UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

November 22, 2011

MEMORANDUM TO: ACRS Members

FROM: Ilka Berrios, Staff Engineer /RA/
Technical Safety Branch, ACRS

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS THERMAL-HYDRAULICS PHENOMENA SUBCOMMITTEE MEETING, SEPTEMBER 7, 2011

The minutes for the subject meeting were certified on October 20, 2011. Along with the transcripts and presentation materials, this is the official record of the proceedings of that meeting. A copy of the certified minutes is attached.

Attachment: As stated

cc w/o Attachment: E. Hackett
C. Santos

cc w/ Attachment: ACRS Members

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

November 3, 2011

MEMORANDUM TO: Ilka Berrios, Staff Engineer
Technical Safety Branch, ACRS

FROM: Sanjoy Banerjee, Chairman /RA/
Thermal-Hydraulics Phenomena Subcommittee

SUBJECT: MINUTES OF THE ACRS THERMAL-HYDRAULICS PHENOMENA SUBCOMMITTEE MEETING, SEPTEMBER 7, 2011, IN ROCKVILLE, MD

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting are an accurate record of the proceedings for that meeting.

/RA/ 11/03/2011
S. Banerjee Date

Chairman of the ACRS Thermal-Hydraulics
Phenomena Subcommittee

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MINUTES OF THE THERMAL-HYDRAULICS PHENOMENA
SUBCOMMITTEE MEETING
SEPTEMMBER 7, 2011

The ACRS Thermal-Hydraulics (T-H) Phenomena Subcommittee held a meeting on September 7, 2011 in Room T-2B3, 11545 Rockville Pike, Rockville, Maryland. The meeting convened at 8:30 a.m. and adjourned at 11:12 a.m.

The entire meeting was open to the public.

No written comments or requests for time to make oral statements were received from members of the public related to this meeting.

ATTENDEES

ACRS Members/ Staff/ Consultants
- Sanjoy Banerjee, Member
- Said Abdel-Khalik, Member
- J. Sam Armijo, Member
- Joy Rempe, Member
- William J. Shack, Member
- Ilka T. Berrios, Staff
- Kathy Weaver, Staff
- Graham Wallis, Consultant

NRC Staff
- John Burke, RES/DE
- Ervin Geiger, NRR
- Paul Klein, NRR
- John Lehning, NRR
- Richard Lobel, NRR
- Stuart Richards, RES/DE
- Stephen Smith, NRR
- Z. Gary Wang, RES/DE
- Warren Lyon, NRR/DSS
- Jennifer Gall, NRR/DSS
- Stewart Bailey, NRR/DSS
- Matt Yoder, NRR/DCI
- Paul Klein, NRR/DCI
- Greg Makar, NRO/DE
- Rick Jervey, RES/DE
- Sheila Ray, RES/DE
- John McKirgan, NRO/DSRA
- Clint Ashley, NRO/DSRA

Other Attendees
John Butler, NEI

SUMMARY

The purpose of the meeting was to review Draft Final Regulatory Guide (RG) 1.82, "Water Sources for Long Term Recirculation Cooling Following a Loss-of-Coolant Accident," Revision 4. The meeting transcripts are attached and contain a description of each matter discussed during the meeting. The presentation slides and handouts used during the meeting are attached to these transcripts.

The following table lists the significant issues that were discussed during the meeting with the corresponding pages in the transcript.

SIGNIFICANT ISSUES	
Issue	Reference Pages in Transcript
Discussion of RG 1.82 provided by NRC staff	6-93
The staff provided the history of RG 1.82 and what are the main changes made in Revision 4.	6-8
Dr. Wallis raised a question regarding the GSI-191and suction strainers guidance, which needs to be updated.	8-11
Dr. Wallis raised a question regarding the zone of influence (ZOI) guidance and experiments. There is lack of guidance on how to perform the experiments. Member Shack raised a concern on how the RG implicitly endorses NEI 04-07 and just avoid mentioning ANSI 58.2.	11-16
The staff discussed the strainer head loss testing, and how the new strainer designs have to be qualified by testing and not using correlations. Chairman Banerjee and Dr. Wallis raised a concern regarding the head loss testing not showing the worst case scenario.	17-23
Dr. Wallis and Member Armijo asked the staff if the effects of the water temperature have been tested and what prototypical is.	25-30
Dr. Wallis asked a question regarding the effects of thin beds. Member Abdel-Khalik asked if the back side of the strainer has been look at after one of the thin bed experiments has been performed.	30-43
Dr Wallis raised a concern regarding the debris quantities transported to the ECCS strainer. What it is expected from the industry? Is the industry allowed to use CFD calculations?	44-47
The staff discussed how the chemical effects should be addressed.	47-48
The staff discussed the downstream effects, which has two categories in-vessel and ex-vessel. Chairman Banerjee and Dr Wallis raised questions regarding the downstream effects tests.	48-63

The staff discussed the amount of detail and the references that should be included in the regulatory guide	64-66
The staff discussed the protective coatings.	66-67
The staff discussed the latent debris.	67-70
The staff discussed the vortexing and air ingestion.	71-77
Chairman Banerjee asked for clarification regarding the status of the BWRs.	81-84
Dr Wallis asked if air tests for the ZOI and debris damage are accepted.	85-89
Presentation from NEI. NEI questioned the purpose of the regulatory guide being issued now when it still has a number of issues to be resolved.	91-102
Conclusions provided by the staff. Staff explained why the regulatory guide should be issue now.	102-105
Subcommittee discussion	105-112

DOCUMENTS PROVIDED TO THE SUBCOMMITTEE

The following document was provided to the members prior to the meeting:

- Memorandum to William H. Ruland, Director Division of Safety Systems, NRR; Michael G. Evans, Director Division of Component Integrity, NRR; Patrick L. Hiland, Director Division of Engineering, NRR; Thomas A. Bergman, Director Division of Engineering, NRO; Charles E. Ader, Director Division of Safety System and Risk Assessment, NRO; Edward L. Williamson, Assistant General Counsel for Operating Reactors, OGC, "Request for Concurrence on Regulatory Guide, RG 1.82," dated 06/10/2011 (ML111330239)

Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
Thermal-Hydraulics Phenomena Subcommittee

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Wednesday, September 7, 2011

Work Order No.: NRC-1111 Pages 1-112

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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

THERMAL-HYDRAULICS PHENOMENA SUBCOMMITTEE

RG 1.82, "WATER SOURCES FOR LONG-TERM RECIRCULATION COOLING FOLLOWING A LOSS-OF-COOLANT ACCIDENT"

+ + + + +

WEDNESDAY

SEPTEMBER 7, 2011

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Sanjoy Banerjee, Chairman, presiding.

COMMITTEE MEMBERS:

SAID ABDEL-KHALIK, Chairman

J. SAM ARMIJO, Vice Chairman

SANJOY BANERJEE, Member

JOY REMPE, Member

WILLIAM J. SHACK, Member

ACRS CONSULTANTS PRESENT:

GRAHAM B. WALLIS

NRC STAFF PRESENT:

ILKA BERRIOS, Designated Federal Official

JOHN BURKE, RES/DE

ERVIN GEIGER, NRR

PAUL KLEIN, NRR

JOHN LEHNING, NRR

RICHARD LOBEL, NRR

STUART RICHARDS, RES/DE

STEPHEN SMITH, NRR

GARY WANG, RES/DE

ALSO PRESENT:

JOHN BUTLER, NEI

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

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

8:30 a.m.

CHAIRMAN BANERJEE: The meeting will now come to order. This is a meeting of the Thermal-Hydraulics Phenomena Subcommittee. I'm Sanjoy Banerjee, chairman of the subcommittee. ACRS members in attendance are Sam Armijo, Said Abdel-Khalik, Joy Rempe, William Shack. ACRS consultant in attendance the former chair of the ACRS is Graham Wallis. Ilka Berrios of the ACRS staff is the designated federal official.

The subcommittee will review the draft final regulatory guide 1.82, Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident. This is Revision 4. We will hear presentations from the NRC staff. In addition we have received a request for time to make an oral statement from John Butler from the NEI. No written comments from members of the public regarding today's meeting were received.

The subcommittee will gather information, analyze relevant issues and facts and formulate proposed positions and actions as appropriate for deliberation by the full committee. 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. A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice. Therefore we request that participants in this meeting use the microphones located throughout the meeting room when addressing the subcommittee. The participants should first identify themselves and speak with sufficient clarity and volume so that they may be readily heard. We will now proceed with the meeting and I will call upon John Burke to begin. Thank you.

MR. BURKE: Good morning. Okay.

MR. RICHARDS: I'm Stu Richards. I'm from the Office of Research and I work with John and Gary. We're glad to be here and thank you for your time. The only thing I'd like to note is that you know there are some things that are not addressed by this reg guide update. We have to move forward with the things that we can update it with and some of these other issues that are resolved we'll come back and revise the update. The revised reg guide has those issues to resolve.

CHAIRMAN BANERJEE: Right. We expect to write a letter in the October full committee meeting.

MR. RICHARDS: Right. Correct. We

appreciate that. And with that, John?

MR. BURKE: All right. Good morning, thank you. Next to me is Gary Wang of the staff. Gary helped me do this revision to the reg guide. So what we're going to talk about today if I can -- is the reason for the revision. And I selected topics from the reg guide that we added a lot more detail in what had been the previous revision. And a review of some of the public comments. So Reg Guide 1.82, Water Source for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident was last revised in November, 2003. And that was to incorporate the information we knew at the time for PWRs based on the 1990s work with the BWR suction strainer. So in the 1996-1998 time frame suction strainers for BWRs were evaluated and the reg guide was revised at that time. So then in 2003 we added some information that we learned from the BWRs to make it apply to the PWRs. Since then, since 2003 quite a bit of research has been done both by the NRC and industry to improve the knowledge about PWR suction strainer guidance. So this revision incorporates what we've learned since 2003 and also incorporates as a result of GSI-191.

This revision is a complete rewrite of the prior revision to improve the readability and updated

information. And what I mean by that, in the prior revision those separate sections for BWRs both in the background and in the regulatory position and a separate section for PWRs. Where it was appropriate, those are combined now. So in the background section there's common background and common regulatory positions followed by much shorter reactor type-specific regulatory positions.

This revision endorses various topical reports by industry. An NEI guidance report on GSI-191 or Generic Letter 2004-02.

MEMBER SHACK: I was curious, I didn't go through a check. Is there complete consistency between 0407 and this reg guide?

MR. BURKE: It's more, I would say unless there was an exception to 0407 by the SE.

MEMBER SHACK: In the SE.

MR. BURKE: Yes. And then also, like I said, and the safety evaluations for those topical reports. And then some of the NUREG reports that have been completed since 2003.

Another area that we added into this one was the -- in the areas of head loss testing, vortexing, protective coatings and chemical effects those weren't addressed in much detail in the topical

reports, but the staff has issued guidance memos to NEI and those are incorporated in this revision. And then as part of the improvement in readability and usability obsolete figures and tables were deleted. And it also incorporates guidance on Generic Letter 2008-01 on gas accumulation in ECCS containment spray systems.

And like Stu mentioned earlier not everything related to GSI-191 or suction strainers is included in this revision. The issues listed here --

DR. WALLIS: I think report one is unfortunate.

MR. BURKE: Yes.

DR. WALLIS: I mean I read this and I read the statement that 10psh should be independent of the calculated increases in containment pressures caused by phosphate LOCAs. And so I said aha, they've abolished containment over-pressure, right? There's the statement. And then the weasel words later on as it does now. I don't think that's very good. Are you going to straighten that out?

MR. BURKE: Yes. Someday.

(Laughter)

DR. WALLIS: Someday. Will I still be alive?

(Laughter)

CHAIRMAN BANERJEE: Weren't you the one, Graham, that actually wrote that 2005 ACRS letter?

DR. WALLIS: It's taking a long time. I mean it's a simple thing, isn't it?

MR. BURKE: There was a SECY paper approved early this year, SECY-1114 addressing that issue and the staff is working through that. And so we -- we plan on revising both this reg guide and Reg Guide 1.1

DR. WALLIS: Well, the words minimize to the extent possible are the most vague guidance you can give guidance you can give it seems to me.

MR. BURKE: I agree and like you said those words have not changed from the prior revision except maybe to make it -- we've reorganized it to try to make it a little bit better but we haven't changed our position yet.

DR. WALLIS: Thank you.

CHAIRMAN BANERJEE: I mean there's also in between Fukushima that has happened and lessons learned. I mean, there's a lot of water under the bridge now which we have to take into account.

MR. LOBEL: This is Richard Lobel from the staff. We made the decision not to make any changes

to the reg guide in this area because there's a lot going on and it just wasn't the right time to try to put down some final guidance or even really interim guidance. We're working with the BWR Owners' Group right now. They have a contract with Sulzer Pumps and they're doing some work with pump uncertainty and that kind of thing that we've talked about before with the committee. And we're waiting for that to be done. There's several power up-rates that are being reviewed right now that are waiting for this work that's being done by the BWR Owners' Group. So really I wouldn't put anything into the words that are in the reg guide now. The decision is just to leave that part as is because we're not ready to make the revision. I can talk about that more later if you want but that's not really the subject of this meeting.

CHAIRMAN BANERJEE: Yes, we've got that. Yes.

MR. BURKE: And like I said, we're not adding any specific guidance on downstream in-vessel effects for a similar reason. The testing is still going on by industry and the test results are being evaluated by the staff. And then in line with, there was another SECY paper recently approved or SECY-10-113 that provided the staff some direction from the

commission and that is still under evaluation so that's not in this revision either.

Some of the selected topics that I picked to talk about today are those listed, suction strainer head loss, chemical effects, debris downstream of the strainer, coatings, latent debris and vortexing and air ingestions.

DR. WALLIS: When you talk about ZOI it seems to me this guidance is vaguer about ZOI than it was before. It doesn't cite references, it says you've got to do experiments but no one's going to do experiments for the 2-foot pipe in a 100-foot containment or something are they? How are you going to do that?

MR. BURKE: The guidance on ZOI hasn't changed any.

DR. WALLIS: But it says you've got to do experiments. It doesn't refer to any document about how to do it, it just says you've got to do tests.

MR. BURKE: True. And the, I guess right now the Owners' Group is doing some testing.

DR. WALLIS: On a full-size, full-scale?

MR. BURKE: No, I believe it's 3- or 4-inch diameter pipe.

DR. WALLIS: So there's always that

problem of how do you predict this ZOI which by some methods is the whole containment. How do you -- what's the right way to do that?

MR. BURKE: I know the committee did not like what was in NEI-0407 and --

MEMBER SHACK: But this sort of implicitly still endorses NEI, you just avoid mentioning ANSI 58.2. But you go back to 0407 and there it is.

MR. BURKE: Yes, that's true.

CHAIRMAN BANERJEE: Remind me, was the ANSI withdrawn?

MEMBER SHACK: Yes.

MR. BURKE: In 1988 I believe.

DR. WALLIS: So there's sort of a hole there isn't there?

MR. BURKE: The staff has agreed to accept what is in 0407 and the ANSI 58.2.

DR. WALLIS: So they accept something that doesn't exist?

MR. BURKE: Well, it's withdrawn. It exists.

MEMBER SHACK: Some effort at least with GE with the ESBWR to do a more realistic calculation in zones of influence. Did that go somewhere? Or was that just a conceptual thing that? Is anybody really

doing those kinds of calculations?

MR. BURKE: Steve? John?

MR. SMITH: Yes, this Steve Smith from the staff. The ANSI model was not withdrawn because there was any technical shortcomings seen. It was withdrawn because ANSI couldn't support -- support continuing to have the model out there. They just didn't, for some reason they just stopped --

MEMBER SHACK: If you go to the ANSI website there's statements there that because of comments by Professor Wallis.

MR. SMITH: They didn't see anything wrong with it. They just couldn't, they couldn't come up with any --

MEMBER SHACK: Justification for it.

DR. WALLIS: So they didn't see anything wrong with it? They actually said that?

MR. LEHNING: This is John Lehning from the staff. The -- we spoke with the people from the ANS committee that worked with the standards and the reason that they told us that they withdrew that is that there's a 10-year period where the committee has to meet, review and then continue to accept that standard for the next 10-year period. And so that was -- they had not done that on it before any of the ACRS

comments on the model had been put forth.

MR. SMITH: Now, that said, there is an ongoing project that the PWR Owners' Group is working on to develop a new model which should be a more accurate model and Research is helping us to review that model and it's also being validated against the more recent tests, some other tests that were done by Westinghouse Canada and the new testing that's being done with the 4-inch nozzle that John talked about earlier. So that is what we're hoping to come up with a more accurate model.

Now, the PWR Owners' Group is hoping that it's going to show smaller ZOIs than what we're currently showing for various materials but it hasn't been -- it hasn't been completed yet. I mean, the model is complete, relatively complete. They still haven't validated it to all the new test data but they have validated it to Marviken data which is a larger scale, which is a larger-scale test.

DR. WALLIS: Marviken is pretty short range.

MR. SMITH: That is true and that's one of the questions that we are discussing with them, you know, how valid is it at the further distances because the Marviken tests were relatively, you know, very few

L over Ds out where they were taking --

DR. WALLIS: So you're hoping the new model will be less conservative?

MR. SMITH: No, we're not hoping that.

DR. WALLIS: But you're hoping it will show a smaller zone of influence?

CHAIRMAN BANERJEE: They're not industry.

DR. WALLIS: But it seems to me that there is a problem if it shows a bigger zone of influence.

MR. SMITH: It may be -- it will be a problem for some plants.

DR. WALLIS: And then you'll rewrite the guidance or something?

MR. SMITH: We will consider, yes, we will rewrite the guidance if we need to, you know, if there is a reason to rewrite it once the new model is accepted by us. If the new model shows smaller ZOIs you know then plants will be able to use that, if they participate in that project they'll be able to use that to show smaller ZOIs and less material obstructed. I think it's a proprietary testing so we won't be able to generally put it out there, you know, accept it. But if we do see an issue that would indicate the ZOI should be larger we would have to do something about that.

CHAIRMAN BANERJEE: If I recall, maybe my memory is faulty, at least some of the tests that were being done had some problems with regard to internal choking. Have these tests been redone?

MR. SMITH: That's correct, that's the current project right now is redoing those tests that were done previously with no upstream choking taking place.

CHAIRMAN BANERJEE: Right. Okay, so the whole thing is still up in the air and until we get more reliable data and a more reliable model we're just going to go on the basis of the existing model.

MR. SMITH: That's correct.

DR. WALLIS: That's very strange. On the expansion of a supersonic jet there's an old story and it shouldn't be debatable within the technical community. It should be clear. What's the problem?

CHAIRMAN BANERJEE: Well, there's also the two-phase aspect.

DR. WALLIS: Yes. You mean if it's two-phase you can't do anything for 10 years?

CHAIRMAN BANERJEE: Well it's a little more difficult as you know.

DR. WALLIS: Well, let's drop it. We've made the point I think now.

CHAIRMAN BANERJEE: Yes. Okay. Let's carry on.

MR. BURKE: All right. In the area of strainer head loss prototypical head loss testing is now the recommended or preferred way of determining suction strainer head loss. In the prior revision of this reg guide, NUREG/CR-6224 contained a correlation where -- and we don't, the staff no longer accepts the use of the correlation for determining strainer head loss. And as discussed in the next bullet there were some limitations on the use of the correlation in the safety evaluation for NEI-0407 and we believe those limitations are still valid. And so in the reg guide we're recommending any new strainer designs be qualified by testing and not use the correlation.

CHAIRMAN BANERJEE: If you go back and look at say the BWR strainers.

MR. BURKE: Yes.

CHAIRMAN BANERJEE: This is -- I saw the public comment on this as well. Do they use this 6224 and what would happen if they do? You would have to reevaluate it or something?

MR. BURKE: Yes. In the 1996 time frame the BWRs by and large used the correlation. Recently we, the staff pointed out to the Owners' Group some of

our concerns with the use of the correlation and the BWR Owners' Group has agreed to go back and revisit that area and take a look at the appropriateness of what they did 15 years ago. That is being handled outside of the generic letter or GSI program. It's, there were a list of 12 areas that, like chemical effects and coatings and downstream effects and then this is one of them where the BWRs did things quite a bit different 15 years ago. They are revisiting that as a separate program now.

DR. WALLIS: Could I comment on this? Now you have no theoretical way of predicting, that's acceptable, of predicting strainer head loss. I understand. You can scope but you can't predict --

MR. BURKE: Correct.

DR. WALLIS: -- the two tests. And then in the text it says the test specs should be designed to determine the worst case head loss from all of the possible types of debris burdens. Now we know from the history of the tests that it's very difficult to do that, there are always surprises and so on. And I think determining the worst case may take thousands of tests. If you really want the Mount Everest you've got to measure all the peaks. And that seems to me very unrealistic.

MR. SMITH: What we've done -- this is Steve Smith again. What we've done with the testing is we have developed guidance which is referenced now in the reg guide. And the utilities have been using this guidance in the tests done in the last few years. And we understand that they may not, by using this guidance they may not come up with the highest possible head loss that could ever occur. However, we feel it's a reasonable assurance that they're going to come up with a head loss that is limiting for what could happen in their plant because there are many aspects of the way that the evaluation is done that have conservatisms in them. So from debris generation to transport, all these things contribute some conservatism to the evaluation. And the way we have the testing done is also a conservative test methodology. And we have them test various conditions, you know, depending on what their potential debris loads are to the point where we believe that they're going to come up with a head loss that will be limiting for their plant.

DR. WALLIS: Well, that's a very different statement than the one that I just read. And maybe then you need to think about the guide. If the guide asks you to find the worst case head loss from all

possible types of debris tests.

MR. SMITH: And that is, that's basically what --

DR. WALLIS: That's a very tall order.

MR. SMITH: That's basically what the guidance is telling them to do.

DR. WALLIS: Well, that's a very formidable task for industry.

CHAIRMAN BANERJEE: But there was a public comment on this if I recall as well because I mean, they were concerned that you know there is such a multiplicity of brakes, locations and all, you know, the debris iteration, that it's not a linear relationship. The biggest break does not necessarily give you the largest head loss. So there should be some form of -- they ask for almost like a design basis, the comment that I read, just like a design basis accident that there would be some sort of a design basis to use. Though I feel that your guidance, even if it doesn't -- this is just private opinion, it's not the committee's necessarily at the moment -- does get you know to a point where you're never going to be able to identify what is the worst possible case, but you've got enough conservatisms in your guidance probably to cover a lot of the issues.

For example, with regard to settling and other things like that, you know. There is some conservatism built into that guidance. We can look at the guidance in more detail offline if needed. We do have the guidance available.

MR. SMITH: Yes, I think the way to look at it is we understand you could -- you may always be able to make the head loss get a little bit higher if you keep testing, but there's not going to be a significantly higher head loss and the probability is that the head loss during a real event is going to be significantly lower than what these guys find during their test.

DR. WALLIS: Well, that's what you say but in some testing, you see we've got the history here where people have done tests then suddenly found the head loss 10 times anything they measured before for some peculiar combination of things.

MR. SMITH: I know.

DR. WALLIS: So your assurance that it's a nice linear well-behaved problem is a little bit unsupported by some of this process.

CHAIRMAN BANERJEE: I don't think they're saying it's linear.

DR. WALLIS: Well, but it's well-behaved.

You don't suddenly find all the mountains are like this and suddenly there's a peak 10 times as tall.

CHAIRMAN BANERJEE: There's very strange things that you find.

MEMBER SHACK: But I mean they are looking at thin bed versus maximum debris versus beds with stratified debris which covers a range of conditions that could lead to surprises.

DR. WALLIS: So you're looking for an intelligent search for high pressure drops, really, not sort of for just a scattered thing. If you start, if the industry starts to find evidence of a high pressure drop for certain conditions I think what you're asking is that they don't just put that aside, they think about it and explore with more tests. I think that's what you're looking for is a very intelligent search for what could be worse within the conservatisms and so on, but not finding the absolutely worst. But not being content with a few points which show some anomalies.

CHAIRMAN BANERJEE: I think you're just taking contention with the words as written.

DR. WALLIS: That's -- yes, that's a bad word to look for.

CHAIRMAN BANERJEE: That's not that. It

should be called --

DR. WALLIS: But you should look for symptoms of causes or evidence for possible higher pressure drops or something and pursue that which is a more sensible engineering thing to do. But you're not going to look for the very worst, you'll never find that.

CHAIRMAN BANERJEE: Well, what sort of surprises you in a lot of these things is you make a relatively small change to an experiment and you can get sort of an outlier. So anyway, for what it's worth let's carry on.

MR. BURKE: I'll take a look at how that's worded.

CHAIRMAN BANERJEE: Yes, just -- maybe, what he's really saying is it may be very hard to find what is the absolute worst case so they really need guidance as to what to do and if they follow staff guidance maybe that's enough.

MR. BURKE: I think I understand.

CHAIRMAN BANERJEE: Yes, okay.

MR. BURKE: And like we talked about a little bit, that staff guidance was put together by the staff going to the different facilities, witnessing the testing and reviewing the protocols the

different vendors were using and putting this guidance together. And it was discussed at public meeting in 2007-2008 and it's been incorporated into the reg guide by Regulatory Position 1.311.

CHAIRMAN BANERJEE: We also brought up from previous meetings a number of issues as to what you mean by prototypical or representative because you could have flows which were partially parallel to the strainers where the normal velocity is very low. So if you just used the normal velocity to the strainers it might show that you could get settling, but because you have components parallel in certain cases the Reynolds number can be fairly high and that would keep things in suspension. So we liked what the staff did in not allowing people to take credit because that seemed a conservative way to go whereas if you did it strictly based on, you know, these very low velocities through the strainers you probably allow settling. So these are the sort of conservatisms which are built in, at least into the guidance. Am I correct? Correct me if I'm saying something wrong. You know, I'm just speaking from memory.

MR. LEHNING: This is John Lehning again from the staff. That is a correct statement. There's two choices. I guess a plan could either choose the

test with an agitated tank and ensure essentially 100 percent transport or in the case where you know the staff has still been discussing with one vendor how to test with a test that allows settlement credit. If that test, in that test protocol the vendor would have to account for not only the normal but also this parallel velocity of the surfaces and the turbulence, et cetera, as well.

CHAIRMAN BANERJEE: Right. Okay.

MR. LEHNING: So that's correct.

DR. WALLIS: Can we go back to slide 8? I'm sorry here.

MR. BURKE: Sure. If I can figure out how.

DR. WALLIS: Now you've done a fairly good job on this guidance and we're just picking up things where we think we might help you to maybe change it a little bit in the direction of improvement. This water temperature effect. It's said here that scaling temperature to ensure that other phenomena do not have a non-conservative effect when the temperature is scaled. Well, we don't know how to predict, right? We don't know how to predict pressure drop, it's all got to be done by testing. And yet somehow, somebody's got to know how to scale temperature. Now

it's not only viscosity, temperature changes chemical effects, it changes the flexibility of the fibers, it probably changes the mobility of the particles within them. Temperature does various things, right? I don't understand why you don't require tests at real temperatures. Then you'd know and we wouldn't have this question all the time about what's the effect of temperature.

MEMBER ARMIJO: Yes, I was going to ask that question in a different way. But the water temperature can have big effects. We saw it in a limited amount of testing I think done for the AP-1000, I'm not sure. But also there's a lot of chemistry going on, you know. And does your prototypical head loss testing that you recommend, are you looking for true prototypicality with regard to the water chemistry as well as the temperature as well as all the fluid flows and geometries and everything else? What are you -- is that going to be not included? What is prototypical? I guess that's the bottom.

MR. BURKE: I'll let Steve try that one again.

MR. SMITH: This is Steve Smith. The testing has generally not been done in buffer borated

water at the early high temperatures that could occur during or following an accident. Typically the temperatures that have been tested have been between room temperature and about 120 degrees. There has been some tests run by some utilities that actually ran. They never went above 212 degrees. They would run up to about 190 degrees and do a long-term 30-day test and cool the fluid down, actually use a prototypical fluid. But that's only been a few utilities that have done that. Most of the tests have been done in room temperature up to 120 degree just tap water, river water, things like that.

CHAIRMAN BANERJEE: With surrogates.

MR. SMITH: With surrogates, yes.

CHAIRMAN BANERJEE: And we approved, I mean, we discussed and the staff agreed to certain surrogates.

MR. SMITH: That's correct.

CHAIRMAN BANERJEE: We looked through this in some detail in the past.

MR. SMITH: And that's in accordance -- this is all in the -- in our guidance that's referenced in the reg guide.

DR. WALLIS: Well, the question is why not make -- work with prototypical temperature?

CHAIRMAN BANERJEE: Because eventually it can get pretty cool, right?

DR. WALLIS: Yes, but there are higher temperatures being found when you initiate or something.

MR. SMITH: Some plants actually have very high temperatures when they initiate recirculation. We haven't seen an indication that the higher temperature test resulted in a significant difference in head loss. Usually the higher temperatures actually result in a reduced head loss due to the reduction of viscosity. We haven't noticed any, say, bed issues that would create higher head losses at these tests that were done up close to 200 degrees.

DR. WALLIS: Has anybody really explored that? I mean, there have been a handful of tests at temperature. No one's really looked for temperature.

MR. SMITH: We haven't explored it and we're not aware of any testing that was done, you know, above.

DR. WALLIS: But you're not aware means you don't know.

MR. SMITH: That's correct, we don't know.

CHAIRMAN BANERJEE: Were these high-temperature tests done with surrogates or with actual

chemistry?

MR. SMITH: The high-temperature tests were done with chemistry that was the same as what would be expected in a plant, some of the tests.

CHAIRMAN BANERJEE: And stuff didn't get gooey?

MR. SMITH: Did not get gooey.

MR. KLEIN: This is Paul Klein from NRR. In the tests that we're aware of where people have used either high-temperature near 200 degrees or even higher temperatures with autoclaves there's never been any occurrences that we thought came close to the more typical test which is the pre-mixed surrogate. So any tests that have had representative environments and then evolved the chemistry over long periods of time have been -- tended to be much less aggressive with respect to chemical precipitates compared to the WCAP premix surrogate that's added to the tap water and ambient temperatures.

CHAIRMAN BANERJEE: In a sense this is a bounding. You know, in the absence of a detailed model I think we have to accept some sort of bounding or bounding test.

DR. WALLIS: But then there's this statement in here. Maybe you need to be careful about

the guide when it's talking about the scaling temperature to make sure that other phenomena do not have a non-conservative effect when temperature is scaled. I mean, that implies to me you've got to do tests to show that this is the case.

Can we move on to the thin bed effect? No one knows what it is. It's like entropy or something. People have discovered anomalously high pressure drops with thin beds. People have discovered anomalously high pressure drops with various things. And people have supposed that a thin bed effect was because the particles somehow filled up the holes in the fibers. That's not unique to thin beds. So it's still very vague what this thing is. We're sort of looking for one of those things in Alice in Wonderland or those rhymes of Edward Lear or something where no one quite knows what it is but it's something you have to worry about. And I would look forward to the day when we understand what it is and so we know what we're looking for and how to avoid it.

CHAIRMAN BANERJEE: Other than I mean what should -- is there some wording change that?

DR. WALLIS: Well, it seems to me it's not unique to thin beds. I mean, it's something to do with the particles filling up the interstices, that

can happen any time and it could happen on top of a bed. You could have a thin bed covered with something else, you could have something else covered with a thin bed. There's all kinds of -- there's nothing unique about having a very thin layer of fibers.

CHAIRMAN BANERJEE: I think the point that they might be trying to make is that you can get very high pressure drops even in the case that you don't have --

DR. WALLIS: Even. But not only with thin beds.

CHAIRMAN BANERJEE: Yes, not only. But.

DR. WALLIS: So maybe we need a better understanding of what it is. Then we could know what we're looking for. It's not just because the bed is very thin there's a problem, it's just that there have been anomalously high pressure drops.

CHAIRMAN BANERJEE: I guess the point is even with a small amount of fiber you can get --

DR. WALLIS: You can fill up the interstices.

CHAIRMAN BANERJEE: Yes.

DR. WALLIS: Yes. But then if you have the small amount of fiber there first with a lot of debris you could do it, then put fiber on top and it

won't make any difference.

CHAIRMAN BANERJEE: Sure.

DR. WALLIS: So it's not really clear what you're looking for. So, again, this is one of these things I raised before. But I think it's very difficult to ask industry to look for something when no one knows what it is.

CHAIRMAN BANERJEE: But that's why they've laid down a protocol.

DR. WALLIS: Yes, but that protocol if you look at some of the tests doesn't really always cover thin bed effect. From what I've looked at.

MR. LEHNING: This is John Lehning from the staff. I guess there are two things associated with a thin bed and why it's highlighted in the guidance. I think the subcommittee has hit on one that there is a small amount of fiber that's necessary in some cases to get this type of effect. I think the other thing is an issue with the testing and in order to do let's say a relatively finite number of tests to qualify the strainer we understand and have seen that with just a small amount of fiber we can concentrate the particulate into a thin layer whereas if, you know, we're talking about larger quantities of fiber, you know, and I'm trying to concentrate. That's what

we're really looking for is a thin layer where we've concentrated and minimized the flow area through that by concentrating the debris area. So by having the thin bed we can control that in an experimental setting and try to recreate that most conservative condition possible. So the staff sees it differently. We do think, you know, we understand what we're looking for, what the industry is looking for and this is a way to create that during a test and have confidence that --

DR. WALLIS: Well, how about the tests where having more particles made less pressure drop? That doesn't fit your model at all.

MR. LEHNING: I think that the testing you may be referring to reflects on the in-vessel.

DR. WALLIS: Yes, but it's still a fiber bed with particles in it. It's a different --

CHAIRMAN BANERJEE: The geometry --

DR. WALLIS: A different geometry, yes. But it's still presumably a fiber bed with particles in it and anomalously having more particles led to less pressure drop which seemed very strange to me because I can imagine having the thin bed already there. Then you pile particles on top. That's not going to reduce the pressure drop. I don't understand

that at all. So there are these anomalous things.

MR. SMITH: We have seen anomalous results during the in-vessel testing and that's why it's not included in this revision to the reg guide.

DR. WALLIS: And it doesn't have any relevance to this? I mean, the bed that formed in the in-vessel test is somehow uniquely different from the bed formed on the strainer?

MR. SMITH: We've seen many more strainer tests than we have fuel tests and we feel much more comfortable with the consistency of the tests that have been done for strainers in that condition. We are not comfortable with the tests that have been done for fuel with the consistency of those tests and that's why we're not including that in this one. But we think that the test program that we have set up or the guidance that we have set up for the strainers will capture a reasonably maximum head loss for the plants.

CHAIRMAN BANERJEE: If I understand the purpose of this revision it's to try to compartmentalize the problem to some extent, that we deal with the strainers here, we deal with the in-vessel stuff again in a separate tank and eventually there's a containment accident pressure issue. We

deal with that separately. So at least trying to -- if I'm wrong tell me, but I think that's what we're trying to do, at least solidify the guidance with regard to the strainers so that industry knows what it has to do. Because you know, it's not up in the air.

MR. LEHNING: That's correct.

CHAIRMAN BANERJEE: Right.

MEMBER SHACK: Well, let me express it another way. They feel confident enough in their guidance for the strainers that they can actually put it in a reg guide which is kind of a fairly, you know, sort of carved in stone --

CHAIRMAN BANERJEE: And hopefully for awhile.

MEMBER SHACK: Hopefully lasts for awhile whereas the other stuff they're still kind of working their way through that.

CHAIRMAN BANERJEE: With good reason. I think we're willing to deal with the in-vessel effects later when it comes.

DR. WALLIS: But if there's some evidence that it feeds back to strainers we can't ignore it.

CHAIRMAN BANERJEE: It does. However, I mean that's more of an ill-posed problem because small changes in configuration and so on can make fairly

large changes whereas I think with the strainers there's enough experiments done now that you know you've covered a fairly wide range of conditions and you have some confidence that you can get it. But we can review the evidence if necessary.

DR. WALLIS: No, I think I would say I respect the comfort and confidence of the staff. I mean, you've looked at this for a long, long time.

CHAIRMAN BANERJEE: Right, a very long time.

DR. WALLIS: And so the comments are from someone who doesn't have the time to look at it that much. But I think what I'm trying to do is avoid you finding some discomfort in the future if something turns up that was unpleasant.

MEMBER ABDEL-KHALIK: Did anyone look at the back side of the strainer after one of these thin bed experiments?

MR. LEHNING: Yes, they typically do try to look at that.

MEMBER ABDEL-KHALIK: The back side.

MR. LEHNING: For certain strainer designs they have. I think that typically they look at the outside much more so than the inside.

MEMBER ABDEL-KHALIK: Was there any

interaction between neighboring holes that you find more in thin beds than you would in a thick bed experiment?

MR. LEHNING: Maybe could you clarify your question a little bit more? Do you mean --

MEMBER ABDEL-KHALIK: If fiber --

MR. LEHNING: -- on the inside of a strainer?

MEMBER ABDEL-KHALIK: If fibers are longer than the pitch between neighboring holes then there may be more interaction between neighboring holes in the case of a thin bed than you would in a thick bed experiment. So you can only find that out if you look at it from the back side.

MR. SMITH: Yes, just from experience, from seeing a few of these tests generally what you see is a bed that forms on the surface and you'll see dimples. If you actually peel that bed off you'll see dimples that -- where the debris is actually penetrating down into the hole somewhat. But really there's nothing happening on the back side of that strainer besides just little dimples sticking down where the holes were.

MEMBER ABDEL-KHALIK: But you get that by pulling the bed off. But has anyone looked at it

before pulling it off?

CHAIRMAN BANERJEE: To see this band.

MR. SMITH: I don't know of anyone who's done that. There is one strainer vendor who actually does disassemble and these are the strainers that have the bypass eliminator, like it's like a steel wool inside and they pull that out after the test. But other than that I don't know of any other vendor that actually, you know, has used a borescope or something to look in the inside of the strainer.

MEMBER ABDEL-KHALIK: Because it may just simply be you know interactions between neighboring holes that are more prevalent in the case of a thin bed than there are in the case of thicker beds.

CHAIRMAN BANERJEE: One of the main effects with these thin beds which make them difficult to predict is you blow holes in them. That sort of --

DR. WALLIS: That should help you, though.

CHAIRMAN BANERJEE: Well, it helps you but what it makes it is difficult to predict, you see, because the prevalence of these holes and how they come about.

DR. WALLIS: In some tests you have one hole, some tests you get none.

CHAIRMAN BANERJEE: Yes.

MEMBER ABDEL-KHALIK: Okay. Is there any way to find out if anybody had looked at the back side of the strainer after a test? Without peeling off the back.

MR. LEHNING: I guess the staff has seen testing and the vendors have seen testing from the outside and watching how the debris builds up we haven't seen differences between the two. I understand your view that you know only from the inside you can see this but I guess our view would be from seeing this from the outside we haven't seen substantial differences with how it builds up and don't believe that that's the fundamental driver.

DR. WALLIS: Let's look at the history here. You had a research program where people asked you the questions and tried to figure out what was going on. And then in the last few years you've simply looked at prototypical testing where people have measured something without trying to understand, or doing diagnostic tests or examining what was going on. So it hasn't been a sort of scientific inquiry as to what is a thin bed effect and how does it happen. It's been what kind of pressure drop do we get, that's been the question and there hasn't been this questioning of all the phenomenon. Am I being unfair?

I think I'm describing what's happened. I think it's a bit unfortunate that you haven't maintained some effort to understand the phenomenon at the same time.

MR. LEHNING: This is John Lehning from the staff again. The way we see it is that at the beginning we did testing at a more general level and understood the phenomena at general level. And then what was done during the implementation phase is the licensees went and did specific testing. They implemented a procedure that was based on these more sort of general concepts and things that we did understand and so we did try to understand at each plant let's say you know very detailed aspects of what's going on and why their debris bed arranged in a certain way. But we did base our overall procedure on a look at you know not only testing on a small scale but also tests --

DR. WALLIS: Well, I have an offer for you. If you understand the thin bed effect and how to predict it would you please come to my university and give a seminar on what it is, how you predict it and how you know how to avoid it?

MR. LEHNING: As much as I'd like to take you up on that --

(Laughter)

MR. LEHNING: The proposition there is that we can't -- we don't have correlations as John Burke's slide pointed out and so we do have to do testing. But we do understand what quantities tend to push this in certain directions and which quantities --

DR. WALLIS: Well, I think that's a very good test. I mean think about it, rather than just talking to your colleagues if you had to explain to an intelligent, well-informed audience, technically competent some of these things, how would you do it? And I think I would have difficulty. I don't know how you'd do it so I'd be interested to see.

MR. LEHNING: We could I mean do it at a qualitative level but in terms of quantitative prediction --

DR. WALLIS: If I invited you would you do that?

CHAIRMAN BANERJEE: Why not? But leaving that aside, I have a separate question here. Often instead of using real materials, for example, latent debris in a containment might have a lot of hairs, you know, surrogates for these are used. And we're not sure that you know your guidance covers this because we've run into problems in the past where the sort of

fibrous debris or whatever that's being used is not entirely similar to what you would expect. There are two aspects to this. One is a lot of the limitations on pressure losses depend on these holes being blown through the thin bed. I think this is more evident when it comes to downstream effects, I mean, in-vessel effects than the screens. We're not particularly worried about the latent debris effects on the screens, but just to warn you when it comes to downstream it might be sort of important to have typical debris rather than surrogates, particularly things like hairs which seem to have a different behavior from other fibers, at least the one or two tests that we've seen. So this is just a flag for the downstream effects. It's less of a concern I would say. You wanted to make a comment on that?

MR. KLEIN: Actually not a comment on that but to address an earlier question about the back side strainers. I was thinking about some of the vertical loop testing that I've observed that have included thin beds with high head loss and in those cases there didn't appear to be a network of connecting fibers on the back side of the strainer that would explain that thin bed effect.

MEMBER ABDEL-KHALIK: Where -- did these

experiments actually result in an unusually high pressure drop?

MR. KLEIN: With -- very high pressure drops.

CHAIRMAN BANERJEE: So you didn't see a network?

MR. KLEIN: No, we didn't see a network on the back side.

CHAIRMAN BANERJEE: Let's continue. How are we doing for time? Because I have this habit of losing track of time when the discussion gets interesting. Are we okay?

DR. WALLIS: We may be covering things now which are on the schedule later or something. But that's not so bad because we don't seem to ask the same question again. We hope.

MR. BURKE: And I think this discussion, I think John mentioned all points to the reason why we want testing and we don't like the correlation anymore.

Chemical effects if we're finished with head loss guidance. In the prior revision of this reg guide the chemical effects issue, it was just stated that chemical effects should be considered. There was no guidance given on how to consider chemical effects.

In this revision we're providing a little more detail on how to address chemical effects. The Westinghouse Topical Report WCAP 16530-NP-A accepts the industry approach as one method to evaluate chemical effects in the SE on that topical report. So those two items are incorporated into this revision. And again, in the March 2008 letter to NEI one of the attachments or enclosures to that letter addressed chemical effects.

DR. WALLIS: I'm sorry. Are you going to talk about debris transport which is way up front in the guidance? I don't see it here.

MR. BURKE: I wasn't going to.

DR. WALLIS: Because it says in the guidance the calculation of debris quantities transported to the ECCS strainer -- seems to be an important issue -- should consider all modes of debris transport. So you expect these people to analyze debris cascading downstairs and where do all the fibers go and how big they are and all that? I don't think they can possibly do that. So what are you asking for?

MR. LEHNING: John, I can take that. This is John Lehning from the staff again. So this is saying that when we talk about the modes, the major modes of wash-down. And so it could be washing down

gradings or stairs or other things like that. So we don't expect that licensees have a detailed I guess model of that, but we do expect that they either treat it conservatively or in some kind of representative way.

DR. WALLIS: Well say that. Say it's conservative because there's been no research on all the detailed mechanisms to -- there's been some in settling, stuff like that.

MR. LEHNING: Right, there have been certain tests for example on how much debris washed down from gradings, et cetera, but there are details where in a large part there is not data. So --

DR. WALLIS: So I think you need to be careful when you say that -- the implication to me really is that they're supposed to analyze all this motion of the debris throughout all this complicated geometry of the containment. I don't think that's what you're looking for. Maybe you need to give some clearer guidance that helps industry.

CHAIRMAN BANERJEE: Let me ask for clarification of that. Are they allowed to for example do CFD calculations which get some level of turbulence based on some correlation which is very difficult for us because of hindered settling and

turns and flows to what -- whether some of the debris will settle, especially the fines, or would they have to take the conservative approximation which is none of the fines or the fibers settle. I mean, if that's what you imply then you should probably say that.

MR. LEHNING: This is John Lehning again. The -- in terms of the analytical evaluation there have not been any accepted cases where the staff has allowed settlement of fine debris based on a CFD calculation and some kind of turbulence metric or other metric. It's not to say that we would never allow that. We didn't put that in the regulatory guide but our safety evaluation on NEI-0407 does cover that. And furthermore to go back to the other point on the detail of this or the flow-down and wash-down models, that is somewhat covered in position 1.3.4.7 where we say in lieu of detailed models licensees can conservatively assume that as all the debris washes down into the pool. So that is our default position pretty much is that we don't credit that hold-up in upper containment. We assume that the debris washes down but licensees, you know, if they have enough detail and we're to accept that the testing that they do then we're willing to accept something different.

CHAIRMAN BANERJEE: So is there any aspect

of the wording, Graham, that you feel is ambiguous?

DR. WALLIS: Well, there's that and there's some detail on -- I'm looking for my notes here -- about sort of ensuring that drains don't clog and so on. Well again, is there a guidance on how you do that? There's quite a few words about things which should be considered and then it just stops there. It doesn't say how.

MR. BURKE: Isn't that in NEI-0407? On the upstream effects?

DR. WALLIS: It may have been in there but I mean -- then maybe you should give the reference or something. You should say as in so-and-so or give a pointer to how they're going to do it. You're supposed to help these guys figure things out as well as --

MR. SMITH: If you look on 1.3.7(A) where it talks about upstream effects. The first sentence there says the staff's SE provides guidance on evaluating flow paths upstream. So I think that should be adequate.

DR. WALLIS: So it is there somewhere, okay. Maybe it just isn't in the part I was reading. Thank you.

MR. BURKE: Okay. So the chemical

effects, we've added three regulatory positions to -- one in the comment section and then one each in the PWR-specific and another one in the BWR-specific positions on chemical effects.

CHAIRMAN BANERJEE: You don't say anything specific here about the use of surrogates or is it implied in the WCAP SE?

MR. BURKE: It's implied by accepting the WCAP.

CHAIRMAN BANERJEE: All right.

MR. BURKE: Downstream effects. Downstream effects has two subcategories, ex-vessel and in-vessel where ex-vessel would be piping systems and components downstream of the strainer and in-vessel is typically looked at as the fuel. So the prior revision of the reg guide just stated that debris clogging of flow restrictions should be assessed but provided no guidance on how to do that. So for in-vessel effects the staff has accepted WCAP 16406-P-A and --

CHAIRMAN BANERJEE: Ex-vessel you mean.

MR. BURKE: For ex-vessel, correct. And that provides a method to evaluate the system components of abrasion, wear, blockage of flow paths in orifices or the pump seals. One thing that was

brought out in the public comments is that this is a proprietary report indicated by the "-P." The staff safety evaluation is a public document. We reference both of those in this revision of the reg guide and we make a footnote that this is a proprietary Westinghouse Topical Report. So the details are limited that we can put in this reg guide.

And then on the in-vessel as we mentioned earlier there is a Westinghouse report 16793-NP. The report is still under review by the staff so we're not providing detailed guidance at this time for in-vessel. On protective --

MEMBER ABDEL-KHALIK: Go back to the previous slide, please.

MR. BURKE: Okay.

MEMBER ABDEL-KHALIK: You made the point that this WCAP report is proprietary.

MR. BURKE: Yes.

MEMBER ABDEL-KHALIK: And therefore you are constrained as to how much detail you can offer in the reg guide.

MR. BURKE: Yes.

MEMBER ABDEL-KHALIK: What are you telling people? You go work it out with Westinghouse?

MR. BURKE: Pretty much. If what you need

is in the safety evaluation then the safety evaluation is a public document. But if you need the details that are in the topical report then yes, go work it out with Westinghouse and the PWR Owners' Group.

MEMBER ABDEL-KHALIK: You don't have an alternate acceptable method that you can offer people that is not proprietary?

MR. BURKE: No, we don't.

MR. LEHNING: This is John Lehning. I mean, we're not saying you know go to Westinghouse, we're saying come up with a methodology that's acceptable. So they're free to come up with their own method, they're free to purchase that from Westinghouse, they're free to you know do whatever they need to do.

MR. SMITH: I think right now all of the PWRs are participating and the BWRs are trying to work something out with the PWR Owners' Group to be able to use that report. So it seems like it's going to be consistent throughout all the operating reactors, the way that they evaluate this, the downstream ex-vessel, you know, not the in-vessel part but the ex-vessel part. I think that everyone is at least attempting to use this one methodology.

MR. BURKE: There are two associated

NUREGs that -- they're mentioned in the public comments. I don't remember if we have them mentioned in the reg guide or not. But two research efforts to look at downstream effects. But that are public documents, that provide a little more information and more public information than what you could get from just the safety evaluation.

CHAIRMAN BANERJEE: Are they worth mentioning or are they so tangential to this report?

MR. BURKE: I believe the approach velocities or the velocities used in the research were not typical of the velocities now with the large strainers. I think that was the reason we did not discuss them in any detail.

CHAIRMAN BANERJEE: Does this guidance shed any light on what passes through the -- or how one should calculate what passes through the strainers that you get downstream?

MR. BURKE: In the reg guide we give a couple methods of determining that. And the staff has accepted several different methods and the term we use is "bypass flow," what debris passes through the strainers. Some of the vendors use a grad sample technique to determine what is downstream of the strainers. And I know one vendor in particular uses

a filter system with a 1 micron filter socks downstream of the strainer. And the staff has accepted either approach but we don't specify which approach is best or which one we prefer.

CHAIRMAN BANERJEE: But is this based on -- these experiments that are being done currently or have been done to look at head losses on the strainers and the screens or whatever, obviously the amounts that pass downstream could be measured. Are they being measured in these tests and is some sort of an estimate being made of what might go downstream from the strainers?

MR. BURKE: It's handled different by the different vendors. I know like I said one vendor has put in filter socks downstream of the strainer with 1 micron size hole.

CHAIRMAN BANERJEE: So they are trying to measure it.

MR. BURKE: And they, yes, they weigh the sock afterwards to see how much debris is captured downstream. And then they're using that quantity to do the in-vessel testing.

CHAIRMAN BANERJEE: The reason I'm asking is we had a question at a subcommittee meeting somewhere back in history maybe four or five years ago

because there were some assumptions being made about how much debris gets through. And there was a discussion as to how this might be measured and correlated or whatever.

DR. WALLIS: I picked up on this too and on page 29, item G the only place I found anything was licensees may sample the flows downstream of the test strainer. That's a very vague statement, they may or they may not. There's no guidance about how they estimate debris bypass. I think you need to give them some help about how they should estimate debris bypass.

CHAIRMAN BANERJEE: Because then it has a significant effect on downstream effects.

DR. WALLIS: Yes.

CHAIRMAN BANERJEE: I mean all downstream, ex-vessel and more importantly in-vessel.

MR. SMITH: This is Steve Smith. We currently don't have a specific guidance on how to measure bypass. All of the strainer vendors have measured bypass in some fashion during testing. However, no vendor has attempted to measure the bypass of when you have both particulate and fibrous debris in the loop. It's very difficult to separate that debris, to capture that debris. Your, basically your

downstream mechanism is going to clog up faster than your strainer. It's really something that's hard to do. So what they have done is generally they assume that all of the particulate bypasses the strainer. And then what they do is they attempt to measure in a separate test with only fibrous debris in it how much fiber bypasses the strainer. Now as John said there is different -- different vendors use different methodologies for that. Some try to capture the entire whatever passes through the strainer and some take samples, and there's advantages and disadvantages to each way of doing that.

CHAIRMAN BANERJEE: When it comes to looking at these downstream effects though what are you going to require them to assume that these tests that they're doing, fibers separately and assuming all the particulates pass through. Is that going to set the benchmark for what they have to do?

MR. SMITH: Yes. Because of the importance of the amount of fiber that bypasses and how that affects the head loss for the in-vessel we haven't really come to an agreement with industry on how that's going to be measured. You know, what would be a conservative measure of how much fiber might bypass. But that is very important for those tests.

We're still working with industry on what would constitute a conservative amount of bypass for each plant.

DR. WALLIS: I think maybe you should state that in the guidance because at the moment it doesn't help them at all.

MR. SMITH: Yes, we understand. You know, we know that we have some unknowns with the in-vessel. We don't think that the bypass is important, you know, the amount of fiber bypass is very important for other aspects. So we could, I suppose we could change the wording for the bypass for now but certainly when we update for in-vessel we would want to do that.

DR. WALLIS: Now you said that you assume all the particles go through the strainer?

MR. GEIGER: This is Ervin Geiger, NRR. In the WCAP 6406-P there is guidance for determining what -- for estimating what the bypass is. Like Steve said, all particulate is assumed to bypass plus all particles, some percentage over the size of the openings in the strainer assumed to bypass and that includes fiber, certain sizes that would also bypass. So it depends on the strainer hole size and it's like a 25 percent larger than the strainer hole size in the criteria.

DR. WALLIS: I think this is related to page 630 when it talks about sequencing. This is another issue which is a bit difficult. It says the most transportable debris should be added first and the least transportable last. So but this is a loop. So you add the particles, they go through the strainer, they're gone. Then you add the fiber, they pile up on the strainer, then the particles come around again and they get stuck on the fibers. So this way in which you modeled the whole loop seemed to be important, not just how you add stuff to the strainers in the test. Because stuff comes around again. If the particles go through the fibers form a bed, then they come around and they have another go at getting stuck. Was this model in the test?

MR. GEIGER: There was some depletion -- in the WCAP there's a depletion allowance for downstream effects depending on --

DR. WALLIS: Well, I was saying this is related also to strainer pressure drop, too. How you do the tests. Does it consider this sort of recycling of the fines --

CHAIRMAN BANERJEE: But of course any recycling is subject to capture mechanisms downstream as well. So it's not as straightforward.

DR. WALLIS: It's not a straightforward experiment. And if they get caught in the reactor they don't recycle.

CHAIRMAN BANERJEE: Yes, so I think what they're saying is it all goes through, that's sort of a conservative position to take, whereas --

DR. WALLIS: Is it?

CHAIRMAN BANERJEE: Well, I thin it's conservative in the sense of erosion of downstream components and things like that. It could be better, I mean it could be that some part of it gets stuck in the --

DR. WALLIS: Well, my questions were I'm not sure how you know what's more transportable. You have to explain what you mean by that. And also it wasn't clear to me which sequence is going to be more conservative because of these interactions of various effects. So it's hard to determine which sequence really is conservative when some things go through and some things don't.

CHAIRMAN BANERJEE: Well, they've taken a position.

DR. WALLIS: I'm not sure what you mean by least transportable. You have to somehow give a definition or guidance about how you estimate

transportability which is a new thing. You have to define it or something.

CHAIRMAN BANERJEE: Let me try to get this clear because you've spoken it in words but I don't know if this guidance is available or not. If I understand it, you're saying that with regard to downstream effects essentially all the particulate matter which is smaller than the hole size goes through. Yes, for ex-vessel, yes. And the fibrous matter which gets through which is probably not all that important for ex-vessel anyway is based on experiments which are done with fibers alone. Is that guidance available somewhere or is it just lore at the moment? Can they refer to something?

MR. SMITH: I think that the 16406 tells you that you have to, you know, test your strainer to determine how much fiber would bypass.

CHAIRMAN BANERJEE: But what you're saying is industry practice is if they do it with fiber alone. Is that what?

MR. SMITH: When determining the amount of fiber that would bypass, that's correct.

CHAIRMAN BANERJEE: Right.

MR. SMITH: There's no particulate in the test when they're looking for fiber bypass.

MR. SMITH: Yes, because it's much more difficult to separate how much is particulate. Okay.

DR. WALLIS: But then on page 21 I have another related question. It says should also consider the potential for further decomposition of the debris as it is transported to the debris strainers. So what starts out as a fiber might end up as particles? Or something?

CHAIRMAN BANERJEE: Particles may become smaller.

DR. WALLIS: What are they supposed to do with this? Are they supposed to analyze the breakup of fibers on the way to the strainer? What are they supposed to do?

MR. SMITH: What it is is that's for fibrous debris that may not transport and we have accepted some industry testing that shows how much erosion would be expected for the most common types of fibrous debris. So that's what that statement is about.

DR. WALLIS: So this requires industry testing in order to answer this? I mean, every time you put down something they have to do you have to give them help about how to do it it seems to me. This is what guidance is all about.

MR. SMITH: And these, this information is available on --

DR. WALLIS: But could you put a pointer in there or something?

MR. SMITH: Just, I don't know if that report, that's also a proprietary report but is it referenced in the?

MR. LEHNING: No.

MR. SMITH: We may be -- that might be a good report.

DR. WALLIS: So we have a whole lot of these I noticed where they're asked to do something and it doesn't tell them how to do it. I think that you should always, when you ever ask them to do something in the guidance you should think, well, how are we going to ask them to do it.

MR. SMITH: In addition to the proprietary report that comes up with a more realistic number for erosion we do have default values that are included in the guidance you know which is a very, very conservative number.

DR. WALLIS: So it's there somewhere.

MR. SMITH: Most plants would not want to use that default number because it's 90 percent erosion.

DR. WALLIS: Ninety percent erosion?

MR. SMITH: Yes. Basically 90 percent of your material that's left in the pool would erode into fine material by the end of the event.

DR. WALLIS: It all goes through the strainer?

MR. SMITH: It would go to the strainer.

CHAIRMAN BANERJEE: So it was piece of cloth, whatever, left behind it would become fiber?

MR. SMITH: I don't think we would require cloth to erode. We would require any of the base insulating material like the NUCON or tent mat, those types of materials.

CHAIRMAN BANERJEE: So what happens with cloths?

MR. SMITH: Cloth just, it just hangs out there in the pool.

DR. WALLIS: Well, I think this really surprises me. Ninety percent of this stuff break up and become fines?

MR. LEHNING: This is John Lehning. That's, like Steve said a default conservative position. It was based on short-term testing for 2- to 4-hour type periods under fairly significant turbulence in the pool. And so again we would not

expect that to be representative of what --

DR. WALLIS: But I would expect to see that when I read that they have to consider this effect. I would like to read that the default assumption is blah blah blah so they know what they have to do. Otherwise it's just a vague statement, just consider something, but that's -- that's -- at the very first level you have to do engineering and figure out how to work it out.

MR. LEHNING: Our view of what the regulatory guide was is stating the principles of what has to be done and then the documents like the safety evaluation for 407 and other more detailed review guidance for strainer testing cover the details.

DR. WALLIS: The reg guide is helping industry to figure out how to do the job in an acceptable way.

CHAIRMAN BANERJEE: Well, are you suggesting that references should be put more --

DR. WALLIS: Yes, I think so. If you're putting in something like that there's got to be something so that --

CHAIRMAN BANERJEE: More frequently --

DR. WALLIS: -- should be doing this doesn't have completely open-ended requirement. Put

down some references or something.

CHAIRMAN BANERJEE: Yes. What they're saying is there are SEs and so on.

DR. WALLIS: Yes, that's right.

CHAIRMAN BANERJEE: Which makes their position clear. But what you're saying is put those pointers in so people know where to look.

DR. WALLIS: Otherwise I don't think it's guidance.

CHAIRMAN BANERJEE: All right.

MR. BURKE: We've tried to make this a roadmap.

DR. WALLIS: Right.

MR. BURKE: Just like the head loss testing that we were talking about earlier.

CHAIRMAN BANERJEE: Yes, he wants a few more science.

MR. BURKE: That particular document is 40 pages. This, this 16406 is 200 pages. We don't want a 500-page reg guide.

DR. WALLIS: No, but just a reference isn't a lot of pages is it?

MR. BURKE: We'll try to provide a few more road signs, okay?

CHAIRMAN BANERJEE: All right.

MR. BURKE: Okay, are we ready for coatings then?

CHAIRMAN BANERJEE: Yes, we're ready for coatings.

MR. BURKE: All right.

CHAIRMAN BANERJEE: Well, maybe before you go on to coatings let me see. Why don't we take a little break.

MR. BURKE: All right.

CHAIRMAN BANERJEE: This might be a good time to do it. So if it's okay let's break for 15 minutes, come back at 5 past. Okay?

(Whereupon, the foregoing matter went off the record at 9:49 a.m. and resumed at 10:04 a.m.)

CHAIRMAN BANERJEE: Back in session. And it's in your hands, John.

MR. BURKE: Let's talk about protective coating for a little while.

CHAIRMAN BANERJEE: I'm sure Graham will have lots to say about this.

MR. SMITH: Can we make a point before we start? One thing John and I were discussing during the break, some of the questions about the amount of detail and the references included in the reg guide, we understand this reg guide may be a little bit more

harder to pin down some of the technical bases for it because some of those are changing, especially with the downstream effects and things like that. But we do reference the knowledge base right in the beginning in the discussion. This is NUREG/CR-6808 which documents a lot of information you know that underlies the basis for this. The other thing is that we're coming out with a new knowledge base which will also provide, you know, a good background or an updated background on the knowledge we have in this area.

In part what we think as far as the amount of detail that's included in this is that people who are working on these types of evaluations are going to have some background and should be familiar with at least these knowledge base type documents. So just being familiar with those would give them the knowledge of where to go to look for more detailed guidance. It's really difficult to put -- this document could end up being a thousand pages long if we put every bit of guidance in this thing so that's kind of what we're struggling with is where to put the guidance in, where to put the references in. And we'll try to improve that but we think that there is a good knowledge by the people who are doing these types of evaluations of where to go look for this

stuff.

MR. BURKE: And like Steve said, the current knowledge base, NUREG/CR-6808, is being revised and I'm also the project manager for that. And the schedule for that is about this time next year it should be published. We have a good draft and we're, the NRR and NRO staff and I have provided comments and we're incorporating those comments now. So that knowledge base document is moving along.

CHAIRMAN BANERJEE: Okay.

MR. BURKE: On coatings then. Like I say here in the prior revision of this reg guide just listed coatings as one debris source and left it at that. It provided no guidance on how to evaluate coatings and the characteristics of coating debris. And that was similar in the BWRs 15 years ago. The URG which was the BWR version of NEI-0407, the URG stood for Utility Resolution Guidance and the staff safety evaluation did not provide a lot of guidance on coatings.

So in March 2008 the staff wrote a letter to NEI and industry with one of the enclosures being a guidance on how to handle coatings for GSI-191 and we've incorporated that into this reg guide. And specifically we added information about both qualified

coatings which means coatings that have been tested to withstand a LOCA and then unqualified coatings. And coating debris transport analysis as opposed to insulation debris transport as a -- there was a separate research effort mentioned here, NUREG/CR-6916 which we've accepted to provide a guidance on how to handle coating debris transport.

Okay, latent debris. In the prior revision to the reg guide latent debris was very minimally addressed. It just, it pretty much relied on the cleanliness program of the licensees and that was about all it said. Since GSI-191 came about there's been an NEI report, NEI-02-01 revision 1 on how to evaluate latent debris in containment. And the NEI guidance report 0407 incorporates that prior NEI report and the staff safety evaluation accepted that process. And it's basically a process of taking samples in containment, determining how much latent debris you have and determining the mix between fibers and particulate.

DR. WALLIS: So what you're doing on this side is exactly what you said was so difficult to do in the report. You're giving pointers to all useful documents that tell you how to do it.

MR. BURKE: True.

DR. WALLIS: Thank you.

MR. BURKE: And one thing I wanted to point here, for the low-fiber plants which is plants with very little or no fiberglass insulation latent debris is the major source of fiber that collects on the strainers.

CHAIRMAN BANERJEE: All the -- new reactors are also the main source of debris.

MR. BURKE: If I understand it right the new reactors have assumed a certain quantity of latent debris similar to what the current plants have and then they have an ITAAC to confirm that later on.

DR. WALLIS: Well --

MR. BURKE: Or to benchmark it might be a better terminology.

CHAIRMAN BANERJEE: Yes, but in some cases based on downstream effects they may have to ensure the latent debris is below a certain amount.

MR. BURKE: Right. Vortexing and air ingestion is the next topic. This issue has changed a lot with the new types of strainers.

CHAIRMAN BANERJEE: Before you move on.

MR. BURKE: Okay.

CHAIRMAN BANERJEE: Going back to latent debris. As I just was saying hair seems to behave

differently from fiber. Now, these programs -- at least there are some indications that that's the case. So that it's not so easy to do experiments with hair but there's been the odd one done where somebody's gone to a barber and got the hair and put it into an experiment. It does show some rather interesting characteristics. For example, compared to fibrous debris the buildup of pressure loss over time takes longer but once it gets there you know it keeps rising because holes don't easily blow in hair whereas they do in other types of debris. So in some ways whether fiber bounds hair is not clear, or a mixture of hair and fiber. But you're not determining things like hair care, right? Though it might become important in the future.

MR. BURKE: I think that's correct. I'm not, I don't have a lot of detailed information or knowledge on how the NEI-0201 sampling is done, fiber versus hair. When you do smear samples in containment you're going to collect both.

CHAIRMAN BANERJEE: Yes, you are but correct me if I'm wrong but there's no --

MR. SMITH: From the testing that was done, now this was testing that was done for a new reactor I believe that included the hair.

CHAIRMAN BANERJEE: There's only one case.

MR. SMITH: It was, I believe that was done for a plant that has a break that would allow the strainer to be bypassed. So they did testing with larger fibers than the existing reactors are tested with because the fibers cannot bypass the strainer in the new reactors. I think that they were testing for a specific grate that would completely bypass the strainer and allow debris to flow into the reactor. So I think that's why they tested with the hair. So I'm not really familiar with the differences in how the head loss came up for that test.

CHAIRMAN BANERJEE: Yes, so you're absolutely right of course. That was the case. The issue though is would all the hair be taken out by the strainers or would it also, some of it bypass?

MR. SMITH: Most of the hair would be taken out. I think that the hair load in containment is probably relatively low and then what would be filtered out by the strainer would make it so that there would be a very small amount downstream of the strainer, at least for the operating reactors. I understand that this guidance is also for other reactors you know that aren't in operation yet. So you know, there may be some thought to be put into

that.

CHAIRMAN BANERJEE: Yes, okay. Let's move on.

MR. BURKE: Okay. In this revision of the reg guide most of the changes are in Appendix A to this reg guide and they're related to Generic Letter 2008-01.

DR. WALLIS: This is the only place you actually have formulae.

MR. BURKE: Yes.

DR. WALLIS: And tables of numbers, how to predict and things like that.

MR. BURKE: Correct.

DR. WALLIS: And it's very strange. You say that all these things depend on a Froude number. Now a Froude number has nothing to do with a vortex, vortices. If you have a bathtub which is very still and you open the drain all that happens is the water goes out and at some level the depression of the surface will begin to suck air down. That's a Froude number effect. But you don't get vortexing until you have vorticity. The Froude number has nothing to do with vorticity. So there's something odd about this, the technical basis of this appendix.

MR. BURKE: But the basic guidance hasn't

changed in this appendix.

DR. WALLIS: Well, I didn't look at what the experiments were and all that, I just looked at you know various straightforward what seemed to be the basic technical assumptions and they just seem strange to me.

MR. SMITH: For the new strainers what we do is that we have them test at the minimum submergence level and maximum flow rate to ensure that vortexing will not occur. Now some strainer vendors have used the Froude number to -- as a predictor. It's not, you can't directly take the Froude number and say whether you're going to have vortexing or not, but under the conditions that they tested with they could draw some parallels as to you know what submergence, what flow rates you would have which are inputs to the Froude number and where vortexing would occur for their strainers.

DR. WALLIS: I guess what I'm saying is technically from a fundamental basis Froude number has nothing whatever to do with vortices.

CHAIRMAN BANERJEE: It's the gravity with velocity over --

DR. WALLIS: Velocity draw-down of the surface which is a rather modest thing about a drain.

Well then you just put a bit of vorticity in the bathtub and you get this swirling, sucking noise and all that. But you have to put that in and that's done by the upstream flow to this thing which is the important part really. So you need some CFD or something to predict vorticing or experiments with suitable geometry like the real thing. It's mentioned slightly in the text.

MR. SMITH: That's why we --

DR. WALLIS: But the Froude number is not --

MR. SMITH: That's why --

DR. WALLIS: -- for vorticing.

MR. SMITH: That's why we have them test the specific strainers --

DR. WALLIS: That's good, yes.

MR. SMITH: -- under the limiting positions.

CHAIRMAN BANERJEE: You require tests, right?

MR. SMITH: Yes, we require tests of -- all the strainer vendors have done tests. And some licensees may not have a specific test for their strainer but if their strainer type was tested under you know conditions which were shown not to vortex

which were more limiting for another plant we would allow them to use that.

DR. WALLIS: Well, the table is very conservative so minimum submergence of 9 feet is that what they have? It seems, for the Froude number you've got it seems very conservative so maybe that's okay.

MR. SMITH: And generally that's included for -- we really don't see any plants that have this type of you know sump anymore. Some do have sumps downstream, that could be a sump downstream of their strainer where this type of an evaluation could be done, but generally most of the strainers are piped directly into the pump suctions now.

DR. WALLIS: While we're talking about submergence could I bring that up? On page 30 it says ECCS strainers should be located in the lowest flow level and containment to maximize the pool depth relative to the strainers. That's the submergence of the strainer. And then on page 9 it says elevating the sump strainers slightly above the containment floor level, preferably on a pedestal, minimizes the potential for debris buildup. Well, that's contrary to the other reg guidance.

CHAIRMAN BANERJEE: And there is another

statement which says it should slope up.

DR. WALLIS: That's right and how much should it slope up. And the word "minimize" is entirely inappropriate. It doesn't minimize potential at all. It may reduce the potential but it certainly doesn't minimize it. Minimize is used -- the word "minimize" is used --

MR. SMITH: There are competing effects. Some strainers are down in the sump under the floor so they're a lot more likely to have debris transport to them unless they have a large curve or something around.

DR. WALLIS: I'm just saying giving two bits of guidance which are in contradiction doesn't help. One thing says it should be as low as possible, the other guidance says it should be on a pedestal. That's sort of --

MR. SMITH: Both are true.

DR. WALLIS: Both are true.

MR. SMITH: The pedestal at the lowest level.

(Laughter)

DR. WALLIS: Well, but the idea of on a pedestal minimizing the potential, that doesn't mean anything.

MR. BURKE: I mean, the ones I've seen, you want them on the lowest floor but --

DR. WALLIS: You want some settling around them so that they're not --

MR. BURKE: But they might be up 2 or 3 or 4 inches above that base floor level.

DR. WALLIS: Yes.

MR. BURKE: So the heavy insulation that does transport on the floor doesn't collect on the strainer.

DR. WALLIS: I agree with that. I'm not sure anyone knows how to predict these and you certainly don't minimize anything when you do that.

MR. LEHNING: This is John Lehning. I think the wording could possibly make --

DR. WALLIS: The word "minimize" is used in a sort of profligate way throughout this report to mean reduces or may help or something. Anyway, be careful of that sort of a statement. And I don't think it guides because then how would they determine how big the pedestal should be and things like that? Anyway. I just brought that up as another thing I noticed in here which seemed a little strange. Thank you.

MR. BURKE: One other thing to point out

on this slide then is along with Generic Letter 08-01 we added information to differentiate between transient and steady state operating conditions for the pumps. The prior revision was just for steady state pump operation.

DR. WALLIS: I noticed that but then you don't say anything about how to determine how long it could work in a state at which something happened. You use just transient condition for the pump.

MR. BURKE: That's in table A-2.

DR. WALLIS: Is it there somewhere?

MR. BURKE: Yes, table A-2 in the appendix.

DR. WALLIS: So I should look at that.

MR. BURKE: There's one, there's a column about the operating point at the best efficiency point and then transient operations.

DR. WALLIS: Okay, thank you.

MR. BURKE: That's it. Like I said Appendix A has been revised to incorporate this information and on my second bullet there, what I have in parentheses, the box-like strainers, I was reminded some of the new reactors may have box-like strainers. What's in parentheses is not entirely correct for new reactors.

DR. WALLIS: There were some good points about partially submerged strainers and things like that in this appendix.

MR. BURKE: I had a lot of help from NRR on this appendix.

DR. WALLIS: You see this is interesting because now you're being specific about some of the technical things that have to be considered in a way that you're not in some other parts of the report. So maybe it's appendices where one should look for things.

MR. BURKE: Maybe.

DR. WALLIS: Maybe there will be more appendices in the future. And they're allowed to have credit for horizontal parts of a strainer or something?

MR. BURKE: Correct. Horizontal parts.

DR. WALLIS: Why is that? Because I mean you have these strainers which are disks, stacked disks. An awful lot of that is horizontal. You don't, you certainly get credit for that. And you have pockets which have horizontal surfaces. I don't know what you mean by no credit may be taken for any horizontal strainer surfaces.

MR. BURKE: That was more in line with the

square screen-shaped strainers and --

DR. WALLIS: Well, that's making sure it's properly submerged and things like that. Okay.

MR. BURKE: So that's it for the specific areas of the reg guide I was going to talk about. On the public comments we received comments from five separate organizations and some of the I guess more controversial ones we've already talked about in some depth here, the use of containment accident pressure, the use of the NUREG/CR-6224 correlation. And like I mentioned earlier, Appendix A criteria was revised to match the current criteria or current staff guidance for Generic Letter 2008-01 and then we talked quite a bit about head loss testing and what's in this reg guide is consistent with the head loss testing guidance the staff issued in March 2008.

DR. WALLIS: Now was the statement on page 2, maybe I misunderstood. It said this reg guide is a rule.

MR. BURKE: Which page are you looking at?

DR. WALLIS: Page 2, right at the beginning where it says what it is.

MR. BURKE: Page 2 of the reg guide?

DR. WALLIS: Did I misunderstand that? This is a rule but not a major rule. Did I

misunderstand that?

MR. BURKE: I don't know what page.

DR. WALLIS: It seems strange. I don't know what it meant. Page 2. Right at the beginning when you're saying what it is. Maybe I mistook, maybe I misread it.

MR. BURKE: Oh, okay, I see it here. This is a rule as designated by the congressional --

DR. WALLIS: Is a reg guide ever a rule?

MR. BURKE: I think this particular choice of words.

MR. RICHARDS: This is Steve Richards with the Office of Research. I think that has to do with the OMB requirements for congressional approval and the process that we have to follow for submitting this down through OMB. It doesn't really relate to whether it's an NRC rule.

DR. WALLIS: I thought a rule was something much stricter than a reg guide. You have to obey the rules. You have to observe the reg guide.

MR. BURKE: I think this is boilerplate language that you see in all reg guides.

DR. WALLIS: Aren't there rules which are different? The rules --

MEMBER SHACK: That's what he's

explaining. This is not an NRC rule, this is --

DR. WALLIS: It's a government rule, not an NRC rule? Maybe that should be made clearer because if you just say it's a rule that sounds as if it's an NRC rule.

MR. RICHARDS: We've actually had quite a bit of discussion on this part of generic language in reg guides with the Office of the General Counsel to meet the legal requirements of OMB. We can take your feedback but --

(Laughter)

DR. WALLIS: There's nothing you can do about it.

MR. RICHARDS: We've been through the mill on these words, so.

DR. WALLIS: So I won't drag you through the mill again.

MR. RICHARDS: The important thing here is that we meet the OMB requirements for the way we process reg guides. And it really is addressed at that aspect of the reg guide process.

MR. BURKE: All right?

CHAIRMAN BANERJEE: One of the things, going back to your previous slide, is can you sort of tell us a little bit more with regard to the situation

regarding the BWRs?

MR. BURKE: The BWRs?

CHAIRMAN BANERJEE: The BWRs.

MR. BURKE: BWR, yes.

CHAIRMAN BANERJEE: Because clearly you know this 6224, you started to tell us something about what's going on but maybe a little more detail.

MR. BURKE: All right.

CHAIRMAN BANERJEE: That's a little troubling.

MR. BURKE: I'll tell you as much as I know.

CHAIRMAN BANERJEE: Okay.

MR. BURKE: In the 2007-2008 time frame the staff started to take another look at the BWRs and looked at the differences in how the BWR strainers were handled in the 1996 era versus how we're handling GSI-191 now. And we came up with 12 technical areas that were handled different, like protective coatings that I mentioned already or latent debris or downstream effects. The NRR staff sent a letter to the BWR Owners' Group in 2008 outlining those 12 items. And since then we've had a series of meetings with the Owners' Group making -- to ensure we had a common understanding of the differences. And the

Owners' Group has begun to address those. I guess the first issue they're looking at is downstream in-vessel effects. And they've submitted a topical report to the staff for the staff to review. And the whole issue, they've laid out a schedule and a plan on addressing all 12 items culminating in a revision to this URG or Utility Resolution Guidance document. And their schedule is to have a revised URG submitted to the staff in 2015.

In the area of head loss testing in the 6224 correlation, I don't know if you were around in '96 when the BWRs did their thing but for the most part the BWRs qualified their strainers by generic testing. There were not very many plant-specific tests done back then and Research did their own work and came up with this correlation that was published in this NUREG. And that's how the BWRs are primarily qualified, using that correlation. In the area of protective coatings they -- we left it really unclear in our guidance how to handle protective coatings. Most of the BWRs, we talked a little bit earlier about the zone of influence and the spherical zone of influence and the ANSI standard. The coatings for the BWRs was handled completely different. They used a conical projection out of the break location and used

the surface area of that projection as the area of the coatings that would be destroyed. So they're looking at all those issues and revised their guidance.

CHAIRMAN BANERJEE: So how will this reg guide affect them?

MR. BURKE: This revision of the reg guide wouldn't necessarily affect the operating BWRs.

MEMBER SHACK: Well it explicitly says it doesn't, doesn't it?

MR. BURKE: I mean, yes. Like I said in the public comment matrix on the comments to the correlation we're not back-fitting or we're not imposing a back-fit on the BWRs with this revision of the reg guide to say you have to go do plant-specific testing. We're just saying any strainers in the future should be qualified with plant-specific testing.

DR. WALLIS: You talked about coatings. On page 20 it talks about erosion of concrete at the point of impact.

MR. BURKE: All right.

DR. WALLIS: Is that something that matters?

MR. BURKE: It could. I mean it --

DR. WALLIS: You worry about the coating

coming off, but there's something behind the coating.

MR. BURKE: The jet -- there's a multi-part answer to that question. The jet will erode the coatings at the point of impact. It could erode the concrete. What the AP-1000 -- now as far as the PWRs and the operating reactors in GSI-191 the staff position is the debris that we use with the WCAP 16530 and some of the other debris sources more than adequately cover any concrete abrasion that would occur. Westinghouse did some testing quite a few years ago that's discussed in the SE for the AP-1000 where they demonstrated that you would have very minimal concrete erosion from the jet. So for GSI-191 we don't require a specific debris source from the concrete erosion and in the -- the Westinghouse report that I mentioned earlier is a proprietary report. So unless you're a Westinghouse client you don't have access to it. So you should do, you need to address concrete erosion somehow.

DR. WALLIS: Somehow, okay. It is part of the problem, it could be.

MR. BURKE: It could be.

DR. WALLIS: Do you accept air tests for the zone of influence and debris damage?

MR. BURKE: Do you want to handle that

one, Steve?

MR. SMITH: Do we accept air tests?

DR. WALLIS: Yes. There have been tests using air jets rather than two-phase steam water tests.

MR. SMITH: Yes. The basis for -- the basis for most of our zones of influence is those air jet tests that were done for the BWRs.

DR. WALLIS: That bothers me because if you have, you know, the way that they take rust off ships and so on and the way I take debris off my maple syrup thing and all that is to get droplets because droplets on impact produce a local water hammer in the droplet which is very effective at getting a local very high pressure. Droplets are very different from gaps when they affect the surface and clean it or do something to it. So I'm not sure that you should accept air tests at all.

MR. SMITH: Unfortunately we don't have a lot of steam tests that were done. Most of the testing has been air tests. The new testing that is being done now is steam testing, so.

DR. WALLIS: It's steam water.

MR. SMITH: Steam water, yes, two-phase testing on saturated water testing and then the

rupture disbursed and you can have a two-phase jet. So we will gain some knowledge from that testing to determine if there is a difference between air, steam, water, you know, the different media. So you know, we are waiting to see what this shows us but right now our position is that there is not a large difference and most of the damage is done just by the pressure.

DR. WALLIS: But you don't clean dirty surfaces usually using an air jet, you pull in particles of water or something because they clean it far more effectively.

MR. SMITH: Yes. We're not trying to clean anything but --

DR. WALLIS: No, but it's similar and when it's peeling something off the surface.

MR. LEHNING: I just want to -- this is John Lehning again.

DR. WALLIS: If I wanted to peel the skin off a potato and I take a garden hose I do much better if I use it in the droplet mode than in the jet mode. I've done the experiment. So just telling you there's evidence that droplets are very useful at peeling things off surfaces. So I wonder if you should accept air jets at all for evaluating damage to insulation.

MR. LEHNING: This is John Lehning from

the staff. When we did accept those air jest test results for the thresholds for damage in the 0407 there was a 40 percent factor that those factors were reduced from the value where they were at air testing, they were reduced 40 percent to account for this uncertainty with two-phase. Steve mentioned that we've looked more at the data and you know, we haven't seen a significant difference you know trying to correct for maybe differences in what the threshold for damage was considered in different tests, et cetera. But I think if we look at the regulatory guide positions here the idea is that we want testing to be done in a representative way. So if we're going to be going forward using testing for a certain purpose, if it's a steam break then it should, you know, the best idea would be to test with that kind of fluid or if it's a two-phase test, test that.

DR. WALLIS: I think it depends on what you're impacting on. If you're impacting on a coating then the droplets are probably much more effective at peeling it off. If you're impacting on something like a blanket then there's probably global effect of pressure and the droplets don't make much difference.

MR. SMITH: Yes, that's true. Definitely the material interaction with the jet media could have

a significant effect.

DR. WALLIS: So you're on top of all that.

MR. BURKE: The guidance on the coatings, like I was mentioning earlier, we have provided more specific guidance on coatings and the zone of influence for coating destruction is based on the new --

DR. WALLIS: Steam water.

MR. BURKE: -- steam water testing.

DR. WALLIS: That's good. Thank you.

MR. BURKE: And that's all I have.

CHAIRMAN BANERJEE: Any questions?

MR. BURKE: And the last sentence is what I wanted to repeat. There's nothing in this reg guide that I would consider new staff guidance. It's all either in safety evaluations or guidance letters to industry. It might be new in this document but it isn't new to the industry or --

CHAIRMAN BANERJEE: It's in practice.

MR. BURKE: In practice, yes.

CHAIRMAN BANERJEE: All right. So I think we go around the table but first we take presentation from NEI. So thank you very much and we'll come back.

DR. WALLIS: So you're just going to give us the overview like this? You're not going to put up

your very interesting figures, diagrams that show what we need to -- sort of a box diagram of things like that?

MR. BURKE: In the appendix?

DR. WALLIS: I'll just comment in my written report then if you're not going to put that up. There's some funny things about the box diagrams but generally they're helpful. Okay. I'll just comment on those.

MR. BURKE: All right.

CHAIRMAN BANERJEE: Okay, thanks John, thanks Gary and.

MR. BUTLER: Are we ready? Would you like me to stand here?

CHAIRMAN BANERJEE: Wherever you like. Just use a microphone.

MR. BUTLER: Let me come around so I can face you.

CHAIRMAN BANERJEE: Yes, I think that's better.

DR. WALLIS: The box diagram is actually in the thing itself. They start on page 28. You weren't going to say anything about those? You're apparently not.

CHAIRMAN BANERJEE: Go ahead.

MR. BUTLER: My name is John Butler. I'm with NEI and I appreciate the opportunity to come speak to you. I asked for some time here before I heard the presentation so this is mainly just to make sure I had some time reserved in case I had something important to say. I listened to the discussion and the presentation that John gave. I thought it was a very good discussion and I'm glad I came.

As far as important points to make I don't have any significant problems with what I heard and how they've captured the current guidance. I do have to say I don't know how our comments have been addressed in the revised reg guide as well as any other stakeholder comments so I'm not making any comment on how those comments have been addressed in this revised draft because we haven't seen it yet. But what I heard in the discussion does accurately reflect where we stand with guidances out there.

My main question, and I'll pose it as a question, is what is the primary purpose of this reg guide and take -- answer that question relative to is it appropriate to issue it now, recognizing as was pointed out there are still a number of gaps in this process that are still being resolved and probably resolution paths that are still being developed. It

was pointed out I think in one of the slides that the commission SRM issued last December encouraged the development of other resolution paths than what have been currently being sought and that is being pursued. I still have hopes that some of those resolution paths will bear fruit so to speak. But the bottom line is we aren't in a position where that can be incorporated in any kind of final form in the reg guide. So if this reg guide is finalized I think there needs to be a recognition of those gaps, also a recognition that is not going to be picked up and utilized right away by anyone if at all or ever. There will be a need to revise this further to incorporate hopefully a final resolution for both Ps and Bs. So I would just ask you to take that into account in your comments.

But as far as the technical discussion I wish this reg guide had a lot more of the technical detail. I wish the reference documents in the reg guide had a lot more technical detail but this issue has been very difficult. The more questions you ask the more questions you create. One of the -- we jokingly said you know how do you know if you've had a successful strainer test or an acceptable strainer test? And the answer is if you get an unacceptable result. Because you can change the parameters of your

test to conservatively address the phenomena in so many different ways to the point where you can't live with the result. So we're hoping that in the end we can find some way to adequately address all the phenomena without doing it in the current fashion which is to compartmentalize all the phenomena, address each of them individually in the most conservative way that we can imagine and then put the pieces back together and find out you can't live with the result. And that's where we stand right now.

I'll stop there and I don't know if you have any questions for me.

MEMBER ARMIJO: I do. You mentioned that this reg guide may never be used by industry, this revision, except as a starting point for another revision later on.

MR. BUTLER: Yes, I'll explain what I mean by that. It is being -- what's in the reg guide is being used currently. It's not being cited. You know, the pieces in this reg guide are being used in various forms as part of --

MEMBER ARMIJO: For example, the BWR, the new work that the BWR --

MR. BUTLER: Well, the BWRs, they currently use the URG but they are addressing some

questions that have been raised as part of the comparison of the P resolution with the B resolution, and are in the process of resolving those questions. And I believe they've probably revised their URG document and utilized that URG document and hopefully the staff SE on that revised document has their resolution approach. They're not specifically citing the reg guide, they are citing the reg guide or the URG as their appropriate guidance document. And when they revise it they'll cite the revision to the URG.

MEMBER ARMIJO: But not necessarily -- but they're using the approaches I would expect where applicable that are in this revised reg guide.

MR. BUTLER: I think you started to say that the reg guide will either now or in a future revision accurately capture the approaches that are being utilized by the Bs as well as the Ps. But it's not like you know the Bs are referencing the reg guide as an acceptable approach. They're referencing another document and the reg guide is just capturing what they are doing if that makes sense.

MEMBER ARMIJO: I think I understand.

CHAIRMAN BANERJEE: So you don't think that -- let me try to phrase this correctly. The reg guide basically captures what's going on right now.

MR. BUTLER: Correct.

CHAIRMAN BANERJEE: It sort of puts it into a structure which at least gives some regulatory certainty on these issues, at least what is being done today in the sense that it's all been staff guidance documents and things like that, it'll become part of the reg guide. You don't think that is a particularly useful thing to do until say the commission position has been dealt with? Because that gives you alternative methods as you pointed out to resolving the issue.

MR. BUTLER: It does you know put into a single document positions that are --

CHAIRMAN BANERJEE: All over the place.

MR. BUTLER: All over the place. I don't know that plants and licensees have had difficulty finding those documents if they're citing. So I don't, you know, while it's nice to have it all in one place I don't know that not having it in one place has been a particular point of difficulty. Those areas where we do not have specific guidance and some of those were pointed out in the discussion today, this reg guide doesn't help those situations because the guidance just doesn't exist. As was pointed out in the last slide this reg guide doesn't pose any new

staff positions it just kind of captures in one place all the staff positions that are in various documents.

DR. WALLIS: So John, you mentioned that it doesn't present acceptable approaches. Those were your words, was it didn't present an acceptable approach. In some cases the guide will say you have to consider all methods of debris transport or something like that, it's a general, very general statement. Would you like to see a more specific description of what would be acceptable approaches to this consideration? Because you mentioned that it didn't present acceptable approaches. The implication to me was you'd like to see them.

MR. BUTLER: My preference would be to step back and take a more holistic look at how we're addressing this issue. The current approach of addressing the phenomenon in a compartmentalized fashion is not giving us an easily resolvable path.

CHAIRMAN BANERJEE: But John, if you look back and this is just a question. Except a few high-fiber plants most of the plants have been able to move towards resolution at least of the strainer issue if not the downstream in this case, correct?

MR. BUTLER: Yes, but --

CHAIRMAN BANERJEE: That's the reality.

MR. BUTLER: These are --

CHAIRMAN BANERJEE: Using this approach.

MR. BUTLER: It's got to look at the situation they find themselves in. These are plants that are basically no-fiber plants. The only fiber source they have would be the latent debris source that they assume and --

CHAIRMAN BANERJEE: Or low-fiber.

MR. BUTLER: Low-fiber, all right?

CHAIRMAN BANERJEE: There's some fiber.

MR. BUTLER: And with this low-fiber source and the conservative methods that we employ that they are able to scrape through with acceptable results with a strainer that probably approaches you know three or four thousand square feet, a couple of orders of magnitude larger than what they started with. And --

CHAIRMAN BANERJEE: That's done.

MR. BUTLER: It's done until they find out something in their containment that they had not accounted for before. And because we're not dealing with something that you can easily just punch in a number and see how it affects your results and there's no margin in your analysis because of the conservative methods so a plant that had very low fiber suddenly

finds themselves with, you know, and I've used this analogy or example kiddingly, finds a Snicker bar wrapper in their containment. Well, there's no testing that demonstrates what the effect of a Snicker bar wrapper is on their strainer test. They have no margin in their analysis to account for that area of the screen that would be accounted for by this Snicker bar wrapper so they are in a potentially inoperable condition because of this finding.

It's that lack of the capability to evaluate new findings and the lack of any margin in your analysis even though you're you know a very low-fiber plant that it's not a very comfortable position for a plant to be in.

CHAIRMAN BANERJEE: So what you're saying if I read you correctly is that if we leave aside the high-fiber plants, there are a few of these around, even the other plants are very close to the sort of, they have virtually no margin. Is that what you're implying?

MR. BUTLER: Yes, either no margin or there's no way to quantify the margin.

CHAIRMAN BANERJEE: They may have margins because --

MR. BUTLER: But if you can't quantify the

margin then you have no margin.

CHAIRMAN BANERJEE: Yes. But based on all the conservative assumptions and so on that go into the testing, so you're saying based on that there isn't much apparent margin. So that even relatively small changes in some conditions which arise or are not foreseen can cut into that, or lead to some new testing, whatever is needed. Is that your view?

MR. BUTLER: Yes. Yes. And we've already seen instances where plants have discovered fiber sources or insulation sources in the containment that they had not accounted for before and they're faced in a very tenuous position of do they replace that fiber, do they shut down and remove that fiber or do they have some way to justify that there's enough margin in their analysis to continue operation til the next outage. You know, it's -- it's not a comfortable position to be in for many plants.

CHAIRMAN BANERJEE: And of course the high-fiber plants still.

MR. BUTLER: Yes.

CHAIRMAN BANERJEE: So what would you advocate at this point, that the reg guide be held in abeyance till the commission's various alternative ways to deal with this are evaluated and become part

of the reg guide? What's your sense?

MR. BUTLER: I don't have a strong recommendation either way.

DR. WALLIS: I think you'd like more guidance. Other than just a summary of this is what the staff is sort of generally looking for. How they would -- what they would accept, more of a guidance about what would be an acceptable way to do things rather than some statement about what you have to do. Is that what you're looking for?

MR. BUTLER: Not particularly, no.

DR. WALLIS: The problem is how do we know we've met the requirement. And it's still very much up to submitting something and seeing how the staff responds rather than being sure that this time you've got it right.

CHAIRMAN BANERJEE: Well, I think we'd be -- Joy, you had a question.

MEMBER REMPE: It may be a different way of phrasing what you're trying to say. Are there places in this current reg guide where they've opened up additional uncertainty for the plants because they were less specific than they could have been, they've added worst case type wording? Is there anything that's a problem with what they've done here that

caused some consternation among the plants?

MR. BUTLER: First off, I preface my answer with I haven't seen this final draft revision. But based upon my memory of the earlier draft that was provided for public comment it is as far as I can tell an accurate reflection of the guidance that exists elsewhere. So I don't think it causes anybody any concern. They are implementing that guidance that is elsewhere in an appropriate fashion. So there's nothing in the reg guide that I'm aware of that would change how they've implemented that guidance.

MEMBER REMPE: It's the document basically. And it could maybe go a bit further.

MR. BUTLER: Any questions that exist now existed before the reg guide.

MEMBER REMPE: Okay. Okay.

CHAIRMAN BANERJEE: I think that's an accurate statement we can see as well. I mean there may be spots here and there where there can be some clarity, more clarity, but I don't think it changes anything for the industry from what is practice today.

MR. BUTLER: And Dr. Wallis, to answer your question, I don't think I gave you a proper answer. I mean, to use the analogy that was used earlier today I don't think that adding more signposts

along this route is the answer. I would rather find a different route.

CHAIRMAN BANERJEE: Well, that's part of the commission's directive anyway.

MR. BUTLER: Right.

CHAIRMAN BANERJEE: So that'll be considered.

MR. BUTLER: Yes.

CHAIRMAN BANERJEE: At some point.

MR. BUTLER: Well thank you very much for your time.

CHAIRMAN BANERJEE: Thank you. All right, I think -- is there any summing statement beyond the conclusions that the staff would like to make? Yes, please do it.

MR. RICHARDS: Yes, I'd like just to make a couple of comments. Again, I'm Stu Richards with the Office of Research. I thought it was a very good discussion today, a lot of good feedback and comments. I think we hit the message about having more pointers or road signs. We'll take that back and look at it. To respond a little bit to John Butler's comments, we recognize that there are gaps in the reg guide. I think John laid that out pretty well. We didn't come here with all the solutions to GSI-191, nobody's

saying that. And we recognize that as conditions are resolved hopefully in the future that we need to come back and revise reg guide again to incorporate that. John Burke mentioned that there are no new positions, you just talked about it. So it comes back to the question of why do this. Well, we're trying to stay in process. One thing I think we've found over the years in general with regulations is you get these interim staff guidance documents, you get SEs, you get guidance spread out all over the place and that is a bad thing. The agency's process to bring guidance together is to put it into a reg guide. So we are trying to stay within that process, that process requires us to engage the public maybe more fully than we would otherwise and it's requiring us to engage the ACRS. So those are positive things. If you think about, well, let's not do that, let's not go forward with the reg guide then we're going to not touch those bases, we're not going to take those steps to come up with this unified position. So I would caution you that if you're encouraging us not to follow our own process but rather to continue to go along piecemeal you know there's maybe a consequence potentially for that path.

CHAIRMAN BANERJEE: We are not, by the way.

MR. RICHARDS: All right. And this reg guide was last amended in 2003 --

MEMBER ARMIJO: Well, we don't decide anything. We're just the subcommittee.

CHAIRMAN BANERJEE: No, we can only recommend to the full committee.

MR. RICHARDS: Well, if the full committee comes back with a letter saying no, why don't you just wait on this reg guide till you resolve these other issues or there's more policy issues to be dealt with you know we could be five years down the road and we'll be sitting here going wow, I wonder why we didn't update that reg guide. The last time it was done was 2003. We have a larger reg guide update program right now because some of our guidance dates back to the 1970s. We're trying to learn from that not necessarily good experience to maintain our guidance reasonably up to date. Stu, go ahead.

MEMBER ARMIJO: What happens with all the other documents that you mentioned, the ISGs and other guidance documents? Do they get retired when this NUREG guide gets issued or do they stay in place and we've got multiple, still multiple documents?

MR. RICHARDS: Well, you know as it was described in this case the reg guide points to a lot

of these documents when it provides that roadmap. If you have ISGs for instance in the digital I&C area ultimately the intent of the staff I think would be to incorporate that into our normal regulatory process which is a regulatory guide and then to retire the ISGs such as in the digital area. So you know, the staff has mechanisms to kind of move things forward in a quicker manner but it you know sometimes it bypasses or shortcuts the longer process. I mean, why do we do ISGs? It's because we need to do something quickly.

MEMBER ARMIJO: Right, I understand.

MR. RICHARDS: The downside of that is that we skip some of those other steps that we benefit from for such as being here today. So we're -- my boss and I, we want to stay within the reg guide process, we want to get away from you know some of these mechanisms that have developed over the years that may be quicker but are not as thorough, don't include all that public comment and comment from the advisory committee.

CHAIRMAN BANERJEE: See, I should mention that of course we've been involved for a long time in this issue, almost every step of it. So we are fairly up to speed except for the latest testing that's going on, you know, in various areas. And so it's

worthwhile taking, you know, comments from the subcommittee as to their thoughts about this. I think we're fairly well educated. Even Joy.

MEMBER REMPE: I wasn't involved at the beginning of it.

CHAIRMAN BANERJEE: Some of us have been involved in this for a very long time but so let's start with you who has --

MEMBER REMPE: The least information.

CHAIRMAN BANERJEE: A correct view of the situation.

MEMBER REMPE: Well, I appreciated the discussion today and I learned a lot. So I want to thank you for that and I may be more sympathetic to what's going on on your position too. But I think it would be beneficial to listen to the comments that were brought up about the road signs. And I'm sure Graham will have a very detailed list of things you may want to try and incorporate before it comes before the full committee. I think it just would make a better document in my impression even though it may not solve some of the concerns industry has at this time.

CHAIRMAN BANERJEE: All right. Sam?

MEMBER ARMIJO: I have no comments. I

understand what's going on.

CHAIRMAN BANERJEE: Okay. Said, what's?

MEMBER ABDEL-KHALIK: I have really no additional comments except for the question I raised regarding the condition on the back side. And the comment was made that there was at least one experiment that was observed in which nothing was observed on the back side. If that is not documented anywhere I think it would be a good idea to document that information.

CHAIRMAN BANERJEE: Bill?

MEMBER SHACK: No real comments. You know, we've been unhappy in the past because reg guides have been so woefully out of date. I mean, the rev 3 doesn't look anything like the current guidance. This is really --

CHAIRMAN BANERJEE: It's completely almost a rewrite.

MEMBER SHACK: You know, I really think -- I like the idea of keeping the reg guides, even if it's only collecting what we're already doing and you know we don't know enough to really make it more definitive. You know, in defense of the vagueness you know this is still really the licensee's condition. If the staff doesn't really have a definitive list of

things that should be considered the licensee should be asked to consider all things and they can dispose. So I think part of the thing here reflects the fact that we still have questions and that this is a very difficult problem to deal with because we simply don't have a good fundamental theory and approach for developing a whole integrated process. And that's a fact of life.

CHAIRMAN BANERJEE: Graham?

DR. WALLIS: Well, I think it's useful to pull together the staff's position on the various issues. That's what I'm being told has happened. I mean, it's all over the place and here's some there where you can look at it all if you could know where to find the real stuff by pointers. I do as I've said several times in a guide look for more guidance. I was hoping after all these years to have clarification of how to do some of these things. It's not saying you've got to do it but more clarification of how to do it and more assurance that the NRC and industry knows how to address and resolve some of these technical issues.

I mean, the technical issues are there but then I don't get a feeling that on matters such as say the ZOI there's been much progress. It seems to be

even going backwards about how industry is supposed to address the ZOI. No longer do we refer to a standard for instance which seemed to be the acceptable way to do it. And you have to sort of dig and ask questions to find out that yes, the NRC will accept this old standard which has probably some technical faults similar to thin bed. I mean, thin bed is introduced but it must be very puzzling to someone to know what we do about that because we don't really know as I said what it is. So I was looking for more clarity about -- and so confidence that we really know what these things are and this is how to go about solving them, and if you do it that way we'll accept it. And I don't see that much. So I do think it's very useful for the staff to put together what I think is a true assessment of its present position on these various matters.

CHAIRMAN BANERJEE: Okay. So --

DR. WALLIS: And I will give you a report.

CHAIRMAN BANERJEE: Of course.

DR. WALLIS: I don't know what effect it will have but I'll raise some of the questions I raised orally today I think.

CHAIRMAN BANERJEE: The only thing I can say is that we'll write a letter in the October

meeting. And we are going to need a presentation which would be I don't know maybe an hour, hour and a half, something like that should cover it. We'll have to look at the agenda and see how crowded our October agenda is for the meeting. But most of the points you've made I think are useful. A couple of diagrams might be nice to show, you know, to illustrate what's going on. It's always nice to have visual effects.

DR. WALLIS: We never looked at those diagrams.

CHAIRMAN BANERJEE: It's in the report, I mean in the reg guide but it's always nice to have a few diagrams. Even when I made this presentation to the commission once I showed them bits of insulation floating around and sort of getting to places. It helps the uninitiated to do that.

MEMBER ABDEL-KHALIK: I think it would be helpful rather than just making a general statement that you got 84 comments and they were resolved in the appropriate manner to point out to what some of the significant comments were and how they were actually addressed.

CHAIRMAN BANERJEE: So, yes, because I'm sure that most of the full committee will not have the time to go through these comments in detail. There's

a lot of comments. It took me like an hour and half actually to just read them and see what the responses were. So it would be useful to have that certainly. Any other guidance that we should provide with regard to the full committee meeting?

DR. WALLIS: Well, John Butler raised the question of why issue it now.

CHAIRMAN BANERJEE: Well, maybe that should be addressed. I mean, I think Stuart addressed it at the end, at least your view of it. And --

DR. WALLIS: It may sort of describe the staff's present position but some of these issues are not resolved yet. Is it useful to answer that no one's going to refer to this particular reg guide? I'll refer to the other documents behind it. So what function does it serve except as a sort of a summary of where we are today.

CHAIRMAN BANERJEE: Right, so they're going to address that, okay. Why do it. And clearly there are situations where we simply don't know enough and I think we should simply say that in the light of that we are taking fairly bounding positions. We have to, what else can we do, right? So in particular where that's the situation that should be said.

I think John made a comment that there are

many conservatisms being piled one on top of the other. Is that true or not? That's what NEI said. That's not necessarily what the staff thinks and maybe the ACRS thinks differently too on this. It's not so obvious to me that that's the case but I think we should address that as well. Is it really true that that's happening.

DR. WALLIS: Well, I think you should also start off saying what a reg guide is for and why this meets those terms at this time.

CHAIRMAN BANERJEE: Okay. So with that if there are no other comments I'd like to thank the staff and I'd like to thank NEI for their comments. And we look forward to seeing you in October. The presentation was very good, it was very clear. You had the right people here to answer all the questions and I think you answered them satisfactorily. So we look forward to seeing you again and I'm going to adjourn the meeting. Anything else?

DR. WALLIS: I was hoping you would.

(Laughter)

CHAIRMAN BANERJEE: Early, which has never happened to a Thermal Hydraulics meeting before.

(Whereupon, the foregoing matter went off the record at 11:12 a.m.)

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Regulatory Guide 1.82 Revision 4

Water Sources for Long-Term Recirculation Cooling Following a Loss-Of-Coolant-Accident

ACRS Subcommittee Meeting
September 7, 2011

Presented by John Burke and Gary Wang
Office of Nuclear Regulatory Research

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Overview

- Background
  - Reason for the revision
- Selected topics from the Reg. Guide
- Review of Public Comments

U.S.NRC
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Background

- Regulatory Guide (RG) 1.82, “Water Sources for Long-Term Recirculation Cooling Following a Loss-Of-Coolant-Accident”, was last revised in November 2003 to improve the guidance for debris accumulation evaluations of PWR strainers.

- Research conducted by both the NRC and industry related to GSI-191 over the last several years has increased the understanding of the behavior of ECCS suction strainers. This in turn led to the desire to update the regulatory guide.

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Background

- Draft of RG 1.82 Rev. 4 is a complete re-write of the prior revision to include updated information and improve readability.

- The discussions in the Background Section and the Regulatory Positions common to both PWRs and BWRs are provided first, followed by guidance specific each reactor types, i.e. PWRs and BWRs, respectively.

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Background (cont'd)

- Draft RG 1.82 (Revision 4) endorses various industry Topical Reports, the NEI guidance report and the corresponding Safety Evaluations (SE), and NUREG reports.
- Incorporates staff guidance on head loss testing and vortexing, protective coatings, and chemical effects.
- Deletes obsolete figures and tables for sump screen design.
- Incorporates latest staff criteria for issues related to Gas Management in ECCS and Generic Letter 2008-01.

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Background (cont'd)

- The issues listed below are deferred to a future revision of the RG.
  - This draft revision does not include changes in guidance for containment accident pressure (CAP) impacts on net positive suction head (NPSH).
  - It does not provide detailed staff guidance for downstream in-vessel effects.
  - Several GSI-191 resolution closure options were recently approved by the Commission. The staff is currently evaluating those options, such as a risk-informed approach, in response to SRM-SECY-10-0113, dated December 23, 2010.

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Regulatory Guide

The following issues were considered to need more detailed guidance by the staff in the revision 4 of RG 1.82:

- Determination of Suction Strainer Head Loss
- Treatment of Chemical Effects
- Evaluation of Debris Downstream of Strainer
- Treatment of Coating Debris
- Treatment of Latent Debris
- Evaluation of Strainer Susceptibility to Vortexing & Air Ingestion

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Determination of Strainer Head Loss

- The use of prototypical physical head loss testing is the recommended method for determining suction strainer head loss. The use of a empirical correlation, i.e. NUREG/CR-6224, which was previously accepted in RG Rev. 3, is considered acceptable for scoping only.

- Limitations of the correlations are discussed in the SE for NEI-04-07 and include:
  - Cal-Sil insulation, coating particulates, chemical precipitates, and latent debris were not included in testing to determine correlation
  - Sensitively to debris preparation and introduction into test loop
  - Water temperature effects were not included
  - Thin bed effect was not sufficiently addressed

- This RG change is consistent with the staff SE for NEI 04-07.

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Determination of Strainer Head Loss, cont.

- Regulatory Position 1.3.11. of draft RG 1.82, Revision 4 incorporates detailed staff guidance on methods acceptable for conducting head loss testing as disseminated to industry in a NRC staff letter to NEI dated March 28, 2008.
  - The NRC staff evaluated the industry's head loss testing protocols, and witnessed head loss testing at each of the vendor test facilities in 2006/2007. The staff then developed guidance in the areas of testing procedures, scaling, surrogate debris similitude, data extrapolation, etc. for staff and licensee use.
  - The guidance was discussed in public meetings in 2008.
  - That guidance is incorporated into this RG revision in Regulatory Position 1.3.11.

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Chemical Effects

- The effects of chemical reaction products on strainer head loss should be considered. The guidance in the prior revision was brief. This revision provides more details.
- Strainer designs should be validated through plant specific testing that includes chemical effects.
- The staff SE for WCAP-16530-NP-A accepts this industry approach as one method that may be used to evaluate chemical effects that may occur in a post-accident containment sump pool.
- March 2008 letter to NEI provided additional guidance for an overall approach to evaluate the chemical effects on strainer head loss.
- Regulatory Positions 1.3.10, 2.2, and 3.3 incorporate the above staff guidance.

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Downstream Effects

- Downstream effects has 2 sub categories, ex-vessel and in-vessel effects.
- The prior revision of the RG stated that debris clogging of flow restrictions downstream of the sump screen should be assessed, but provided no specific methods (RP 1.1.1.12).
- For ex-vessel effects; WCAP-16406-P-A, provides a method, acceptable to the NRC staff, for licensees to use in evaluating the downstream impact of debris that passes through the strainer and enters the ECC systems and components. (abrasion, wear, blockage of flow paths).
- Regulatory Position 1.3.8 was added to endorse topical report WCAP-16406-P-A.
- For in-vessel effects; Core inlet blockage tests were conducted for various mockup fuel assembly designs. The results of the tests are documented in WCAP-16793-NP. This report is still under review by the staff.

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Protective Coatings

- Regulatory Position 1.3.5 was added to include guidance for the treatment of protective coatings.
- The prior revision just listed coatings as a possible debris source
- NRC Staff Review Guidance regarding protective coating provides a general approach to conduct plant-specific coating evaluations.
- This guidance covers the failure characteristics of both qualified and unqualified coatings.
- Coating debris transport analysis is acceptable if it is within the scope and parameters of NUREG/CR-6916, (which was presented to ACRS in February 2006).

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Latent Debris

- Latent debris is the general area dirt and dust, etc. present in containment. It may contribute significantly to head loss across the suction strainer during post-LOCA recirculation operation.
- Revision 3 of the RG relied on licensees cleanliness programs to minimize this source of debris.
- NEI 02-01 Rev 1 “Condition Assessment Guidelines: Debris Sources Inside PWR Containment,” provides an acceptable approach for determining latent debris quantities and characteristics.
- NEI Guidance Report 04-07 provides methods that can be used to evaluate the impact of latent debris on strainer blockage.
- The staff Safety Evaluation for NEI 04-07 accepts the industry approach in these documents.
- Regulatory Position 1.3.6 was added to address this issue.

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Vortexing & Air Ingestion

- Vortex formation and air ingestion may occur depending on strainer submergence, strainer configuration, and fluid field geometry. In the previous revision of the RG, there was a 2% air ingestion criterion as the threshold for pump degradation.
- NPSH(req) adjustment due to air ingestion was maintained from prior revision
- This criterion did not differentiate between transient and steady state conditions and was based on studies conducted many years ago.
- GL 2008-01 “Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems” was issued in January 2008 to address the issue of gas accumulation in the emergency core cooling, decay heat removal and containment spray systems.
- During resolution of GL 2008-01 it became clear that guidance was needed to cover a broader range of pump operating conditions.

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Vortexing & Air Ingestion, (cont.)

- Appendix A of this RG has been updated to provide the latest staff guidance for evaluation of the potential for vortex formation and air ingestion.

- These changes also reflect the geometry of the strainers now installed. (box-like strainers made of flat screens are not used anymore).

- Table A-2 “Impact of Ingested Air on Pump Performance” now includes steady state and transient operation information.

- The changes to this Appendix are consistent with the latest staff guidance issued for GL 2008-01 as discussed during public meetings with NEI and licensees.

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Public Comments

- The draft RG (DG 1234) was published for public comments in the summer of 2010.

- 84 comments were received from 5 separate organizations.
  - The use of CAP for NPSH, use of the NUREG/CR-6224 correlation, coordination with GL 08-1 criteria, and head loss test methods were the subject of many of the comments.

- The comments were carefully evaluated by the staff. The comments were incorporated into the draft RG 1.82, revision 4, as appropriate.

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Conclusion

- This revision of RG 1.82 incorporates the latest staff guidance for evaluating ECCS suction strainer blockage that is contained in a variety of documents such as Safety Evaluations and staff guidance letters. There are no new staff positions that are being promulgated in this revision.