation is not about that.

CHAIRMAN WALLIS: No, but it -- it doesn't allow for anything like this.

MR. PIETRANGELO: No. It will -- I'll address that in the closing remarks.

CHAIRMAN WALLIS: You'll address that? Okay. Thank you.

MR. BUTLER: Well, the question you're raising is whether or not you need an exemption to the regulation and --

CHAIRMAN WALLIS: Yes, whether or not this path has any viability in the present rule.

MR. PIETRANGELO: Yes, good question. We'll get to that.

MR. BUTLER: Well, our objectives -- hopefully, it is becoming a little bit apparent, and we can argue about the level of conservatism that the baseline and refinement options maintain. But overall I think hopefully there is agreement, but there is a strong level of conservatism in a deterministic approach.

What we want to avoid is a resolution that is driven by an extremely low frequently event. We'd like to focus our attention on events that have a little bit higher risk significance. So with that in mind, we want to have an option where you can incorporate risk insights in the resolution of the issue.

In doing that, we'd like to define an alternate break size. The current direction of the 50.46 rulemaking effort is to define that based on break frequency, so we can take that as kind of our lead. We may not have the same kind of advance of that effort, so we'll have to take a little bit of latitude in how we define that. But we can at least go in the same direction.

We acknowledge that we'll need to demonstrate a mitigation capability for breaks larger than alternate break size, and have some means to assure that the -- that there is an acceptable risk impact of whatever approach is utilized.

One of the driving factors in our risk-informed discussions with the staff is the schedule under which GSI-191 resolution is currently following.

It's a very set schedule, and there is very little entertainment of anything that could potentially delay that schedule. And so that puts a lot of pressure on our reaching some level of resolution or agreement on the approach fairly quickly.

And the last sub-bullet there is recognizing that and recognizing the --

CHAIRMAN WALLIS: Well, why should it be driven by schedule rather than by sense? I mean, if the right thing to do is something or other, why should this be driven away from consideration by means of some arbitrary schedule?

MR. PIETRANGELO: Legitimate question. We don't have an answer.

CHAIRMAN WALLIS: Okay.

MR. BUTLER: Maybe that's a question that should be directed to --

(Laughter.)

This is not intended to be a pilot for 50.47, because we -- because of the schedule, because of our need to have something in place to support the current schedule, in advance of the 50.46 rulemaking. I'm sure there will be elements of this that they will -- the two efforts will share. And if we can be close to that effort --

CHAIRMAN WALLIS: Well, it could be absurd. I mean, it could be that you guys do all of this analysis and then you're forced to put in bigger screens, and then two weeks later comes out some change to 50.46 which, if it had been implemented, would have made the whole thing unnecessary.

MR. PIETRANGELO: Part of the rationale for putting this risk-informed approach in is to avoid what you just said, to have them at least be targeted in the same direction.

MR. BUTLER: The timeline or the past timeline -- not the future timeline -- on March 4th, we -- I think it was the first written expression of willingness on the staff's part to entertain a risk-informed resolution option for GSI-191. We have been -- the industry has been trying to introduce risk as an element of the resolution option for a number of years, and primarily with applying LBB and fraction mechanics in terms of the -- how debris generation is calculated.

But March 4th, we started the discussion. Our first public meeting of this was not until May 24th -- on May 25th. At that meeting there was an NRC proposal or their thoughts on the direction we should take. At the same time, industry provided its own thoughts on the direction this should take.

CHAIRMAN WALLIS: Is that the one with the green and purple areas and the --

MR. BUTLER: Yes. Yes.

CHAIRMAN WALLIS: Okay.

MR. BUTLER: And then, last week we met again to discuss the proposals, and I think we are hopefully going to continue those discussions on an accelerated basis. So, again, this is -- what I'm presenting to you today is kind of a status of where those discussions are.

There are four general components to risk-informed resolution. So I think there is general agreement on these components. There will be an identification of an alternate break size that will be used to identify below which what you use for your design basis analysis, above which what you use for demonstrating mitigation capability, and for any kind of risk calculation.

CHAIRMAN WALLIS: And then, of course, there's the question of how -- how much mitigative capability do you have to demonstrate? It's really a great deal. Then you're almost back to --

MR. BUTLER: That's correct.

CHAIRMAN WALLIS: -- full break size

anyway.

MR. BUTLER: That's correct.

CHAIRMAN WALLIS: So there's a lot to be done to discuss what's an acceptable mitigative capability.

MR. BUTLER: And one of the difficulties we're faced with here is it's a lot easier to define what is conservative, and it's sometimes very difficult to -- to identify what is realistic.

So we're faced with a situation where we can't clearly define in all aspects of the evaluation what a realistic modeling of the phenomena should be. So we're forced to maintain a number of conservative treatments from the design basis analysis in the mitigation capability area and just make that realistic in certain areas.

MEMBER KRESS: Do you feel locked into this ABS? The reason I ask this question is I presume that's the 50.46 ABS that we'll end up with. That's still in design basis specs. And if you're actually looking for a good risk-informed, you might not want that to be your alternate size to look at. You might want to look at the frequencies again.

And for any break frequency less than 10^{-5}, or greater than -- any break frequency greater than 10^{-5}, that's what you'll consider. And that may be considerably smaller than this ABS they come up with, because it's -- that ABS is still supposed to be a design basis space, and it should be conservative to some extent.

MR. PIETRANGELO: It is actually not -- we are actually not proposing to change the design basis in the risk-informed approach.

MEMBER KRESS: I don't mean for you to do that.

MR. PIETRANGELO: Right.

MEMBER KRESS: But I want you to not let the design basis dictate what you do in the risk-informed space. I don't want it to go the other way.

MR. PIETRANGELO: Right.

MEMBER KRESS: Which is what I interpret this as meaning.

MR. PIETRANGELO: Let's walk through -- we're going to get into the numbers here shortly.

MEMBER KRESS: Okay.

MR. BUTLER: The NRC has put forward a proposal for the break size to utilize here, and I think they, in a June 17th meeting, actually referred to it -- to the debris generation break size, I think in part to differentiate that break size from the alternate break size that will eventually end up in 50.46.

So use whatever terminology you want to use, but in this presentation I'm talking about the break size that would be utilized for GSI-191.

MEMBER KRESS: Okay. That may not necessarily be the one that they use in 50.46.

MR. BUTLER: Right.

MR. PIETRANGELO: Right. It'll be more conservative most likely.

MEMBER KRESS: Why? You know, I would presume we could make it less conservative, because you're risk-informing space here, whereas you're in design basis space on the other.

MR. JOHNSON: This is Mike Johnson. Maybe we talk about it after the current presentation.

MEMBER KRESS: Okay. Okay.

MR. BUTLER: In the break size that the NRC put forward, they identified that as an area equivalent to a double-ended guillotine break of the largest attached piping to the RCS main loop, and defined it in such a way that that double-ended break area within the applied -- throughout the RCS, not just to the attached --

CHAIRMAN WALLIS: Now, these are much

smaller pipes than the main piping, the RCS piping.

MR. BUTLER: The attached piping ranges -- the surge lines range from 12-inch to 16-inch.

CHAIRMAN WALLIS: Yes. But it's a lot smaller than whatever it is, the 40-something --

MR. BUTLER: It's in the hot leg/cold leg -- yes.

CHAIRMAN WALLIS: So the zone of influence now is reduced very, very much.

MR. BUTLER: Yes.

CHAIRMAN WALLIS: And the problem is in magnitude reduced considerably by one stroke of a pen and saying, "We won't consider this size pipe. We'll go to this size pipe."

MR. BUTLER: Well, no, we actually --

CHAIRMAN WALLIS: Well, that comes at the bottom here?

MR. PIETRANGELO: Hang on.

CHAIRMAN WALLIS: But then that's the -- what do you do with these big pipes, then?

MR. BUTLER: Keep in mind the different components. You're defining a break size, and that's just a differentiating point for how you treat the full spectrum of breaks. Breaks smaller than that break size you treat very deterministically, very conservative. Breaks larger than that you treat on a more realistic basis. So you're still treating the full spectrum.

CHAIRMAN WALLIS: But if you don't know how to do them realistically, you're forced to do it conservatively. So this really --

MR. BUTLER: I'll have to bring in the terminology used by our chairman. I can be conservative. I can't be realistic. But I can maybe be realistically conservative and bring in elements of realism to that level of conservatism.

MR. PIETRANGELO: To the extent we can defend that.

CHAIRMAN WALLIS: Well, this has to be seen by what it really is, and now it's not just by terms of words. If you're doing an analysis and it's conservative, we can see the analysis. We shall know what's going on. It's hard for me to tell what you mean by something which is less conservative than very conservative without seeing what it is.

MR. PIETRANGELO: We'll give you some examples.

MR. BUTLER: Let me continue on with break size, so everybody understands what this break size means in terms of different pipes. Define the area as the -- equivalent to the large attached piping. What that would mean is that all of your auxiliary piping, all of the attached piping to the RCS, would be part of your design basis, because it would be smaller than or equal to the break size. And you'd still take an area equivalent to that throughout the main loop piping and --

CHAIRMAN WALLIS: But you don't take the full double-ended guillotine break of a main pipe.

MR. BUTLER: No.

CHAIRMAN WALLIS: So the NRC is proposing to change the 50.46 rule.

MR. BUTLER: Well, again, I'm just defining a break size. How I treat it within the deterministic mode would not include that, but you'd still look at that larger double-ended break for your mitigative capability analysis.

MEMBER KRESS: Sort of a defense-in-depth --

MR. BUTLER: Right.

CHAIRMAN WALLIS: But we don't know what the criteria are for adequate mitigative capability.

MR. PIETRANGELO: He's going to get into that.

MR. BUTLER: I did want to make -- since

you're familiar with the recent --

CHAIRMAN WALLIS: Well, you're allowed to use realistic inputs in 50.46 already, aren't you?

MR. BUTLER: Yes, correct.

CHAIRMAN WALLIS: So this isn't revolutionary in terms of using realistic approaches, as long as you evaluate the uncertainties properly. Okay.

MR. BUTLER: The LOCA elicitation effort, if you're familiar -- how many of you are familiar with that, and the six categories that they looked at? I wanted to make a tie between this break size and the different categories of that effort, define the break size by this criterion.

All of the category 3 and 4 breaks would be below the ultimate break size, and the major contributors to categories 5 and 6 would also be included in this, the surge line, the RHR line, and hot leg breaks, at least up to the alternative break size.

I mention those three because those were the -- identify the elicitation effort as the major contributors to the category.

What I've done here is taken the different frequency estimation efforts throughout the years from

1,400, to most recently the LOCA elicitation effort, charted them up here just to provide a backdrop for a discussion of the different proposals.

MEMBER KRESS: Now, the elicitation curve you have there, is that their mean?

MR. BUTLER: That is the mean, yes.

MEMBER KRESS: But they have a distribution about that?

MR. BUTLER: There is a 95 value, yes. I don't have that charted up here.

MEMBER KRESS: I would be interested in what -- where that falls.

MR. BUTLER: Okay.

MEMBER KRESS: Because my earlier statement was that instead of your vertical line you have there for ABS, I could I think possibly justify going all the way down to three inches, because that's where your frequency is 10^{-5}. And if you equated the frequency to the core damage frequency, without doing all of the other stuff, then you already would have Reg Guide 1.174.

MR. BUTLER: That's correct.

MEMBER KRESS: But I wanted to look at some of the uncertainties associated with that.

MR. BUTLER: Right.

MEMBER KRESS: And that's why I was saying before don't get locked into --

MR. BUTLER: Okay. Well, what I've shown here is where the alternate break size would fall on that in terms of effective break diameter. Depending upon the largest attached piping, that will change a little bit. And what I've shown at the top is the 12-inch Schedule 160 pipe, a double-ended effective diameter would fall up there, somewhere around 14 inches or 14, 16.

But generally, even for plants with smaller surge lines, you'd tend to be limited by the RHR suction line, which tends to be fairly large.

MEMBER KRESS: But if you believe this elicitation curve there, you know -- we're not thinking about defense-in-depth. But if you believe that and use the 10^{-5}, you've already got yourself out of the problem. You're down to three inches, and you're not going to get much debris generated there.

MR. BUTLER: Again, the stuff has raised the point that that effort is still underway. It's still waiting to undergo peer review, so there is a hesitancy to --

MEMBER KRESS: Oh, yes. I understand. I understand. That's not a blessed curve.

MR. BUTLER: Right.

MEMBER KRESS: That's right.

MR. BUTLER: So the deterministic design basis analysis, an additional way of doing it would be done for all break sizes less than the alternate break size. And you'd want to demonstrate some mitigation capability for all breaks larger than that break size.

CHAIRMAN WALLIS: What are these two things where there's a -- there's a preliminary mean and then there's a -- the top one on the bottom. It has LOCA elicitation preliminary mean, and then the bottom says NRC interim LOCA elicitation. What's the difference between those two?

MR. BUTLER: The bottom -- the NRC --

CHAIRMAN WALLIS: Is that something earlier?

MR. BUTLER: This was something earlier. This is the internal staff effort to test out the elicitation effort.

CHAIRMAN WALLIS: Okay. So what one notices here is that none of the other previous studies went beyond six inches.

MR. BUTLER: Correct.

CHAIRMAN WALLIS: So we've got one study that's in the area of --

MR. BUTLER: Well, one thing I do point out, and I probably don't have it charted --

CHAIRMAN WALLIS: It's that one there.

MR. BUTLER: -- there was NUREG-1061, which was the --

CHAIRMAN WALLIS: Okay.

MR. BUTLER: I forget what the title was, but --

CHAIRMAN WALLIS: And the other thing noticeable is that when you get above three inches it's the most recent study which predicts the lowest frequencies.

MEMBER KRESS: Now, NUREG-1150, the numbers are pretty high. Is that for purposes of determining the load on the containment? I can't -- I don't know what else they would want it for.

See, it might have been for a different purpose, and they might have -- they might have chosen a value that -- that might have been realistically conservative for a different purpose.

MR. HARRISON: This is Donnie Harrison from the staff. NUREG-1150 is the PRAs that were done on the five plants back in the '80s. So --

MEMBER KRESS: Yes. But they only needed a break size to determine the load on containment, right?

MR. HARRISON: Well, they were also doing -- this is the large break LOCA frequency, so they were doing the large break LOCA sequence to get a core damage for these, too. So that fits into that part of the equation.

MEMBER KRESS: It would be in that equation, that's right.

MR. HARRISON: So it fed that part of it as well.

MEMBER KRESS: Okay. You're right.

MR. BUTLER: In the mitigation capability analysis, you're looking at basically large breaks only, because you've already addressed the smaller breaks, breaks smaller than the alternate break size, as part of the traditional deterministic method.

So you're looking at the large breaks. And in doing that analysis, since you're only looking at demonstrating mitigation capability, you're using different analysis assumptions, you're allowed -- you would be allowed to use more nominal conditions. You'd be able to take credit for non-safety systems. You'd be able to take credit for operator actions that would, you know --

CHAIRMAN WALLIS: Presumably what you're

supposed to do here is demonstrate a certain probability of mitigation capability. And if you're taking the mean, then it's -- what's the --

MR. PIETRANGELO: We're not doing that in this approach.

CHAIRMAN WALLIS: But if you're taking --

MR. PIETRANGELO: We're not doing a probabilistic --

CHAIRMAN WALLIS: -- realistic, well, the only way I know how to tell a difference between the conservative and realistic is in a probabilistic way. Conservative, you take some extreme thing. Realistic, you say, well, we'll take the nominal and the mean. And then, the question is: well, what's now your probability of success?

MR. PIETRANGELO: And I think, as we will show on the chart, from where that alternate break size is selected, the break frequencies are less than 10^{-6}. You're starting at such a low initiating event frequency that you're already --

CHAIRMAN WALLIS: I think what you said was -- I'm trying to get the difference between mitigation capability and the other one, the design basis conservative. Design basis conservative -- you're going to say that -- make the worst possible assumptions, and we can still show it'll work, right? For mitigation you have to say -- make some other kind of assumptions which then gives us a probability of it working. It's about the only way I know how to understand --

MR. BUTLER: I think what you're pointing out is that there is -- you cannot define what your criteria should be for mitigation capability in isolation. It's something you need to take into consideration.

CHAIRMAN WALLIS: How good is the mitigation going to be? Whether it's got a 90 percent chance of success, or something, you've got to have some measure of that success.

MR. BUTLER: But it also depends on how you define your alternate break size. If they're tied together, you can't define one without taking into consideration how you were going to perform the other.

MEMBER KRESS: When you talk about mitigation, what do you have in mind?

MR. BUTLER: Well --

MEMBER KRESS: Guards around the pipe or --

MR. BUTLER: No. Mitigation we're just showing -- demonstrating a capability to address the event, if it were to occur. Now --

MEMBER KRESS: Address it how?

MR. PIETRANGELO: The same way you do even before --

MR. BUTLER: How we're going to address it for this analysis is to apply effectively the same success criteria that is used for the design basis analysis. Net positive suction head -- we'll just do that calculation using more realistic values in terms of temperatures and credit containment back pressure --

CHAIRMAN WALLIS: So what does this tell you about the chance of success?

MEMBER KRESS: I wouldn't call that mitigation. I would call it something else. But, you know, I think of mitigation, you're going to go in and do something to intervene. But that's okay.

MR. BUTLER: You would be allowed to take credit for any mitigation capability in terms of design features that you couldn't credit in your design basis analysis, deterministic analysis. If it's, for example, non-safety system, you would be allowed to --

CHAIRMAN WALLIS: So you're going to show that it will probably work, in some vague kind of way?

MR. PIETRANGELO: No, no, no.

CHAIRMAN WALLIS: Well, I don't understand the difference.

MR. PIETRANGELO: It's the same -- NPSH required is the same ultimate success criteria.

CHAIRMAN WALLIS: But your inputs are now more realistic?

MR. PIETRANGELO: Correct.

CHAIRMAN WALLIS: So what does that mean? Does that mean they're in the 95th percentile of likelihood or 50th or what? I don't know what realistic means unless you give me some assessment of uncertainties and probabilities. You know what I mean.

MR. PIETRANGELO: He's got some examples of what we're going to do to do it more realistically than what's in the deterministic -- fully deterministic analysis.

For example, beyond the alternative break size, I'm only worried about very large break LOCAs. I don't need any of my high head ECCS pumps at that point. I really depend on one low head pump, so I'm not going to worry about what the NPSH requires, or the high head -- this event is the low head that is making it --

MEMBER KRESS: And we can get away with a lot smaller NPSH.

MR. PIETRANGELO: That's one example.

CHAIRMAN WALLIS: Why do you need any mitigative capability at all if the probability is 10^{-8}?

MR. PIETRANGELO: Because it's required. We can talk about core damage frequency -- because you will mitigate an event.

CHAIRMAN WALLIS: Well, if that's all it talks about, why do you need this deterministic design basis analysis? If 50.46 only talks about mitigation, why do you need the other one? What does 50.46 do, really? What is it talking about? Is it talking about deterministic design basis analysis?

MR. PIETRANGELO: Yes.

CHAIRMAN WALLIS: It is, isn't it?

MR. PIETRANGELO: Yes.

CHAIRMAN WALLIS: So you're going to have to change 50.46 in some way.

MR. PIETRANGELO: No.

MEMBER KRESS: That's going to be two years down the road. This is two --

MR. PIETRANGELO: This is GSI-191.

MEMBER KRESS: I mean, it would be nice to have a different 50.46, but we can't count on it.

MR. PIETRANGELO: That's correct.

CHAIRMAN WALLIS: Well, maybe it will become clearer. Or maybe we're in a space where we just, as technical people, are going to say we don't understand.

MR. PIETRANGELO: Keep going, John.

MR. BUTLER: Well, what we've done -- we are not smart enough to define a realistic sump performance scenario in all aspects. So to simplify the process we've -- the guidance directs the use of the deterministic analysis that's described in Sections 3 and 4 and 5 of the guidance methodology and identifies just key areas where you can make it a little bit more realistic and get the biggest bang for your buck in effect.

We're not trying to make the entire evaluation realistic. So we're looking at primarily how you define the break, the amount of debris generation that is created, and then the calculation of NPSH. Those are the two main areas.

And break sizes -- we're looking at, again, the full range from the alternate break size to the full double-ended break. We're trying to be smart on the break locations in that we -- we'll focus --

already in the spectrum we're looking at we're looking at a low frequency. And then looking at the mitigation capability, we're focusing in for that low frequency the most likely locations.

MEMBER KRESS: Do you use CheckWorks for that?

MR. BUTLER: No, we're using the guidance -- review guidance SRP 362 and maybe 3.1, which tells you to look at the high stress fatigue locations.

MEMBER KRESS: Oh, yes.

MR. BUTLER: In effect, all you're -- you're not look at is the straight, unwelded pipe sections.

CHAIRMAN WALLIS: So do I get this clear -- that the staff is proposing that you demonstrate its design basis analysis up to 16 inches? And you are proposing you just demonstrate a mitigation capability?

MR. PIETRANGELO: No.

CHAIRMAN WALLIS: Well, that's what it says here. This is demonstration of mitigation --

MR. PIETRANGELO: All this is is --

CHAIRMAN WALLIS: -- up to --

MR. PIETRANGELO: We use the very, very conservative methodology up to the alternative break size. But you still have to demonstrate mitigation capability even for those more unlikely break scenarios.

CHAIRMAN WALLIS: But this says up to full --

MR. PIETRANGELO: Up to the full --

CHAIRMAN WALLIS: It doesn't say anything about double-ended guillotine break of a cold leg.

MR. BUTLER: Attached shouldn't be in there. It should be the main loop piping.

CHAIRMAN WALLIS: This is all piping.

MR. PIETRANGELO: Yes.

MR. BUTLER: This is all piping.

CHAIRMAN WALLIS: So this is a mistake, this --

MEMBER KRESS: No wonder you were confused.

CHAIRMAN WALLIS: Okay. No, I wasn't confused. They were.

MR. PIETRANGELO: We stand corrected.

CHAIRMAN WALLIS: So this should read the largest RCS piping.

MR. BUTLER: Yes.

CHAIRMAN WALLIS: Okay. Thank you.

MR. BUTLER: We are also looking at break configuration. We're looking at a full -- double-ended full displacement break. But we allow the physical realities of the specific breaks to be brought to bear. If there are limitations on how large that break can be, how wide -- you know, how far the pipes can separate, in terms of having any kind of flow limitation device, pipe width restraints. If that limits the effective break area, we allow the analyst to take that into account.

Analysis assumptions -- this is an area where we don't have a lot to change. If someone wants to -- to go through the effort of redoing some of their driving conditions in terms of the break flow using more realistic -- you know, nominal power, nominal decay heat, and nominal temperatures, to calculate the thermal hydraulic conditions, they can do that. It's not likely to be something that everyone will take into -- take advantage of, because it is a very costly analysis.

CHAIRMAN WALLIS: So you'd use the same zone of influence?

MR. BUTLER: The same process for calculating that for the effective break area that you end up with.

CHAIRMAN WALLIS: So your analysis of the jet would be the same?

MR. BUTLER: Yes. But you wouldn't be allowed to take credit for non-safety equipment and operator actions that you would expect --

CHAIRMAN WALLIS: Oh, I think that's understandable. I don't yet see a change in the approach to analyzing the physics of the debris generation and washdown.

MR. BUTLER: We're, for the most part, maintaining the conservative --

CHAIRMAN WALLIS: So the key is this last part?

MR. BUTLER: That is one of the keys, yes. The big key is the next slide -- the success criteria.

Now, early discussions of option 3, 50.46 changes, the demonstration mitigation capability is not constrained to the same success criteria that the deterministic analyses utilize. And the discussion was primarily to maintain some cooling capability for the core.

That is a very problematic criteria to apply, so we're conservatively applying NPSH, the same criteria that's applied for the deterministic analysis. But what we're taking into account is a little bit more realism in that calculation.

We're only looking at the minimum number of injection pumps that are needed to maintain core cooling, that you demonstrate NPSH for that minimum number of pumps, and that primarily one low head pump -- instead of requiring that you demonstrate NPSH margin from the containment spray pumps, you need only to demonstrate a capability for containment cooling. From a number of plants that will be demonstrated through their safety grade fan coolers.

In the calculation of NPSH, you would be allowed to take credit for some level of containment back pressure, use more nominal temperatures, and we need to be a little bit more specific in the guidance of how that it is to be calculated. But you use more nominal temperatures and levels, and it's -- instead of using runout flow, you would be allowed to use the expected ECCS flow for the calculation of NPSH.

MEMBER KRESS: What if you turned off the containment sprays?

MR. PIETRANGELO: It helps.

MEMBER KRESS: It helps a lot on --

MR. PIETRANGELO: Yes. Yes.

MEMBER KRESS: And you don't need those to keep the containment from failing, do you?

MR. PIETRANGELO: Not if you have safety

grade --

MEMBER KRESS: Right.

MR. PIETRANGELO: So that's that operator action bullet up --

MEMBER KRESS: That's a possible operation action.

MR. PIETRANGELO: Absolutely.

CHAIRMAN WALLIS: And service water is available.

MR. BUTLER: We would credit operator action to turn off a spray pump. I don't know that -- it would be hard to defend that you credit the pump actually losing suction and failing. That would be a little bit of a stretch.

CHAIRMAN WALLIS: When you credit your fan coolers, they're not safety equipment, are they?

MR. PIETRANGELO: A lot of them are, sure.

CHAIRMAN WALLIS: They are? But they service water, is that also a safety --

MR. PIETRANGELO: Or cooling water, service water --

MR. ANDREYCHEK: Or safety-related service water.

CHAIRMAN WALLIS: So to summarize, what I understand is you're not changing, then, any of this modeling of the scenario, the debris generation and washdown and accumulation. You're simply saying that now let's look realistically at what can be done and what the real effects are on NPSH, and so on.

MR. PIETRANGELO: You basically take everything you did before -- there's the baseline methodology, all of those analytical refinements that we talked about before --

CHAIRMAN WALLIS: That's all still very conservative.

MR. PIETRANGELO: It's still very conservative. You do that stuff up to the alternative break size, and then beyond that alternative break size up to double-ended guillotine break of the largest pipe in the RCS. All right? You still -- if you take all of that and apply pretty much the success criteria that --

CHAIRMAN WALLIS: So you're still doing the same analysis --

MR. PIETRANGELO: That's correct.

CHAIRMAN WALLIS: -- but it's in the guidance that we talked about earlier.

MR. PIETRANGELO: That's correct.

CHAIRMAN WALLIS: You're changing the success criteria.

MR. PIETRANGELO: That's correct.

CHAIRMAN WALLIS: That's where the change is.

MR. PIETRANGELO: Pretty much. Operator actions also is a big part of it. But we took our best shot on the analytical refinements in Section 4. Those carry over.

MR. BUTLER: Now what I've been discussing on the mitigation capability is what we have proposed to the staff in our two meetings. One of the points that the staff has had a problem with is our allowing for the break location to be dictated by the 362 guidance in terms of only looking at the high stress, high fatigue locations.

The staff is -- would prefer that we look at all locations in terms of debris generation without taking into account any kind of frequency of risk in terms of what you would look at. So it's a -- one of the key points of ongoing discussion or disagreement, however you want to put it.

CHAIRMAN WALLIS: Now let's look at this risk-informed path. Risk is a plant-specific thing, and yet the only way it seems to appear in here is in some sort of generic way you say that it looks as if on the average the risk is so low this curves here, that we can simply say we're going to have a different treatment for large breaks than small breaks.

And so this is a global kind of risk thing. It's not as if the plant has to have a good PRA in order to --

MR. PIETRANGELO: It has nothing to do with a PRA.

CHAIRMAN WALLIS: -- do this. It has nothing to do with a PRA.

MR. PIETRANGELO: No, nothing.

CHAIRMAN WALLIS: Okay. I was thinking that to be risk-informed the plant has to make an application, has to show it's got a good PRA, in order to do this at all. But apparently not.

MR. PIETRANGELO: No. That is the staff's position, too, I think. But you could be risk-informed without doing a full probabilistic risk analysis. We do qualitative risk assessments all the time.

And in this particular GSI-191, there are a lot of complex phenomena. I mean, trying to treat all of that probabilistically is pretty difficult. We don't have a base, really, to support that at this point.

So we call that our realistically

conservative approach from the alternate break size up. And we think it's also risk-informed and that it's taking into account initiating event frequencies. But it's not the classic compare -- you know, do the delta CDF calculation and compare it. We did not propose that.

MEMBER KRESS: Well, you almost do it. If you multiply this frequency by your -- the probability and location for your break, it may give you a new frequency that you can apply with the CDF directly. That's almost -- I mean --

MR. PIETRANGELO: We did of do it qualitatively.

MEMBER KRESS: You know that's a conservative --

MR. PIETRANGELO: Right.

MEMBER KRESS: It's almost quantified.

MR. BUTLER: Well, this kind of follows on that discussion. I mean, we're taking a view that the conservative selection of the alternate break size and the additional demonstration capability of the mitigation analysis provides you a robust assurance that you can maintain long-term cooling capability.

CHAIRMAN WALLIS: Well, I think this is one of the points in our letter on this is that doing all of this analysis and stuff is difficult. What really matters is long-term cooling capability. If you can demonstrate that, that's the key thing.

MR. PIETRANGELO: Right.

CHAIRMAN WALLIS: And that seems to be what you're trying to do here.

MR. PIETRANGELO: By NPSH requirement. If you meet that, you demonstrate a long-term cooling capability.

CHAIRMAN WALLIS: So it's the conservatism in these various ways of assessing long-term cooling capability where you're actually gaining something or doing away with -- it's not all that conservative -- it's not conservatism of the debris generation analysis at all. That doesn't come into this at all.

MR. BUTLER: Right.

MR. PIETRANGELO: Not beyond what we discussed in the analytical refinements, no. And if we had more testing and research that we could use, great. But, I mean, we're using what we've got.

MR. BUTLER: In the discussion last week with the staff, the staff provided a little bit more information on what they are looking for. They are looking for something that's a little bit more quantitative in terms of its risk impact, and they proposed one way of doing it is to -- and I'll simplify -- I mean, the staff in their presentation will go through their stage-up to the bottom line.

But I think the bottom line is you would effectively use the NUREG-1150 values. And then, starting with that, credit any benefit that would be provided by a mitigative feature that the plant either has currently but could not credit in the design basis analysis or any -- credit any additional mitigative features that are added to the design -- backwash or traveling screen or active screens.

So that's the two components that you would -- you would take that and calculate what your -- estimate what your delta CDF is.

MEMBER KRESS: Yes. I haven't seen anything dealing with downstream effects yet. Is that going to be --

MR. BUTLER: Frequent downstream effects wasn't factored into this.

MEMBER KRESS: Because it's not in --

MR. BUTLER: We're going to do that. That's Section 7. But Section 6 is looking at how you would modify the treatment of the screen blockage.

MEMBER KRESS: Okay.

MR. BUTLER: Here I've tried to illustrate the NRC approach proposal, starting with NUREG-1150, which is 5E-[4]. You can then credit any additional mitigation features attempting to bring down the delta CDF to a value that's within the Reg Guide 1.174 criteria -- 10^{-5} or --

CHAIRMAN WALLIS: But that is plant-specific.

MR. BUTLER: Yes. What we have proposed by way of comparison, we're trying to credit the break frequency, acknowledging that the values that we have right now for break sizes larger than six inches have not been finalized. But there is significant information that shows there's a downward trend, which will continue.

So we're trying to make a case that the conservative selection of alternate break size -- and, again, I'm showing what NRC has proposed -- would give you a pretty strong basis for saying that your break frequency on breaks larger than that break size are 10^{-6} or lower.

On those four components that I've talked about -- alternate break size, the NRC has a proposal. We have not countered with a proposal. We were hoping to get a little bit further finalization of the LOCA break elicitation effort that -- wait and see if that is going to be immediate.

The design basis analysis -- there doesn't seem to be a lot of disagreement in the -- in our discussions on how that is going to be done. That is really being reviewed as part of the normal review, separate from the risk-informed approach.

Mitigation capability analysis -- the main point seems to be the treatment of break location, and the staff is looking for a little bit more specifics on the input -- or changes to the analysis assumptions and input. We also differ, of course, in how we would demonstrate the risk impact.

Where we stand right now, we are hoping to meet again fairly soon, within the next couple of weeks. The staff is looking for us to revise Section 6 to address whatever agreements we come to and then submit that to the staff for their review.

CHAIRMAN WALLIS: Well, this is all very interesting. If we were writing 50.46 today, this might make a lot of sense. But if you read what it says, it says if you discover an error in your ECCS analysis, which this seems to be -- I mean, new calculations show that the screens get blocked, whereas before they didn't. Then you have to take immediate steps to comply.

So this would be a change in the interpretation of 50.46. It may make a lot of sense, but it -- something would have to be done about responding to the language that's presently in that document.

MR. PIETRANGELO: You noted that in your opening remarks, and I wanted to address it in the closing remarks.

CHAIRMAN WALLIS: Okay.

MR. PIETRANGELO: We've already filed comments on the Generic Letter and what it asked you to do. And we don't view it as -- purely as a compliance issue. All right?

If someone does that baseline -- I mean, first of all, it's kind of generally accepted that the 50 percent blockage assumption may not be conservative. All right? And that's why we're doing all of this stuff.

When a licensee runs the baseline methodology with all of those conservatisms in it, and finds out at the end of that that they don't meet the NPSH required -- let me -- if the meet the NPSH required, they're pretty much done. They can show they have enough NPSH. With all of that conservatism in it, they're basically done, and GSI-191 is not a --

they can close that out right away for their plant.

But let's say you don't meet the NPSH required. Does that mean -- and I kind of took from your remarks, Dr. Wallis, that I'm not in compliance with 50.46 and that requires immediate action. And our answer is no. Okay?

With all of that conservatism in that calculation, we still think compliance is indeterminate.

CHAIRMAN WALLIS: You could always do something like with Appendix K. I mean, you're saying, oh, it's very conservative, and so if we get to 2,500 degrees, really, it isn't so bad because we're very conservative. But that's not the way I would interpret the regulation.

Now, I'm not a regulator, but --

MR. PIETRANGELO: I think the key to this issue is to try to get it resolved once and for all. We've been discussing it for 20 to 25 years now. Okay?

The bulletin went out to try to deal with the issue and the interim actions licensees could take quickly to address the issue -- compensatory action. This evaluation is slated at the long-term fix, and we're basically trying to -- in our comments to the staff on the draft Generic Letter were trying to follow the BWR approach -- do the analysis, figure out where you're at, identify your fix, and give us a schedule for when you're going to be done. That's what we're about here.

And, again, with all of the conservatisms in that baseline methodology, if you don't meet the NPSH required, that means you need to do some more work, do the analytical refinements, try some other design options, try the risk-informed approach, okay, to get at your solution and to report back to the staff.

CHAIRMAN WALLIS: A concern I had at the beginning -- this may be a reasonable approach, this risk-informed. But it obviously is going to be easier on industry than viewing this as a compliance issue.

And I'm just concerned that GL -- the Generic Letter is based on the sort of compliance factor, and if that is pursued, and the risk-informed approach dawdles, and it's three years before it sees the light of day, then it may be, again, an absurdity where you impose a huge backfit, and the next week find that the risk-informed approach is now acceptable and you didn't have to do it. How do you avoid that?

MR. PIETRANGELO: We're trying.

CHAIRMAN WALLIS: Well, maybe it's the staff that has to answer that question. The question that this committee might have is: does it make any sense to issue a Generic Letter which looks like a compliance backfit if risk-informed solutions to the problem are coming down the road?

MR. PIETRANGELO: I would say the staff can answer that this afternoon for themselves. But using a risk-informed approach doesn't mean that you need, let's say, an exemption from 50.46. And what we propose, we don't think you do need an exemption. Okay. We're going -- all 50.46 says is that you go up to the largest pipe and double-ended guillotine break of the largest pipe in the reactor coolant system. Our risk-informed approach does that.

The only other design basis assumptions that are in play, at least that we have identified thus far, are single failure and coincident loss of offsite power. And we think those actually help us in the risk-informed approach by having to comply with them. So we don't think we need an exemption to do it.

And there is really nothing to preclude anything we talked about in the risk-informed approach from being used in the front section of this document in the baseline or refinements. But it's just a way I think of trying to take the knowledge base we have and trying to use the methodology and focus on the more likely things with the more rigorous methodology and still have a realistically conservative approach for treating the less likely scenarios.

I think that's all we have, unless there is any further questions.

MR. LETELLIER: I had one comment. This is Chris Letellier from LANL. The issue of risk-informed analysis of this problem is really philosophical at this point. And I know it's a policy decision that you're trying to introduce to the resolution, but I think what's being ignored is you're going to open up a whole new suite of methods, of tools, and calculations steps, that you don't have guidance prepared for yet.

And so that's really the primary objective of this report and that's not coming along in step. It's not being evolved simultaneously. So that's some work that will be left to do if -- if the staff decides to endorse this. Just an observation.

MR. PIETRANGELO: Yes. I mean, part of the objective -- and I think it was laid out early -- we really didn't have enough time to develop -- I mean, Bruce pointed out a lot of other methodologies to try to evaluate this. We're trying to stick within the same framework that's in the baseline, but changing some of the inputs as well as the success criteria. That's what we can realistically do in the time given.

CHAIRMAN WALLIS: And none of this is in the present guidance. And we reviewed this Reg Guide -- 1.82, is it called? Revision 3. We reviewed that. None of this risk stuff is in there.

MR. PIETRANGELO: No.

MR. BUTLER: It's not in the Reg Guide. There is a description of this approach -- or our proposal of a risk-informed approach in Section 6 of the evaluation --

CHAIRMAN WALLIS: But NEI was really asked to develop a way of analyzing in order to meet the requirements as in the Reg Guide and in the existing 50.46, without considerations of the kind that we just heard about.

MR. PIETRANGELO: No.

CHAIRMAN WALLIS: So we could say that Section 6 is inappropriate at this time.

MR. PIETRANGELO: I disagree.

CHAIRMAN WALLIS: It represents a change

in direction of the way in which the regulations are interpreted, but the -- the Reg Guide -- I thought the NEI guidance was supposed to be -- how do you make the calculations required by -- by the existing 1.82?

MR. PIETRANGELO: Well, first of all, 1.82 requires nothing. It's simply a guidance document.

CHAIRMAN WALLIS: But it says you've got to calculate all of these things. It doesn't tell you how to do it.

MR. PIETRANGELO: It's a way to do it. Well, actually, it's not even that. It's just a compendium of the research and says, "Go figure out how to do it."

CHAIRMAN WALLIS: Well, okay. Maybe the staff will make it all clear to us.

(Laughter.)

But anyway, we are very grateful to you for your presentations this morning.

MR. PIETRANGELO: Thank you.

CHAIRMAN WALLIS: And unlike the presentations we usually get from the staff, we are actually finished before the time.

(Laughter.)

So you could have told us more.

(Laughter.)

MEMBER KRESS: Or you could have told us the same with more words.

CHAIRMAN WALLIS: I understand we're not allowed to start ahead of time, so we take a break now. We will come back here after lunch at 1:30 when we will hear some experience from the French. It's very good to hear about experience, not only analysis. Okay?

So we will break and come back here at 1:30, if no one else has any other questions or points they want to raise.

Thank you. We'll break, then.

(Whereupon, at 12:11 p.m., the proceedings in the foregoing matter went off the record for a lunch break.)

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

1:31 p.m.

CHAIRMAN WALLIS: Come back into session. We're looking forward to a presentation from Masseur Blomart who is going to tell us about some real stuff and give us some really good technical advice.

MR. CARUSO: John, would you like to introduce --

MR. BUTLER: Well, he's already been introduced, so I don't have much to say, but I did want to point out that Mr. Blomart has been assisting us or participating in our efforts to put together an evaluation methodology. EDF is operating under different constraints, they have different designs, different regulators, so there are differences, but I think you'll see that there are a number of similarities in the approaches, and I'd just thought it would be appropriate for you to get a broader view of resolution activities, and so we're proud to have him here.

MR. BLOMART: Just before my presentation I just wanted to say that it was for me an honor to be here and to thank you, everybody, around me to talk about this issue, which for us is an international issue, at least, and what we are looking for on the

EDF side is -- EDF is the French utility side, the common consensus on several parameters which drive this sump issue.

So I will start my presentation by looking at the event, let's say, chronologically in order to say how the debris are produced, where they're going to and so on. So what are the main basis of our regulation? We drop out the RG 182, Revision 2 and use the RG, Reg Guide 182, Revision 3, issued in November 2003 and this is for our PWS, French PWS. We add it to these regulations in our 6224 model in order to base our demonstration on this issue.

So what are the engineering studies scope? They are based on the NEI Working Group as well, so we used extensively common works, and we make an appropriation in our technical notes. We make, what we call in French, a reference design basis regulation, which we proposed in order to get the allowance to proceed.

On my presentation, the example given will be on the PWR 900 megawatt, which is almost -- it's a Westinghouse design, and the scenario taken is 2A reg double-ended guillotine break; in fact, on the hot leg interface. The summary of the presentation will deal with destruction zone, vertical debris transfer, horizontal debris transfer and actualization of NUREG 6224. I will say accommodation in correspondence with higher insulation type and debris type, which are a bit different from what you have in the USA and in the Nukon models.

So, first, destruction zone, water and debris transfer towards ECC sumps. It is across here in the cross-section of a PWR 900 megawatts, and here is imaged 12D ZOI, and it shows that it's quite significant area and volume where we consider everything is destroyed, 100 percent in this area, within this sphere is destroyed, completely destroyed. So that means coatings, insulation and so on, and even concrete due to water jets. A certain amount of concrete, I would say, not the walls but a certain amount of concrete.

Here I have the sumps, the ECC sumps, the sumps at the top, and the section walls here with the double pipes which crosses directly.

MEMBER RANSOM: Did I understand you to say you assume that the concrete is destroyed also?

MR. BLOMART: No, no. I spoke a little bit too fast. A certain part of concrete is destroyed thanks to the jet effects of the two face break.

So here is a picture of the sumps as they are on our plants. They are looking to what we call the circulation zone, which makes all the circular around the building. Here are the screens and the water going down these screens at the level approximately 20 to 30 centimeters above the top level of the screen. So it means that you have got in the range of one meter, 18 to two meters high of water prior any circulation.

So what are our assumptions in this 12D ZOI inference? We assume 100 percent destruction of course limited by full concrete. Full concrete means no opening within these concrete walls. Instantaneous generation of 2400 kilos of transportable insulation, insulation of the 725 type.

This 2400 kilos represents what exists in this 12D sphere.

CHAIRMAN WALLIS: This is all fibers?

MR. BLOMART: All fibers. And the fibers has these dimensions, let's say, so these are very fine fibers. We deliberately consider that all this insulation were completely destructed in very, very, very fine fibers.

CHAIRMAN WALLIS: They've very short.

MR. BLOMART: Very short. There is a large conservatism behind it.

MEMBER FORD: So this is an assumption rather than measurement.

MR. BLOMART: There are a lot of assumptions in our demonstration, yes. It's an assumption but an assumption which goes towards the margins.

CHAIRMAN WALLIS: But these fibers are much smaller than the screen openings in the screens.

MR. BLOMART: Yes. In fact, these fibers go through -- the first step these fibers go through the screens, make a circle around and are stopped in fact at this center after one or two turns. Let's notice that for a grid of screens we've got in France a grid of 2.5 millimeters by 2.5 millimeters for the screens, and if you want to clog screens like that, you have to assume debris should be water of this grid. Water means 2.5 divided by four. And then you are going to clog the sumps, which is very common by our figure.

In addition to that, this is a key figure also, the speed threshold of fibers horizontal sweeping is assumed and observed and tested to be three centimeters per second. That means that provided the speed velocity is above that, the insulation is doing that.

CHAIRMAN WALLIS: For these fibers, the lengths here are the lengths of the fibers in the insulation itself. They're not broken up. Their original length is so short, two millimeters? There's nothing longer than that in the insulation?

MR. BLOMART: Originally it's much longer but depending on the way the situation --

CHAIRMAN WALLIS: So it's broken up.

MR. BLOMART: It's broken up by the jets.

CHAIRMAN WALLIS: But some of it on the outer edge could survive as long fibers.

MR. BLOMART: We assumed everything was broken up.

CHAIRMAN WALLIS: But that's not the case necessarily. The long fibers will clog earlier.

MR. BLOMART: Well, these experiments we found that smallest the debris the worst it is.

CHAIRMAN WALLIS: Oh, the worst?

MR. BLOMART: The more compact it is.

MEMBER RANSOM: Are these fibers an epoxy or something that --

MR. BLOMART: These are glass fibers.

MEMBER RANSOM: The glass is not --

MR. BLOMART: It is made of ropes of glass fibers which shall smash together making a vacuum between them, and the length of these fibers are friable, let's say, at least, and they are located, housed within a jacket on one side and kind of grid on the other side against the pipes.

So we assumed -- because we think it's very conservative, that we should assume these fibers very short. Because with this length we have a more compact --

CHAIRMAN WALLIS: They don't go through the screen.

MR. BLOMART: They will go through the screen first.

CHAIRMAN WALLIS: Initially.

MR. BLOMART: Initially. And then they'll come back to the core, get out via the --

CHAIRMAN WALLIS: So some of the longer fibers start to accumulate and they collect smaller fibers.

MR. BLOMART: Exactly.

CHAIRMAN WALLIS: Okay.

MR. BLOMART: But even though you have not long fibers, it is sufficient to have fiber length of water at the grid, it's sufficient.

CHAIRMAN WALLIS: Because you have a length that's 2.5 centimeters.

MR. BLOMART: Yes.

CHAIRMAN WALLIS: That's a very fine screen.

MR. BLOMART: Yes. Well, it's a screen which is consistent with the screens you have in the United States.

So this is the event. So what happens in fact in reactor buildings? This is again a cross-sections, and the water deducts from the break, the break assumed from experience, because we made the creation in order to establish that the hot leg break was the worst case.

CHAIRMAN WALLIS: These vertical profiles are they waterfalls?

MR. BLOMART: Yes. These are vertical profiles, and these flow paths are possible because there are openings.

CHAIRMAN WALLIS: There are openings. That's just a hole in the floor.

MR. BLOMART: I will show you. So on the circular zones, these are gratings so the water can go down.

CHAIRMAN WALLIS: And the fibers go through the gratings?

MR. BLOMART: And the fibers go through

the gratings, but it's partly blocked we'll see later on. Go down via stairs of course, but you will notice that on the side of the staircase which you see later on will take an intercount.

So I will tell you what happens. There's a grate, an area of expansion in the steady state scenario. That means that currently we are not talking about the transient. We are talking about the steady state phenomena of the break. And what we assume that the water is going down via these passages, and we assume the flow proportional to the width of the passages.

CHAIRMAN WALLIS: So it must go through a couple of doors?

MR. BLOMART: There are no doors.

CHAIRMAN WALLIS: The red path goes through a space.

MR. BLOMART: Yes, three spaces. The water is going up and is flowing down via staircase, gratings, whatever, wherever it is on the floor.

CHAIRMAN WALLIS: Looks like doors it's going through. Those are not doors?

MR. BLOMART: There are no doors. Here you have staircases, gratings. Here you have three passageways.

CHAIRMAN WALLIS: In the middle, between B345 and B --

MR. BLOMART: Yes. These doors are grid doors.

CHAIRMAN WALLIS: They're grid doors.

MR. BLOMART: Large grid doors. So if we look at the level below now, the water is here, it's flowing down here, and all the water occupies, I would say, the area and goes further down at the sump level. So what we can see that all these flows are going but in ever direction.

CHAIRMAN WALLIS: But there's water everywhere.

MR. BLOMART: Yes.

CHAIRMAN WALLIS: The red lines just indicate the major flow.

MR. BLOMART: Exactly.

CHAIRMAN WALLIS: But there's water everywhere.

MR. BLOMART: There's water everywhere, and the red lines indicate where the water can go further down. And it shows in fact that whatever the steam generator you will more or less the same scenario at the level below, in fact. So what is important is to notice what will be the flow at the level of the break flow, and you will choose the steam generator in consequence in order to get the worst case.

MEMBER RANSOM: On the stairwells, you have weirs on the side?

MR. BLOMART: On the side.

MEMBER RANSOM: A weir in front?

MR. BLOMART: Not weir in front. So here we are at the sump level, the area where the water fell down, and we progressively fill up the reactor building bottom. So after half an hour if it is a 2A break, the recirculation starts and these red lines figure out, to some extent, the flow of this bottom, reactor building bottom.

MEMBER RANSOM: Is there an elevation change at that level?

MR. BLOMART: No. It's perfectly flat.

MEMBER RANSOM: It's flat?

MR. BLOMART: Completely flat. Same level everywhere.

CHAIRMAN WALLIS: So what's the -- on the floor above, what's the water depth?

MR. BLOMART: In the steady state area, the water flow is at the level of the weirs.

CHAIRMAN WALLIS: Which is how high?

MR. BLOMART: It's about 15 centimeters.

CHAIRMAN WALLIS: So it's still over the weirs?

MR. BLOMART: Not in a stead state, but you will see that we have an analysis where it is transient in order to accumulate the phenomena.

So this is the event tree Mr. Zeigler talked about. Okay. It's a bit tricky but it's quite interesting. We assume the break level here at the top level in the range of 40 cubic meters of insulation debris. You have two paths here depending on the way this insulation is going, and provided they have to turn to be blocked by dead ends and so on. We break down this amount thanks to the NUREG 6808. We break this total amount in two parts, then again in two parts, and so on, provided all these openings.

At the center of this very simple calculation we find out 25 percent of the total amount of insulation is reaching the bottom of the reactor building. Now, we have only talked about steady state.

CHAIRMAN WALLIS: Hold on. Only 25 percent?

MR. BLOMART: Well, the uncertainties are not there. There are quite big uncertainties, that is clear, because it's based on the worst.

CHAIRMAN WALLIS: So 25 percent would be 50 percent or --

MR. BLOMART: No, no.

CHAIRMAN WALLIS: -- ten percent?

MR. BLOMART: We are in the range from five to ten percent.

CHAIRMAN WALLIS: Okay.

MR. BLOMART: So I am talking now about the transient or the spinning phenomena. So it's clear that at the beginning of the break the water flow will be really significant and will be sufficiently important to overcome the weirs. So here we assume direct flow down to the bottom of the reactor building, directly above the weirs via the openings on the reactor building bottom. In these conditions -- so the area where these overspillings occur were roughly the same, but in every places where the openings were we assumed that the water is going through these openings.

So these are all the weirs. All these weirs are figured out in red there. So what means these weirs we don't see? They're usually there, but if you look there, you can see little steps of 15 centimeters around these HVAC pipes. And even though there are pipes, we assume that all these openings is free of passage. So there are, again, some conservatisms beyond that. On these openings also, there are weirs at the same height, approximately, and we assume exactly the same phenomena. There are weirs there, weirs here, here also.

Well, it's a very long process to come out to global results. While transient, these are the flow rates sketched when the 2A break occurs. So as you said, in less than one minute the LOCA occurs, the pressure is there and so on, and you are in a steady state scenario, so we postulated transient during the first minute, roughly speaking.

So as I told before, 25 percent in a steady state is to be postulated, and we consider 15 percent will go straight to sumps, thanks to this transient event.

MEMBER RANSOM: Are these insights based on intuition or are they based on experimentation or calculations?

MR. BLOMART: Calculations.

MEMBER RANSOM: Calculations?

MR. BLOMART: Calculations.

MEMBER RANSOM: Not experiments. Do you do some modeling or CFB type --

MR. BLOMART: No. We measured the width of every opening where there is a weir or where there isn't any weir. We found out the flow, the consequences of flow rate in this area. We divided the overall insulation by these width and flow rates. We got an amount of insulation arriving at a certain place and so on.

MEMBER RANSOM: Does this assume a fixed level of fluid on the floor?

MR. BLOMART: Yes.

MEMBER RANSOM: And then draining through these openings.

MR. BLOMART: Yes. Yes.

MEMBER RANSOM: A model to flow out to the individual openings.

MR. BLOMART: So in the steady state we got 25 percent, in a transient, 15 percent, and we took ten percent more, and we said that for vertical transfer we assume a 50 percent ratio for the total amount of insulation. That means in the range of 1,200 kilo of insulation at the bottom of the reactor building.

Now we are talking about the spray because here it's always a break, which will involve for breaks about six inches. The spray is automatically actuated, so we have to have a look on the spray system and we made roughly the same -- we use the same procedures. But this spray is responsible of the washdown of the reactor building itself in fact. So it's completed related to the amount of latent debris you can assume in the reactor building. So there are a lot of dead end areas, for example, the core, some area where insulation will be trapped naturally, I would say.

So this is the level of the water prior any recirculation process, the sumps and the height of sumps and all the potential routes which drive all this debris towards the sumps.

So since it was completely related to latent debris, we made on a real plant a walkdown and we sampled -- by sweeping the reactor building with vacuum cleaner, we swept a significant area of the reactor building in order to be able to quantify this amount of latent debris. And in fact we are going to do the same on another plant in order to cross our results and to establish, I would say, a reasonable value and a reasonable and critical values with respect to the latent debris.

Additionally, we broke down this latent debris from where they can, I mean from walls, ceilings, floors, gratings, mechanical equipment, electrical shaft and so on. So we are able to say, well, on ten meters of electrical shafts there are so and so of latent debris. Provided there are a certain amount of meters of electrical shaft, we multiply, so we extrapolate all these results, all these samples to the global reactor building.

So this area is this one, so it's handling area where the accumulator 1 is located, and we swept from 180 degrees to 270 degrees centigrade, at a level of two to three meters in order to have ducts inside. We knew exactly where it was.

MEMBER RANSOM: Am I missing something? Is this an actual case you're talking about?

MR. BLOMART: Yes. Yes, it's a real case.

MEMBER RANSOM: Was that an accident case or --

MR. BLOMART: No, no, no.

MEMBER RANSOM: -- done on purpose?

MR. BLOMART: No, no. It was made during the -- just after the steam generator replacement of SLB2. So the experiment was made after steam generator replacement, and we ordered people to pass the vacuum cleaner very cleanly everywhere after making the cleanup prior to start up. Okay? So it's a real case, and we are going to restart exactly the same samples on another plant in order to cross the results and to be sure that what we put forward is really realistic.

MEMBER RANSOM: How did the insulation material get into the -- did you make a --

MR. BLOMART: No.

CHAIRMAN WALLIS: This is latent debris.

MR. BLOMART: Latent debris. Fibers coming from the areas closed and so on.

So what have we got at the sump level? This is our assumptions. So from the SLB2 to experiments we assumed the quantity of 90 kilos of particulates; ten kilos of eroded concrete under jet effect, as I told you before, ten kilos due to the jet effect; 100 kilos still undefined, let's say labels, gloves and all these exotic debris, which we cannot really identify clearly, let's also all the seals, epoxy seals you put inside the buildings in order to be tight, even though this material is qualified. And coating clusters, we assumed a figure of 250 kilo, which includes every coating inside the 12D ZOI and an amount of coatings, even though it will be qualified, but sufficiently aged to be --

PARTICIPANT: Soluble?

MR. BLOMART: Yes, exactly.

MR. LETELLIER: How did you estimate the amount of eroded concrete?

MR. BLOMART: We made experiments on that. We threw a jet of 150 barrels on the concrete wall just to see what -- it's like a -- you sweep out your walls or whatever. It was an experiment which allowed us to -- and it's pretty conservative in fact. It should be lower than that. We took as is and not to be discussed or to be challenged by Safety Board on this.

MR. LETELLIER: This was a room temperature jet.

MR. BLOMART: Yes, coating jet. But, again, while this figure should appear quite big, but it's a way to build up something which could be really credible once they occur. We are not really -- we've got no idea about the exact figure we should have to assume for coating other materials, latent debris or insulations. It's quite difficult to assume it, but we'll take figures which comes from either experiments or calculations, even though these calculations could appear as a bit fragile or, I would say, a bit basic.

MEMBER FORD: So the total amount of latent debris you have there is about equal to that of the mass of fibers coming from the zone of influence. So this morning we had the hope one of the latent debris was small, and that's not true.

MR. BLOMART: Yes, but I don't want to oppose U.S. approach and French approach. You should keep in mind that in France we are requested by safety bodies to modify our plant as quick as possible provided the fact that we have stated on EDF side that our sumps on 900 megawatts were not satisfactory as they are today, because we were questioned on that. Safety bodies asked us, does EDF assume that these sumps are available for the recirculation process or not, and you will provide us by late December 2003 an answer to this question. It was a very precise answer.

And this question concerns all reactor building in France, 58 plants. So it was a very, very tough questions. We made the calculation in order to see where we could be really, and we said that on the 900 megawatts we were aiming to modify them as quick as possible. Whereas on 1,300 megawatts the surface of the sumps were sufficiently large to assume that the problem is not as accurate as on the 900 megawatts.

I should say that for 900 megawatts the

surface of the sumps varies from 20 square meters in total to 40 square meters, whereas on the 1,300 megawatts the surface of sumps varies from 70 square meters to 80 square meters. So it's double.

MR. DINGLER: We didn't include coatings in the definition, and some of the fire-resistant material was outside. So the definitions are slightly different.

MR. BLOMART: Yes.

MEMBER FORD: But the materials would still be there.

MR. DINGLER: But we're considering those as other debris sources, not defined as latent debris for us.

MEMBER FORD: I see.

MR. DINGLER: So if you look at the other ones, one about 222 we include as latent debris. Some of the tapes that have the fire-resistant material we carry as a separate debris source and coating is carried as separate debris. We didn't look necessarily into our latent debris source.

MR. CAVALO: It's also interesting to point out that our ZOI for coating figures is -- I'm sorry, it's John Cavalo with Corrosion Control Development for the Labs. The coating specimen that we did this year determined that the ZOI for coatings is conservatably only a 1D. The coatings were very resistant to water jetting. Now, what I'm seeing that you're carrying in is a 12D coating ZOI which produces quite a bit more potential debris than what we're carrying in. So that's another difference between approaches.

MR. BLOMART: Yes. We're almost in accordance with what we say, but these figures -- you know, we are in a dynamic process, so these figures were given just in order to assume that we were able to modify along with these values, but we had discussion with the safety bodies and this 1D zone should be credible, I think so, too.

MR. CAVALO: That was not said to be critical of your approach.

MR. BLOMART: No, no, I understand.

MR. CAVALO: We were carrying the same numbering prior to doing our testing. We were using the full ZOI for insulation for coating.

MR. BLOMART: Right. So we have determined -- at this stage, we have determined the amount of debris which are at the bottom of the reactor building, and we have localized where this debris will arrive at the bottom of the reactor building, and then we performed some CFD calculations in order to see how this debris behaves in the flow rate at the sump level. These are very colorful pictures. It illustrates how we find out how the debris will go. So here you have simulation of the bottom of the reactor building with all the cubicles and the water inside, and all these blue arrows are vectors of the speed, velocity and so on.

MEMBER RANSOM: You traced the particles and the fluid?

MR. BLOMART: Yes.

MEMBER RANSOM: What is the density ratio between the material and the water?

MR. BLOMART: It depends on the debris you assume. When you assume insulation, the density is 250 kilos cubic meters. For particulate, the density varies from two to five.

MEMBER RANSOM: Two to five?

MR. BLOMART: Two to five. Two to five density.

MEMBER RANSOM: Oh, specific gravity.

MR. BLOMART: Yes, specific gravity. For concrete, it's the same, it's two. And for particulates -- for fibers, it's glass fibers so it has a density of the glass, in fact.

MEMBER RANSOM: And what is it?

MR. BLOMART: I'm looking for -- I don't have the figure in mind. I don't have it --

CHAIRMAN WALLIS: About two and a half.

MR. BLOMART: -- but it's very dense.

MEMBER RANSOM: About what?

CHAIRMAN WALLIS: It's about two and a half glass to water.

MR. BLOMART: It's two and a half, yes, I think.

CHAIRMAN WALLIS: And where is the sump in this picture?

MR. BLOMART: The sumps are in yellow.

CHAIRMAN WALLIS: The sumps are in yellow.

MR. BLOMART: Here. Four sumps. We have two traits in the reactor building, so we have two sumps of SAI system and two sumps of spray system. So for the SAI system, the flow rates to be assumed is in the range of 1,000 cubic meters per hour, and for the spray system, it's 600 cubic meters per hour.

MEMBER RANSOM: And in the study it is allowed to settle out?

MR. BLOMART: Yes. Yes.

MEMBER RANSOM: The fibers or the --

MR. BLOMART: Yes. That's why I said at

the very, very beginning to drain the fibers you need a minimum speed of three centimeters per second.

MEMBER RANSOM: That is to keep them entrained?

MR. BLOMART: Yes. This is valuable for insulation. But if you're talking about, for example, about coatings, the minimum speed velocity varies from 11 to 24 centimeters per second. So you need a very higher speed velocity to drain the coatings.

CHAIRMAN WALLIS: These arrows are all the same color and the same length, it seems to me.

MR. BLOMART: Yes, because it's only one case.

CHAIRMAN WALLIS: It doesn't show you the magnitude of the speed.

MR. BLOMART: Yes. It's only a very fine picture, but it doesn't inform you of the results. I agree.

MR. LETELLIER: It's generally difficult to benchmark particulate transport in a CFD model, because you only have density and drag coefficients to place on a spherical particle. Did you have data to actually help you model the debris transport?

MR. BLOMART: Well, we --

MR. LETELLIER: Or are you just tracking

unit density particles in the flow?

MR. BLOMART: Yes, that's it.

MR. LETELLIER: Okay. So they're just tracers.

CHAIRMAN WALLIS: They're just following the water, right?

MR. LETELLIER: Yes.

MEMBER RANSOM: Do these calculations assume no slip on the wall?

MR. BLOMART: No slip on the wall? Here at interface, you mean?

MEMBER RANSOM: No, back on the surfaces, that there is zero velocity at the wall?

MR. BLOMART: Oh, okay. Yes, there is zero velocity at the wall.

MEMBER RANSOM: Where is the three --

MR. BLOMART: Three centimeters.

MEMBER RANSOM: -- three centimeters per second?

MR. BLOMART: The mean volume of the --

MEMBER RANSOM: That's the bulk.

MR. BLOMART: Yes. That's the bulk.

MR. MURPHY: Can you tell me what the coating particle size distribution was that you assumed?

MR. BLOMART: As I told before, it's a very fine particle. Everything is below one millimeter, I talked to you. So here we trace, as you said, all the particles, which goes through sumps. While this CFD calculation also helped us to try to build up debris trap. We were helped by these coats to find out if it was possible to install at the reactor building bottom some trap in order to reduce the amount of debris at the sumps. Well, we found very interesting results, but these results are very hard to justify at the bottom, because it depends on the type of flow rate, if it is laminar or turbulent and so on. So it becomes very tricky to justify down to the bottom that we are on the correct track. But we are still working on.

MEMBER FORD: Could I just ask a question --

MR. BLOMART: Yes.

MEMBER FORD: -- before you go on to this part here? So far you have demonstrated that you believe it is 1,200 kilograms of fibers can conservatively reach the sumps, sump screens.

MR. BLOMART: Yes.

MEMBER FORD: And you also say that approximately another 1,000 kilograms of latent debris can also get to the sump screens.

MR. BLOMART: Yes.

MEMBER FORD: And that was based on measurement -- the second one was based on measurement. Are there any data at all from practice? For instance, Barsebek, we've heard, that has been talked about a fair amount. Using the methodology that you've used so far, could you explain the amount of debris at that point?

MR. BLOMART: No. We didn't cross with the experience got from Barsebek. We didn't do that. We started to the point that we had to assume that everything was destroyed within the zones and how we could reduce and so on. How far is credible is a question. It's a question.

MEMBER FORD: And you didn't take into account in your analysis any chemical effects.

MR. BLOMART: That's another thing. Maybe I will deal with this issue later on, but what I can tell you that we ignore chemical effects on the simple fact that we have made calculations, very precise calculations with map codes and so on to identify what was the real temperature at the sumps. And what I can tell you that this temperature is for realistic temperature of the surface water systems it's less than 50 degrees after 24 hours and approximately 40 degrees centigrade after 48 hours. And if we take the design temperature of surface water, the extreme temperature of the surface water, we assume a temperature less than 50 degrees centigrade after 52 hours. So for us, and again I must tell you something more, our demonstration is only related to PCC4 accident. These are DBA accidents. That's very important. We are not delaying severe accident between the two, between both.

So if we consider only DBA accidents, the temperature of the sumps are sufficiently low that we don't have to deal with the chemical effects. So we proceed along after trying to find out what we could say on severe accidents in between. All these scenarios where you don't have any spray system. That means the temperature of the sumps are quite high. They are at 20 degrees for more than 50 hours. So it's really the lack of spray system where the temperature increases and then you could assume or you can say that chemical effects will occur to be verified by test and experiments, but probably will occur.

So this question is limited to severe accidents. It's also limited to all scenarios where spray systems do not occur and will be limited to all breaks which will provide a significant amount of debris. So you can exclude all these fill-and-bleed procedures and all breaks, for example, on the main coolant pump seals and so on. So here or in France on PRA Level 2 we are doing in the range of ten to the minus 7, so we think presumable not to do it.

MEMBER FORD: And your regulator agrees with that?

MR. BLOMART: We discussed it with our regulator.

CHAIRMAN WALLIS: This discussion indicates it may not be easy to determine what is conservative, because you may get less water which is hotter, which you may have to compare with more water which is colder. We don't quite know which is more effective.

MR. BLOMART: Yes. What is effective? The cooler the water is against the sumps, the larger the debris you get. That's clear.

Okay. So I will --

CHAIRMAN WALLIS: So what do you conclude from the study, that everything is okay or not?

MR. BLOMART: We discussed with our safety bodies. We showed what I would call our strategy on this. I would say they did not say no, they did not say yes. They wanted some justification, especially with respect to the temperature of the sumps and the way we use our transfer ratio. But I think there is no larger position on this demonstration.

CHAIRMAN WALLIS: So far all this is theory.

MR. BLOMART: It's theory, yes. To some extent, yes. The safety bodies asked us to identify the total amount of margins we put beyond all these demonstrations, and while it's quite easy, I didn't proceed along the identification of all the margins we have taken, but when you consider 100 percent destruction of the ZOI, the transfer, the speed velocity and so on, there are quite a bit of conservatisms behind all these demonstrations, which may make us quite confident in the way that this would work.

On the other hand, we don't want to be too conservative, because we don't want to have, I would say, too large sumps which will raise some other problems, especially downstream problems. We want to have sumps which will be reasonably clogged and letting, I would say --

CHAIRMAN WALLIS: Well, how about the

ratio of particulates to fibers? Your insulation is all fibers, and yet your latent material is particulate. And it's very important, as I understand, the ratio of these things. Sometimes a thick bed is a better than a thin bed and all kinds of things, depending on the ratio.

MR. BLOMART: Exactly.

CHAIRMAN WALLIS: So it's not clear to me that you're conservative by destroying so many fibers. Is that good or bad?

MR. BLOMART: I showed you the 2A leg break, so it's a maximum break, but we have investigated smaller breaks. And when investigating smaller breaks we have made variations with respect to the particulates and fibers ratio, ranking from one to five. The purpose of these investigations was to accommodate, in fact, the curve given by the NUREG 6224, given a ratio between particulates and fibers in order to anticipate the clogging effect on the sumps.

And that's the reason of this presentation I'm going to make that's -- we made it on one test facility. It's a very small test facility, but at this facility we were able to point to highlighting certain points, thin bed effects on certain curves, big cloggings with fibers only, which reflects another curve of the NUREG 6224. So we were able to go through all the spectrum of this ratio, fibers and particulates, and the corresponding -- which is a factor of the amount of debris.

So we made it with a typical EDF waved screen, so it was a spare part of Bugey, which is a plant. We took aged insulation also which were fragmented with -- we got these very, very fine fibers. We used representative laminar flow rates where the sumps are certain mode, and chemistry and water temperature monitored in line. These are the spectrum.

CHAIRMAN WALLIS: When you say chemistry, you mean you had chlorated water --

MR. BLOMART: Yes.

CHAIRMAN WALLIS: -- and then you had --

MR. BLOMART: PH of 9.7.

CHAIRMAN WALLIS: Then you had some buffer, the hydroxide or something? You had to get a high pH. How did you get a high pH from chlorated water? You must have a --

MR. BLOMART: We put boron inside. We put boron.

CHAIRMAN WALLIS: So low pH in the reactor.

MR. BLOMART: Low pH.

CHAIRMAN WALLIS: But then usually they have some buffering agent.

MR. BLOMART: Yes. I prefer not to answer that question.

CHAIRMAN WALLIS: Okay.

MR. BLOMART: I don't have in mind. But it was representative of the concentration boron. So this is the rank of the test we made. This is a sketch of the test facility, so it's a short facility. This is where the screen is located, and we flow inside the water with an amount of debris.

CHAIRMAN WALLIS: Is the water recycling?

MR. BLOMART: Yes.

CHAIRMAN WALLIS: There's a loop.

MR. BLOMART: It's a loop. So this is sketched where the sumps were clogged. I will show you what we got. So it's a three-stage sump. So you have three grates, one beyond the other. And the width of the grates from upstream to downstream decreases. So it's real sumps like we have in our plants. It's waste sumps, and here you have a cross section of debris, a compound of debris and particulates together, which clog the sumps.

MEMBER RANSOM: That's been removed from

the --

MR. BLOMART: We cut.

MEMBER RANSOM: You cut it away.

MR. BLOMART: We cut the blankets in order to see how --

MEMBER RANSOM: It's right around the sides where it's gone. Is that also cut away?

MR. BLOMART: No, no. We have only this part, only a part of the sump in the flow route. So you can see it very easily because it's white. It's circulation.

And here your typical thin bed effect. Very, very typical because it follows the waste. It's very thin, and it's very dramatic for the sumps. So you can get these results provided a certain ratio between particulates and fibers. This is very important.

MR. MURPHY: Did you measure the pressure drop and compare that to the correlation?

MR. BLOMART: Yes. That was the purpose. You know the curve of 6224, it's like you have a big --

MR. MURPHY: That's what I was looking for here.

MR. BLOMART: -- a big hill. And it goes

down and increases again. So we focused on the left hand side of the curve together with the right hand side of the curve in order to accommodate this curve, which are a function of the total amount of debris.

MR. ARCHITZEL: That photo looks mostly to be fiberglass fiber. Did you do a series of tests where you had particulate and fiber?

MR. BLOMART: This is particulates and fibers.

MR. ARCHITZEL: That's a combination?

MR. BLOMART: You can only get a difference with particulates. If you have no particulates, things will run very --

MEMBER RANSOM: You mean the fibers go right on through.

MR. BLOMART: No, no. The fibers will be stopped here, will be stopped but water can go through very easily because you have a vacuum ratio quite significant between the fibers.

MEMBER RANSOM: So you have small head loss through --

MR. BLOMART: Exactly. So the thickness of the blanket is not representative of the head loss.

MEMBER RANSOM: What about the thin?

MR. BLOMART: The thin is -- the thin bed effect produced a high head loss. So it's very important --

CHAIRMAN WALLIS: Because all the particulates are concentrated in the thin layer --

MR. BLOMART: Exactly.

CHAIRMAN WALLIS: -- which is much more dense than if they were spread out through a fat layer.

MR. BLOMART: Exactly. Correct.

MR. ARCHITZEL: Did your previous slide also find a correlation?

MR. BLOMART: Yes. Each experiment we did responds to one point on one curve among the old curves of the 6224. I mean it's dependent on the total amount of debris, so given the total amount of debris, you get one curve, and then on this curve, you can find -- for this you will find one point on the curve. So we will accommodate this 6224 curve to our insulation and the particulates.

CHAIRMAN WALLIS: In the real accident, it must depend then on which comes first, and if the fibers come first and build up a layer before the particulates get there, it will be different than if the particulates get there first. So you have to keep track of that, presumably, in the real case.

MR. BUTLER: It's a closed circuit.

CHAIRMAN WALLIS: So you assume that it all goes through the reactor and gets spit out the break and comes around again.

MR. BLOMART: Yes. Yes. Well, somewhat, yes.

CHAIRMAN WALLIS: Okay.

MEMBER RANSOM: You put diametacious earth on it and then you filter out the particles. It's very much like a swimming pool type filter. And then after you've coated the filter with diametacious earth, it's a very effective filter for stopping particles.

MR. BLOMART: The thing which is very important that this scenario occurred in a time schedule, in a very short time schedule. So the clogging occurred within, I would say, ten minutes of recirculation phase. It's very, very, very quick.

CHAIRMAN WALLIS: So it doesn't take many circulations.

MR. BLOMART: Many times to recirculate, no.

MR. LETELLIER: You mentioned that the test was scaled, and just now you mentioned that you kept track of the number of circulation cycles. Can you please explain the scale? What was preserved?

MR. BLOMART: What is preserved, here you have a given surface of sumps, so you have to adapt the total amount of debris you flow in your facility to the total surface of the sump. That's important.

Okay. So this presentation and this way we're going to do in France. We think we are capable to assume good predictions.

CHAIRMAN WALLIS: To make good predictions?

MR. BLOMART: Yes.

CHAIRMAN WALLIS: To make it.

MR. BLOMART: We made it. We made it.

CHAIRMAN WALLIS: And make good predictions.

MR. BLOMART: Yes.

CHAIRMAN WALLIS: Can you tell me something about this now? What you showed us in the example with the big zone of influence was a big break in the hot leg, and this transmitted a great deal of debris to the screen, but you didn't say anything about thick films and thick beds and thin beds. I'm trying to work out is the big break worse than a small break or how does that work?

MR. BLOMART: It's not evident, no. The

big break is not obviously the worst case.

CHAIRMAN WALLIS: It's not obviously the worst case. You have to calculate the thin bed effect and everything in order to find out the worst break size.

MR. BLOMART: You have to proceed along the NUREG 6224. You have to pay attention to the left hand of the curve.

CHAIRMAN WALLIS: So it's not clear that doing away with the big break necessarily does away with the worst case; is that correct?

MR. BLOMART: It's not so easy to answer your question.

CHAIRMAN WALLIS: It must be plant specific. I mean there are all kinds of different insulations and --

MR. BLOMART: No, no. You address not a break in order to be sure what shape will have the 6224 curve. In order to be able to predict the appropriate way as head loss given a certain ratio between particulates and fibers. On the one hand, this is the results you must have. On the other hand, and which drive the design, the total surface of the sumps is a big break, in fact.

CHAIRMAN WALLIS: What I'm trying to say

the amount of fibers depends on the break because they're broken up from insulation. The particulates, if it's all latent debris, may be the same no matter what the breaks are.

MR. BLOMART: Yes.

CHAIRMAN WALLIS: So your ratio of fibers to particulate depends very much on the break size, and it's conceivable then that the smaller number of fibers gives you more of a thin bed and that would correspond to a smaller break size. So it's conceivable that the small break could be worse than the big break because it gives you the thin bed effect.

MR. BLOMART: Yes.

CHAIRMAN WALLIS: Is that a fair statement?

MR. BLOMART: Correct. This thin bed effect is totally influenced by the design of the sumps themselves. If you consider wave sumps or flat sumps, a design as proposed to us, they can more or less accommodate this thin bed effect, and that's a key issue in the solution you will implement in your plant, because it's a very important point. Provided you have solved this issue, you will deal with a 2A break, big break LOCA, LOCA break.

But, first of all, you have to get this from the industry that can address it and not challenge the sump, structure of sumps.

CHAIRMAN WALLIS: The two pictures you showed us, in one of them, the wavy screen --

MR. BLOMART: Yes.

CHAIRMAN WALLIS: -- in one of them, the surface of the bed is flat.

MR. BLOMART: Yes.

CHAIRMAN WALLIS: In the other case, the surface of the bed looks like a blanket which follows the screen. That's the thin bed, presumably. The thin bed follows the screen --

MR. BLOMART: Yes, exactly.

CHAIRMAN WALLIS: -- and the thick bed -- why does the thick bed fill up like that? Why does it hydraulically do that?

PARTICIPANT: Maybe it's too difficult a question.

MR. BLOMART: What we have said when performing these tests is that if you don't have a good ratio between particulates and fibers, the blanket will be formed whatever the shape is. So it fills up --

CHAIRMAN WALLIS: It looks like different layers. It looks like a sort of gray layer that follows the fiber.

MR. BLOMART: Oh, no, because it's dry.

CHAIRMAN WALLIS: It's just because it's dry?

MR. BLOMART: I think. We took it out, so I think it's -- the blanket is formed whatever the shape is, but the density within these waves is much higher. Yes, much higher.

CHAIRMAN WALLIS: So it's not a homogeneous --

MR. BLOMART: Yes. In this case, it's not homogeneous. But it may be a bit difficult to explain. What I wanted to illustrate essentially is a few benefits.

CHAIRMAN WALLIS: So that essentially means that if you have wavy filter, you don't analyze it the same way as you do a flat one?

MR. BLOMART: Maybe Mr. Zeigler will answer.

MR. ZEIGLER: I had the pleasure of working with the good people at EDF on this and talking with them and looking over their results. What you're seeing over here is something which we have seen in what we call the more advanced strainers where you do have a wave situation going like that. The initial debris bed formation of the fiber won't be uniform in the coverage of it and will form this thin bed. And as you accumulate more and more fiber, the interstitial space gets filled up and the screen then transitions from this wave surface area to the projected surface area, and that's how you calculate now the head loss with this reduced surface area when you have a high degree load on it.

So it's a matter of transitioning what you're seeing as you accumulate more and more debris, now the gaps will get filled up preferentially and the whole screen now transitions to the projected area. So that's how you acquiesce for the NUREG 6224 correlation, take into effect the geometrical factors. So this is a time-dependent occurrence that occurs on screens that are not flat plate. That is why in the presentation this morning with Mr. Andreychek and Mo Dingler over here were careful in saying that we're applying a flat plate correlation. That's exactly to make sure that we're on the conservative side and that we're always using the projected flat plate barrier.

MEMBER KRESS: But that didn't tell us why it does it.

MR. ZEIGLER: Why it does?

MEMBER KRESS: Yes.

MR. ZEIGLER: It's basically how it accumulates on it. We have seen that always in all the tests on it, that you accumulate in the crevices and it builds up to the crevices.

MEMBER KRESS: Must have something to do with flow patterns, but I don't know.

MR. ZEIGLER: Correct.

CHAIRMAN WALLIS: Okay. So you're saying that they have a conservative method which assumes the wiggly screen is flat.

MR. ZEIGLER: He took the wiggly screen area, the total area of the wiggly screen to calculate the thin bed. Once he goes into the thick bed, he transitions into the projected area.

MR. BLOMART: Exactly. I wanted on this slide to illustrate -- I wanted to illustrate on this slide all of the consequences of our assumptions. What does it mean in terms of layout? Where were these sumps? So we have four squares which total surface, as I told before, is 40 square meters. If we imagine now the new data we have proposed, you fill up more or less 50 percent of the -- so you will have a sump which will align from, let's say, 40 degrees to 180 degrees. So it's a huge increase, huge increase in surface.

CHAIRMAN WALLIS: Surface area?

MR. BLOMART: Yes. Huge increase in surface area. So since where we are today, so let's say I will give you a figure, because you need maybe information, but we are now in the range of 400 square meters, then in the range of 100 square meters.

MEMBER RANSOM: So you increased the area by a factor of --

MR. BLOMART: By a factor of ten.

MEMBER RANSOM: -- ten.

MEMBER RANSOM: And the old screens were like 40 square meters?

MR. BLOMART: Yes, yes. So today that's where we are.

CHAIRMAN WALLIS: Is that what you would call a backfit?

MR. BLOMART: A what?

CHAIRMAN WALLIS: Is that what NEI would call a backfit?

MR. BUTLER: We don't know what the French regulators call it.

CHAIRMAN WALLIS: Presumably, if you had to put in 40 -- you had to multiply your screen size by ten times, that would be a backfit, wouldn't it, of some sort? Whether it's a compliance backfit or other kind of backfit, it's a backfit of some sort.

MR. BUTLER: One is a regulatory term, and the other is a technical term.

CHAIRMAN WALLIS: Well, it would be significant modifications on the plant.

MR. BUTLER: I think we would all agree that --

MR. BLOMART: But let us say that today we have such an amount of surface because we have a little knowledge about a large set of problems. So today we have a baseline.

CHAIRMAN WALLIS: Tomorrow you will have a large amount. Today you have a small amount because of ignorance. But now with the new design, you will have a lot more.

MR. BLOMART: No. I will not follow you, because I will say the following: That when evaluating the amount of fibers and particulates of unknown particulated debris and concrete and so on, we systematically increase or take the maximum values not knowing exactly where the truth in fact.

Well, I think few evidences to identify the truth, but we are keeping studies -- we are continuing our studies, and these studies show, to some extent, that we could reduce these values and we are aiming at reducing these values some more close to the truth. Because the larger the sumps are, the more risky it is with respect to downstream effects. So we have a great interest to be as close as possible to the truth. That's very important.

MEMBER RANSOM: In the redesign, what fraction of the material which is dispersed winds up on the screens?

MR. BLOMART: It depends. It depends on a lot of things. You mean when assuming the amount at the bottom of the reactor building how much goes there?

MEMBER RANSOM: Yes. And so much material is released.

MR. BLOMART: It depends.

MEMBER RANSOM: Do you also have trapping and things like that in the system?

MR. BLOMART: Yes. So it can go down by a factor of two.

MEMBER RANSOM: How much?

MR. BLOMART: A factor of two to three. So if you have a given amount --

MEMBER RANSOM: Maybe half to a third.

MR. BLOMART: Half, half. Depends on many things.

CHAIRMAN WALLIS: All this material goes through the screen. What makes you think it goes through the reactor? Why doesn't it get clogged up?

MR. BLOMART: Because the screen are tighter at every screen within the reactor.

CHAIRMAN WALLIS: Spaces and things don't attach to fibers?

MR. BLOMART: Yes. The spaces are 2.75 millimeter by 2.75 millimeters for a solid. For the filters at the bottom of the fluorescent are also. For the pumps and so on, we made experiments to see if the pumps were able to function, to operate with rough waters. So we can assume that provided a very clogged filter upstream, the filters, the debris will go through and will clog the screens of the sumps prior any screens downstream of the reactor coolant.

MEMBER KRESS: If you didn't have enough for your filter, you would have mentioned the clog, even the smallest, but it's a matter of -- a race. I think the filter wins the race. We used to do this with aerosols. We could put them through a big hole and they'd eventually clog it, but it takes a lot of time.

MR. LETELLIER: You mentioned in your

proposed redesign as you make the screens larger, you're more vulnerable to debris penetration, and you raise a very subtle issue for the regulator that I mentioned at the international workshop. I'd like these gentlemen to hear it. They are implicitly taking some credit for the presence of debris on their screen in order to protect them from downstream blockage and erosion. And that's a policy decision, that's a position that has to be evaluated for the U.S. plants as well. And tomorrow we'll talk about some screen penetration testing where we're essentially assuming a clean configuration in order to assess the fraction that actually gets through. We're not taking credit for the presence of a filter bed. It's a very subtle point.

CHAIRMAN WALLIS: You worry about erosion because the velocities are higher in the core or something? Why do you worry about erosion downstream?

MR. LETELLIER: For throttle valves or bearings, valve seals.

CHAIRMAN WALLIS: I see. It would be actually, say, in the ECCS, the smaller area parts of the flow passage. Okay.

MR. BLOMART: This is all my presentation. I can answer to you additional questions if you have them.

CHAIRMAN WALLIS: You are EDF, so I will not ask you the questions I would normally ask.

(Laughter.)

MR. BLOMART: Thank you.

CHAIRMAN WALLIS: Thank you very much, very helpful.

PARTICIPANT: Take a break?

CHAIRMAN WALLIS: Well, I think we're ready to take a break. Now, again, we can't start until it advertises, right? We're ahead of schedule again. Here's my consultant.

We will take a break and come back at 3:15, and then we're going to hear how NRR is going to resolve everything. Thank you. We'll take a break till 3:15.

(Whereupon, the foregoing matter went off the record at 2:52 p.m. and went back on the record at 3:20 p.m.)

CHAIRMAN WALLIS: Everything is going to become clear.

MR. JOHNSON: Thank you. I just wanted to say a few words on the presentations and, in fact, the presentations for tomorrow, we've got a number of topics that we're going to be presenting and a host of notes from the staff here to provide presentations, including Ralph Architzel, who is going to provide an overview of the plan and the schedule, Angie Lavaretta and certainly Bruce are going to talk about the methodology today. Tomorrow we're going to talk about the generic letter. Dave Culison who is the primary author, I guess, of the generic letter is going to talk about the generic letter. Leon Whitney is coming in to talk about the bulletin response. I think it's important to tell you where we are on the bulletin. We'll do that very briefly. And then last but not least we're going to talk about from NRR perspective the risk-informed approach and where we are with that, and how we see that progressing.

Also, tomorrow following that is time on the agenda to talk about the Office of Research, the work that's going on on the chemical precipitation effects. And we recognize that that's important, and also looking forward to that presentation. We see this as a valuable opportunity to provide an update on status from the last time we talked to the ACRS. We've got -- in a number of slides you'll see some fair amount of background. We recognize that by this time everybody in the room is fairly up to speed on the background, and so we're going to take your prompting when we get to the presentation where you want us to move faster, and we're going to try to be sensitive to not replow ground that may have been plowed earlier today, so we could keep this moving along crisply and stay on track.

We believe that we've made good progress in terms of working on this issue with all the stakeholders, the industry and the public. Obviously, there are some differences. NEI, the industry pointed out some of those differences this morning. You'll hear about some of those differences as we progress. We think we can work through those differences. And, in fact, it's time to stop talking about what is the NRC approach and what is the industry's approach, and to get to a point where we're talking about what is the approach that we're going to use to go forward with resolution of the issue, and so we look forward to that evolution.

I wanted to make just a couple of points before I sit down. One is, again we sincerely do appreciate the opportunity to meet with the subcommittee this weekend, also in August. And, in fact, in response to your comments, Dr. Wallis, we do recognize that the schedule is not ideal. Ideally, we would already have considered the evaluation. We'd already have it in front of us. The staff would have looked at it. You'd have a chance to look at it before we came before you to talk about the generic letter.

We would have had worked through this guidance on this so-called risk-informed approach or realistic conservative approach. And, in fact, that would be a part of what you would be considering at this time. We would have completed and would understand the implications, whatever they may be, for the chemical precipitation effects. And, clearly, that's not where we are today.

The Commission has made it very clear to us, and we've taken their words to heart. We need an aggressive resolution to this issue, and that causes us to proceed with a compressed time line. That means that we're having to work harder, faster, with greater uncertainties; and, therefore, perhaps greater conservatisms. And we are working with the industry who also, I believe, based on their presentation is working with sort of the same direction in mind.

We want to make sure that we get this issue resolved in a reasonable time frame without sacrificing safety, and that's certainly I think a perspective that certainly all of the staff, and I believe that Tony echoed it in his comments.

CHAIRMAN WALLIS: What do you mean by effective resolution?

MR. JOHNSON: We mean by "effective resolution", resolution on this issue in a way that help causes us not to have to revisit it in a few years based on other offenses, based on other things that we don't know, based on changes in things like 50-46 risk-informed rule making and those kinds of -- we're looking for a resolution to this issue that lets us walk away from this in terms of it being on the plate for something that we need to --

CHAIRMAN WALLIS: Resolution requires hardware modification. You can't walk away from it until those hardware modifications have been performed.

MR. JOHNSON: That's absolutely right. We're going to talk about in one of the presentations or certainly before we close what our time frame -- what the schedule provides for resolution of this generic issue, generic safety issue, and so we'll talk about what that means in terms of time frame. The year is 2007 where we are expecting the licensees will have implemented their hardware fixes for --

CHAIRMAN WALLIS: How are you going to

know what is effective resolution until you've got the responses to the generic letter.

MR. JOHNSON: Yes, that's right.

CHAIRMAN WALLIS: Maybe the problem goes away in five minutes, maybe it lasts for five years.

MR. JOHNSON: That's true. We'll talk more on schedule when we talk about the generic letter, because we've thought about what happens in 2007 and whether, in fact, we go beyond 2007. And we've thought about what flows out of a generic safety issue, so we'll touch on those issue. David will be ready to touch on those issues tomorrow when we talk to the generic letter. Right, David? Very good. So we want to address the resolution to this issue on a time frame that we want to address a resolution to this issue, but we want to resolve it in a way that doesn't sacrifice safety.

Another point I wanted to make is despite the challenges of timing, we do believe it's appropriate and, in fact, beneficial for the Subcommittee to consider the generic letter. The generic letter describes the approach that we will use to convey our expectations to the industry for what we want them to do.

We do apologize. We recognize that the

letter that we gave you was draft. We've gotten substantial beneficial comments, I believe, from external stakeholders on the draft generic letter. We've made some revisions. We've not completed the revisions that we might make to that generic letter, but we're here to talk about what we would propose based on the changes that we've seen, or the comments that we've seen on the generic letter.

There are some important issues to talk about; issues, for example, is this going to be -- should this be an information request that we typically do, or should it be a request for action? Should we ask the compliance question? We talked about that in a meeting. What about timing and schedule, given all of the challenges that we have. And so we've got comments on those issues. We're considering those issues and we'll address those issues in our discussion on the generic letter, our proposed approach.

CHAIRMAN WALLIS: Does this draft respond to all of the public comments?

MR. JOHNSON: We are working on a draft --

CHAIRMAN WALLIS: I don't see how we can comment on anything. Everything seems to be work-in-progress.

MR. JOHNSON: I was really going to say we are -- we believe that the draft that you have took a good shot at addressing the public comments that we have. There are some issues that we need to make sure that we are at closure on, and they could result in some small changes, I believe. And we've briefed our proposed changes up through I'll say Dr. Sharon, and he's consistent with the approach. He's not seen the exact words, so you could see tweaks in the generic letter, but I think we actually have enough meat to enable you to get a good perspective about where we think we ought to go on the generic letter.

We're going to discuss the risk-informed alternative. There are a bunch of discussion and a lot of questions and comments on the risk-informed approach, the risk-informed alternative. We believe it would put us in an untenable situation to end up where we are ready to go forward with an approved methodology, a supplement methodology to the staff to evaluate this issue that does not consider the reality of the fact that we are even today, right today, we are working on risk-informing 50-46.

We believe that it's important that whatever we do with respect to the sump reflect that direction. We believe that we ought to get out in front of that direction, that we ought to be conservative. I know there are questions on that, and we'll talk more about it with respect when Donnie gets into the presentation. We'll talk about how we see ourselves coming out.

I guess I would differ a little bit from John. We do see this as a pilot, if you will, a very narrow application of risk-informing 50-46. You'll see we worked very hard. We're working very hard to make sure that we do things in a way that we believe will be consistent with where we are heading with respect to 50-46, so we look forward to your questions. And I do note that you're being briefed on 50-46 I believe in early July, and so you'll get an opportunity in the next few days to hear where that's going. But again, we see those as lining up in terms of how we proceed.

In the end, the staff is going to need to write a safety evaluation that conveys what we believe is an acceptable approach for evaluating some form of abilities, and for licensees to identify what corrective actions they would implement. We, in fact, do plan to audit, to verify what is done in those evaluations. The oversight process, and the inspection process is absolutely a part of the regulatory process going forward to make sure that we're comfortable that licensees have not just done what they said they did, but they implemented it appropriately, and that it is effective. So for us, it doesn't end in 2007, but certainly we've got a lot of work to do in the coming months. The licensees have a lot of work to do certainly in the coming years with respect to making these fixes to make sure that they address this issue.

That's all I would say in terms of opening. If there are no questions, again Ralph is going to come forward, Ralph Architzel is going to come forward to talk about the overview of the plan and the schedule, and then we're going to talk about the methodology. And I think that's what we planned for this afternoon.

MR. CARUSO: Ralph, you're going to be the guinea pig here and explain it that the ACRS is trying to improve our interactions with stakeholders. The red light here when it comes on, we'll give you a chance to start your presentation, and the numbers - we'll withhold of all our questions for the first 10 minutes of your presentation.

CHAIRMAN WALLIS: He only has half an hour for the whole thing.

MR. CARUSO: That's correct.

CHAIRMAN WALLIS: And is somebody else going to come on later? Ralph, are you ready?

MR. ARCHITZEL: Yes. My name is Ralph Architzel. I'm with the Plant Systems Branch in NRR. I'd like to -- Mike Johnson went over quite a few of the points I was going to raise, so I'm going to go through these fairly quickly. I would like to focus on just some of the changes since we were with you last February.

One of the changes is supposed to be my co-presenter, is that we have Dave Solario as the new Section Chief in NRR, and he's got a sole responsibility now for GSI-191, so there has been a management focus on this issue, and they've dedicated a Section Chief specifically to this task.

All right. Basically, this is an outline of the presentation. I was going to go over who's doing what today and tomorrow, and Michael did that. I guess up front I'm supposed to do the conclusion so that I get my 10 minutes, and I'd like to say the conclusion to my presentation is that the industry initiative with close oversight by the NRC leads to effective resolution. And we are on schedule to close out by 2007. That's the overall conclusion of this presentation.

Again, one thing I would like to go through fairly fast because you've heard all of this last year. For example, that this derives from long-term cooling requirements of 10 CFR 50-46, and the debris blockage can cause the prevention of injection water into the core containment spray system. One thing I would like to note, and it sort of goes to some of the questions earlier, is that USIA-42 did close this issue in 1985, but it was closed with a recognition that quite a few plants would not survive, not the specific plants but on the same type of a basis with ongoing efforts to replace insulation, so it's been recognized. This issue, although it's been recognized, new information later is worrisome, and since then we've established a compliance exception to the backfit rule, so at the time we accepted this in 1985, we might not have accepted it today because of the compliance exception.

I did want to point out sort of an operability or the compliance question. This has been raised before, and it's been the situation for quite a while. And as I mentioned, the new events of BWRs and the new information that was identified during the BWR resolution are reasons that we have opened GSI-

191.

Last year again I told you during this generic issue program stages, the first three are done. The technical session was done by Research, regulations and guidance development is pretty much -- they're still in the process with the NEI methodology and our issuance in terms of our SER and that methodology, and how we are proceeding. Implementation, some coming in the fall of next year. I'll just go on to the next slide.

You've heard about the technical assessment, the debris, the thin bed wasn't known in '85, upstream throttle valve and downstream blockage issues have been added to the resolution of this problem, although they're not specifically part of GSI-191. And then you have other effects like the lows on the screen once you consider the differential pressure as opposed to clean screens.

The technical assessment conclusions were that plant-specific analysis should be conducted, appropriate corrective actions should be done on a plant-specific basis. The ACRS has previously been briefed in September and July, in September 2001. NRR briefed you on our generic communications and status in February of 2003.

With the action plan, we are implementing the action plan in the guidance development stage. The regulatory guide has been issued. I know it's not as thorough or as detailed as what you were looking for, but we are working on the detailed guidance at the moment.

We did receive the earlier draft versions of the guidance, but now we have a submittal on the NEI guidance for plant-specific evaluation, and we're working on the generic letter for the plants.

One thing we are investigating is the implementation beginning following the guidance review, and that is basically licensees commencing analyses. You'll hear in the generic letter discussion tomorrow when actually the schedules are planned for the plants to actually do the modifications. I've got a schedule chart up here, as well. And there's been some changes in consideration of the generic letter, so some of this is new. I would caution the generic letter, the version you got, has not been released, but it is the current thinking, but there are some changes in the internal parts of the schedule but not the completion dates.

CHAIRMAN WALLIS: I'm told we can ask a clarification question. What does MPA activity mean?

MR. ARCHITZEL: Multi-plan activity. That just means that any time we have a generic letter or bulletin, we have a process where we close out the generic letter, and it takes it out of generic space within NRR. It takes it into another organization where the Project Managers and Inspectors are looking at the resolution of those issues, so there will be like temporary instructions. The inspectors will go out and inspect parts of the generic letter and the actions, and we'll have a closure process on the generic letter and on the bulletin also. You'll hear some of that discussion of the bulletin tomorrow.

We are being supported by LANL in this activity since this was turned over in September, 2001. They do provide continuity of the issue and related technical support. They have performed volunteer plant calculations. Some of those are being considered for alternatives that we may present to the Committee in August, some of the methodologies, and some of them are already used in the methodology in reference. For example, the CFD work that was done by LANL is referenced in the NEI methodology.

They also examined operative recovery actions and determined some of the risks were lower when you consider those aspects. That was a report you've seen earlier. And they are providing input to our safety evaluation on industry evaluation guidelines.

We have been working closely with the industry. We had a lot of meetings, and there is actually two -- you say what could we have done in the two years. There have been quite a few meetings going on between the industry establishing ground rules, and some of them I guess we're still visiting, so it's kind of frustrating but initially it was a voluntary initiative by the industry. I guess you could still call it that, but we're enforcing it through the means of the safety evaluation. It's transformed somewhat from the beginning thought process, from a voluntary initiative into an SER where when the generic letter is in force and there's a regulatory footprint to it. And there has been close coordination between Research and NRR, and ongoing testing. And you'll hear we've been involved closely with NRR, in all research and all the testing programs that have started.

There is the two-phase approach. That's changed since the last time we met. We did issue the bulletin. At the time we met last year, we just had the generic letter in front of you, and we did take the actions to reduce risk and issued them in the form of the bulletin.

CHAIRMAN WALLIS: Some of the industrial comments were that the bulletin already takes care of things. Why do we need a generic letter?

MR. ARCHITZEL: WE're still planning for that regulatory -- there is a chance that as we go forward we might drop back to the way this thing originally started, was just going to be an industry initiative, and we'd issue a regulatory information summary. I mean, if we're thorough enough and we're comfortable with it, we could go back to that if we wanted to.

CHAIRMAN WALLIS: The light is out.

MR. ARCHITZEL: My ten minutes is up. I wanted to show you some samples from --

CHAIRMAN WALLIS: It's all been a little bit confusing to us, is the interplay between the bulletin and this letter.

MR. ARCHITZEL: Well, when you saw it, it was one document.

CHAIRMAN WALLIS: One or two.

MR. ARCHITZEL: The reason we split it was to -- when we were going through the review process and management was looking at it along with staff, the idea was some of these actions where we were calling for measures to reduce the risk shouldn't be held up. This is a significant enough issue that we should put that out right away. We shouldn't subject it to a 60-day public comment period, and then resolve all the public comments.

CHAIRMAN WALLIS: Have any been taken as a result of the bulletin?

MR. ARCHITZEL: Yes. And Leon Whitney will talk a lot -- the bulletin has gone out. All the plants have answered. One plant said they were in compliance - that's Davis-Besse. The rest of the plants have answered, and we have a presentation --

CHAIRMAN WALLIS: Only Davis-Besse that claims to be in compliance?

MR. ARCHITZEL: That's correct.

CHAIRMAN WALLIS: That's interesting. We've been assured by them about things before.

MR. ARCHITZEL: Well, we didn't accept that answer to say that they're in final compliance with this issue. We caveat in our response to them, we've still got to look at it with the new guidelines, but as far as the time being, at that time, they only had to declare compliance with their current licensing basis, which they could show -- they had an easier time. We did an inspection. But anyway, you know they have quite large sum screen modification -- and some of the plants might have -- they didn't declare non-compliance, but it was easier for them just to take the interim measures and try and declare that they were in compliance.

As I mentioned, we're reviewing the responses to the bulletin. We're actively reviewing the sump evaluation methodology. It's a little difficult there considering the time frame, and we're in a different mode on evaluating that methodology. We're going to basically limit the interactions between us, and we don't have time for RAIs and meetings, et cetera. We might have some phone calls but we might just be establishing alternatives that are acceptable to us. And so you'll hear about that a little bit from Angie and Bruce, but it is a different review in that sense.

For the closeout we plan to inspect on a sample basis the plant-specific evaluations requested by the generic letter. Those are the inspections led by technical people who understand how you do the methodology, but they'll be inspections to track the results.

I'll just leave the chemical precipitation issue for now. You'll hear about it tomorrow, but there is currently nothing in the guidelines as you heard on the chemical precipitation issue. But NRR Staff has been closely following that resolution, so we do have NRR Staff, a chosen engineer in the Chemical Engineering Branch that are following that. And then we have the downstream effects included in the generic letter, as well.

CHAIRMAN WALLIS: When I look at the status, what I see is reviewing, reviewing, developing, planning, being developed, to be evaluated. It looks as if everything is in a pretty early stage.

MR. ARCHITZEL: I have the generic letter. The generic letter, I wouldn't say that's an early stage. I'd say --

CHAIRMAN WALLIS: But nothing seems to be finished. It's all under development, review, review, or being planned or something.

MR. JOHNSON: I think that's a fair point. The bulletin is out. We're looking at compensatory action. We'll talk more about that, but with respect to the generic letter going forward, we really aren't at the stage where we're wrapping up, reviewing, approving and those kinds of things.

CHAIRMAN WALLIS: It seems premature for

us to comment. And if you came back saying we've got this thing under control, we know what we're doing, this is why, then I think we could comment. But all of this looks like stuff which is going on, hard to get a hold of. How can we contribute?

MR. ARCHITZEL: The generic letter is more final, and that you'll hear it from Dave tomorrow, but basically, it --

CHAIRMAN WALLIS: Are you going to talk about the generic letter?

MR. ARCHITZEL: Yes. We're going to do that.

CHAIRMAN WALLIS: I didn't quite see it in the program, and I thought --

MR. ARCHITZEL: There's a session on it tomorrow.

CHAIRMAN WALLIS: Okay.

MR. ARCHITZEL: I guess specifically on the schedule, the key there is that we are still shooting for a safety evaluation by September. Now on the generic letter, one thing that relates to your schedule is we're looking to issue that in August and you don't have a July meeting, so that's one of the reasons we're meeting a little bit early. We've still got to go CRGR but you don't have an August meeting, so meeting that schedule had to be now, and they're still working on the final. Part of it is accommodating the ACRS schedule in terms of when you have the full committee meetings. And then some of these are new. Dave will go into a little bit more, but when you start commencing the evaluations --

CHAIRMAN WALLIS: This is the schedule.

MR. ARCHITZEL: The biggest change there is down at the bottom about when the modifications start being made in accordance with the generic letter in 2006. That's a change from before.

CHAIRMAN WALLIS: Then you have a conclusion that everything is going to be okay by 2007. That's what the first slide said.

MR. ARCHITZEL: Right. We're going to have it done by 2007.

CHAIRMAN WALLIS: Well you were giving me very little confidence. I don't know what the rest of the subcommittee feels like. I mean, you've given me nothing substantial to buttress your conclusion. You've got plans and you're doing work and all that. I don't see anything specific.

MR. ARCHITZEL: You'll get some specifics in the other presentations.

CHAIRMAN WALLIS: You have an accident

plan to address TSI. What is this plan? Does it have milestones, does it have measures?

MR. ARCHITZEL: It does have milestones.

CHAIRMAN WALLIS: Your criteria for decision making and all that kind of stuff, or is it a fuzzy thing?

MR. ARCHITZEL: It has milestones, but some of them have -- well, just as an example in reviewing methodology, it was originally a 10-month process. So we're now -- I guess I can give you a warm feeling. I guess the point is that we're on track to get it completed, and we've got an alternate method of doing it, and it's developing our own methodology. I don't really know how to tell you. It's not going to be a normal review, so it's not going to give you a warm feeling.

MR. JOHNSON: Yes. I guess I would just add we, in fact, do have a very detailed schedule with a bunch of intermediate milestones that we're not showing you. For example, the milestone for issuance of the draft generic letter were commonly hit and we did that. We had milestones to provide for public comment on that. We're on track. This is a part of the inspective process to give the closure on the generic letter and get it issued by August, so I mean hopefully you have a better sense at the end of this presentation, but we've got a bunch of milestones that we're working. Although it is certainly true that there are issues that we're considering like the risk-informed alternative that we're still doing active work on, and we're going to bring that to a quick close if we're going to be able to stay on schedule to continue to meet intermediate milestones to meet the final resolution.

MR. ARCHITZEL: Really, since it is more or less an overview-type presentation, I want to get into the details of what we've done so far on the methodology review, but I also would like to offer an opportunity that I did have some samples of insulation that PCI provided. And would the Committee be interested? Ralph or Bruce can pass them around to you right now and you see some of the material that's involved in some of these analyses. You get a feel for what it looks like.

So my overview is sort of completed right now, but I'll pass this around and Gordon can explain any pieces for it. Okay. One thing, here's just an example -- is that okay with the committee?

CHAIRMAN WALLIS: Sure.

MR. ARCHITZEL: You might to see this type stuff, so here's like what Mineral wall looks like. Here's some Nukon base that was provided by PCI. Gordon, if you've got any additional comments you want to make --

CHAIRMAN WALLIS: Do you have a shot of what it looks like when it's been shattered by a two-phase depth?

MR. ARCHITZEL: Well, you've seen that in the -- here's a Nukon blanket that it's open instead of closed. Here's some other closed ones.

MR. CARUSO: Bruce, the samples that you have are from the University of New Mexico for the meeting in February. Were those typical --

MR. LETELLIER: Ceramic fire burnates.

(Simultaneous speech.)

MR. CARUSO: Well, I remember that you had a bunch of different samples. Those were typical of this sort of material that's been chewed up and --

MR. LETELLIER: Yes, basically this fiberglass blanket where you can receive it as manufactured and you shred it to create or make --

MEMBER RANSOM: Are all of these in compliance now?

MR. ARCHITZEL: Yes. They're in different plants --

MEMBER RANSOM: You'll find all of these different things in different plants.

MR. ARCHITZEL: Some of them aren't as commonly in plants.

CHAIRMAN WALLIS: These is just for the musement on the side. Okay. What I understand is what are the technical issues, how they're going to be resolved, what are the regulatory issues, how are they going to be resolved? I haven't had it explained to me in a logical sequence. Maybe I'm being very stupid, so I can say yes, I have great faith in the way you're going about it. These things don't tell me how the issues are going to be resolved as for the procedural things. You're going to issue letters, you're going to evaluate this, you're going to review that. I don't have a good feeling about the problem is going to be resolved properly. That's what I don't get. Now maybe I'm being very stupid.

MR. ARCHITZEL: Well, it's more to -- like, for example, the 100-page response letter we got from NEI on our RAIs, you've had that. You've seen that, it's been distributed to you. And the individual questions --

CHAIRMAN WALLIS: I know it's substantial. NEI has done a lot of work. They've come up with a document that's much more believable than what they had last year. That's something I could point to and say now do I really need to look at that? Maybe that's some substantial improvement in the situation. What have you done to substantially improve the situation? You're going to tell us that?

MR. JOHNSON: Yes. This will still be available to you that says here's the schedule and here are the comments --

CHAIRMAN WALLIS: Okay.

MEMBER FORD: There will be an overview of all the challenges and how they fit into the overall problem?

MR. ARCHITZEL: There's going to be individual pieces that are addressed.

MEMBER FORD: I think what we're all struggling with is we know there's an overall problem. We know how it fits into the regulatory structure. What we don't have a good feeling for are what are the technical challenges and who is doing what to resolve those challenges as an overview. And then we're going to hear each individual person talk about chemical effects.

MR. ARCHITZEL: The very next presentation we will give some of what you're looking for.

MEMBER FORD: That's great.

MR. ARCHITZEL: Probably not everything that you want because recognizing that we're really going to come to you on August 17th to give you a more detailed conclusion of how we resolved the issues completely, but the very next presentation --

MEMBER FORD: Great.

MS. LAVARETTA: Good afternoon. My name is Angie Lavaretta. I've worked for the NRC as a Reactor Systems Engineer for about 10-years and with the Plant Systems Branch, and I'm joined by Dr. Bruce Letellier of Los Alamos National Lab, who is assisting us with the technical review of the NEI sump evaluation methodology guidelines.

Clint Schaffer, who's listed on the agenda, is also a major contributor for Los Alamos on this review, but Bruce and I will be providing the joint presentation on the status of our review today.

All right. For the summary, this presentation will relay the following major conclusions; that although the staff identified a number of concerns in response to the original submittal received from NEI last fall, the final methodology was submitted with improvements, and we'll talk about the content; that the Staff with support from Los Alamos is evaluating the methodology guidance and is considering alternatives for unresolved issues; that NEI has recently responded to Staff RAIs which to a large degree are applicable to the final version of the methodology and is under review now. And that we are in process with this review, and may not be prepared to provide details of our final approach and final position with regard to all areas today, but that we will be prepared to provide a full discussion of the final approach and position when we return on August 17th.

As far as the status of the review, NEI submitted a draft methodology guidance to the NRC on October 31st. We had identified problems in a preliminary review and followed up with a more detailed request for additional information in February and March of this year. In response to our comments, NEI devised a new approach which you heard described earlier this morning.

The Staff agrees that this baseline evaluation of the sump followed with refinements provides improvements, such as additional justification for assumptions made, added conservatism, and the use of a sample calculation, in particular, that we believe is conducive to consistency and user-friendly approach for the licensees.

In our initial review of the May submittal, the technical details and content seemed similar to that in the October 31st submittal. Therefore, as we are reviewing the NEI response to our RAIs on the earlier version, we're finding that the responses apply to this review, this recent submittal, and they seem to be helpful in adding detail that improves our understanding of the approach used in the May 28th submittal.

The major areas of the sump evaluation are listed here, break characteristics which we'll not be discussing at this presentation. There's a separate presentation tomorrow on the risk-informed application; debris generation, a consideration of latent debris, debris transport, head loss and downstream and chemical effects. Dr. Letellier will expand on some of these areas of review.

DR. LETELLIER: The intent of our presentation this afternoon is to give you an idea of what review activities we're engaged in at present, more than to present the results of the findings, but I would like to give you some overall impressions similar to those that Angie has been sharing with you.

CHAIRMAN WALLIS: Do you have copies of this?

DR. LETELLIER: There are about five slides here, and they will be included as a supplement. The explanatory information provided in the RAI responses was generally very helpful, and one of our key activities is to make sure that that information is carried over into the final document. Because of our limited opportunity for interaction on the compressed schedule, there's some question about how we document and incorporate that additional detail.

I think it's the intent of the staff that the combination of the industry guidance and the Staff SE together will provide the regulatory basis, the guidance document that should be followed, so we're working hard to make sure that that additional explanation is preserved.

In our initial review, we had a number of very technical questions about references and supporting arguments. In general, the RAI responses broadened their application of conservatisms in order to respond to those RAIs. We find that there has been careful thought given to the logical construct of these methods, so that it is self-consistent, and it is a contiguous argument.

Sometimes that was done at the expense of physical detail. They were simplifying assumptions that were made. And one of the main challenges that the Staff has and myself personally, is to recalibrate our intuition of conservatism under the proposed simplifcations. Keep in mind that we've been studying the gory details for three years about the phenomenology of step-to-step and how we might create predictive models and what the physics are involved. And now all of a sudden we're faced with oh, 60 percent small, 40 percent large.

Now we have to reintegrate those assumptions into our perception of overall conservatism, and that's one of our main challenges, particularly in light of our review of the baseline assumption. I think it's critical that everyone agrees and understands why the baseline is conservative, and that it serves the role that the NEI has proposed, that it be an initial opportunity for vulnerability assessment and that it serve to point out the key areas where the licensees might seek refinements.

In some cases in the May 28th submittal, the supplementary refinements that were discussed this morning are a little bit hard to find out, culled out explicitly. And the Staff is trying to judge how much effort, or how we should prioritize our effort into a review of those refinements.

There's an awful lot of very good background information provided, but you'll find that it's also not very explicit in how that information should be followed from start to finish at times. So our key review activities, number one, is to understand the baseline conservatism, to do a confirmatory analysis of the zone of influence volumes. That is such a key aspect to the vulnerability assessment to this issue in general that it deserves some validation.

To their credit, the NEI has followed our suggestion to codify, if you will, some of the more technical aspects of the analysis, and in that way improve the consistency of evaluations across the industry. I think that will improve the efficiency of reviews that come later.

There are some questions we still have about the treatment of coatings as a debris source. There are still some unsubstantiated assumptions and where the word "conservative" is used often, we would like to have our own understanding of what degree of conservatism is implied.

The last bullet there is to actually conduct a comparison of the transport assumptions between the very simplified event trees that you saw this morning, compared to something more detailed, more similar to what EDF pursued in their plant wash-down analysis. And because we have the benefit of that work that was done to support the volunteer plant assessment, LANL and our contractors have those tools available, so we want to do a crosswalk, if you will, to see if we get the same answer, and to help us understand what degree of conservatism is in the simplifying assumptions.

One key aspect that I wanted to mention, on the face of your first impression of the baseline is it is very conservative overall. But, nonetheless, there are steps that you could argue under some conditions are not conservatism, and so we have this balance between over and under that we're trying to compensate. The key assumption that I'm alluding to that was not mentioned this morning, is in order to partition the fine debris between active sumps and --

CHAIRMAN WALLIS: Now we can ask questions.

MR. LETELLIER: In order to partition the fine debris between the quiet sump pools and the active sump pools, there's an assumption, inherent assumption of uniform mixing throughout the volume of water. And that's something we would like to examine because we know from the example that EDF presented and in our volunteer plant study, there are preferred pathways for debris washdown, and sometimes they can be very close to the sump screen. It's not a given that the fine debris ends up in the reactor cavity simply because there's a large volume of water there. So that's an example of one issue that we're examining.

CHAIRMAN WALLIS: Now you say careful thought is being given. That's fine. That's good, logical construct is good, but what's the substance of the experimental evidence, the sort of validation by comparison with real data that makes us believe that the methods are okay? Is that something that's being done or is going to be done?

MR. LETELLIER: The industry has appealed to what I would say the historical or traditional knowledge-base with regard to debris generation, debris transport, debris head loss.

CHAIRMAN WALLIS: Because it's been accepted in the past, it's now okay?

MR. LETELLIER: In most circumstances, it is the best available information that we have to-date. It doesn't mean that it's ideal quality or quantity of information. For example, there are still a number of insulation types that are not fully quantified as far as the physical response or head loss properties.

In those circumstances, the industry has tried to rationalize a conservative position. For example, substituting the properties of another debris type. As you heard this morning, when the damage pressures or damage behavior in insulation are unknown, they apply the properties of the most vulnerable insulation type. That's a good example. And those simplifying assumptions I found to be very self-consistent.

I have some additional thoughts about some of the individual steps of the accident scenario. We can go through these pretty quickly, I hope. With regard to debris generation, as we said, the baseline defines the damage volume based on the most vulnerable insulation type. That is very conservative, and I think most plants should pursue the refinement. Where data is available to have an insulation-specific damage pressure, that is something that could easily come to agreement on.

I found in discussions with the contractors that have worked up some of the methodology, that thee has been a consistent application of the ANSI jet model, at least as far as the philosophy goes of computing a volume underneath a pressure contour which represents damage potential, and remapping it into the spherical zone. That has been done in a consistent way.

Now there are still some deficiencies in the model. Perhaps the ANSI jet is not the ideal thing to be using. Again, it may represent the best available at this point in time.

CHAIRMAN WALLIS: How does it compare with the experiment? If you take the ANSI jet model and what you know about damage pressures, does it model what happens when you take a real jet and real insulation and put it in the jet and see if it gets damaged or not?

MR. LETELLIER: There have not been any specific blowdown experiments performed with respect to insulation damage. The ANSI model is based on structural loading approximations, and so there are some discrepancies between the pressures that you predict with the model and those you might expect on a smaller object, like an insulated pipe. That's the status of knowledge. I can speculate on improvements to the model, ways to modify that data and how the correlations were validated. I'm not sure that it's constructive to pursue at this time.

MEMBER RANSOM: Is this ANSI jet model documented somewhere?

MR. LETELLIER: Of course.

MEMBER RANSOM: On paper or what?

MR. LETELLIER: The ANSI ANS standard, 58.2 from 1998 is the best reference.

CHAIRMAN WALLIS: I looked at that, and there's a lot of -- I mean, you could say yes, this is a nice looking model, but is it valid?

MR. LETELLIER: Presumably, it fits the data upon which it was based, which again were done for a large flat plate jet center line objects. It was intended to --

CHAIRMAN WALLIS: But that's not what happens. There isn't a large flat plate in the real system, is there?

MR. LETELLIER: For debris generation?

CHAIRMAN WALLIS: Yes.

MR. LETELLIER: Typically, that will not be the case. That's right. If you want to think about it as an abstraction, the radial pressure distribution on a large flat plat only maps the longitudinal component of the dynamic pressure, and so there's something missing there. We've got transverse flows that you would expect to impinge upon a target.

CHAIRMAN WALLIS: I thought the ANSI jet was for a free jet. There's no flat plate there at all, is there? The flat plate was the Sandia experiment.

MR. LETELLIER: No, I think they're very similar in nature, actually. The standard itself references the Sandia model as an alternative, if it's used appropriately.

One thing that was not discussed this morning is that there hasn't been any adjustment of the damage pressures for two-phase jet effects. The effects have not been observed or documented. It's speculative that there may be an important difference between a jet that entrains water droplets and a steam jet or an air jet surrogate. The NEI has chosen not to accommodate that explicitly; however, they have accounted for -- they've tried to make a conservative assumption about the fraction of fine material that's formed. And in that manner, hope to bound that uncertainty.

MEMBER FORD: Now as you go through this list, is it your objective to get data on all of these questionable items?

MR. LETELLIER: Time does not permit us to seek additional information. From a regulatory exercise, from NRR's perspective, we are making the best use of available information. And in some cases, there will be a default conservatism that's adopted.

MEMBER FORD: So how do you know if one of these items is not the killer? You decide by engineering judgment, we don't have the time or money to look at that one, having used engineering judgment, that's okay. How are you sure about that?

MR. LETELLIER: That is part of the challenge of assessing the competing conservatisms over and under.

MEMBER FORD: Now is that how we could help?

MR. LETELLIER: Very much so. I've given you a set of candidate priorities where I personally feel we should focus our efforts. If you can offer recommendations as to the path to pursue our refinement or a more legitimate approach, that would be more than welcome.

MEMBER FORD: Now will that be an

objective for the August meeting?

MR. LETELLIER: We are proceeding --

MEMBER FORD: Is that too late?

MR. LETELLIER: We are proceeding with our review at present. For example, I'm personally trying to validate the zone of influence calculations, and evaluate the ANSI model, so that work is underway. In order to make a timely contribution, it would have to be sooner than August 17th. The staff is hoping to present our final recommendations in that time frame.

CHAIRMAN WALLIS: But you're aware of the difficulties. I mean, the Sandia model had no mechanism for loss except a shockwave, and the ANSI jet model has some other mechanism, entrainment or something is going on.

MR. LETELLIER: It has a transition zone.

CHAIRMAN WALLIS: Which I didn't understand physically, completely different from the Sandia model, so who's right? It calls for a definitive experiment it seems.

MR. ARCHITZEL: Well, can I make the point, that you'll hear from research tomorrow, and there is some international experimental work that's going to go on.

CHAIRMAN WALLIS: It's going to go on.

MR. ARCHITZEL: Yes, it's like in two years, so it's not timely for us. The point is we're making decisions now on the information we have. We're going to make conservative end decisions.

CHAIRMAN WALLIS: Conservative decision is to say the whole containment is --

MR. ARCHITZEL: Well, that's been done for the boilers in some cases. That's correct. But don't need to necessarily be that conservative. But I guess the point is, there are residual questions out there. It's not that there's not research planned, but --

CHAIRMAN WALLIS: But you don't want to get egg on your face. You don't want to say we'll embrace this jet model, and then find that two years from now someone has done an experiment, and it turns out it wasn't right. Part of the reason we're in the situation today is because the research wasn't done in the past. People made judgmental decisions, 50 percent or something, and it turned out to be maybe not a very wise decision in the light of new knowledge.

MR. ARCHITZEL: We probably need help along those lines, but that is the path we're going down right now. We don't have the luxury of waiting for the results.

MR. LETELLIER: In fact, the ANSI model was embraced, endorsed, if you will, for the BWR resolution. It was exercised to compute damage zone volumes.

The industry has examined the initial conditions for both a hot leg and a cold leg break, and in order to what they termed bound the damage volumes. I would like to run more state point conditions during blowdown. I'm curious to know if as the quality of the steam increases, as it dries out during blowdown, the jets don't get larger actually.

For debris characteristics, the coatings is damaged. The questions we have are whether or not there are possible temperature effects. The industry, to their credit, has done some experimentation with high pressure water jets at two different temperatures, which we would call nominal. They do not approach the jet temperatures.

The reason for my questions on concrete ablation earlier from EDF gentlemen is that the current industry position is that a few mils of paint protect your concrete from high pressure jets; and yet we have some data that shows concrete ablation occurring. And there's some speculation that it's really the temperature gradient that you get spalling from the concrete surfaces because of the temperature shock, and that's something that has not been tested. There is also -- we have some concern about the performance of paints at those high temperatures, as well, so that's something we're looking at.

CHAIRMAN WALLIS: Presumably if it's hot enough, you actually vaporize moisture within the concrete and it comes apart.

MR. LETELLIER: That's possible too. Again, I mentioned that it is plausible the two-phase damage mechanisms - there are plausible two-phase damage mechanisms that could be different from a steam jet. And the industry is compensating by conservative debris size distributions.

At present, we don't have a physical basis for judging how conservative that may be. Some of those plausible mechanisms are erosion by droplets, penetration with internal expansion, flashing within the blanket. There are a number of conditions that could be different.

In general, the industry chose to replace missing damage pressures by -- they were compensated by an assignment of damage pressure equal 4 psi, which is one of the most vulnerable debris types that has been tested under surrogate conditions.

Another aspect of debris generation is, as they explained this morning --

CHAIRMAN WALLIS: The pressure is whatever pressure is achieved on the surface during direct impact, as a pressure that would be measured at the surface, presumably some sort of stagnation pressure.

MR. LETELLIER: On the object, that's right. And those were determined experimentally by putting pressure sensors in a free jet expansion, so the field, the pressure field was mapped by a surrogate object, not a large flat plat, but a small pressure transducer.

MEMBER RANSOM: They are stagnation pressures so that they can be translated to dynamic pressure. Well, they are dynamic pressure measurements.

MR. LETELLIER: Yes. As I explained this morning, there are only two size categories, the large 4 by 4 inches, and everything smaller. While we might agree that the assignment of the fine debris fraction is conservative, they have ignored any potential degradation of the large pieces.

CHAIRMAN WALLIS: So it's the pressure that destroys the insulation. It's not the suction at the high velocity flow flowing passed the sides of it?

MR. LETELLIER: It's a pressure differential.

CHAIRMAN WALLIS: It is? I don't know. If I put a cylinder in a flow, I get a stagnation pressure on the front, and I get low pressure on the sides that sucks things off.

MR. LETELLIER: And again, there are potential shock effects from the initial blast. There are many physical phenomena. We've had this discussion before. The intent of the experimentation is --

CHAIRMAN WALLIS: I would think that squeezing insulation against the pipe is unlikely to pull it off, but same sort of suction ripping it off is more likely to --

MR. LETELLIER: The sheer force --

CHAIRMAN WALLIS: Droplets in a flow get broken up by being ripped off from the sides or sucked up out of the back, and they also can get punched in the front. There's a variety of destruction mechanisms. It's not just --

MR. LETELLIER: Indeed. The intent of the experiments were to correlate the observed amount of damage with some physical metric that's rational. They could have chosen temperature to correlate those effects, and said at this location in a free jet, I observed X amount of damage. They could have used any metric.

Latent debris you will hear more about tomorrow in the research presentation. The industry has participated in a cooperative effort to collect debris samples which were characterized at LANL. We have some results to share tomorrow and the report actually should be posted on ADAMS for public accessibility this week.

I'd like to point out that the collection methods and the completeness to which the surveys are performed are critical to the proper estimation of inventory, we found quite a variety between the collection methods between the plants. And some of them did a much better job of collecting the sub-10 micron particles than others. I think it's really an experience basis needed to assess the effectiveness of these strategies. The media, for example, is another good data point.

In general, the industry is relying on the results of a foreign material exclusion program to preserve the -- I guess to minimize the inventory of latent debris, and for some plants that are on the margin of vulnerability, that may become a safety-critical function to maintain cleanliness. That's a byproduct of that assumption. They are estimating debris on both horizontal and vertical surfaces. And again, the report should be available this week.

CHAIRMAN WALLIS: It is arbitrary to say 4 by 4 is large, and anything less than that is small.

MR. LETELLIER: It's related to the physical size of the gradings and what can be obstructed for containment flow and what could not. Again, it's a very simplified -- it's a very convenient assumption to manage only two groups rather than seven, the whole distribution, so it improves the efficiency and the consistency tremendously. Our challenge is to assess whether they've adequately covered all of the steps, all of the details that we've been concerned about to this point.

CHAIRMAN WALLIS: It would seem to me that Mr. LeMar was only considering small particles. He wasn't considering these 4 inch by 4 inch, 10 centimeter by 10 centimeter whatever you want to call them. I don't know what you'd call them in --

MR. LETELLIER: Flocks.

CHAIRMAN WALLIS: Flush clots or something floating around.

MR. LETELLIER: Again, I think they

partition their debris distribution into two parts, the large and the small. And they assumed that the small was completely degraded into individual fibers.

CHAIRMAN WALLIS: Again, does this have a realistic basis or does someone just grab a number from the air and say 4 by 4?

MR. LETELLIER: It does have a realistic basis. There is always a distribution observed, at least in the surrogate test, from individual fibers all the way to only minor damage on a cassette. And the intent has been to pick a fraction, the 60 percent or 40 percent that bounds all previous test data, so that there is a physical basis. You may not agree that it's high fidelity, but there is a rationale.

MEMBER RANSOM: Are the PWRs here similar to the French PWR, where most of the affluent goes through gradings before it finally gets down to the sump, so the large debris would pretty much be strained out by just the plant configuration itself.

MR. LETELLIER: There is such a variety of designs in USPWR containment structures that plants have a various amount of grading, of decking.

MEMBER RANSOM: Is there any credit taken for that or can they take credit for that?

MR. LETELLIER: They can if they do a

careful detailed washdown analysis as you saw an example of. In fact, that's what our assessment of the volunteer plan looks like. For the BWR study, it was critical to know whether the break occurred below the gradings or above, and that affected the amount of upward blowdown, and also the washdown fractions that reached the suppression pool. Those same attributes are still relevant to this problem.

In general, the outline of the event sequence for washdown show generic pathways, but little guidance on what retention factor should be used. In effect, exactly your question about what factors are reasonable to assume under water flow versus spray impingement, versus different conditions.

I did notice that one assumption about fine reflective metallic insulation, the fines that are carried to upper containment are assumed not to wash back down. And there's very little justification given for that, except an expectation of low water velocity. And I just need to think about that. There are any number of little assumptions, either explicitly mentioned or implicitly carried with the analysis that is quite a sorting task.

Again, I mentioned the assumption of initial uniform debris assumed within the pool.

There's no treatment of debris transport during pool formation. We know that that will occur. There will be piles of leaves in containment. The containment sump itself can be a dead cavity that draws debris in that direction. You can pile it up on the screen.

They have simplified that process by saying it's all very fine. It's homogeneously mixed in the water. It goes wherever the water goes. And again, the only basis we have for judgment is to compare our best estimate of a detailed washdown transport with that assumption and see how they match up.

At present, there's no consideration of location for where the debris is introduced into the pool. And again, appealing to simplicity, they do that for convenience. But in some cases we know, ice condenser plants in particular, can have a very localized water flow return pathways, and sometimes they could be very close to the sump.

CHAIRMAN WALLIS: So all of these are plant-specific things too.

MR. LETELLIER: Yes.

CHAIRMAN WALLIS: So it's going to be very difficult besides this guidance for the staff to look at each one of these submittals and say ah-hah, you haven't considered the fact that this path is close to the sump, or that this is something peculiar about something else.

MR. LETELLIER: That's true.

CHAIRMAN WALLIS: So who's going to do that? We haven't yet had a staff member sent up with any technical knowledge to convince us that he's really on top of all these technical problems, to enable him or her to pick out yes, this is assumption is okay. No, that one isn't.

MR. LETELLIER: I think it's always been the intent or the desire of the staff to generate information for internal use, that the effort at compiling the knowledge base was a first attempt at that. The revisions of the reg guide are an education process for the staff, as well as the contractors.

Eventually, we will be faced with training the auditors, whether it's the people you see in the room or the regional inspectors. There will have to be some succinct statement or applications guide that are offered for that process.

CHAIRMAN WALLIS: There's got to be some principle involved here that you don't overload the staff with judgmental decisions which they're not in a good position to make.

MR. LETELLIER: In order to satisfy that concern, the best solution is a conservative baseline that everyone can agree on. Then you obviate the need for the detail. Unfortunately, there are some licensees that won't be able to accommodate that level of conservatism. They will have the greatest challenge in pursuing the refinements.

CHAIRMAN WALLIS: I just want to ask you, at the beginning I said that LANL had made this parametric study, and found some recent conclusions. Now there's this NEI methodology. Do you think the NEI methodology is going to come up with anything different from what you folks came up with? And if so, in what direction? You're in the best position to tell us.

MR. LETELLIER: It's speculation at this point. I can cite a number of additional conservatisms that the baseline imposes that we did not.

CHAIRMAN WALLIS: That would make things worse. So the implication would be that the conclusions would be even more severe in terms of plants having to do something, than conclusions from your study.

MR. LETELLIER: Again, I think the

industry attempted to convey the reason for the baseline, and it serves several purposes; one of which is to direct additional effort, where to put their attention. I think there is a policy issue before the staff and this body as to how do you interpret the results of the baseline. You may not be privy to those results. They may bypass that and pursue the refinements just as part of the normal course of analysis.

In some cases, as I said, the proposed refinements are additional detail, but they're not always directly tied logically to their prior simplifications. In many cases, I don't see a progression, a natural progression from the assumptions of the baseline into a refinement. In particular, I guess the effect of pursuing a refinement on all of the other assumptions is not well integrated. The connections are still not adequately explained.

It's never been clear to me whether if you choose Path A, do I have to take the most detailed path all the way through, or can I pick and choose? Simple versus complex at any step, and what are the implications of that for the prior assumptions that you've already made? That's not well described.

MEMBER FORD: Now what you're saying is scary, because you're going through a whole list of very valid question marks, and yet we don't seem to have any decision process to decide what should be looked at in experimental detail, and what they're going to just take as engineering judgment and put off on the side. And you're saying that you need to make those decisions now in order to come up with your final answers in the August meeting, which is what you said, but I don't think you really meant the final decisions. So when are these decisions made?

MR. LETELLIER: At this point in time, we don't have the luxury of pursuing additional experimentation. It is an engineering judgment exercise. The best approach to this review is to preserve the logical construct that the industry has provided and make sure that it's imposed in a consistent manner through the refinements.

MR. JOHNSON: Conservative and consistent.

MR. LETELLIER: Chemical effects you'll hear more about the test plan tomorrow from the Research side. Just to reiterate the bottom bullet, at the moment, this is considered to be an open item in the licensees response to the generic letter. It should be a GL, pending completion of these tests.

MEMBER FORD: And the objective of that program is what, the specific quantitative objective is what?

MR. LETELLIER: Primary objective is to determine whether or not adverse chemical effects are created in a reasonable containment environment. Secondary objective, if the adverse chemicals, gelatinous material or particulates are formed, can we quantify the head loss in a manner that allows us to do sump screen vulnerabilities.

MEMBER FORD: For all the various types of insulation that we have.

MR. LETELLIER: Our principal concern right now is the fiberglass because it performs a filter medium. It also seems to contribute to the chemistry of the solution. It sheds chemicals, silica, manganese, iron. All the constituents of the glass seem to participate in the chemistry in important ways.

CHAIRMAN WALLIS: Your first instinct would be that it would be fairly neutral. It's not a very aggressive environment. If you put glass fibers in there, nothing much should happen.

MR. LETELLIER: It depends on the flow velocities, and the diffusion conditions near the surface of the fibers, but others can correct me if I'm wrong. Under high velocity, the fiberglass can lose up to 3 percent of its mass per day through shedding --

CHAIRMAN WALLIS: Isn't it more likely that the particulates will engage in chemical reactions that the large surface area, all kinds of chemicals in there. Dirt contains pretty well everything, so isn't it much more likely that those particulates will be involved in chemical reaction?

MR. LETELLIER: You're talking about two phenomena here. First of all, there's a dissolution mechanism where you have contributors to the soup, if you will. And there's the whole issue of saturation and precipitation.

What you mention about participating in the reaction in the form of a catalyst or nucleation site, of course it is a very dirty environment. Both the debris on the screen can participate, as well as the debris that's laying in the corners. And the test, I hope you could see, is designed to accommodate those various conditions.

That's the extent of my comments, and we'll let Angie finish with a summary.

MS. LAVARETTA: I guess I could speak to

some of the comments that were made before. The comment that having a large number of plants because of the conservative treatment, going to the hardware fixes, I don't know that I personally would agree that that's a bad outcome. I think because of the aggressive schedule we have, the conservative treatment is going to allow for us to serve safety. As long as these plants are bounded by the results of their analysis, what's important is to bring closure to this in an expeditious fashion, and I think the schedule is driving this. And we want the plants to be responsive and --

CHAIRMAN WALLIS: It is interesting that the schedule is driving. I would think that the important thing to do is to assure the technically knowledgeable public that the right decision is being made.

MS. LAVARETTA: I think it is the right decision to fix the problem that's been around for as long as it has been.

CHAIRMAN WALLIS: Just because it's schedule driven. But you don't want to compromise something. You don't want to go and compromise some critical area because of the schedule, and then find out that this isn't technically defensible.

MS. LAVARETTA: I'm not sure it's compromising to improve the design of the sumps.

MR. SOLARIO: Excuse me, Dr. Wallis. You have a good point. You're asking whether or not we take a few more years, perhaps, to study more information. And I think Mr. Johnson in his opening remarks explained to you the direction the staff has. We're trying to balance that against trying to make progress, and this is what we think is the best course of action right now.

CHAIRMAN WALLIS: I agree. I agree. I mean, it may well be that everything is going to work out fine. I know you are doing this as quickly as you can, but it's artificial to say we will do it in a month if the job requires longer than a month. It's a very artificial way to do business. If I want someone to fix my car, I say fix it so that I can drive it. Don't just spend 10 minutes. Whatever you do, you have to fix the requirement, and that's the assurance that presumably the observers from the outside need to get.

MS. LAVARETTA: I agree. It would be ideal to develop the data to support the assumptions that are made.

CHAIRMAN WALLIS: Well, I don't know.

You've got to give assurance to the observers from the outside that a good technical job is being done. And yes, it would be great to do it on time, and even better to do it ahead of time.

MR. JOHNSON: We understand. And to be honest, I think actually the danger -- there's a greater likelihood that we'll come up with a fix that is overly conservative.

CHAIRMAN WALLIS: That might be true, yes. Just because you want to be careful.

MR. JOHNSON: But again, we're trying to balance coming out on the conservative side.

MS. LAVARETTA: As far as our approach to the resolution, the staff is holding discussions.

CHAIRMAN WALLIS: That gives me reassurance that things are working out.

MS. LAVARETTA: This is a two-page list. We'll be looking to clarify anything that we don't understand. We're doing further review on a number of areas, as Bruce described, in the treatment of coatings. There's a use of pressure washer data that they're using as a basis for its characterization. I'm not sure whether this data is applicable to the conditions you see inside containment during a LOCA. We're going to be talking more about it. The ZOI mapping that's being done. We're having LANL do verification exercises to come to a position on that use.

There's the debris transport assumptions that he discussed, and also the use of single phase debris generation modeling in a two-phase regime. So the final bullet is we're looking to find a balance between over-conservatism and the under-conservatisms that we've identified.

CHAIRMAN WALLIS: That's a very dangerous bullet. You should have criteria for what's adequate conservatism, and you should be able to express those criteria so that they're understandable. This is the most wishy-washy statement I've ever seen.

MS. LAVARETTA: Well, we're not in a position where we can give you the details today.

CHAIRMAN WALLIS: No, but I mean we're going to take a balance between plus infinity and minus infinity. That's a ridiculous statement. We've got say we know how to evaluate what's conservative and not. This is how we do it.

MS. LAVARETTA: Hopefully, it will more specific, and we'll be able to identify exactly what areas we are looking at, where we see the problems, where we see the over-conservatisms, and find a way to put --

CHAIRMAN WALLIS: Well, how do you know it's over-conservatism? There's got to be some criteria for what's conservative enough.

MR. JOHNSON: Well, I think, and you guys correct me if I'm wrong - I think what one of the genesis of this statement was that there would be this baseline analysis that is, in general, very conservative. But then plants would be taking refinements as they needed to, and so how does that overall analysis for each individual plant - how does that end up? I think wasn't there some of that -- was there some of that perspective in that bullet hopefully?

MS. LAVARETTA: Right. Well, we're in the process of developing a way to compare these areas, and I'm not prepared to discuss the details.

MR. JOHNSON: It's really trying to not just look at the baseline as if overly conservative, because you could probably come up with criteria about that or the refinement. It's what will come out of the mix for an individual plant, and will it be okay with respect to how they have evaluated the sump using the evaluation --

CHAIRMAN WALLIS: Well, I think you should forget the bottom bullet there and express it some other way.

MS. LAVARETTA: We will do a better job.

The areas where the guidance does not provide a lot of information, if any, is the downstream blockage, the calcium-silicate debris effects, the chemical effects which you heard about and will hear more about tomorrow, and the risk-informed option.

For those areas that may not be resolved, we're considering options for how we'd like to see them treated; whether it's by some conservative treatment or by some other approach that we'll come up with on our own.

CHAIRMAN WALLIS: So tomorrow we get this risk-informed --

MS. LAVARETTA: Yes.

CHAIRMAN WALLIS: All right.

MS. LAVARETTA: And we'll be able to speak to the specifics of our approach to this when we come back to you in August.

CHAIRMAN WALLIS: Now the risk-informed option might not make any difference, because it might turn out that three inch break is the worst break anyway in terms of similar effects or whatever, I don't know. So it may not make any difference, but at least it's there.

MS. LAVARETTA: So we'll be back on August 17th with our final position and final review, and then we're scheduled for a full committee meeting on September 8th, 9th, and 10th.

CHAIRMAN WALLIS: I think we need at some point to figure out if we can add any value at this time, besides saying we're looking forward to the results of all the things you're doing. Maybe we can do that tomorrow, or do that today? How can this subcommittee and the ACRS add value to the resolution of this issue at this moment when so many things seem to be in the process of being worked on.

MEMBER RANSOM: Mr. Chairman, I'd like to contribute a thought.

CHAIRMAN WALLIS: Good.

MEMBER RANSOM: We've been for some time now talking about zone of influence models that are tied to diameter. Well, the thing that does the damage is the energy of the jet, and the energy of the jet has got to scale with the diameter squared, so you'd wonder can you have a linear zone of influence model? The damage mechanisms are things like flutter, shear, not normal forces, which mostly materials do contain, and so fatigue and things like that come into play in ripping the material apart, and they're all related to the energy you have available to expend on these structures.

CHAIRMAN WALLIS: These are the kinds of questions that the technical community out there is going to ask when they look at how you resolve this issue. And you want to be sure that you don't have major questions like this which remain unanswered. This may be just one of the questions that could be raised about these mechanisms. What I'd like to see personally would be something along the lines of the NEI methods, but really solid technical work, and we could look at it and say yes, that's really good. We accept that. That's the way on which to base your decision. That's the mechanism, so recommend to the Commission that yes, you've now got a good technical basis on which to make decisions. That's what we'd like to see. I don't think we can get too involved in the legalistic side of it, because that's not our expertise. And until we actually look at the NEI document and staff's assessment of it, we're not really in the position to do that.

MR. JOHNSON: It would be best, but you'd like to see the draft SE basically.

CHAIRMAN WALLIS: I think that would be where we could start to add value.

MR. JOHNSON: Have we shared with the ACRS the list of our key issues?

MS. LAVARETTA: With the baseline?

MR. JOHNSON: With the baseline, or with refinements and -- sort of the most significant of those issues and the direction that the staff will take in terms of resolving those issues.

MS. LAVARETTA: The comments, I don't think I've actually transmitted the list to Ralph, but I've got the list together in preparation for August.

MR. CARUSO: I saw the RAI list to which NEI responded on June 10th. That's all we have at this point.

(Simultaneous speech.)

MS. LAVARETTA: I haven't transmitted it. I'm planning on transmitting it for the August meeting.

MR. LETELLIER: The RAI response actually documents all of our detailed comments. It's just a Question and Answer - that's the format that they chose. That would be the most complete set of evaluation interaction that we have. We could certainly help you prioritize. It's 103 pages.

CHAIRMAN WALLIS: So what are being asked to do this time is to say go ahead with this generic letter. Is that what we're being asked to do?

MR. JOHNSON: That's right. We're focused --

CHAIRMAN WALLIS: How does anything we've heard today affect this generic letter?

MR. JOHNSON: You have not heard about the generic letter today. When you -- theoretically, what you've heard today will give you some perspective about some of the comments that we've gotten regarding schedule, at least. But I think there are background -- but more importantly, it was our first opportunity to get to you to tell you where we are on the evaluation of the guidelines, both the industry and the NRC. So we recognize that again, you're in a situation where you haven't had a chance to dig into either the evaluation of --

CHAIRMAN WALLIS: Well, I think we may have reached the same conclusion we reached for the Reg Guide 182, that there are a lot of questions out there. They're being worked on but it's best to get something out in order to make sure that something happens. And, therefore, getting the generic letter out would help because it forces some response and forces people to work on the problem seriously, because they've now got some set things to do. In that sense, it's good. But it's very difficult, I think, for us to anticipate successful conclusion.

MR. JOHNSON: Is it possible for us to talk tomorrow some more about how we can give you what you need to be more effective in August?

CHAIRMAN WALLIS: We can talk about it tomorrow. Sure.

MR. JOHNSON: I think that's where we get the most benefit in terms of --

MEMBER FORD: I think there's two problems, Graham. The first one is what's on the table right now is expected of us. And I think we'll get a better idea tomorrow in the first two presentations tomorrow because they talk about the generic letter, and also the bulletin. So we can find out what the kind of scope of what the expectations are for us, so we can satisfy them there. But what I'm far more concerned about is how can we give advice on the overall technical aspects. We have a huge problem, and I personally, because we haven't seen even schematic-types of data and the assumptions and the problems associated with that, I don't feel that an informed technical person that can give any good advice, apart from being destructive rather than constructive.

CHAIRMAN WALLIS: Well, we gave advice in our last letter, and NEI seems to be following some of it. I mean, they're looking at the risk-informed side of things, and they're looking at alternative or ways to get long-term cooling, operator actions and other things can assure that in spite of the fact that there's some uncertainty about the sump screens, the core is going to be protected. And those have been useful. But in terms of the technical problems with the debris generation and all that messy stuff, I don't know that we can contribute.

MEMBER FORD: Well, without more information than we've got so far.

MEMBER KRESS: Well, considering the fact that I don't really know how we're going to deal with downstream effects, I still think the best approach to resolving this thing is a risk-informed one. You have to relegate it a low enough CDF that you can accept it on risk screens. So I would certainly like to see them approach that strongly.

CHAIRMAN WALLIS: We're going to hear about that tomorrow, the staff's perspective on the risk-informed. Of course, it may not make any difference. It may turn out that it's the small break that matters. Who knows? So we're going to meet again tomorrow. NEI has left though, haven't they, so we won't be seeing them again, or at least Tony has left.

MR. BUTLER: I'll be here tomorrow.

CHAIRMAN WALLIS: You'll be here, so you'll be the representative of --

MR. BUTLER: I'll forward any questions you have to Tony.

CHAIRMAN WALLIS: And then tomorrow at the end of the day maybe it will be clear how the ACRS might add value. I think you might mull that over, and perhaps have actually a couple of transparencies at the end or something which says these are the areas where you can be most helpful to us. Are we ready to end up today?

MR. CARUSO: I think we are.

CHAIRMAN WALLIS: Okay. The sequel will take place tomorrow, and we'll meet here at 8:30 tomorrow. And with that I will - what's the right word - recess the meeting five minutes ahead of schedule.

(Whereupon, the proceedings in the above-entitled matter went off the record at 4:55 p.m.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Thermal-Hydraulic Phenomena

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

John Mongoven
Official Reporter
Neal R. Gross & Co., Inc.

Industry Actions in Response to PWR Sump Performance Issues

Opening Remarks

Advisory Committee on Reactor Safeguards
Thermal Hydraulic Phenomena Subcommittee
June 22, 2004

Tony Pietrangelo
Nuclear Energy Institute
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NEI

September 30, 2003 ACRS Letter

Recommendation:

1. Draft final Revision 3 to RG 1.82 should be issued in order to facilitate licensee response and the resolution of technical issues. In addition, the staff should carefully review implementing guidance being developed by the Nuclear Energy Institute (NEI) because of the issues identified, the complex phenomena involved, and the need for more accurate plant-specific assessments.

- Industry evaluation guidance was submitted for staff review on May 28, 2004
- Industry presentations will provide an overview of the guidance document, highlighting the manner in which the complex phenomena are to be addressed as part of the plant-specific assessments

NEI

September 30, 2003 ACRS Letter

Recommendation:

2. The knowledge base report is a compendium of research results relevant to the problem, but it is confusing and it cannot be used directly as guidance for the analysis of sump blockage. Acceptable methods should be developed for use in satisfying the functional requirements described in RG 1.82.

- Recommendation highlights
  - Complex phenomenological nature of the associated processes
  - Limitations in scope and applicability of test data
  - Uncertainties associated with translation and application of small-scale tests and experiments
  - Variability in plant designs and expected plant conditions
  - Difficulties associated with modeling chaotic flow processes
- Industry guidance has attempted to address these issues within the schedule constraints established by NRC staff

NEI

September 30, 2003 ACRS Letter

Recommendation:

3. An adequate technical basis should be developed to resolve the issues related to chemical reactions.

- Testing will be conducted to investigate chemical reactions under prototypic conditions
- Co-sponsored by NRC Research, EPRI and Westinghouse Owners Group

NEI

September 30, 2003 ACRS Letter

Recommendation:

4. The staff should consider the possibility that the uncertainties associated with the calculational methodology may be so large, or that strainers may prove to be so susceptible to debris blockage, that alternative solutions may be required to ensure long-term cooling. This might involve, for example, changing the types of insulation used within containment or implementing diverse means of providing long-term cooling.

- Methodology is structured to provide an early indication of susceptible areas of design and operation that will assist the evaluation of resolution options (Baseline)
- Recommendations and guidance for refinement of Baseline results are provided and include both design refinements and analytical refinements

NEI

September 30, 2003 ACRS Letter

Recommendation:

5. The staff should investigate a risk-informed approach to sump screen blockage.

- Evaluation guidance provides two options for resolution
  - Option A – "traditional" deterministic approach
  - Option B – Risk-informed approach
- Progress of on-going discussions between NRC staff and industry will be presented

NEI

Overview of Industry Evaluation Methodology

Advisory Committee on Reactor Safeguards
Thermal Hydraulic Phenomena Subcommittee

June 22, 2004

Maurice (Mo) Dingler
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1

Introduction

- Objective of Methodology
  - Provide a suggested consistent framework with plant-specific inputs which allows for plant specific applications
  - This allows for utilities to perform conservative evaluations of PWR post-accident containment sump performance of their plant

2

Background

The evaluation is a multi-step effort addressing:

- Postulated Break (size and location dependent)
- Determination of debris generation (quantity, types, size distribution)
- Evaluation of transport and hold-up (highly dependent on plant design and postulated scenario)
- Incorporation of contributory factors (latent debris sources, spray wash down)
- Calculation of screen deposition and resulting headloss

3

Considerations

- The guidance development effort was complicated by a number of factors
  - High degree of variability in plant designs (layout of containment)
  - Very few plants were close in configuration (insulations types and quantities differ from plant to plant)
- Utilizes built-in conservatisms to accommodate uncertainties

4

Evaluation Steps

Four major steps:

- Debris Generation
  - Break Location
  - Break size
  - Zone of Influence
  - Debris Characteristics
- Latent Debris
- Debris Transport
- Head Loss

5

Approach Taken

- Baseline Methodology
- A common, conservative method that all plants may use
  - Upon completion of Baseline Analysis, the results will indicate either adequate NPSH margin or a need to take other appropriate action, i.e., analysis refinement or plant modification
- Analytical Refinements (Supplemental Guidance)
  - Additional refinements (options) provided for more realistic but still conservative evaluation of post-accident containment sump performance
  - Accomplished through a combination of input/design and method revisions

6

Section 3: Baseline Evaluation

Debris Generation

- Break location
  - Maximum debris generation
  - Worst case combination of debris types
- Break Size
  - Double-Ended Guillotine Break
- Zone of Influence
  - Spherical, radius based on minimum insulation destruction pressure

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Section 3: Baseline Evaluation

Characterizing Debris

- Debris characteristics
  - Large pieces
  - Small (fine) pieces
- Latent Debris
  - Generally not considered a major contributor
  - Estimate total latent debris in containment
  - Set debris characteristics
  - RES research may provide additional quantification of amount and physical characteristics

8

Section 3: Baseline Evaluation

Debris Transport

- Uses transport logic trees to quantify debris capture and non-transport
- Addresses
  - Washdown
  - Erosion of insulation
  - Pool transport

9

Section 3: Baseline Evaluation

Head Loss

- Use NUREG –6224 head loss correlation
  - Provides for evaluation of a conservative head loss
- Effects of debris bed composition and material properties
- Thin bed evaluation is considered

10

Section 4: Analytical Refinements

Debris Generation

- Break locations
  - Use Generic Letter 87-11
- Break size
  - Double-Ended Guillotine Break
- Zone of Influence
  - Material Specific ZOIs
  - Directed Jet

11

Section 4: Analytical Refinements

- Debris Characteristics
  - Use of additional existing test data
- Debris Transport
  - Nodal Network Model
  - Computational Fluid Dynamic (CFD)
- Head Loss
  - NUREG 6224
  - Use of alternate head loss correlations, if applicable

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Section 5: Design and Admin Controls

- Debris Transport Obstructions:
  - Floor obstructions (curbs)
  - Debris obstructions (trash) rack
- Considerations for Screen Modifications:
  - Passive strainer design
  - Backwash strainer design
  - Active Strainer design

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Section 6: Risk-Informed

- Define Maximum Alternate Break Size (ABS)
  - Design basis analyses address break locations from Section 4.2.1 of the Analytical Refinements
  - Separate analyses performed to demonstrate mitigation capability for break sizes larger than ABS
- Mitigation capability analysis performed using modifications of conservative DBA methods, assumptions and success criteria

14

Section 7: Additional Design Considerations

Items to be considered in the design

- Structural analysis of sump
- Upstream effects
- Downstream effects
- Chemical effects
  - Joint Industry/ NRC test program

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Industry Evaluation Methodology-Baseline Evaluation

Advisory Committee on Reactor Safeguards
Thermal Hydraulic Phenomena Subcommitee

June 22, 2004

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Overview

- PWR Methodology Introduction
- Evaluation Method Approach
- Baseline Method
  - Break Selection
  - Debris Generation
  - Latent Debris
  - Transport
  - Head Loss
- Summary

Evaluation Method Approach

- Section 3 – Baseline Methodology
  - A common, conservative method that all plants may use
  - Uses plant-specific inputs which allows for plant specific applications
  - If a plant determines that sufficient head loss margin exists, no additional evaluation is required
- Section 4 – Analytical Refinements
  - Additional refinements (options) provided for more realistic but still conservative evaluation of post-accident containment sump performance

Baseline Break Selection

- Break Types
  - Double-Ended Guillotine Break
  - Conservative – maximizes region for debris generation
- Break Locations
  - Considerations
    - Maximum total debris generation
    - Worst case combination of debris types
    - Break locations taken at arbitrary intervals
  - Debris generation is an iterative process based on multiple break locations
  - Break exclusion zones not considered

Baseline Debris Generation

- Selection of Zone of Influence (ZOI)
  - Philosophy similar to that used for BWRs
  - Uses ANSI/ANS 58.2-1988
    - Free expansion of a flashing jet from a subcooled reservoir
    - Insulation damage pressure related to jet static pressure
    - Select material with the lowers damage pressure to define the ZOI
    - Calculate equivalent sphere assuming double ended break
  - Yields a conservatively large region for debris generation
    - Jets from both ends of the DEGB assumed to be freely expanding
    - T/H input values selected to maximize jet volume
    - Can be beyond current licensing basis jet impingement evaluations
      - 10 times break diameter
      - Based on NUREG/CR-2913, dated January 1983

Baseline Debris Generation

- Debris Characterization and Evaluation
  - Two debris sizes identified
    - Fines – smaller than 4" x 4"
    - Large - greater than 4" x 4"
    - Provides for conservative debris behavior
  - Erosion implicitly addressed by assuming all non-jacketed insulation is eroded

Baseline Latent Debris

- Conservatively estimate total latent debris in containment:
  - Calculate or estimate surface areas
  - Took samples (swipes) of various areas to estimate quantity of latent debris
  - Set debris characteristics
- Characterization of latent debris by RES may provide additional quantification of amount, physical characteristics
- Generally not considered a major contributor, but is accounted for

Baseline Debris Transport

- Four modes of debris transport considered
  - Blowdown transport
    - Initial distribution of debris
  - Washdown spray transport
    - Transport from upper elevations of containment to pool
  - Pool fill-up transport
    - Transport as pool is building on containment floor
  - Recirculation transport
    - Movement of debris after recirculation is initiated

Baseline Debris Transport

- Use transport logic trees
  - Similar to method used for BWRs; NUREG/CR-6369
  - Quantifies debris capture and non-transport
  - Includes latent or resident containment debris
- Identifies
  - What insulation is retained and where it is retained
  - What insulation is transported to sump
- Addresses final distribution about containment
- Provides for a conservative estimate of
  - Debris distribution about containment
  - Debris transport to containment sump screen

Sample Logic Tree for Transport

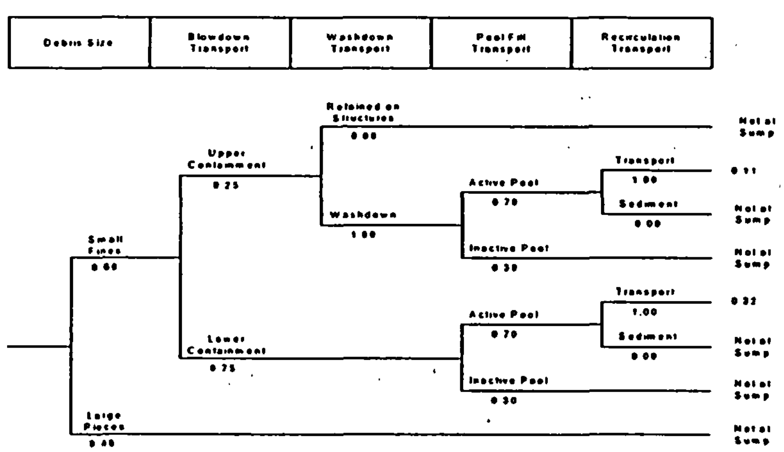


Figure 3-3. Nukon Transport Logic Tree (Sample Problem)

Baseline Head Loss

- Use NUREG/CR-6224 head loss correlation
  - Semi-theoretical correlation
  - Accounts for
    - Debris characteristics (thickness, porosity, surface-to-volume ratio, compressibility)
    - Working fluid characteristics (velocity, density, viscosity)
  - Flat plate application of correlation
  - Debris quantities are specifically accounted for
  - Provides for a conservative head loss calculation
    - Demonstrated by test data

Summary

A Baseline Methodology

- Has been defined to evaluate post-accident sump performance
- The method accounts for the five evaluation steps
  - Break Selection
  - Debris Generation
  - Latent Debris
  - Transport
  - Head Loss
- The method is applicable to all plants with plant-specific input
- Provides for application of compounded conservatisms in the evaluation of sump screen head loss

Industry Evaluation Methodology - Refinement Options

Advisory Committee on Reactor Safeguards
Thermal Hydraulic Phenomena Subcommittee

June 22, 2004

Tim Andreychck
Principal Engineer
Westinghouse Electric Co., LLC
andreyts@westinghouse.com
412-374-6246

Overview

- Introduction to Refinements
- Refinement of Break Selection
  - Break Size
  - Break Locations
  - Selection of Zone of Influence
  - Debris Generation
- Refinement of Latent Debris
- Refinement of Debris Transport
- Refinement of Head Loss
- Summary

Evaluation Method Approach

- Section 3 – Baseline Methodology
  - A common, conservative method that all plants may use
  - Uses plant-specific inputs which allows for plant specific applications
  - If a plant determines that sufficient head loss margin exists, no additional evaluation is required
- Section 4 – Analytical Refinements
  - Additional refinements (options) provided for more realistic but still conservative evaluation of post-accident containment sump performance

Introduction to Refinements

- Definition of an Analytical Refinement
  - An analysis option
  - Builds on approach taken in Baseline Methodology
- Objective of Analytical Refinements
  - Provide for more realistic but still conservative evaluation of post-accident containment sump performance

Refinement of Break Selection

- Break Type
  - Double-ended Guillotine Break
  - Same as Baseline Methodology

Refinement of Break Selection

- Break Locations
  - Use Generic Letter 87-11, "Relaxation in Arbitrary Intermediate Pipe Rupture Requirements."
    - Dynamic effects (missile generation, pipe whipping, pipe break reaction forces, jet impingement forces, compartment, subcompartment and cavity pressurizations, and decompression waves within the ruptured pipe) and all environmental effects (pressure, temperature, humidity, and flooding) resulting from arbitrary intermediate pipe ruptures eliminated from consideration
    - Consistent with a plant's licensing basis
  - Application focuses attention on high stress and fatigue locations
    - Terminal ends of a piping system at its connection to a component
    - For example, junction of a steam generator and the primary system piping.
  - Consideration of maximum debris generation and worst case combination of debris types retained
    - Steam generators are a large source of insulation debris
    - Also may have multiple insulation types applied
  - Therefore conservatism is retained

Refinement of Debris Generation

- Selection of Zone of Influence (ZOI)
  - Define Material Specific ZOIs
    - Credit robust insulation inside containment
  - Yields a conservatively large region of debris generation for a specific material
    - Jets from both ends of the DEGB assumed to be freely expanding
    - T/H input values selected to maximize jet volume
    - Can be beyond current licensing basis jet impingement evaluations
      - 10 times break diameter
      - Based on NUREG/CR-2913, dated January 1983
  - Debris generation is dependent upon material properties

Refinement of Debris Generation

- Selection of Zone of Influence (ZOI)
  - Directed Jet
    - Similar to approach described in NUREG/CR-2913, (January 1983)
  - Yields a conservatively large target-based region for debris generation for a specific material
    - Jets from both ends of the DEGB assumed to be freely expanding
    - T/H input values selected to maximize jet volume
    - Can be beyond current licensing basis jet impingement evaluations
      - 10 times break diameter
      - Based on NUREG/CR-2913, (January 1983)
  - Debris generation is dependent upon material properties

Refinement of Debris Generation

- Debris Evaluation
  - Additional tabular listings of material debris characteristics provided
    - NUREG/CR-6808
    - Industry data, where available
  - Provides for realistic debris behavior

Refinement of Latent Debris

- No general analytical refinement offered
- Plant-specific environment (procedures, cleanliness, etc.) may justify changes to latent debris source term
  - Debris volume
  - Debris characteristics
- Again, generally not considered a major contributor, but is accounted for

Refinement of Debris Transport

- Two refinement options identified
  - Nodal network
    - Based on open channel flow techniques
    - Uses bulk fluid velocities to evaluate debris transport, erosion, etc.
  - Computational Fluid Dynamics
    - Uses commercially available codes
    - Uses local fluid conditions (turbulent kinetic energy, velocities) to evaluate debris transport, erosion, etc.
  - Both approaches require similar information; for example:
    - Containment design
    - Pool height, water sources to the pool
    - Quantity, type and size distribution of debris

Refinement of Head Loss

- No refinements offered for:
  - NUREG/CR-6224 head loss correlation
  - Evaluation of thin bed effects
- Additional information is presented on the following:
  - Background information on the development of head loss correlations
  - A summary of head loss tests performed to date
  - Alternate head loss correlations
  - Discussion of possible analytical refinements
  - Discussion of head loss correlations for alternate strainer designs

Summary

- Analytical Refinements to the Baseline Methodology have been identified
  - They are analysis options
- The Analytical Refinements provide for more realistic but still conservative evaluation of post-accident containment sump performance
- Standing option to use plant- or vendor-specific data, if available and applicable

GSI-191 Risk-Informed Resolution

Proposed Approaches

Advisory Committee on Reactor Safeguards
Thermal Hydraulic Phenomena Subcommittee
June 22, 2004

John Butler
Nuclear Energy Institute
jcb@nei.org

NEI

Outline

- Industry Objectives
- Proposals
  - Industry
  - NRC
- Status

NEI

Objectives

- Deterministic analysis addresses uncertainties by compounding conservative treatment
  - Resolution driven/defined by extremely unlikely break scenarios
- Desire resolution option that considers likelihood and risk
- Provide option for GSI-191 resolution that incorporates risk insights:
  - Define "Alternate Break Size" Based on Break Frequency
  - Demonstrate Mitigation Capability for Breaks larger than ABS Using Realistic Methods and Inputs
  - Assure acceptable risk impact
- Address GSI-191 schedule constraints using approach that is simple and straightforward in both development and implementation
  - Not intended to be 10CFR50.46 risk-informed rule change "pilot"

NEI

Timeline

- March 4, 2004 NRC letter expressing willingness to discuss risk-informed resolution option
- Public meeting on May 25, 2004
  - NRC proposal
  - Industry proposal
- Public meeting on June 17, 2004

NEI

Risk-Informed GSI-191 Resolution

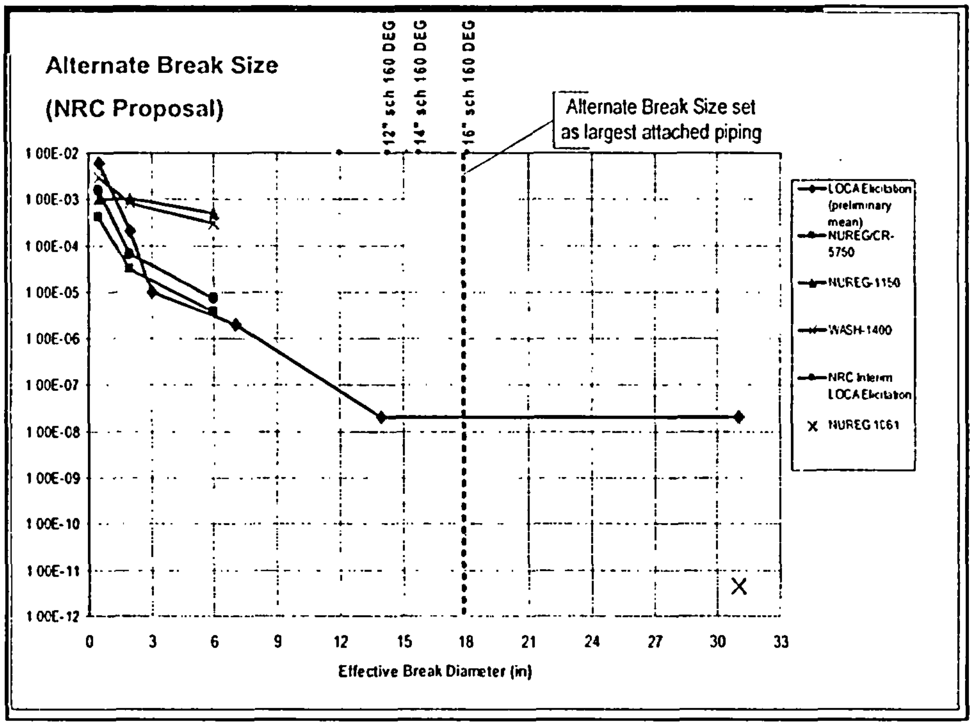
- Four components:
  - Identification of an alternate break size (ABS)
  - Design-basis, deterministic analyses for break sizes up through ABS
  - Demonstration of mitigative capability for breaks larger than ABS
  - Demonstration that RG 1.174 acceptance guidelines are satisfied

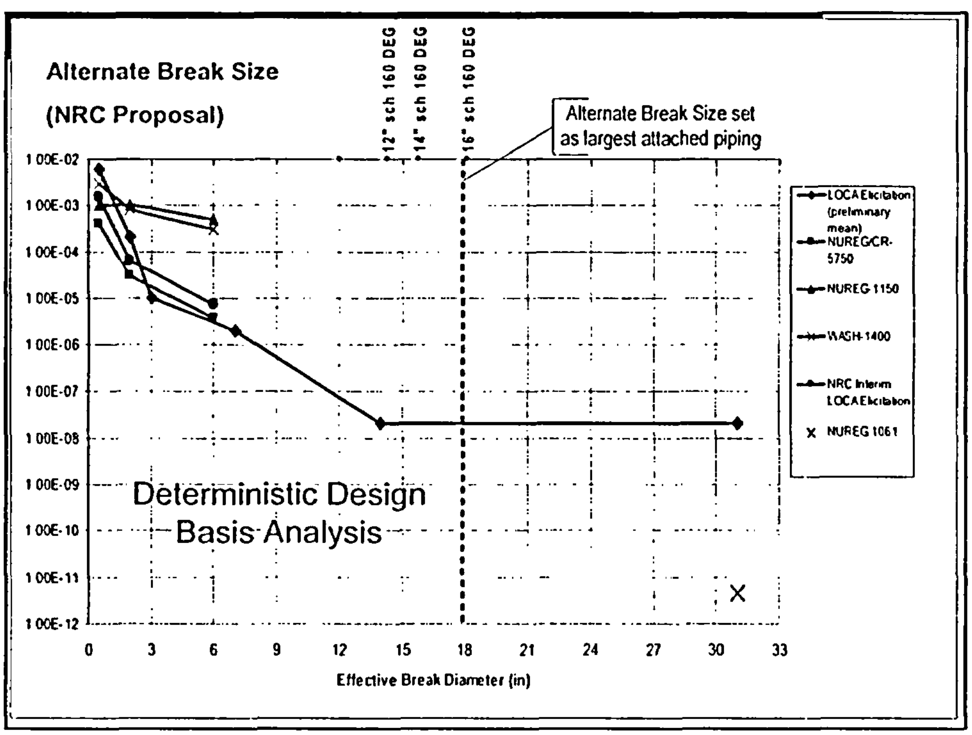
NEI

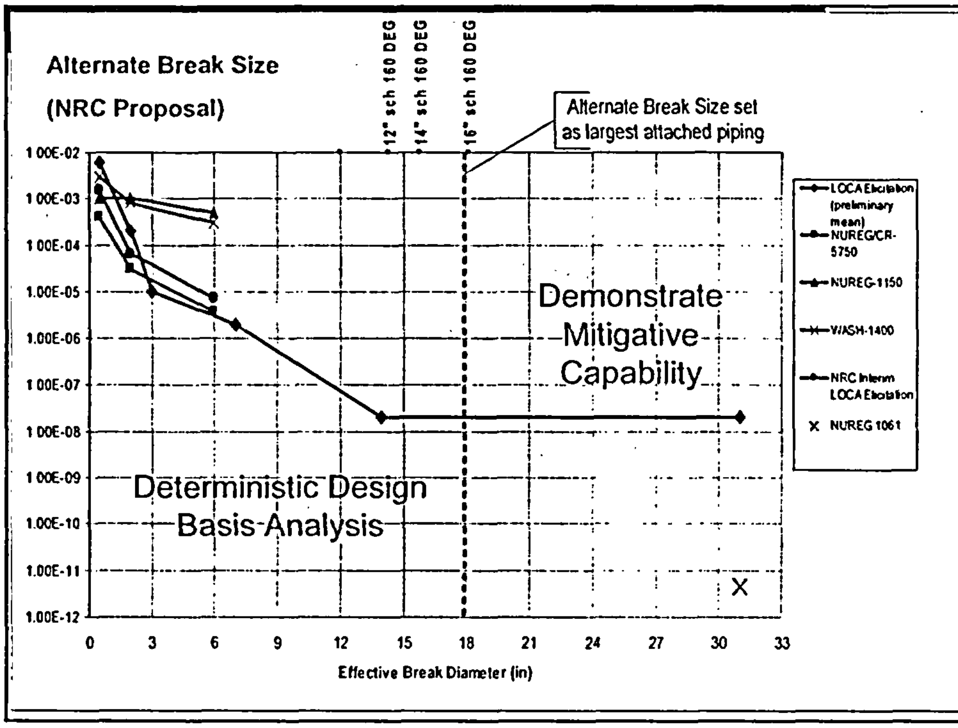
Alternate Break Size

- NRC Proposal
  - ABS = Area equivalent to a DEGB of the largest attached piping to RCS main loop piping
- Using this ABS, the Design Basis Analyses would include all auxiliary lines and all break locations in main loop piping for sizes up to ABS
  - Includes all breaks in Categories 3 & 4 of Elicitation Effort
  - Includes major contributors to Categories 5 & 6 of Elicitation Effort
    - Surge line
    - RHR line
    - Hot leg breaks (up to alternate break size)
- Spectrum not addressed by Design Basis analysis is Main Loop piping with effective break area greater than Alternate Break Size

NEI


Alternate Break Size
(NRC Proposal)
12" sch 160 DEG
14" sch 160 DEG
16" sch 160 DEG
Alternate Break Size set as largest attached piping
1 00E-02
1 00E-03
1 00E-04
1 00E-05
1 00E-06
1 00E-07
1 00E-08
1 00E-09
1 00E-10
1 00E-11
1 00E-12
0
3
6
9
12
15
18
21
24
27
30
33
Effective Break Diameter (in)
LOCA Elicitation (preliminary mean)
NUREG/CR-5750
NUREG-1150
WASH-1400
NRC Interim LOCA Elicitation
NUREG 1061


Alternate Break Size
(NRC Proposal)
12" sch 160 DEG
14" sch 160 DEG
16" sch 160 DEG
Alternate Break Size set as largest attached piping
1 00E-02
1 00E-03
1 00E-04
1 00E-05
1 00E-06
1 00E-07
1 00E-08
1 00E-09
1 00E-10
1 00E-11
1 00E-12
0
3
6
9
12
15
18
21
24
27
30
33
Effective Break Diameter (in)
Deterministic Design Basis Analysis
LOCA Elicitation (preliminary mean)
NUREG/CR-5750
NUREG-1150
WASH-1400
NRC Interim LOCA Elicitation
NUREG 1061



Demonstration of Mitigation Capability

- Performed to demonstrate that mitigation capability is retained for break sizes between ABS and DEGB of largest pipe in RCS
- Analysis performed using modification of conservative DBA methods, assumptions and success criteria
  - Use of realistic vs. conservative inputs
  - Eliminate non-mechanistic assumptions
  - Nominal vs. Bounding
  - Credit for non-safety equipment and operator actions

NEI

Industry Proposal - Demonstration of Mitigation Capability

- Guidance directs the use of DBA methodology with identified set of modifications
- Necessary to simplify the review, acceptance and performance of DMC analysis

NEI

Industry Proposal - Demonstration of Mitigation Capability

- **Break Sizes**
  - Range of break sizes from ABS to full DEGB of largest attached piping
- **Break Locations**
  - Main Loop Piping locations identified using SRP 3.6.2* and MEB 3.1**
  - Addresses locations susceptible to high stress and fatigue

* SRP 3.6.2, *Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping*

** Branch Technical Position MEB 3.1, *Postulated Rupture Locations in Fluid System Piping Inside and Outside Containment*

NEI

Industry Proposal - Demonstration of Mitigation Capability

- **Break Configuration**
  - Full Circumferential break assumed to result in pipe severance and separation amounting to at least one-diameter lateral displacement unless physically limited by piping restraints, structural members, or piping stiffness as may be demonstrated by analysis
  - Limited pipe displacements at the break location, line restrictions, flow limiters may be taken into account, as applicable

NEI

Industry Proposal - Demonstration of Mitigation Capability

- **Analysis Assumptions**
  - Nominal Thermal/Hydraulic Conditions
  - Debris Source Term
    - Developing recommendations for "nominal" latent debris source term and relaxation of treatment of unqualified coatings
  - Credit for Non-safety equipment and operator actions

NEI

Industry Proposal - Demonstration of Mitigation Capability

- Success Criteria
  - Conservative application of NPSH criterion utilizing more realistic calculation assumptions
  - Demonstrate NPSH margin for minimum number of ECCS injection pumps
  - Demonstrate long-term containment cooling capability
  - Time-variable nature of required and available NPSH can be considered
  - Limited operation in cavitation (negative NPSH margin) can be considered, where justified
  - Nominal parameters used in NPSH calculation
    - Containment sump temperatures and levels
    - Containment backpressure
    - ECCS flow

NEI

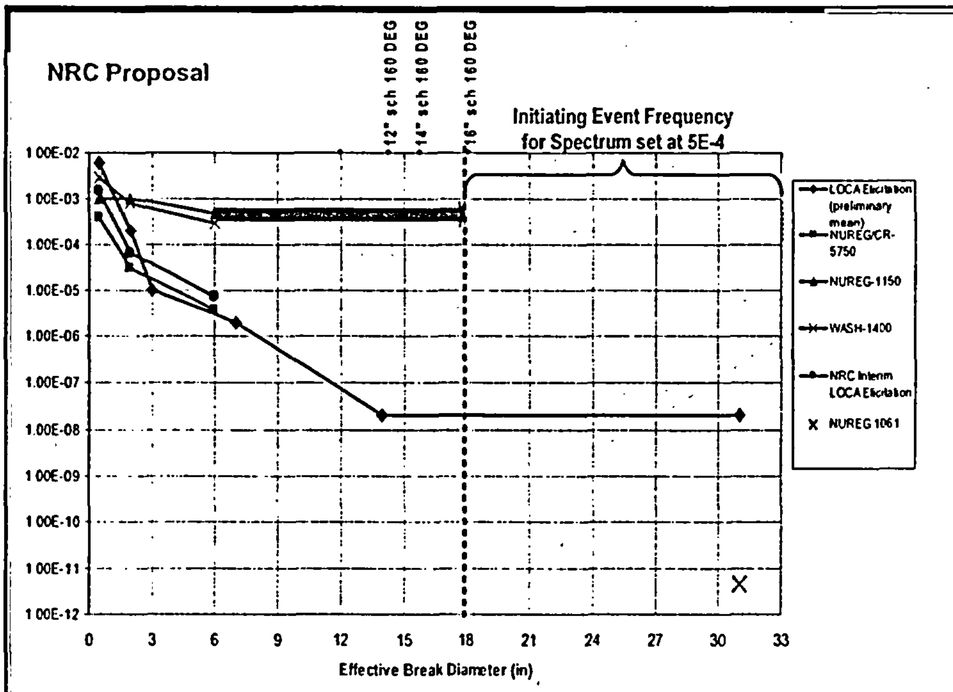
NRC Staff Position on Break Locations

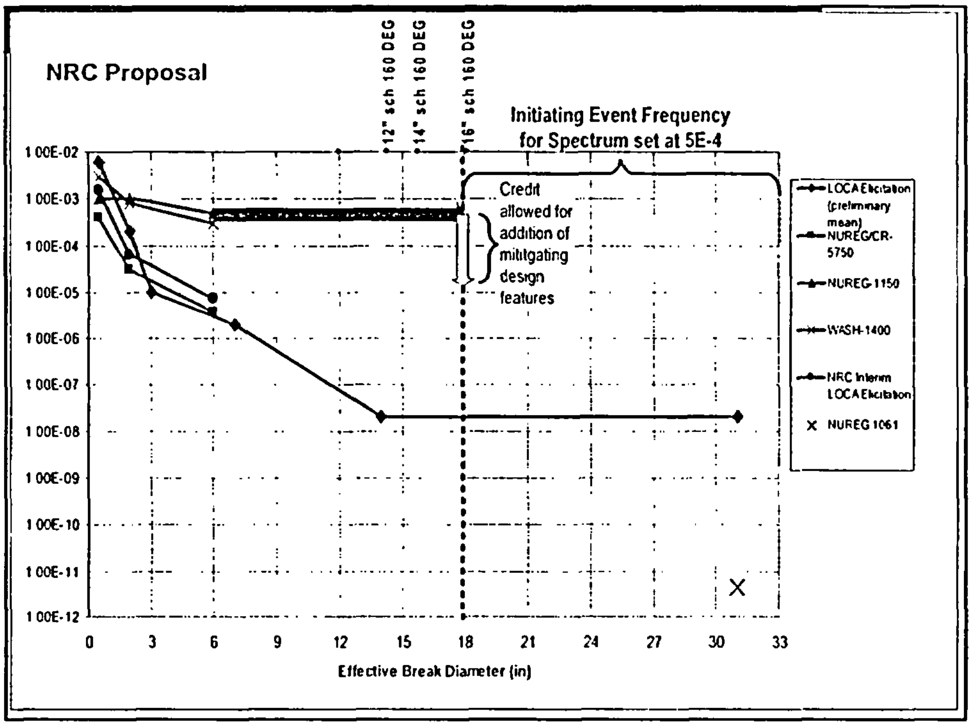
- NRC rejected similar BWROG proposal- inappropriate to cite SRP 3.6.2 as a basis for determining pipe break locations to demonstrate compliance with 10 CFR 50.46
- Regulatory Guide 1.82, Rev. 3 suggests that a sufficient number of break locations be considered to "reasonably bound" variations in debris generation by size, quantity and type
- 10 CFR 50.46 rulemaking on path to require demonstrated mitigative capability up through a DEGB of the largest piping in the RCS, independent of break location – not planning to identify specific break locations
- Staff Position – for breaks larger than the "debris generation" break size, a risk-informed approach to resolve GSI-191 should require demonstrated mitigative capability up through the DEGB of the largest pipe in the RCS, considering break locations which result in the worst-case scenarios for ECCS Sump recirculation capability

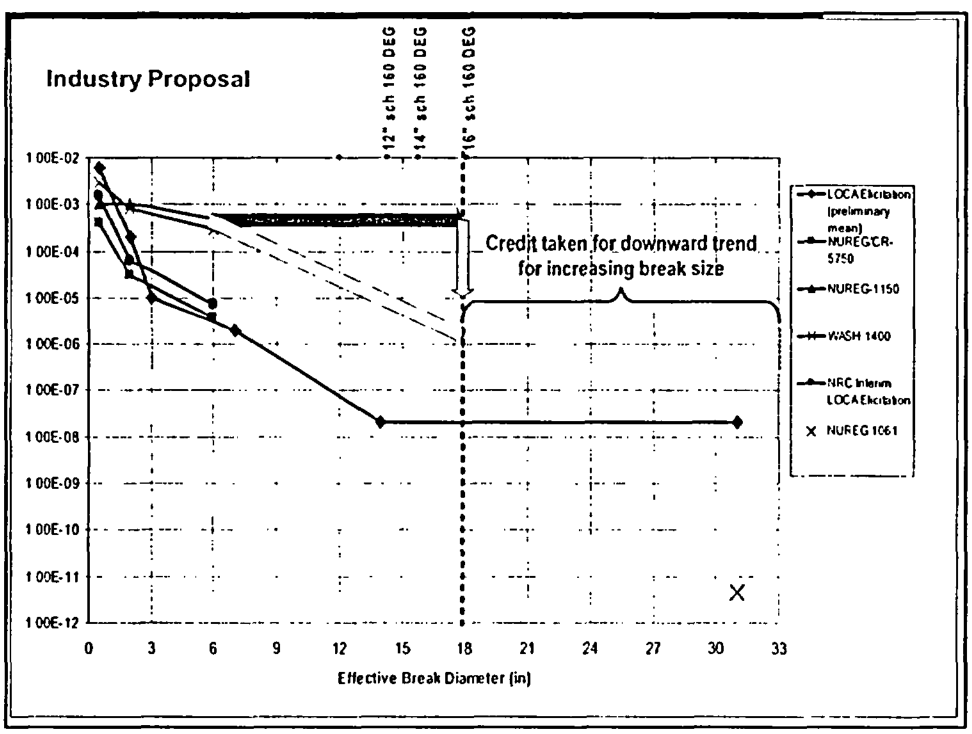
NEI

Risk Impact

- Industry believes conservative selection of ABS and DMC analysis provides robust assurance of long-term cooling capability
- NRC proposed alternative utilizes NUREG-1150 and credits addition of mitigative features (e.g., backwash, traveling screens)




NRC Proposal
12" sch 160 DEG
14" sch 160 DEG
16" sch 160 DEG
Initiating Event Frequency for Spectrum set at 5E-4
Credit allowed for addition of mitigating design features
1 00E-02
1 00E-03
1 00E-04
1 00E-05
1 00E-06
1 00E-07
1 00E-08
1 00E-09
1 00E-10
1 00E-11
1 00E-12
0 3 6 9 12 15 18 21 24 27 30 33
Effective Break Diameter (in)
NUREG/CR-5750
NUREG-1150
WASH-1400
NUREG 1061


Industry Proposal
12" sch 160 DEG
14" sch 160 DEG
16" sch 160 DEG
Credit taken for downward trend for increasing break size
1 00E-02
1 00E-03
1 00E-04
1 00E-05
1 00E-06
1 00E-07
1 00E-08
1 00E-09
1 00E-10
1 00E-11
1 00E-12
0 3 6 9 12 15 18 21 24 27 30 33
Effective Break Diameter (in)
NUREG/CR-5750
NUREG-1150
WASH 1400
NUREG 1061

Status

- Four components:
  - Identification of an alternate break size (ABS)
  - Design-basis, deterministic analyses for break sizes up through ABS
  - Demonstration of mitigative capability for breaks larger than ABS
  - Demonstration that RG 1.174 acceptance guidelines are satisfied
- Industry assessing options and schedule based on June 17 public meeting
- Section 6 will be revised and submitted to NRC

NEI

DEBRIS FILTRATION UPSTREAM SIS – SP PUMPS

DEBRIS FILTRATION SCOPE OF STUDIES

Regulation scope :

- **Drop out of RG 1.82 rev.2 & NUREG 0897 rev.1 model (destruction cone…) for PWR's**
- **Use of RG 1.82 rev.3 (nov. 2003) & NUREG 6224 model (destruction sphere …) for PWR's**

Engineering studies scope :

- Use of NEI 02.01 (mi 2002) Guidelines thanks to « PWR Owners's Group containment sump evaluation methodology » (draft released to french owners nov. 18th, 2003)
- EDF appropriation in a technical note « Design references for filtration studies for accumulation of debris upstream SIS-SP recirculation pumps ». This includes typical caracteristics of French PWR's (insulation types, functional operational parameters…).

Engineering studies scope :

- Example given for the présentation : PWR 900 (WEST)
- Scenario : 2A hot leg break LOCA (SG interface)

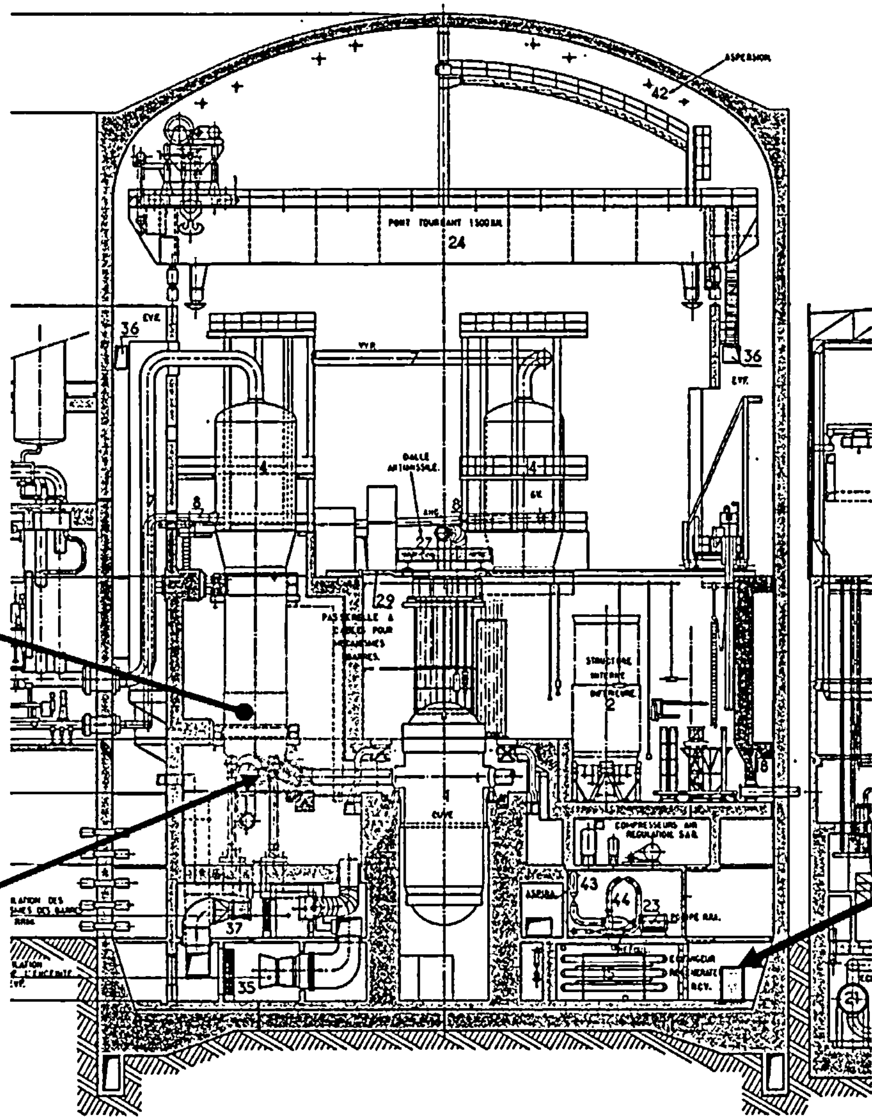
Présentation Summary :

- Destruction Zone (ZOI)
- Vertical debris transfer
- Horizontal debris transfer
- Actualisation of NUREG 6224 head loss equations

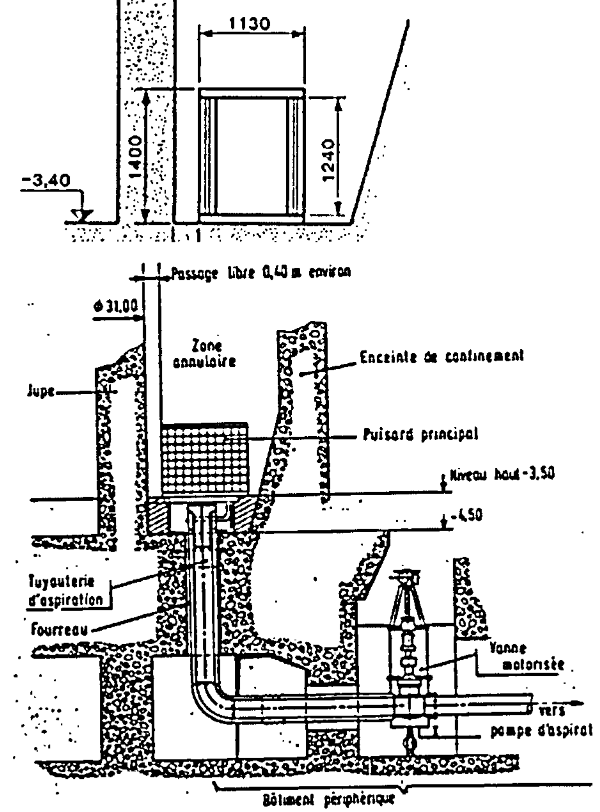
DESTRUCTION ZONE

WATER AND DEBRIS TRANFER TOWARDS ECC SUMPS

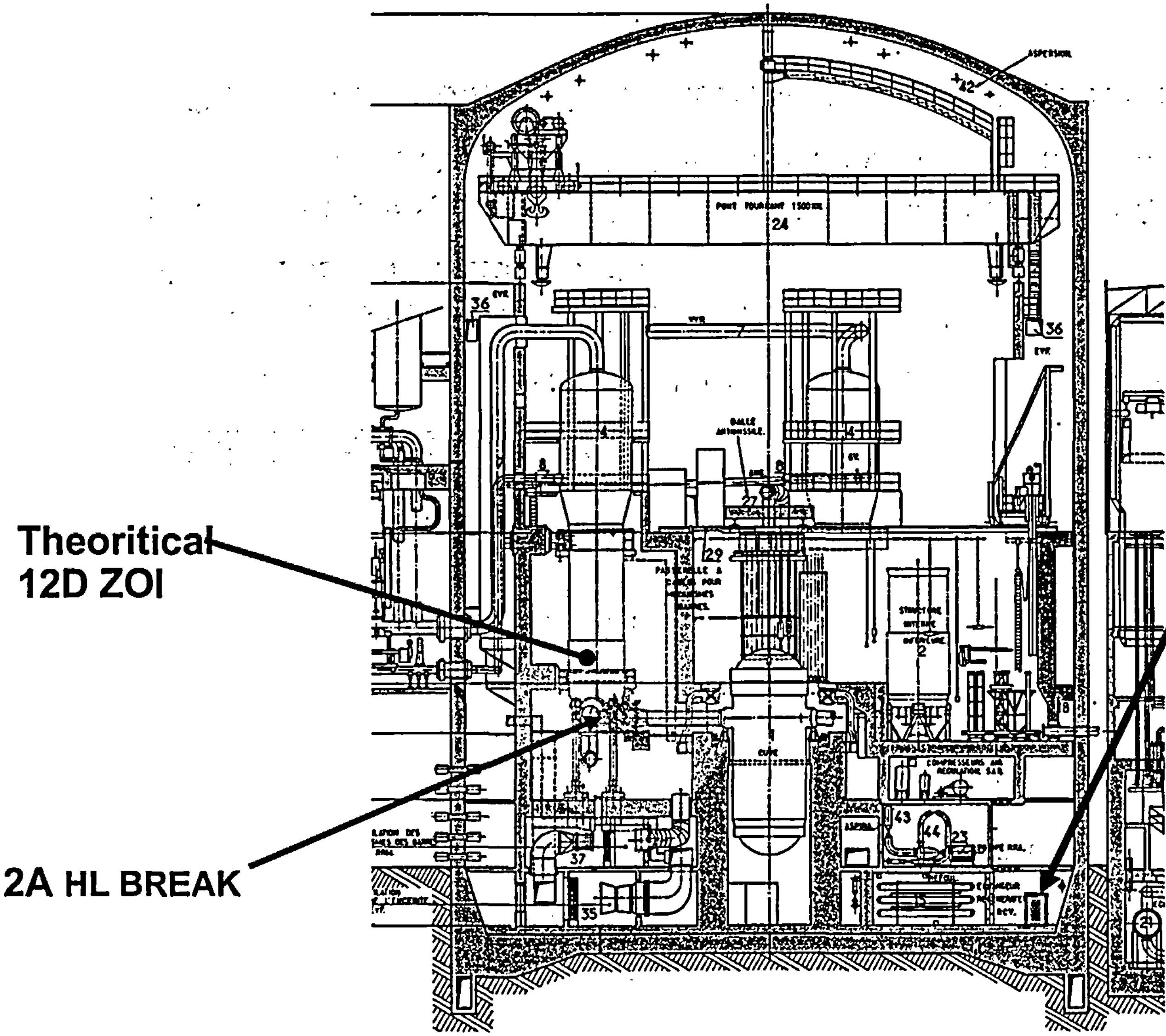
ECC – SIS SP RECIRCULATION MODE – 900 PWR's

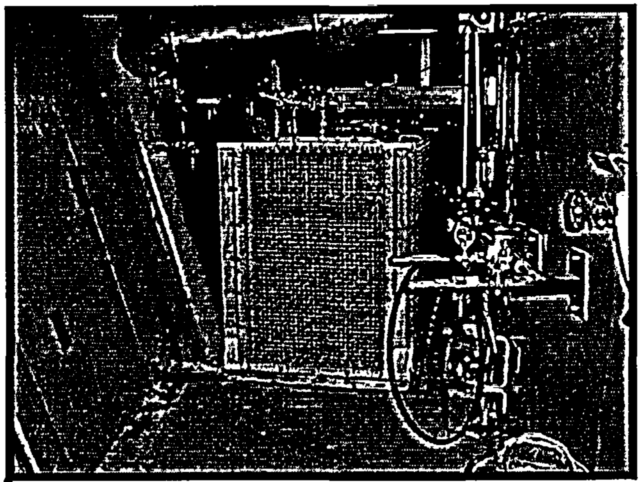


SUMPS

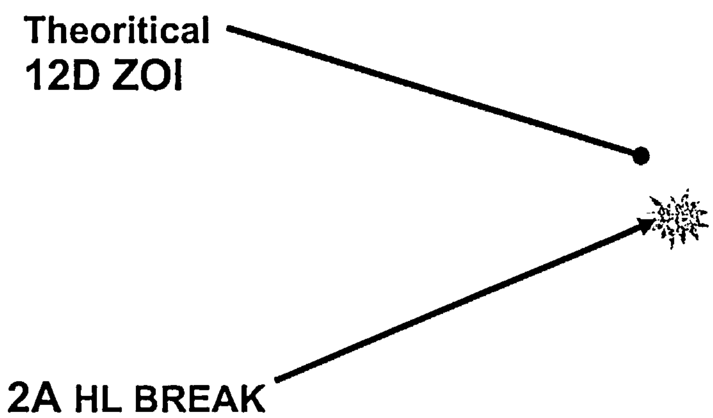


ECC – SIS SP RECIRCULATION MODE – 900 PWR's





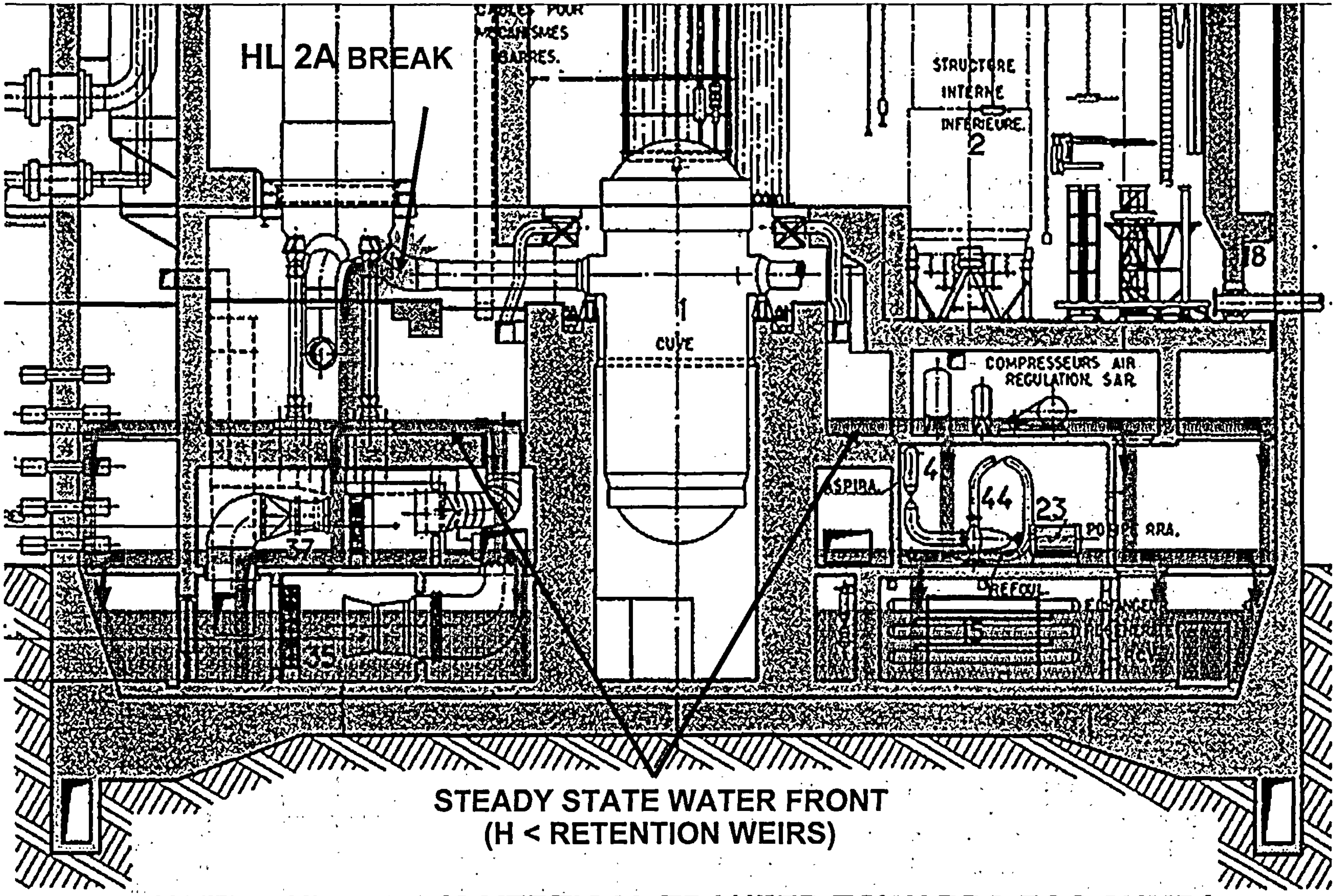
ECC – SIS SP RECIRCULATION MODE – 900 PWR's



<u>DESIGN REFERENCES</u> :

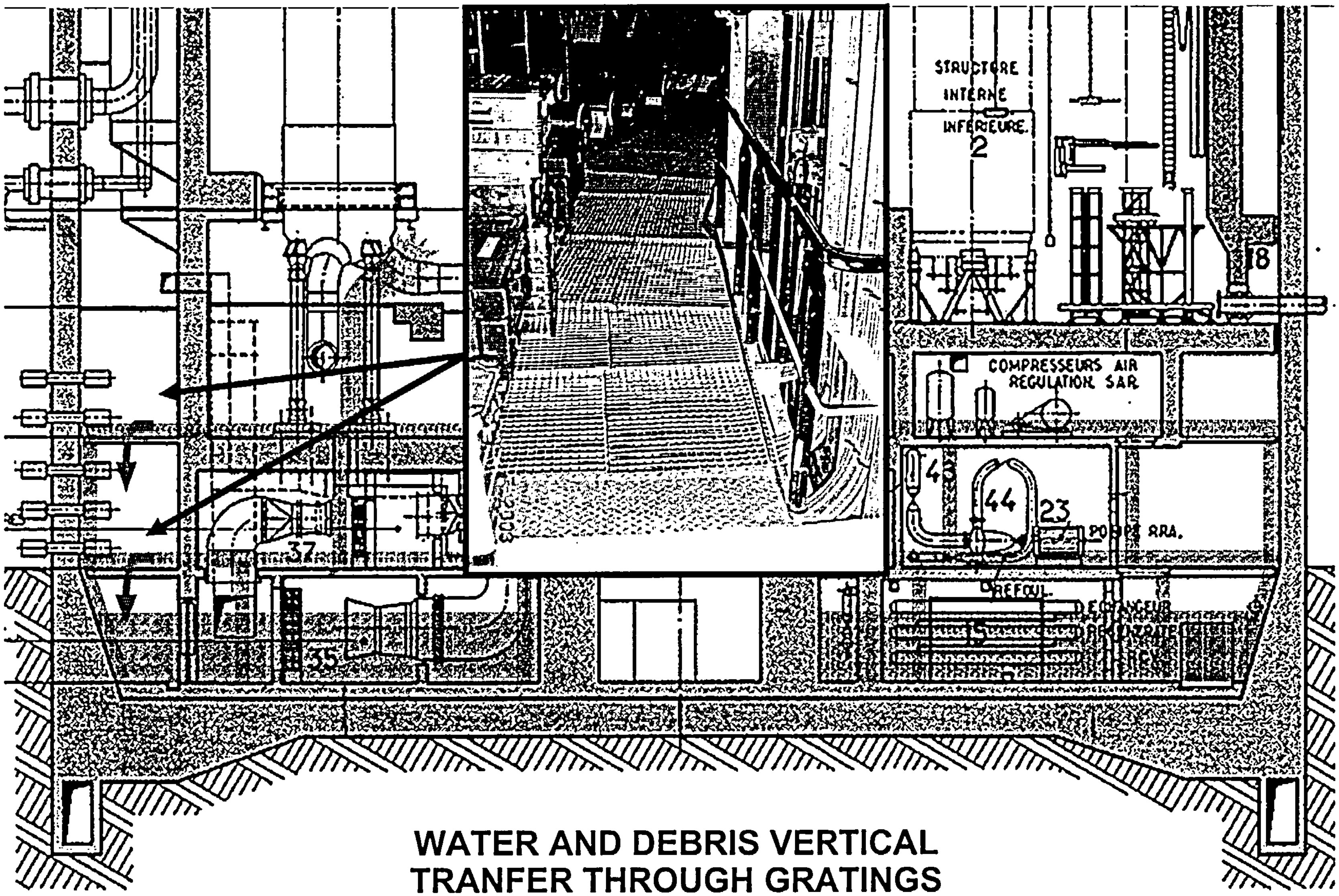
- **100% destruction in 12D ZOI (limited by full concrete walls boundaries)**
- **Instantaneous generation of 5290 lb (2400kg) transportable insulation fibers located in the 12D sphere**
- **Mean fibers length : 0.02 inch (0.5mm) – diameter : 8 micrometers.**
  Less than 10% of fibers above 0.08 inch (2mm) length.
- **Speed threshold of fibers horizontal sweeping : 1.2 inches/s (3 cm/s)**

ECC – SIS SP RECIRCULATION MODE – 900 PWR's



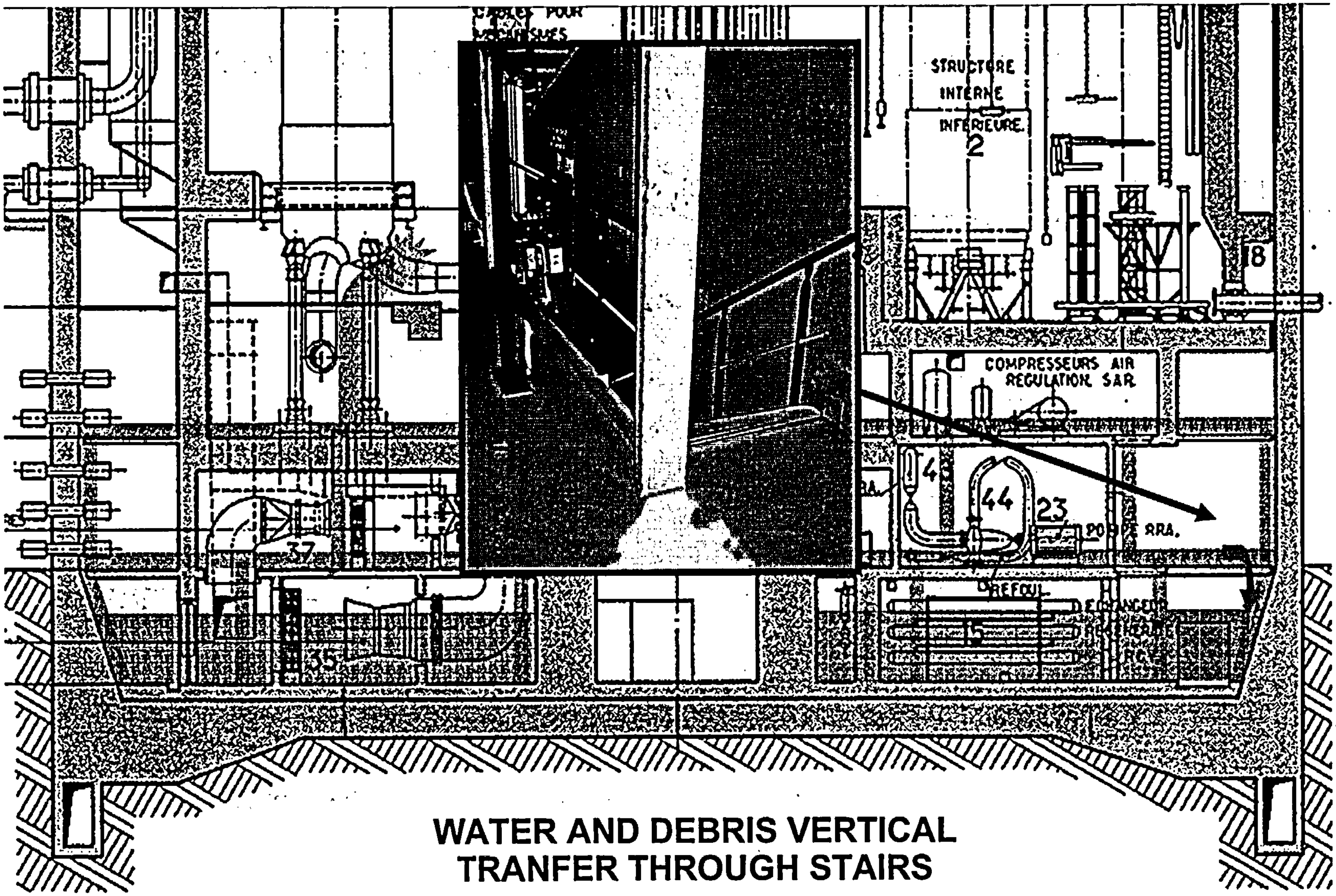
WATER AND DEBRIS VERTICAL TRANFER TOWARDS ECC SUMPS

ECC – SIS SP RECIRCULATION MODE – 900 PWR's



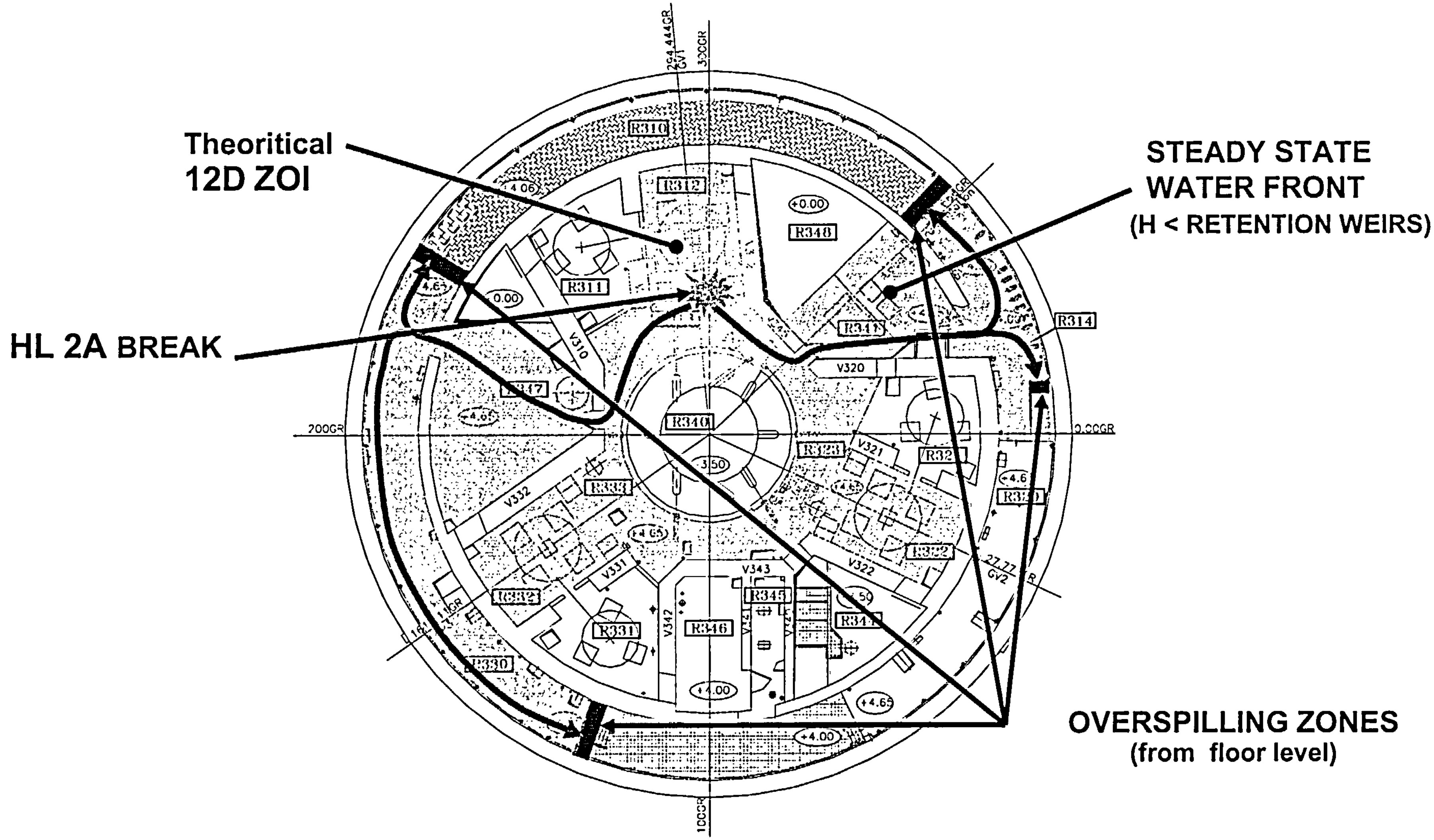
WATER AND DEBRIS VERTICAL TRANFER THROUGH GRATINGS

ECC – SIS SP RECIRCULATION MODE – 900 PWR's



WATER AND DEBRIS VERTICAL TRANFER THROUGH STAIRS

ECC–SIS SP RECIRCULATION MODE – 900 PWR's lev. +4,65m

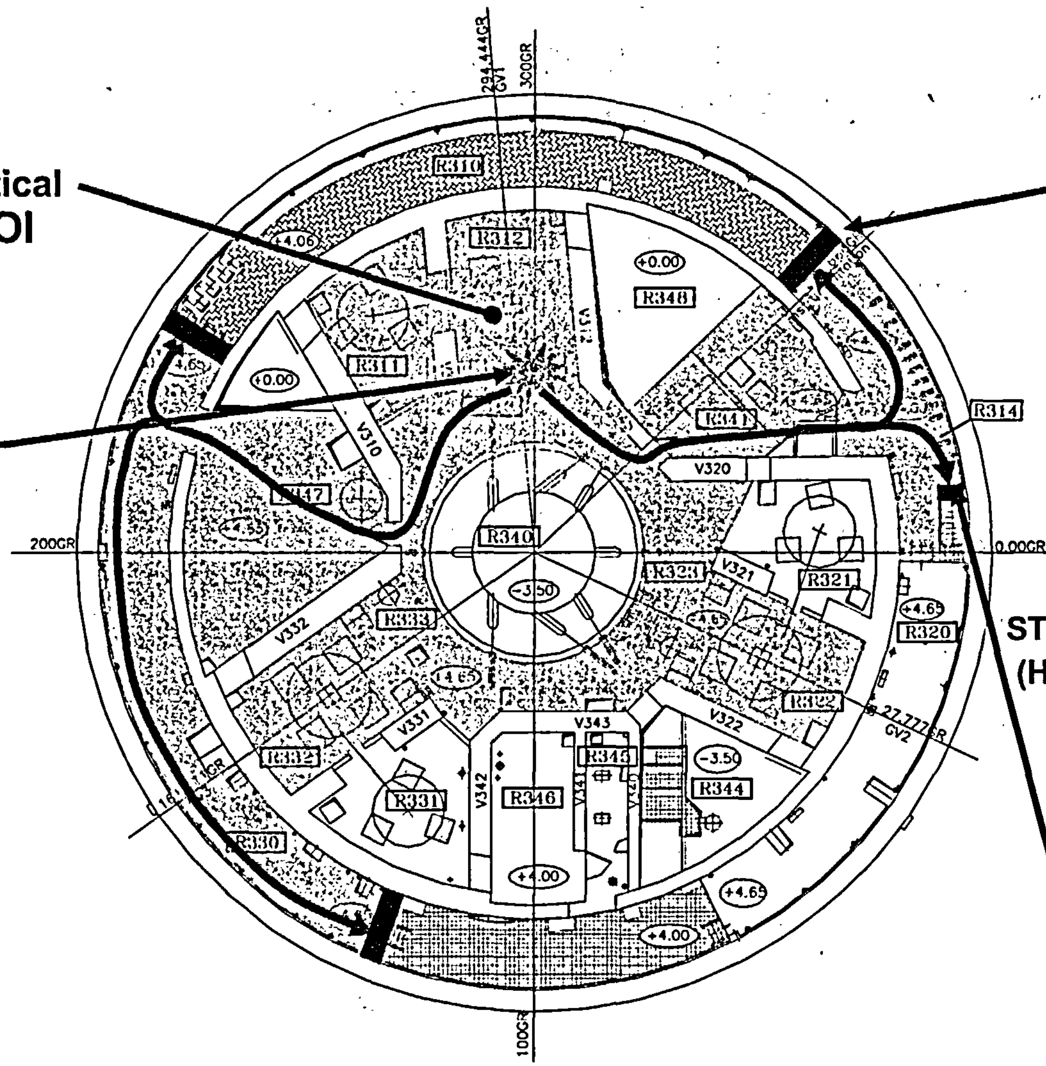


WATER AND DEBRIS HORIZONTAL TRANFER ON BREAK FLOOR

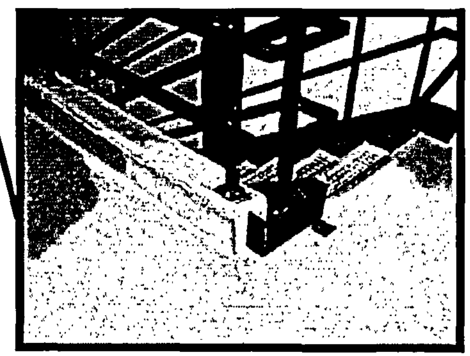
ECC–SIS SP RECIRCULATION MODE – 900 PWR's lev. +4,65m

Theoritical 12D ZOI

HL 2A BREAK

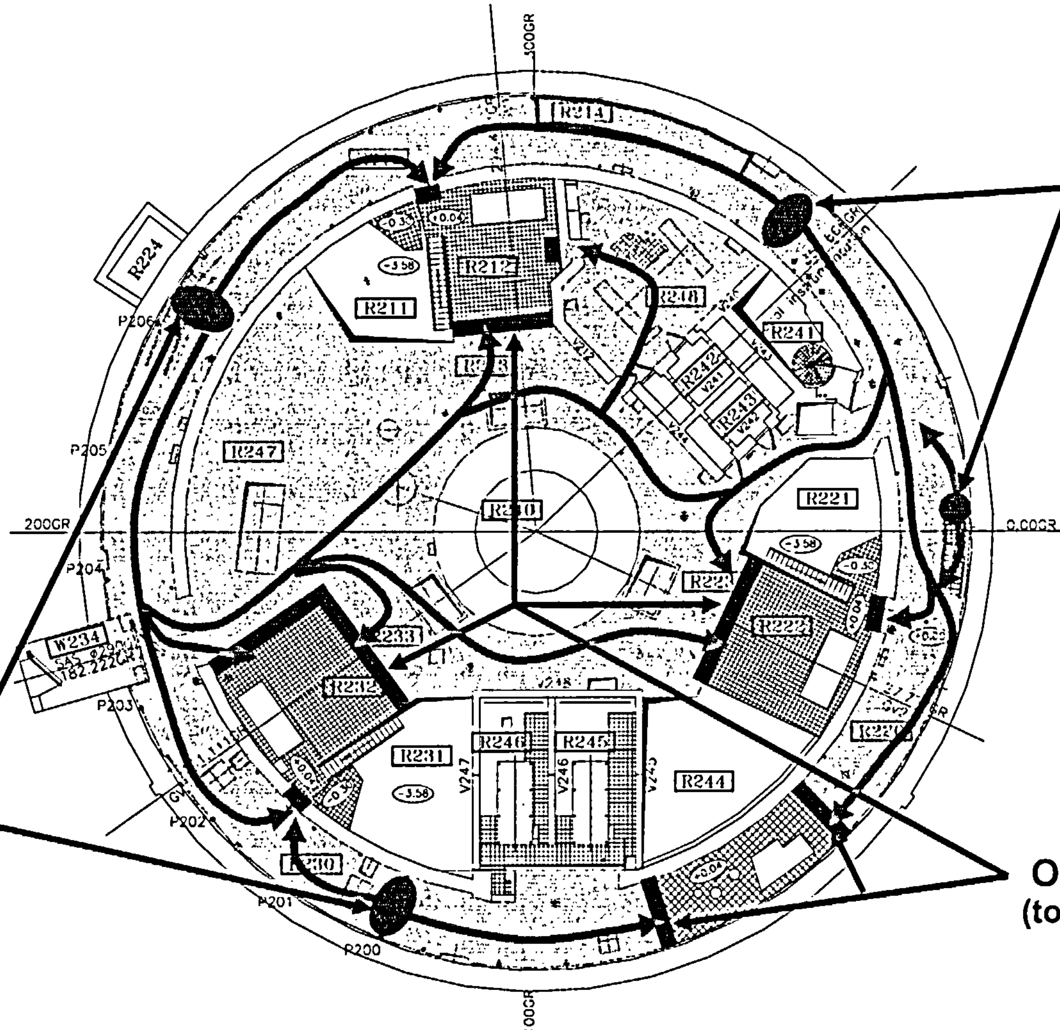


STEADY STATE WATER FRONT (H < RETENTION WEIRS)



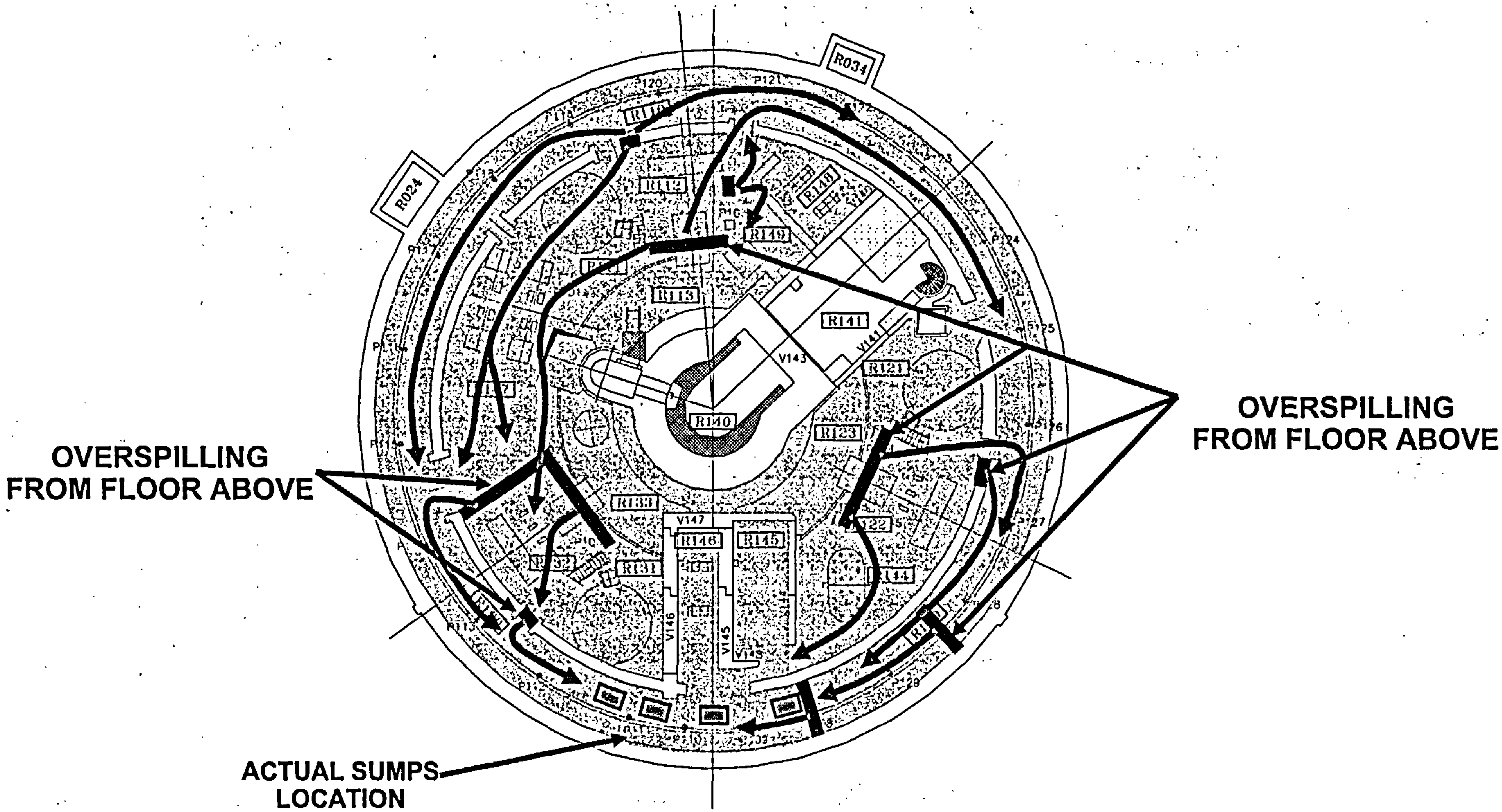
WATER AND DEBRIS HORIZONTAL TRANFER ON BREAK FLOOR

ECC–SIS SP RECIRCULATION MODE – 900 PWR's lev. +0,00



WATER AND DEBRIS HORIZONTAL TRANFER ON FLOOR 0.00m

ECC–SIS SP RECIRCULATION MODE – 900 PWR's lev.–3,50



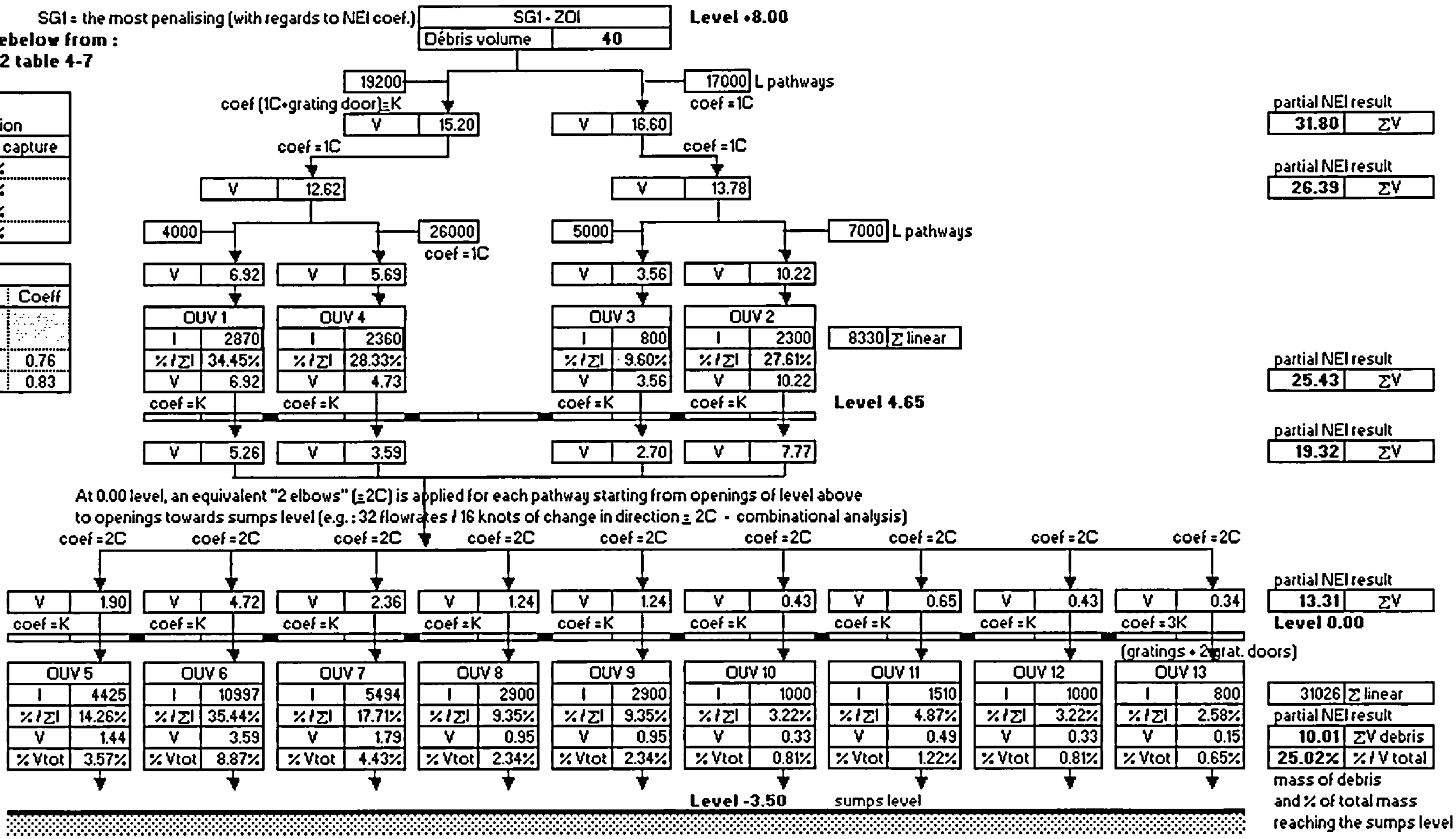
WATER AND DEBRIS HORIZONTAL TRANFER ON SUMPS FLOOR –3.50m

Debris capture rate are based on parameters herebelow from : NEI-NUREG/CR-6808 § 4.2.1.2 table 4-7

NEI-NUREG/CR-6808 table 4-7 : Small Fibrous Debris Capture Fraction	
Structure type	Debris capture
I-Beams and pipes	9%
Gratings : V Shaped Grating	28%
Gratings : Split Grating	24%
90° bend in flow	17%

Debris capture fraction chosen		
Structure	Rate	Coeff
[illegible]	[illegible]	[illegible]
Gratings (K)	24%	0.76
Elbow (C)	17%	0.83

LEGEND
I = linear overspilling width (in mm)
L= pathways
V = Debris volume (in m3)
OUV = openings

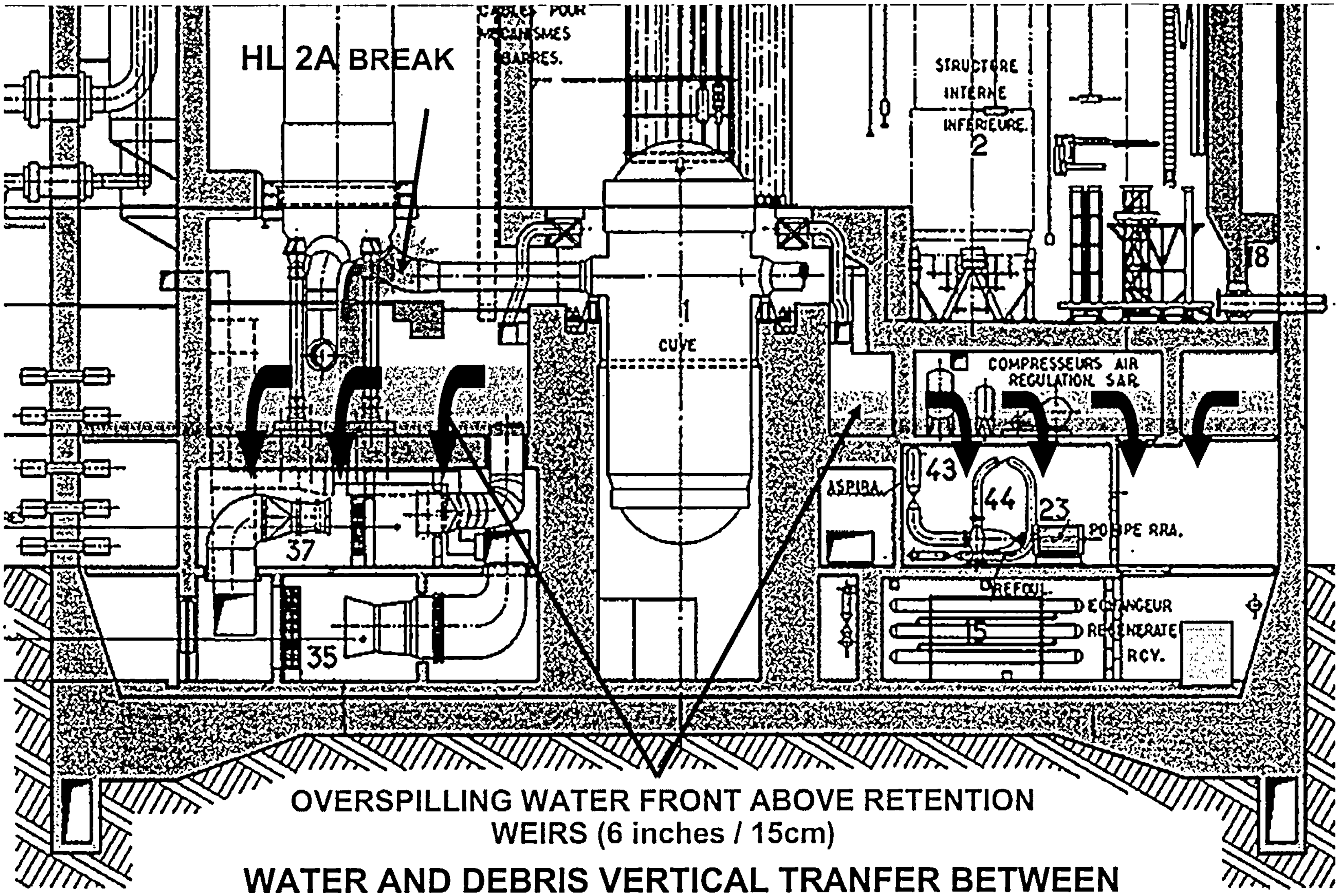


WATER AND DEBRIS VERTICAL TRANFER – INSULATION DEBRIS TRANSFER RATIO CALCULATION

WATER & DEBRIS TRANSFER WITH TRANSIENT OVERSPILLING

LEVEL +4.65m

ECC – SIS SP RECIRCULATION MODE – 900 PWR's



WATER AND DEBRIS VERTICAL TRANFER BETWEEN BREAK LEVEL & ECC SUMPS

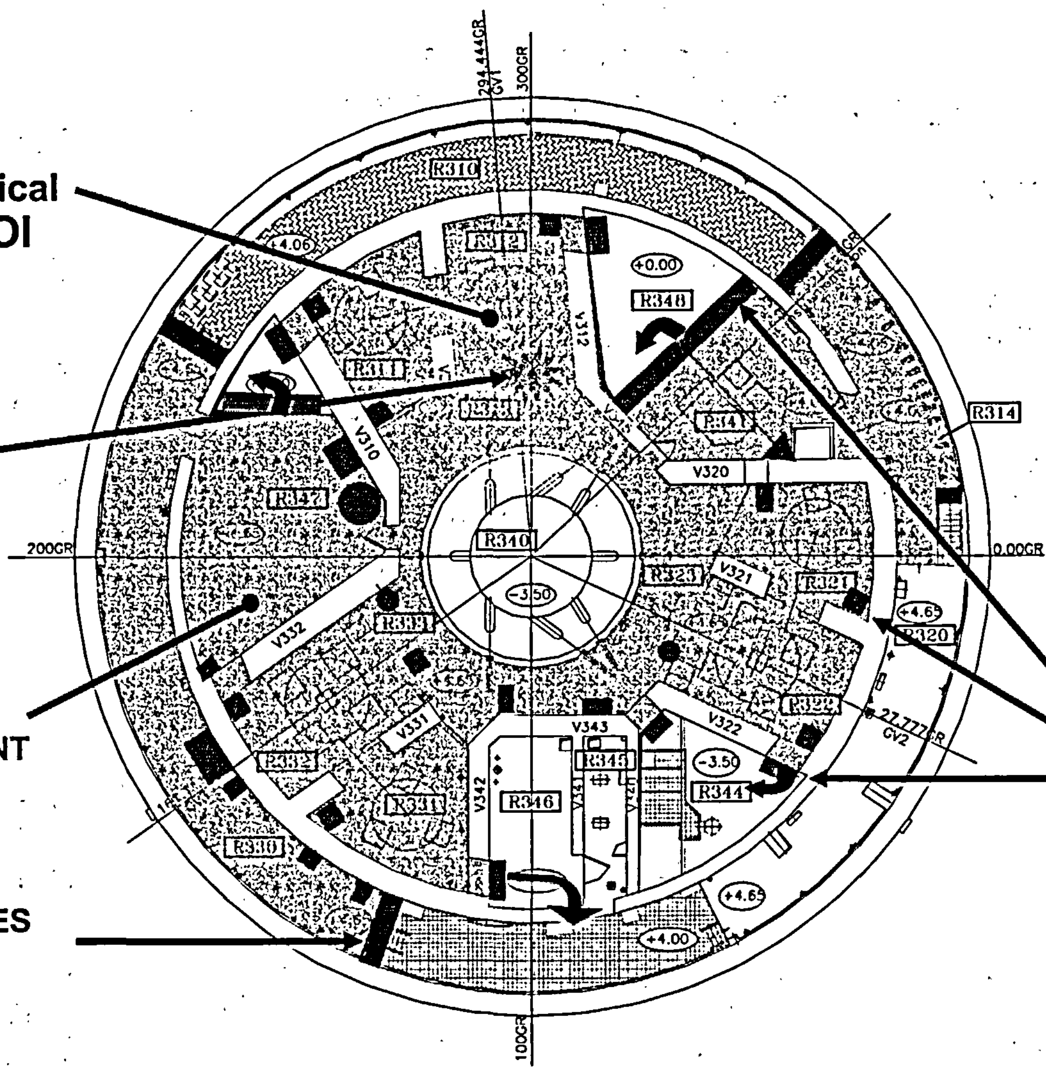
ECC – SIS SP RECIRCULATION MODE – 900 PWR's level +4,65

Theoritical 12D ZOI

HL 2A BREAK

ANTICIPATED RISK : MAXIMUM AREA OF OVERSPILLING WATERFRONT PHENOMENOM

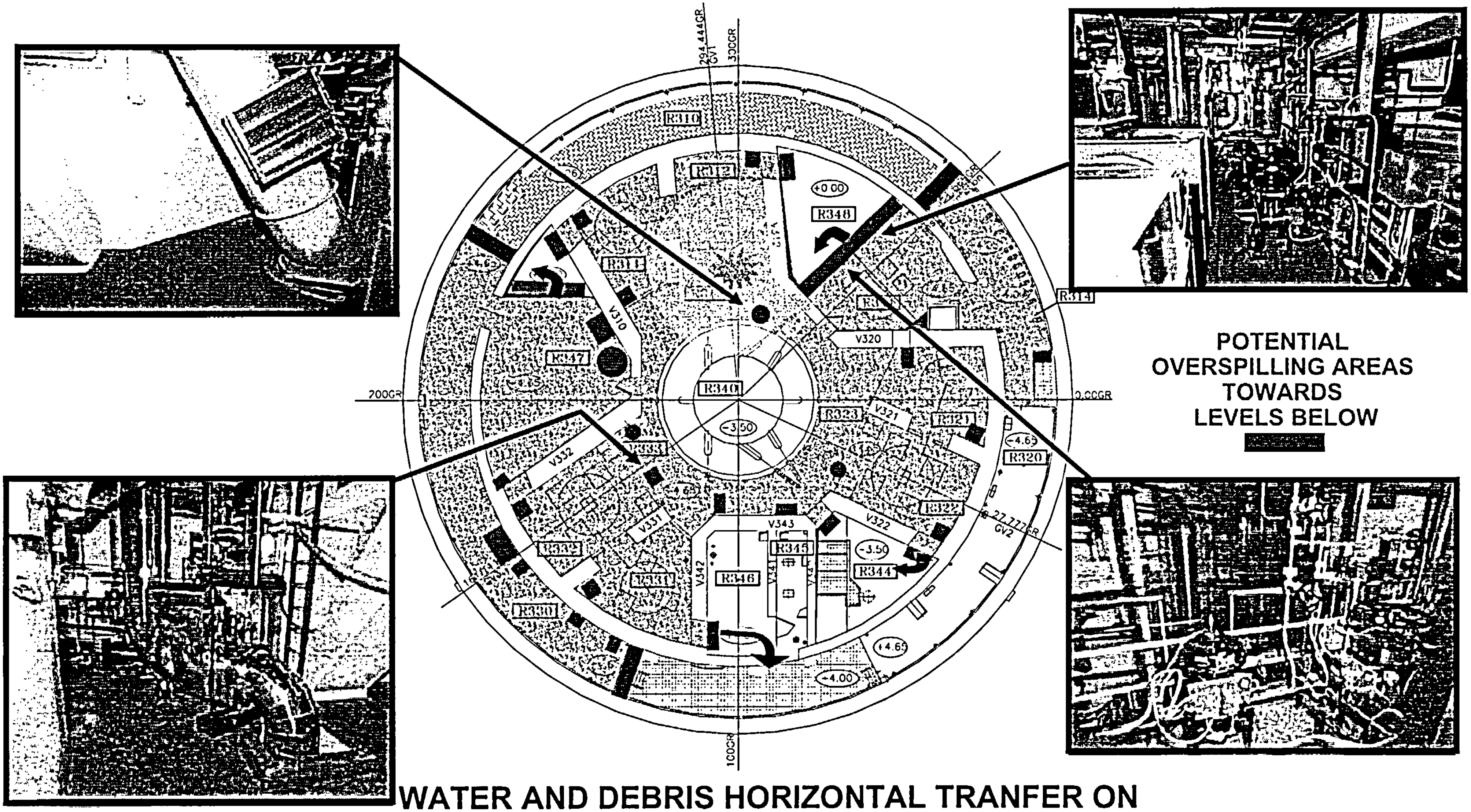
OVERSPILLING ZONES (from floor level)



POTENTIAL OVERSPILLING AREAS TOWARDS LEVELS BELOW

WATER AND DEBRIS HORIZONTAL TRANFER ON BREAK FLOOR

ECC – SIS SP RECIRCULATION MODE – 900 PWR's level +4,65



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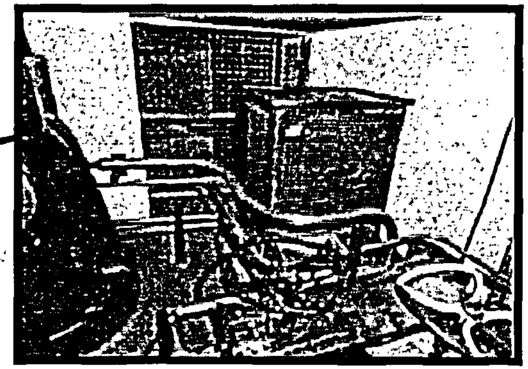

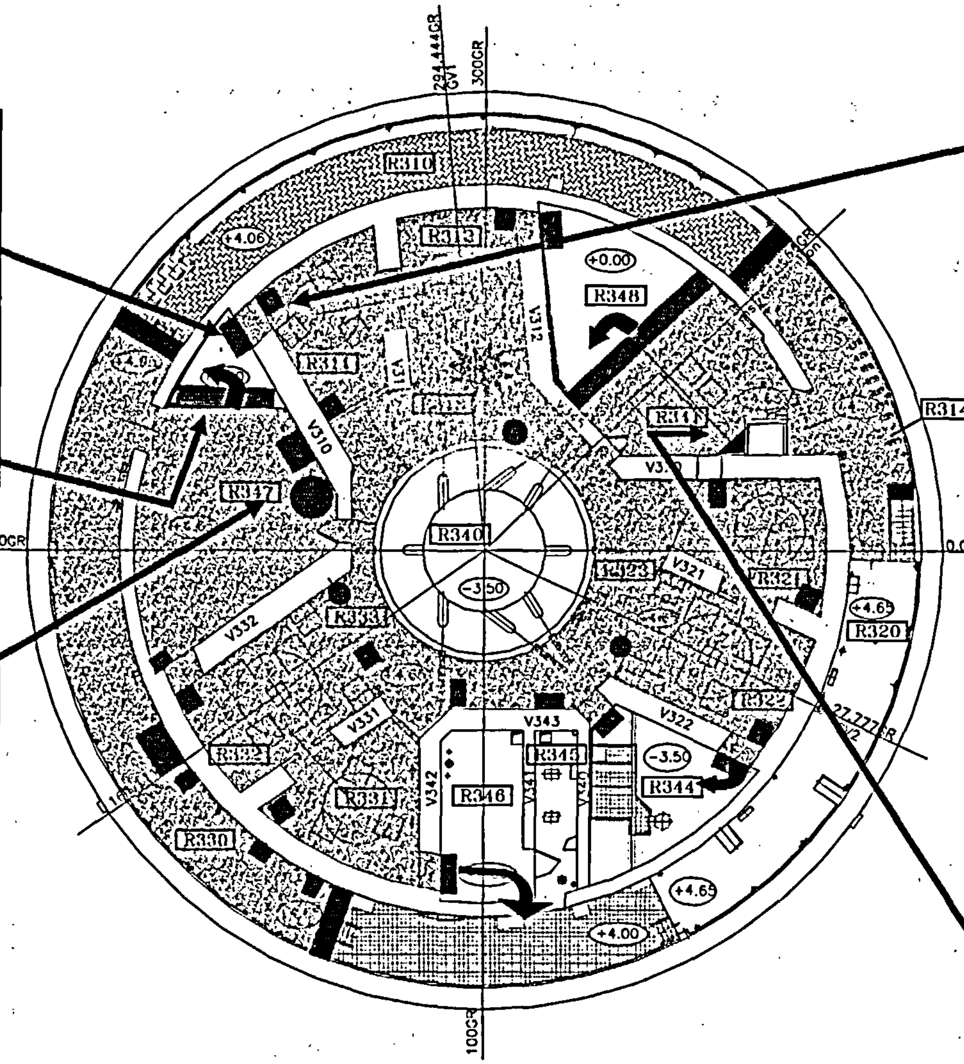

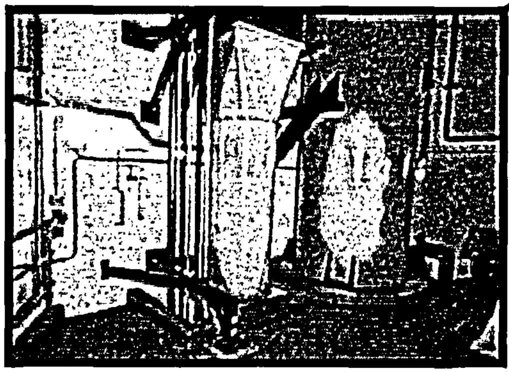

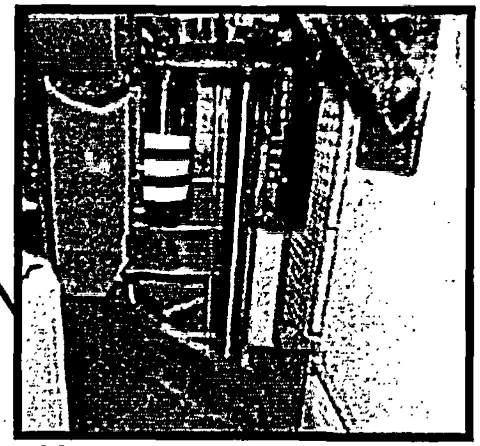

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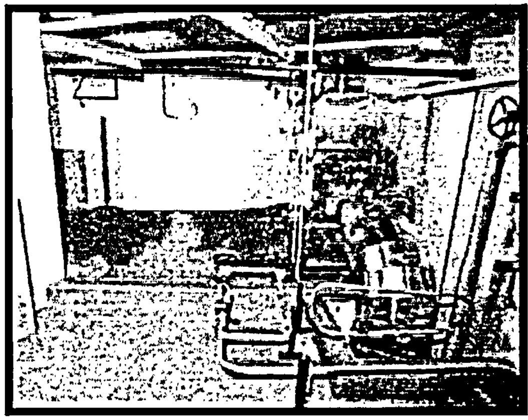
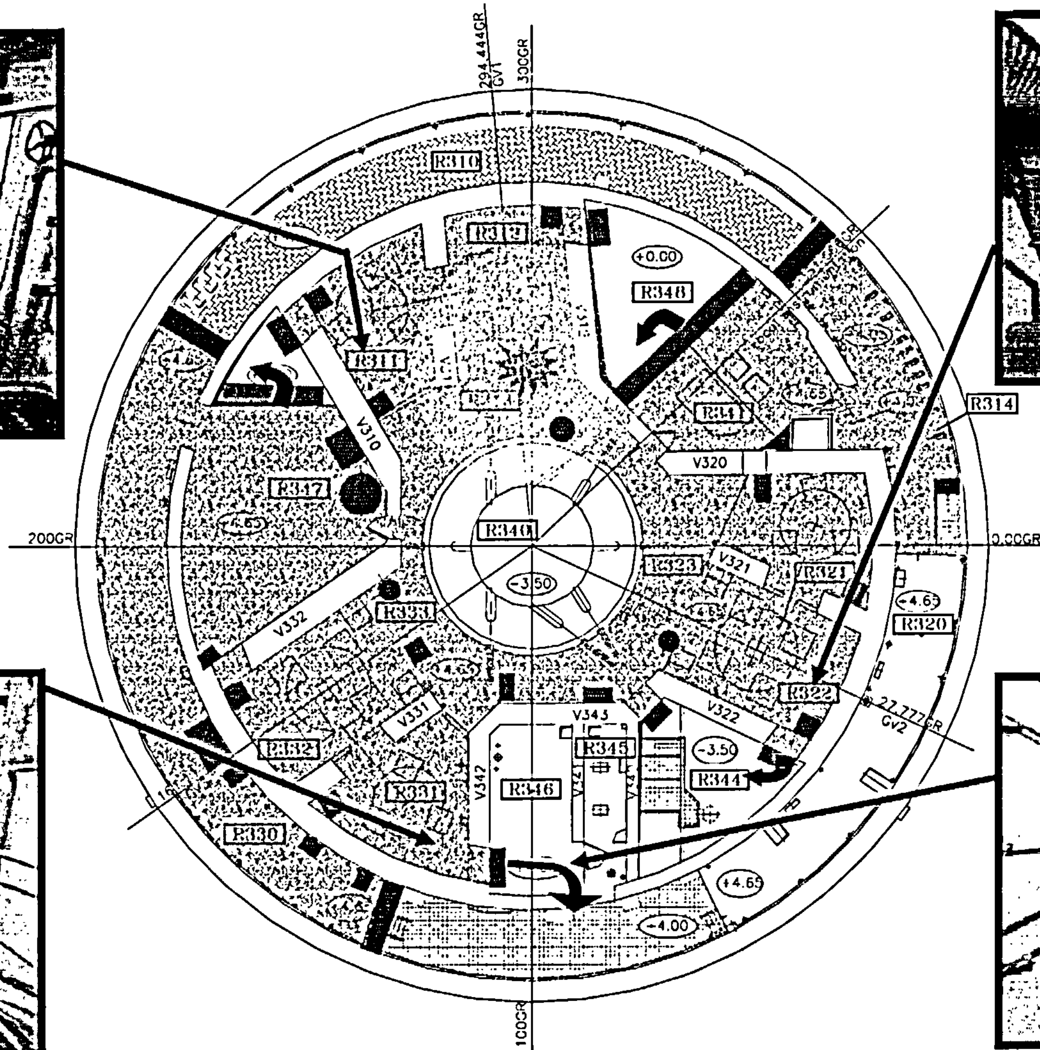
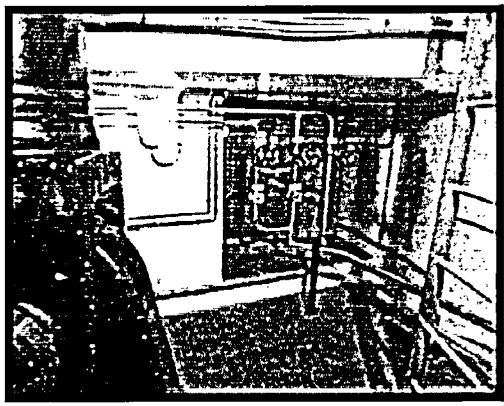
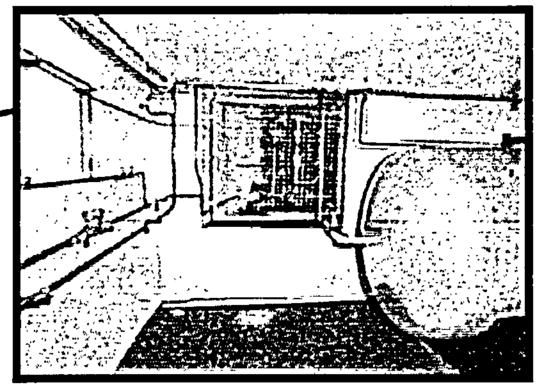




POTENTIAL OVERSPILLING AREAS TOWARDS LEVELS BELOW





WATER AND DEBRIS HORIZONTAL TRANFER ON BREAK FLOOR

ECC – SIS SP RECIRCULATION MODE – 900 PWR's

Phenomenom	Time threshold	Flowrate	Retention weirs overspilling
MPC partial drainage	t=0s to t=20s	6.7 e+006 gal/h 25506 m^3/h	YES
Accumulators drainage	t=20s to t=60 s	2 e+006 gal/h 7803 m^3/h	YES
Fuel storage tank drainage	t=60s to t=1800s	7 e+005 gal/h 2654 m^3/h	NO

<u>OVERSPILLING CONSEQUENCES</u> :

- **Temporary bypass during steady state water transfer**
- **Aditional debris amount : 10 to 15%**

VERTICAL INSULATION DEBRIS TRANSFERT RATIO :

- 25% in steady state (valid for small breaks without any overspilling)

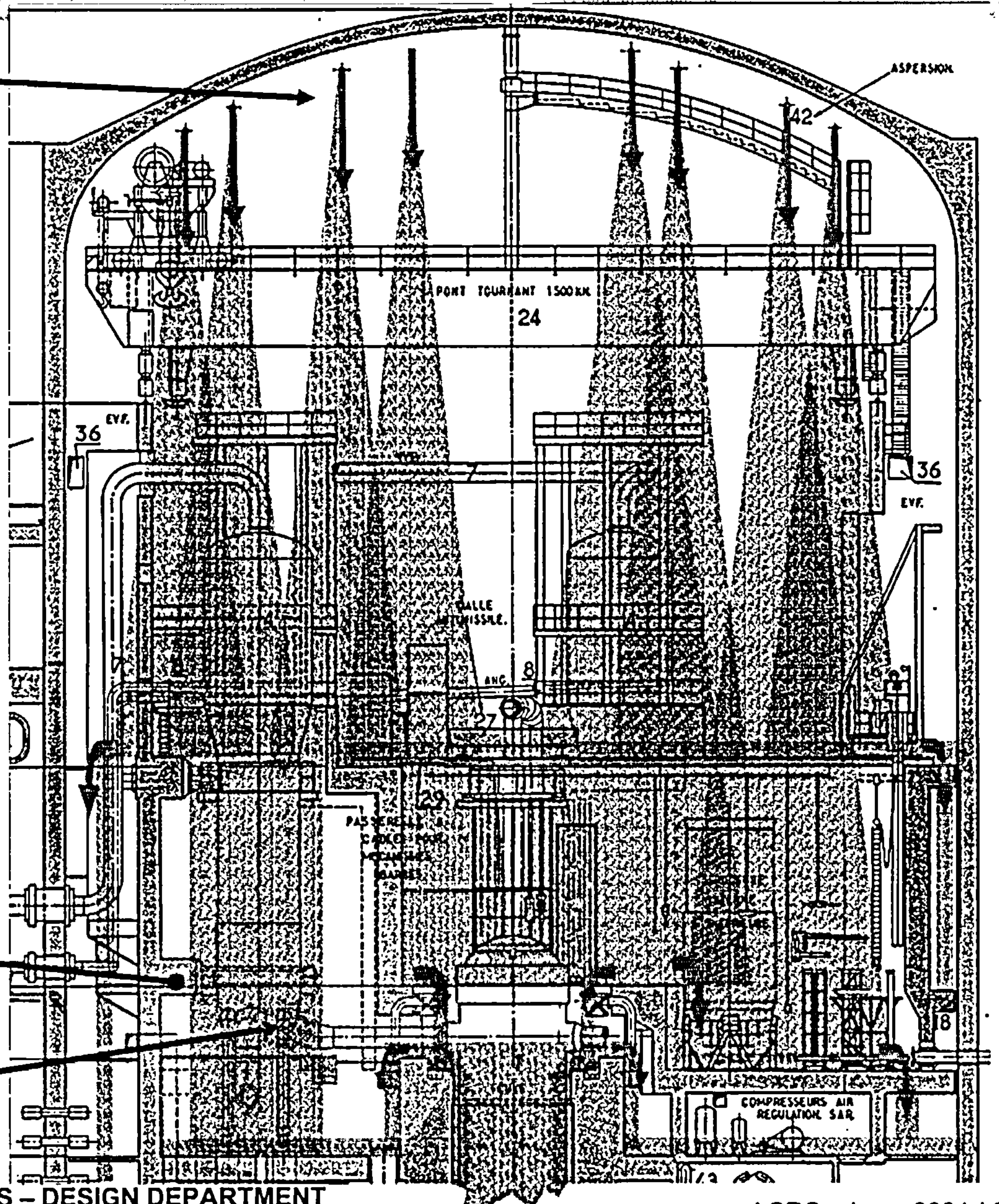
- Conservative transfert ratio global value : 50% (including the overspilling transient)

- Fiber mass at level –3.50m : 2645 lb (1200 kg)

2A HLB WATER AND DEBRIS TRANFER CUMULATED WITH CONFINEMENT SPRAY

ECC – SIS SP RECIRCULATION MODE – 900 PWR's

SPRAY SYSTEM

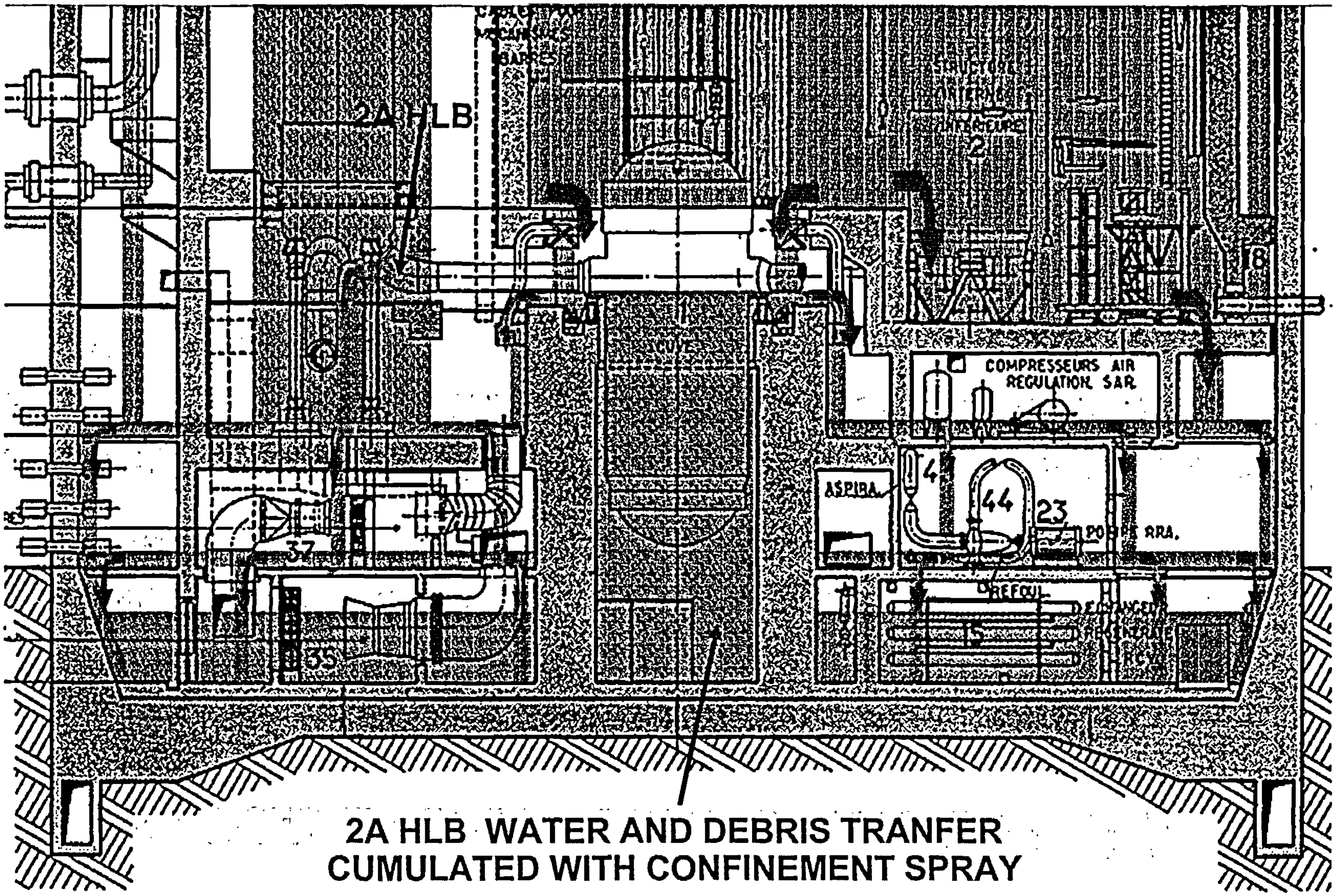


VERTICAL CONFINEMENT SPRAY WATER TRANSFER

Theoritical 12D ZOI

2A HLB

ECC – SIS SP RECIRCULATION MODE – 900 PWR's



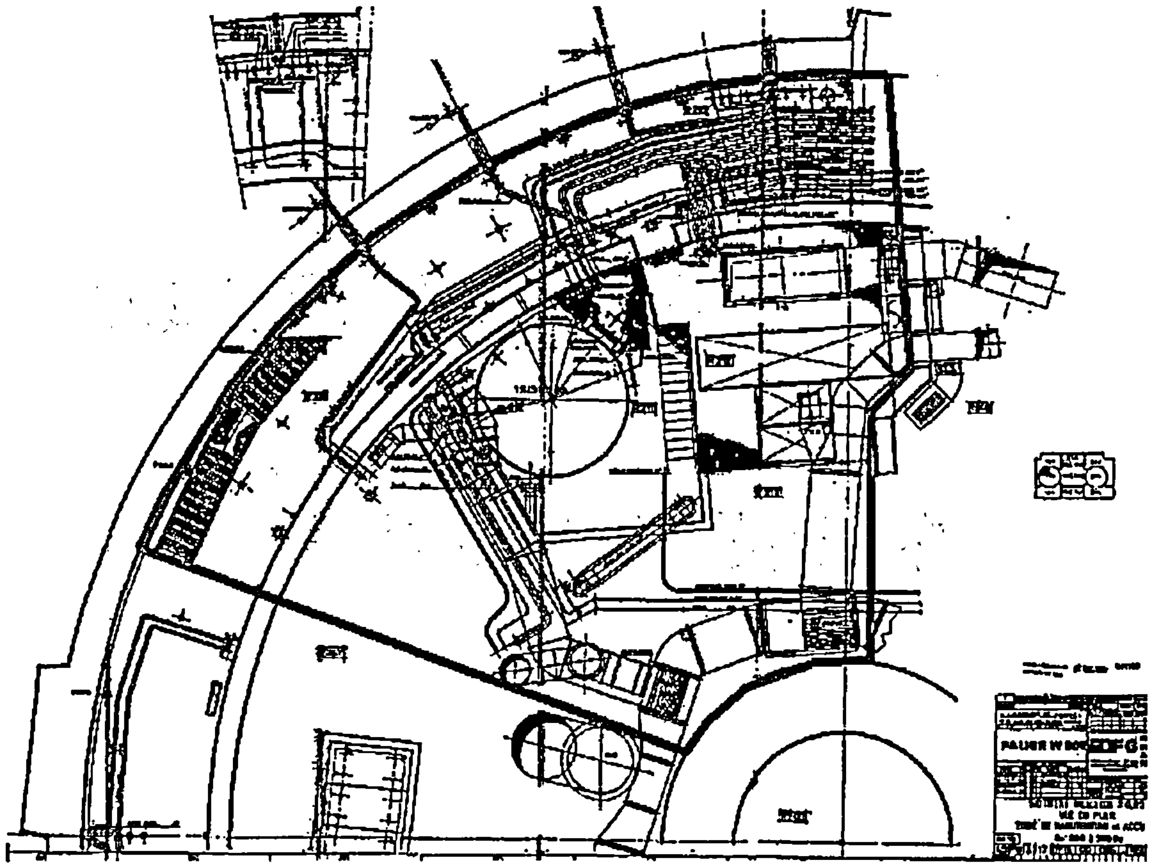
2A HLB WATER AND DEBRIS TRANFER
CUMULATED WITH CONFINEMENT SPRAY

SLB2 walkdown & sampling - typical values to 900 PWR's :

- SLB2 particulates sampling area was chosen thanks to a representative density of equipments (mechanical, electrical & civil structures).
- Particulates deposited on the equipements were broken down in order to establish typical particulate parameters for each equipment.

SLB2 sampling area :

RB +0,00m – handling area & accu 1 from 180° to 270°



PARTICULATES DEBRIS QUANTITY

AT SUMPS LEVEL

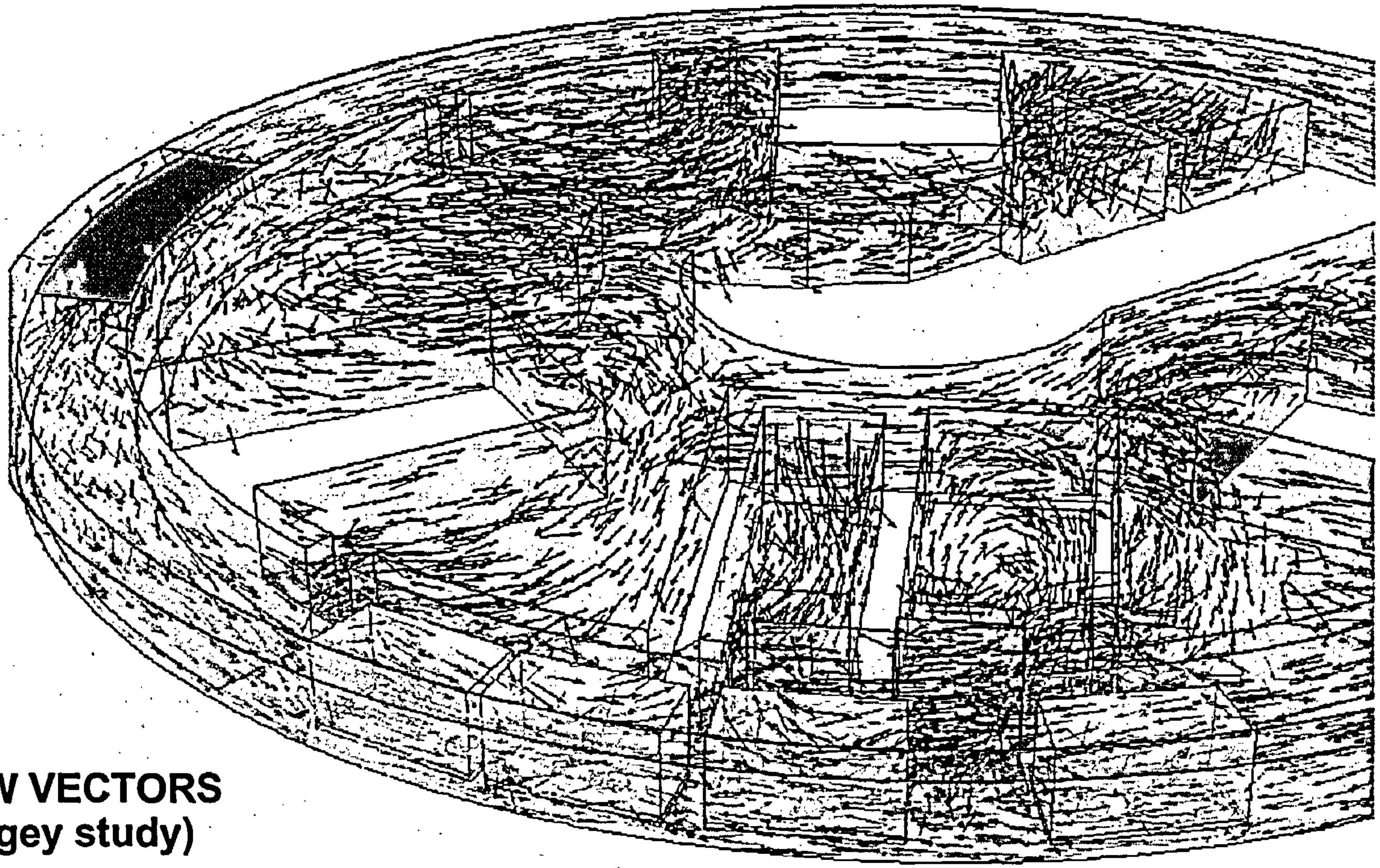
ECC – SIS SP RECIRCULATION MODE – 900 PWR's

- Latents particulates masses (SLB2 basis) :	198 lb (90 kg)
- Eroded concrete under jet effect in ZOI :	22 lb (10 kg)
- Other materials (still undefined*) :	220 lb (100 kg)
- Coating clusters :	550 lb (250 kg)

* fire-resistant materials, mastic etc.

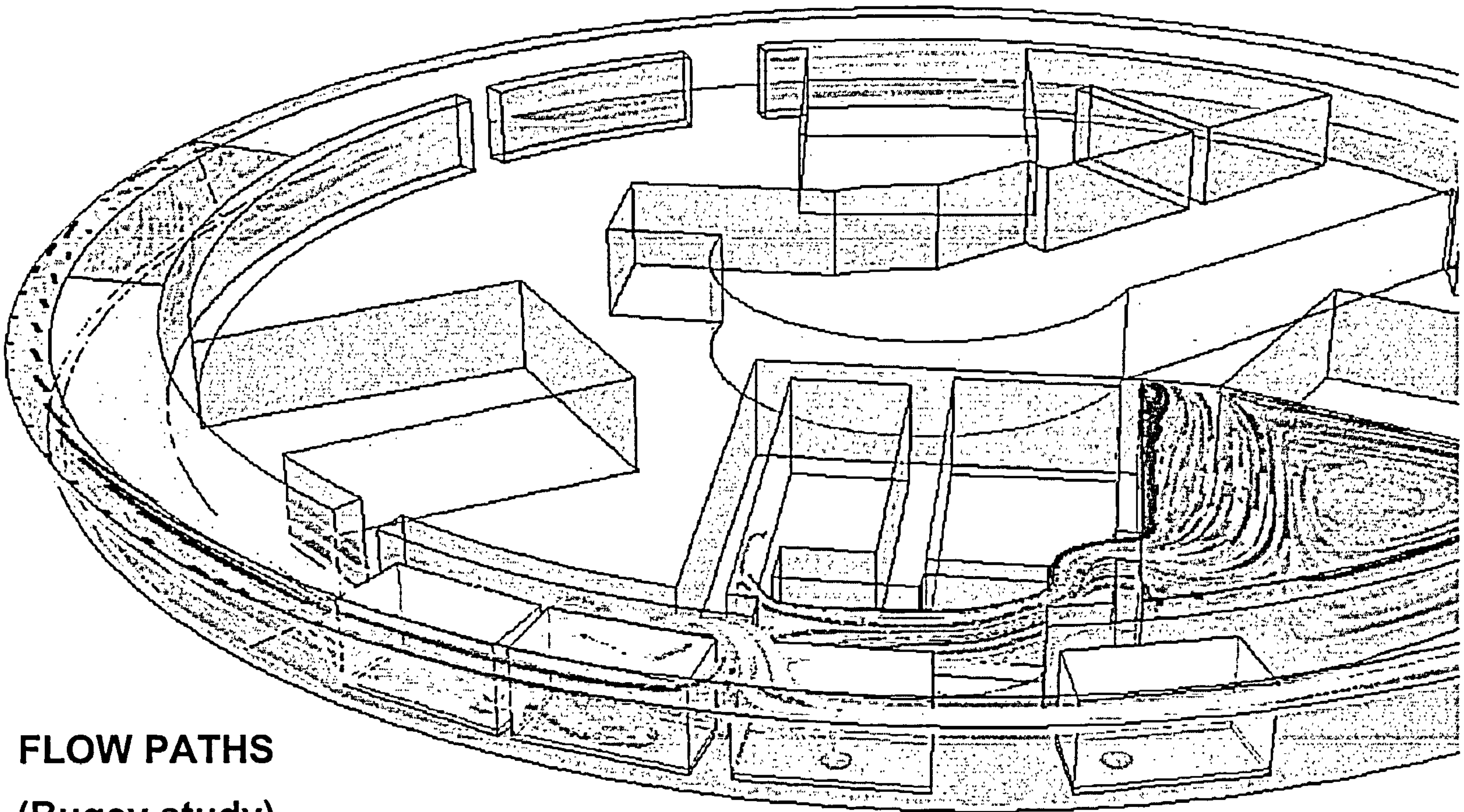
CFD CALCULATIONS OF WATER & DEBRIS TRANSFER AT SUMPS LEVEL

ECC – SIS SP RECIRCULATION MODE – 900 PWR's



FLOW VECTORS
(Bugey study)

ECC – SIS SP RECIRCULATION MODE – 900 PWR's



FLOW PATHS

(Bugey study)

OVERVIEW ON ONE TEST FACILITY

TEST FACILITY :

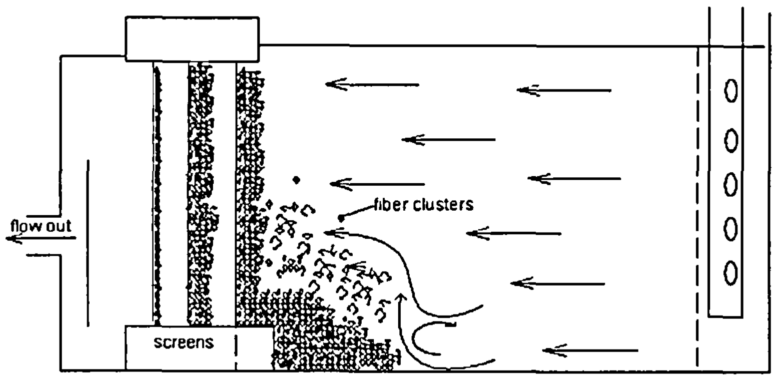
- Typical EDF waved screen (Bugey spare part)
- Typical EDF insulation (taken from insulation MCP Dampierre / aged from 10 to 20 years)
- Representatives laminar flowrates
- Chemistry & water temperature monitored in line

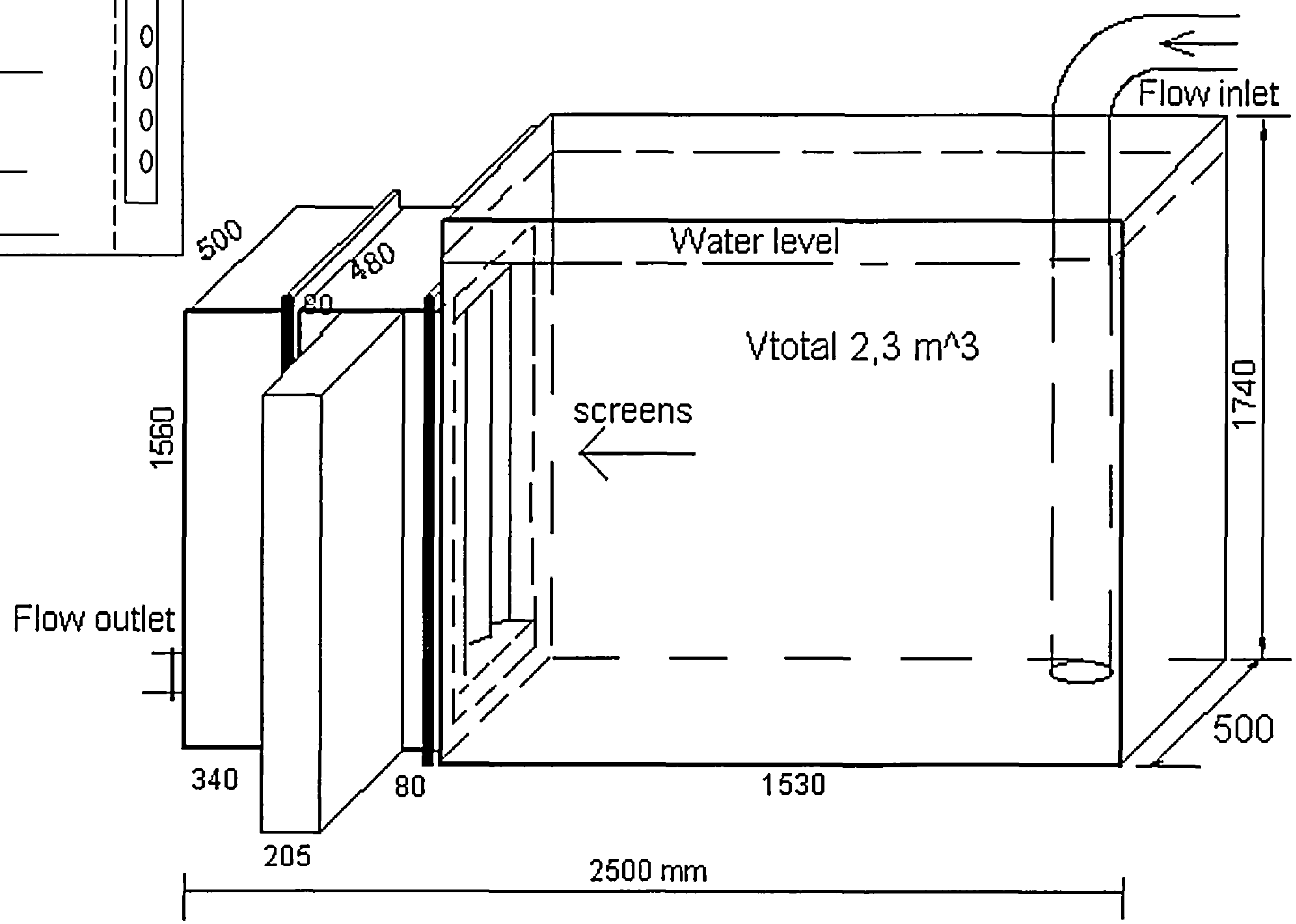
TESTS OBJECTIVES :

- Actualisation of NUREG 6224 head loss equations via a reliable test facility

PARAMETERS CHOSEN FOR TEST :

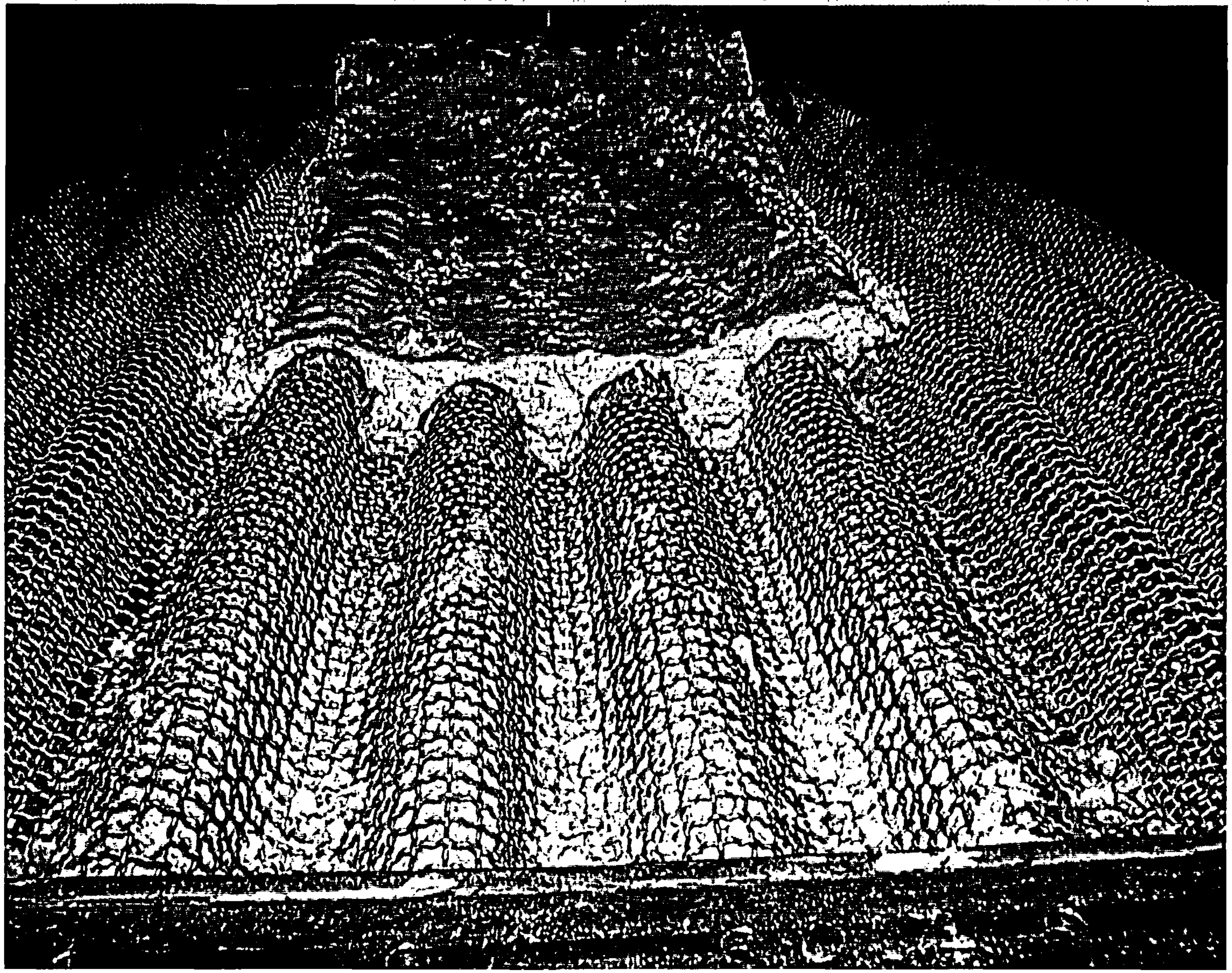
- Destructured insulation deposited on the facility floor
- Maximum load : bed thickness ~6 inches (15 cm) (2A HLB)
- Minimum load : bed thickness ~1.2 inches (3 cm) (thin bed effect)
- Temperature variations from 30 to 80°C





FORTUM TEST FACILITY

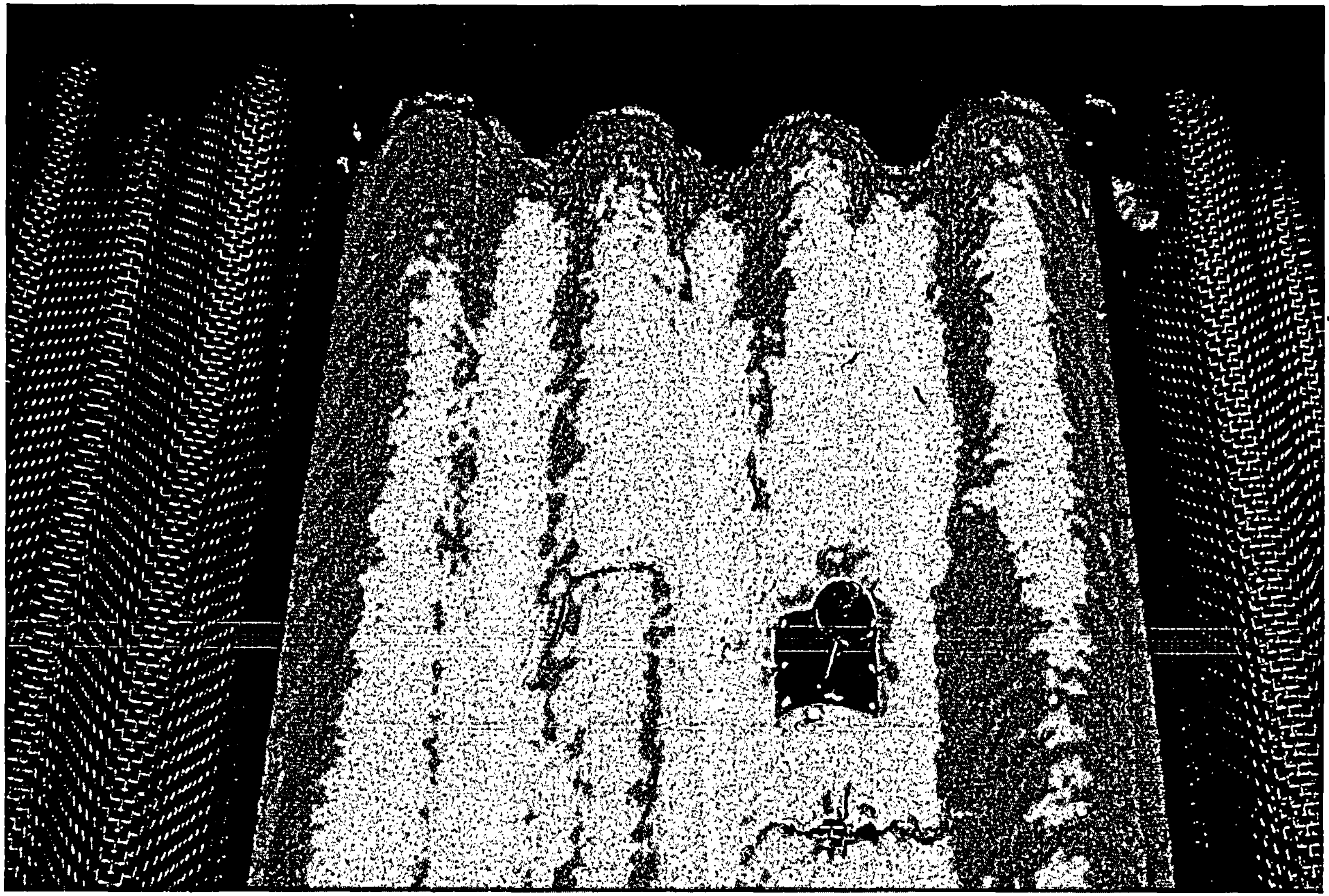
ECC – SIS SP RECIRCULATION MODE – 900 PWR's



BUGEY SCREEN CLOGGED

(FORTUM test)

ECC – SIS SP RECIRCULATION MODE– 900 PWR's



THIN BED EFFECT

(FORTUM test)

CONCLUSIONS :

➢ Thanks to reliable tests facilities & representative samplings, EDF is capable to assume good predictions of sumps screens behaviours and therefore head losses

➢ Large conservatisms related to the debris amount to be postulated at sumps screens are still included in the demonstration. It leads to potentially introduce significant margins in the design. To be refined ?

➢ Applicability to all french PWR's.

United States Nuclear Regulatory Commission

STATUS AND PROPOSED RESOLUTION OF GSI-191 "ASSESSMENT OF DEBRIS ACCUMULATION ON PWR SUMP PERFORMANCE"

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Office of Nuclear Reactor Regulation

Division of Systems Safety and Analysis

Plant Systems Branch

June 22, 2004

OVERVIEW

- Generic Safety Issue (GSI) - 191
- Generic Issue Program Stages
- Technical Assessment
- Regulations and Guidance Development
- GSI-191 Implementation and Verification
- LANL Support Activities
- Industry Meetings/Initiatives
- Status
- Current Plans and Schedules

Conclusion – Industry initiative with close oversight by NRC leads to effective resolution
On Schedule to close out by 2007

United States Nuclear Regulatory Commission

Generic Safety Issue GSI -191

- 10 CFR 50.46 (b)(5) and Appendix A to 10 CFR 50, Criterion 35 Require Long Term Emergency Core Cooling
- Debris Blockage of Sump Screens may Prevent the Injection of Water into the Reactor Core or Containment Spray
- USI A-43 Examined Emergency Sump Performance
  - closed in 1985 (Generic Letter 85-22; Reg Guide 1.82 Rev. 1)
- GSI -191 Re-Assesses Effect of Debris Accumulation on PWR Sump Performance due to
  - Events at BWRs
  - New information identified since USI A-43 closure, including during BWR resolution

Generic Issue Program Stages

(Management Directive 6.4)

1 Issue Identification
2 Initial Screening
3 Technical Assessment
4 Regulation and Guidance Development
5 Regulation and Guidance Issuance
6 Implementation
7 Verification

Technical Assessment

- Confirmed Recirculation Performance is a Credible Concern for PWRs
  - More and finer debris could be generated by a HELB
  - Sump clogging due to thin bed effect
  - Upstream (inventory loss) and downstream blockage (HPSI throttle valves) concerns
  - Other effects such as loads on screens from debris beds at design conditions

Technical Assessment Conclusions

- Plant Specific Analyses should be conducted to determine whether debris accumulation will impede or prevent ECCS operation during Recirculation
- Appropriate Corrective Action, as necessary, should be implemented based on these plant-specific analyses
- The Industry and the ACRS were briefed on the study findings in July and September, 2001,respectively.
  - -ACRS agreed with potential issue; developing guidance for plant-specific analyses if needed, and requested review of proposed final disposition
- NRR Briefed ACRS on Generic Communications and Status in February 2003

Regulations and Guidance Development (Stage 4) and Issuance (Stage 5)

- NRR Action Plan Developed to Address GSI Resolution
- Revised Regulatory Guide 1.82 November 2003
- Bulletin 2003-01Interim measures to reduce risk
- PWR Industry (NEI) Submitted Guidance for Plant Specific Evaluation (May 28, 2004)
- Generic Letter for plant specific evaluations

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GSI-191 Resolution/Closure

- Implementation (Stage 6) begins following Guidance review and approval Fall 2004
  - focus shifts to plant specific MPA activity
- Verification (Stage 7) planned though a combination of Audits, inspection activities and GL response reviews
- Leads to effective closure of GSI-191

LANL Support Activities

- NRR Contracted LANL for technical support
- Provides continuity of GSI issue and related technical support
- Selected support activities:
  - Calculations for volunteer plant
  - Evaluated potential operator recovery actions to complement parametric study results
  - Addressed testing or knowledge base uncertainties
- Input to SER on Industry Evaluation Guidelines

United States Nuclear Regulatory Commission

Industry Meetings/Initiatives

- NEI PWR Sump Performance Task Force 1997
- Regular Meetings and Conference calls
- Since completion of Technical Assessment:
  - NRC Action Plan addressed
  - Industry Initiative program
    - Evolved to submittal with NRC evaluation
    - Regulatory Implementation via Generic Communications
  - Close coordination between RES and NRR on GSI-191 related emerging technical issues

Status

- Two-phased generic communication approach taken
  - Bulletin 2003-01 for interim measures to reduce potential risk
  - Generic letter to address plant specific evaluation
- Staff is currently reviewing responses to Bulletin
- Proactively reviewing Sump Evaluation Methodology
- Ongoing development of a Risk-Informed Option
- Plan to inspect, on a sample basis, licensees' plant-specific evaluations requested by generic letter
- Chemical precipitation issue – testing being developed
- Downstream effects to be evaluated by licensees as well as sump blockage

Licensees conduct configuration assessments of containments/sumps (NEI 02-01)	August 2002 to Sept. 2004
Industry Evaluation Guidelines submitted	May 2004
NRC issues final generic letter	August 2004
NRC completes review of Industry Evaluation Guidelines	Sept. 2004
Licensees analyze sumps with approved guidelines	Commence Oct. 2004
Licensees make modifications, if needed, using approved guidelines	Begins in 2006
NRC reviews responses, inspects analyses on an audit basis	Begins in 2005
NRC closes GSI-191	December 2007

GSI-191:
NEI Containment Sump Evaluation Methodology

Presenters
Angie Lavretta, 301-415-3285
Bruce Letellier, 505-665-5188

ACRS Subcommittee Briefing
Rockville, MD
June 22-23, 2004

Summary

- Final NEI Sump Evaluation Methodology Guidelines Submitted May 28, 2004, with Improvements
- NRC Staff, with Support from Los Alamos, is Evaluating the Methodology Guidance and Considering Alternatives for Unresolved Issues
- NEI Response to Staff RAI's Submitted June 10, 2004
- Staff will Brief ACRS Subcommittee on August 17, 2004

Review of NEI Methodology Guidelines

Status of Review

- Final NEI Guidelines Submitted May 28, 2004, with Improvements
  - Developed Discussion of Bases to Justify Guidance Provided
  - Addressed the Use of Conservatism
  - Changed Format to "User-friendly" Approach

- Technical Details and Content in May 28th Submittal Seem Very Similar to That in October 31st Submittal

- NEI Response to Staff RAI's Received June 10, 2004

Review of NEI Methodology Guidelines

Major Areas of Sump Evaluation

- 1. Break Characteristics
- 2. Debris Generation
- 3. Consideration of Latent Debris
- 4. Debris Transport
- 5. Head Loss
- 6. Downstream & Chemical Effects

Review of NEI Methodology Guidelines

Staff Approach to Resolution of Issues

- Staff holding discussions with NEI to clarify and resolve outstanding issues

- Guidance areas requiring further review and/or verification
  - Treatment of coatings debris
  - Mapping of zone-of-influence
  - Debris transport assumption
  - Two-phase debris generation

- Determining balance between over-conservative and under-conservatism

UNITED STATES NUCLEAR REGULATORY COMMISSION

Review of NEI Methodology Guidelines

Staff Approach to Resolution of Issues

- Guidance areas not adequately addressed
  - Downstream blockage
  - Calcium-silicates debris effects (4/04 report findings not considered)
  - Chemical effects (testing underway)
  - Risk-informed option (under development [separate presentation])

- For those issues not resolved, develop "acceptable" alternatives for inclusion in the staff's safety evaluation report

Review of NEI Methodology Guidelines

ACRS Review of Final Staff Position

- Staff will Brief ACRS Subcommittee on August 17, 2004
- Staff will Brief ACRS Full committee September 8, 9, or 10, 2004