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NUCLEAR REGULATORY COMMISSION

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484th MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
(ACRS)

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THURSDAY
JULY 12, 2001

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ROCKVILLE, MARYLAND

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The Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., George E. Apostolakis, Chairman, presiding.

COMMITTEE MEMBERS:

GEORGE E. APOSTOLAKIS	Chairman
MARIO V. BONACA	Vice Chairman
F. PETER FORD	Member
THOMAS S. KRESS	Member
GRAHAM M. LEITCH	Member
DANA A. POWERS	Member
STEPHEN ROSEN	Member
WILLIAM J. SHACK	Member
JOHN D. SIEBER	Member
ROBERT E. UHRIG	Member
GRAHAM B. WALLIS	Member

I-N-D-E-X

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

8:31 a.m.

DR. APOSTOLAKIS: The meeting will now come to order. This is the second day of the 484th meeting of the Advisory Committee on Reactor Safeguards.

During today's meeting, the Committee will consider the following: Draft individual plant examination of external events insight support, status of resolution of genetic safety issues, GSI-191: Assessment of debris accumulation on PWR sump pump performance; potential margin reductions associated with power uprates, the reactor oversight process; future ACRS activities/report of the Planning and Procedures Subcommittee; Reconciliation of ACRS comments and recommendations; and proposed ACRS reports.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. Sam Duraiswamy is the designated federal official for the initial portion of this meeting. We have received no written comments or requests for time to make oral statements from members of the public regarding today's sessions. A transcript of portions of the meeting is being kept, and it is requested that the speakers use one of the microphones, identify themselves, and speak with sufficient clarity and volume so that they can be readily heard.

First item, draft individual plant examination of external events. I guess I'm supposed to lead you guys through this. Well, we had the Subcommittee meeting on the subject. We discussed primarily the seismic and fire-initiated sequences, and the staff is here to brief the full Committee on the subject, and who is taking the lead on this?

MR. RUBIN: Good morning. My name is Alan Rubin. I will try to speak loudly and clearly into the mike, as the Chairman has requested. I'm the Section Chief --

DR. APOSTOLAKIS: With sufficient clarity and volume.

MR. RUBIN: Oh, that also, okay.

DR. POWERS: It's the clarity part you want to focus on.

MR. RUBIN: Thank you. We're starting off on the right foot. Thank you.

My name is Alan Rubin. I'm a Section Chief in the PRA Branch in the Office of Research, and what we're going to present today, me being myself and

John Ridgely, the following feedback -- first of all, let me mention that I think all of the ACRS Committee members have a copy of draft NUREG 1407 in two volumes. It's right here in front of me.

As feedback that we got from the Subcommittee on June 22, the full Committee wanted to hear some more information about it, a broad overview of the methodological issues and needs coming out of the IPEEE Program, which I will discuss, as well as the technical issues associated with the resolution of generic safety issues. John Ridgely will present discussion of picking out four representative generic issues and going into more detail and how they were closed.

Before he does that, I'll give a brief sort of an overview and synopsis of the generic issue closure resolution process, which I think is important as a little bit of background information. Before, however, John Ridgely discusses the generic issues, I'll present one slide on the generic overview of conclusions and further actions from the IPEEE Program.

Putting things into context from the last meeting, we're not going to repeat this in today's full Committee meeting, but we presented an introduction to the IPEEE Program, including the background and scope of the Program, the Program overall objectives, and the IPEEE review process. And then for each of the major areas, the seismic fire and the high winds floods and external events, we presented a discussion of the vulnerabilities that licensees had discussed in their submittals, summary of plant improvements that licensees had planned or had already implemented, perspectives on core damage frequencies, dominant contributors to risk from the various initiating events, as well as model perspectives, which I'll go into in more discussion this morning.

We also discussed briefly covering the 31 IPEEE-related generic issues and sub-issues at the Subcommittee meeting. We also presented a discussion summary of some of the uses of the IPEEE information, how the IPEEE Program results have been used and will be used in the future, as well as overall conclusions and observations.

DR. APOSTOLAKIS: This use of the IPEEE results is puzzling. I mean most licensees use the bounding techniques, screening techniques like five for fires and the seismic margin analysis for seismic and so on. At the same time, I think the report correctly states that the IPEEE exercise confirmed that earthquakes and fires are among the dominant contributors to risk even though their analyses were crude and so on. Since that's the case, shouldn't -- I mean most of the current IPEEE studies really cannot be used for risk management, can they, because they're bounding analysis; they're not risk assessments.

MR. RUBIN: Well, I think they provide more than that. They provide insights for uses, for example, in where the dominant contributors are for a plant. So when NRR is looking at inspection findings, areas to inspect at the plant in the fire or seismic areas, they've used the results of the IPEEE Program. We use the results in looking at the reactor oversight process as well.

DR. APOSTOLAKIS: On a genetic basis --

MR. RUBIN: On a genetic basis --

DR. APOSTOLAKIS: -- you're right. I mean there is information there that is very useful, but if I want to manage the risk of a particular plant and I don't have a PRA, how can I manage it? I mean all I have is a screening analysis with some insights. I'm not saying it's useless, but it's not really what one would call a PRA.

And that's a little puzzling, because it seems that people think that it's worth doing a PRA only for the reactor power and for internal events. For shutdown modes, for external events or anything that deviates from that screening analysis or maybe a little arm waving is good enough. And I don't understand that, I mean especially for the external events, also for the shutdown modes.

I mean there is strong evidence that we have contributions to risk that are comparable to those from internal events of power. So why this reluctance? I mean I'm just asking you now. And shouldn't we be trying to upgrade these studies? I mean as a first step, maybe this was a successful Program, but now that we know more, maybe we should start slowly upgrading those so that we can, first, have a good picture of what the risks are and, second, managing them.

MR. RUBIN: I mean I agree. On a plant-specific basis, when I get the methodologies --

DR. APOSTOLAKIS: They're always plant-specific, right?

MR. RUBIN: Well, when I get into discuss the methodologies, I'll talk about ongoing and planned activities to address these methodological issues to develop standards for an improved PRA for external events. And I agree with you. But, still, I think that there are probably more uses of the IPEEE information that can be applied. They discuss in the report -- I don't know if we want to discuss --

DR. APOSTOLAKIS: On a genetic basis, yes, I don't disagree with you -- useful insights.

MR. RUBIN: Yes.

DR. APOSTOLAKIS: But I mean even that, I think, is a compromise to have to say I have useful insights. Insights usually mean you haven't done a good job. When a research program says, "We gained insights," you know they produced nothing, right?

DR. POWERS: It's a fundamental theorem.

DR. APOSTOLAKIS: It's a theorem that goes back to Euclid.

(Laughter.)

MR. RUBIN: In that case, I won't disagree.

DR. POWERS: No, he was Greek, wasn't he?

DR. APOSTOLAKIS: Sorry?

DR. POWERS: He was Greek, so it wasn't respectable.

DR. APOSTOLAKIS: Who?

DR. POWERS: He was Greek; he can't be respectable.

DR. APOSTOLAKIS: The discussion is deteriorating.

MR. RUBIN: We have a short time; let me continue. Before I get into the specifics, a general discussion of the issues, I want to make a couple of overall comments I think relates to Professor Apostolakis' discussion and lead-in.

In terms of methodologies, it was understood that when the IPEEE Program began ten years ago with a generic letter, 8820, supplement 4, that there were some limitations. And the state-of-the-art of PRA external events was not as advanced as for internal events. And it was not expected that licensees would go beyond the state-of-the-art in their IPEEE analysis. And even with that caveat, we felt that with these limitations the Program was able to accomplish its objectives in terms of licensees being able to identify vulnerabilities with the plant-specific improvements and meet the objectives of the IPEEE Program. Can and should there be improvements? Yes, there certainly can be improvements.

DR. APOSTOLAKIS: Now, again, this identification of vulnerabilities, as you state in the report, and I think we discussed it last time at the Subcommittee meeting, human error rates were not handled very well. In fact, the report clearly states that there is no strong technical basis for the numbers that the IPEEE showed. They either took the IPEEE numbers, which themselves are not the most scientifically derived numbers, and multiplied them by various factors to adjust them to external events.

Now, given that we don't really trust the human error rates, how can we trust the results? How can we be sure that the vulnerabilities have been identified when human performance is an integral part of these accident scenarios, through recovery actions, right, abandoning the control room and doing things from the outside, and trying to stop the diesels aligning the turbine-driven pump of the auxiliary feed water system.

Let's say that the human error rates are significantly underestimated. Are there any vulnerabilities that have been missed?

MR. RUBIN: You're leading into a couple of questions that I was going to cover, so let me answer them now, try to, about the seismic and the fire area. Human error rates, you're right that in many cases human error probabilities were taken as multipliers based on judgment from the internal events IPEEE. In some cases, in the fire for main control room abandonments in areas, there was more detailed analysis of the human operator actions, the human performance.

When we saw, through our reviews that these human error rates that were indicated in the submittals, were very optimistic, in other words, where they did not take into account the effects of fire, smoke, heat, and stress, or in a seismic if they did not take into account the timing and the location of operator actions, we asked plant-specific REIs for each of those. And in some cases, licensees upped their human error probabilities, typically did not find a significant change in their overall CDF, core damage frequency, for those plants.

And in the seismic -- let me give an example in the seismic area. Typically, operator actions for safely shutting down the plant would not be required till a half hour after an earthquake. And what the licensees did in some of their analysis for actions that were required outside the control room, their human error probabilities, although without detailed modeling, they took the error probability of one, but not taking credit for operator recovery actions outside the control room.

In some cases, when actions were required, there were different multipliers depending on the level of the earthquake. Earthquake for a certain G level, they took a certain human error probability as a multiplier of the internal events human error probabilities. And for higher earthquake levels, they took higher multipliers. For actions that might have been required, say, more than an hour after the initiating of the event earthquake, in some cases licensees actually took the human error probability from the internal events IPE.

So there were different -- you know, although they're not a detailed human performance modeling, we try to let them see, based on our reviews, the timing, how the effects of the fire or earthquake were taken into the licensee's analysis. And we felt that for determined vulnerabilities and overall core damage frequency estimates, licensees could come up with results that would not be too far off base.

Are there areas that look for improvements? Yes. In fact, in the fire area, part of the Fire Risk Research Program is looking at human error performance as a result of fire. And that information is going to be factored into a fire risk requantification study, which is part of the Fire Risk

Research Program.

That's kind of a brief summary. I was going to get into a little bit later, so I'll save time later on. I won't have to repeat myself. But that's sort of the outline of the seismic and fire perspectives of how human performance was treated in IPEEEs, why we felt there were some limitations but why we also felt that it wasn't that bad for IPEEE purposes but could be improved. And, again, realizing that we didn't expect the licensees to go beyond the state-of-the-art, we really couldn't pursue it too much further for IPEEE purposes. I know that's one of the subjects that we wanted to get into at this full Committee meeting was the human performance and the methodologies.

DR. APOSTOLAKIS: Well, yes. The spirit of my question was not really why didn't you do more, because you can't really do more, but I mean the state-of-the-art is relatively weak.

MR. RUBIN: But we are planning to do more.

DR. APOSTOLAKIS: Okay. But right now, I mean there is this doubt that all the vulnerabilities have been identified, because humans -- you know, we really don't know how to model that very well. And also the impact of smoke, in general, not just on humans, we don't handle that in fires.

MR. RUBIN: Well, there's empirical data in the fire area. For example, time to recover or suppress a fire manually, which does take into account, not in the modeling, but indirectly the effect of smoke. And there are actually some curves at times to recovery for fires in different areas of the plant. And we looked at that in our reviews, and we saw that if an operator -- if a plant was taking too much credit for suppressing all fires in ten minutes, that's crazy, that's ridiculous, and we pursued that with the licensee. That was a very optimistic assumption. So we pursued that to make sure that a vulnerability was not missed, because there was too much credit for manual suppression, for example.

DR. POWERS: When will you look at the results, particularly for, I believe, at Susquehana, we see that they are remarkable in their lack of vulnerability to fire. And I have been told, though I can't produce evidence, that some of that lack of vulnerability they have to fire is due to extraordinarily high levels of performance by the fire fighting capabilities. Did you not find that overly optimistic or look that in any detail?

MR. RUBIN: We looked at it in great detail. In fact, Susquehana initially came in with a ten to the minus ninth core damage frequency estimate for fires. That's one of the four plants we went to and did a site audit on to see what was going on. We knew that they had an extremely low probability of core damage from internal events also for the similar reasons -- high optimistic expectations on human error probabilities.

The interesting thing we found with our walkdown, even though the Plant did not identify vulnerabilities, they made some procedural improvements in areas where transient combustibles were, they felt, potentially could contribute to higher risk, and they added some procedural modifications to the Plant, even though they didn't fine, quote, "vulnerabilities."

But, yes, we pursue Susquehana. We believe the overall whole quantitative number now is in the order of ten to the minus seventh fires. You can question that one. It's the lowest one of all the submittals, I believe. But there were some insights that were gained, and as a result of our review and audit, some adjustments and some improvements.

Let me go into methodologies. I'll try to be brief. I do want to leave some time for the generic issues portion. I have a lot to cover. So I'll briefly touch on the issues, and if you want to hear -- if I'm going too much into each one of them, because of time, let me know.

In the seismic margins assessment versus the seismic PRA, both of these methodologies were acceptable approaches for identifying vulnerabilities and meeting the intent of the IPEEE Program. Forty percent of the submittals used a seismic PRA, which did enable them to come up with an estimate of core damage frequency, a list of dominant contributors, as well as a plant level fragility curve.

The seismic margin assessment, which was used by the remainder, about 60 percent of the licensees, that was done, and the question from the Subcommittee meeting was why did so many licensees use the seismic margins assessment instead of a PRA, which would give more risk insights. In part, because with the resolution of USA-46, the methodology for a seismic PRA was very consistent with that methodology.

The IPEEE Program went beyond the A-46 in terms of scope, but the methodology was similar, and licensees chose to integrate those two programs together. And they came up with a list of critical components and estimated plant and component, high confidence of low probability, of failure capabilities, and an assessment of the margin beyond the design earthquake but no explicit core damage frequency estimates for the seismic margins analysis. And, therefore, there are some limitations in how you can apply risk-informed activities as the result of the seismic margins and assessment.

And there's an ANS standard on external events that has been issued in draft form that cover seismic events. And that standard includes both methodologies, the SMA, seismic margin assessment, as well as the PRA, with the acknowledgement that there are some limitations on the seismic margins analysis for risk applications.

I think I said as much as I wanted to say on the human error probabilities for seismic events in my introductory comments.

Surrogate elements is another area in the seismic analysis, seismic PRAs that were used. This was sort of a short cut methodology where groups of components are combined together into a surrogate element, which can be screened from the analysis. And this methodology is acceptable if the screening, one, is done in a high enough level, and obviously the surrogate element is included in the plant logic model.

And if the surrogate element does not come out to be a dominant risk contributor, pretty much that's what you'd like to see. But in seven of the 27 licensee submittals that used a seismic PRA, the surrogate element did come up as a dominant contributor. However, the total core damage frequency for those seven plants was in the low ten to the minus fifth range. So although the surrogate element could mask what the actual dominant contributor is, in this case the overall core damage frequency was on the low side. And this is an issue that is discussed and clarified more in the external event PRA standard that the American Nuclear Society is coming out with.

The use of uniform hazard spectra and simplified fragilities and soil evaluations, I'll just briefly touch on. There is acknowledgement that if you take the uniform hazard spectra and don't anchor it correctly at the right frequency ranges, you can come up with low seismic demand. We ask questions in our IPEEE reviews; in fact, some licensees revised their seismic analysis based on the questions. And this use of uniform hazard spectra is discussed in the

ANS standard as well as a draft reg guide that the staff is -- revised draft reg guide 1.60 that the staff is in the process of developing.

Simplified fragilities, that was a point that was brought up, I think, by Dana Powers, at the Subcommittee meeting. There's a comment in the report that this can mask contributions to core damage frequency. And just to go back and reemphasize, we feel that more of the uncertainties in the seismic PRA come from the uncertainty in the seismic hazards rather than the fragilities. Although fragilities can be masking it, more uncertainty comes for the core damage -- for core damage frequency, it comes from the seismic hazard curve.

DR. POWERS: I think if you're interested in what the absolute risk of the facility, that's the way to look at things. The seismic hazard itself is the dominant uncertainty. But a plant manager can't do anything about the seismicity of his area. He can do something about the components within his facility that are most susceptible. And if you use simplified fragility curves, then he really doesn't know which ones to do anything about if he's moved to do anything.

MR. RUBIN: I don't disagree with that.

You mentioned something that's interesting from the last comment on soil. Soil's evaluation is that this was typically -- it was not required for many plants that fell in the reduced or focused scope category for IPEEE purposes.

For those plants that did perform the soil liquefaction analysis, it was an area which if there were improvements, it would be very difficult to show that it would be cost-effective, and an area that there is uncertainty there's no consensus on the best approach to use for liquefaction-induced soil displacement, but it is also an area, a topic, that's discussed in the ANS standard.

Seismic area, I'll conclude with this slide. These are two industry and NRC activities that are ongoing. As an external events PRA methodology, it covers seismic events and also high winds, floods, and other external events. It does not cover fires. There was a draft that was issued for public comment in December of 2000. And I would mention that each of these, both ANS standard and the revised reg guide 1.60, take lessons learned from the IPEEE Program, try to incorporate those lessons into these standards.

The revised reg guide 1.60, there are two NUREG CR reports that will be published shortly, one on the seismic hazard analysis and one specifically on procedures for using uniform hazard spectra. A draft reg guide is in the process, internal staff review process, and it will be issued for public comment.

Now move on to the fire methodological issues. And, again, each of the areas discussed here are pretty well covered and addressed and following ongoing activities that I will discuss. The five versus the fire PRA, we discussed that briefly at the Subcommittee meeting. Only about 20 percent of the submittals used a straight five analysis. Eight percent of the licensees used either a five or some combination of five and PRA or just PRA.

And, in general, we found that both methodologies yielded similar results in terms of what the dominant contributors were to risk, although five submittals seemed to result in a somewhat higher total core damage frequency estimates. And there are some aspects of five that could use some enhancements, such as screening multicompartment scenarios, main control room abandonment, areas and treatment of some of the fire risk scoping study issues.

The Fire PRA Implementation Guide was a guide that had been issued by industry, by EPRI. Many licensees use that Guide, and in our staff review, we sent out 16 generic requests for additional information or questions to address IPEEE's specific related topics. Industry came in and resolved those REIs for IPEEE purposes, and we understand that EPRI plans to reissue a revised guidance in the future.

Human error probabilities, actions, and recovery actions I talked about already. Discussing severity factors, severity factor methodology is a simplified approach instead of using more detailed analysis on the frequency and magnitude of fires. One of the issues -- the approach can be used, but one of the concerns is if licensees tend to double count using severity factors where they could take credit for suppression in addition to a severity factor which can be used to reduce the magnitude or frequency of large fires. We asked questions when this was done in our IPEEE reviews, and NRC's Fire Risk Research Program is a task to look more at the severity factors and analysis of treatment of large fires.

Circuit analysis is the next topic on here. This, perhaps, is probably the number one topic in the fire risk -- NRC's Fire Risk Research Program. There certainly were some state-of-the-art limitations in the analysis of circuit failures in the IPEEEs -- the frequencies and likelihood of hot shorts and multiple hot shorts. These are being addressed in ongoing NRC and industry activities on fire-induced circuit failures. There are some tests and data and industry activities going on in the Cooper Program, which is the cooperative PRA Program that the NRC is participating with and sponsored with a number of foreign countries.

The fire modeling area is the next one. Let me bring back a point that, Dana, you also brought up at the Subcommittee meeting in terms of multi-zone fire scenarios were not large contributors to core damage frequency. And you referred to a quote in the draft NUREG 1742 that said, "Contribution of these scenarios to overall fire-induced CDF range from one percent to about 30 percent." And the question was, well, 30 percent of a large number could still be a large number. We went back and looked at the plant that had the 30 percent contribution from new scenarios, and that total core damage frequency of that plant was around three times ten to the minus five. So the overall multi-compartment contribution was around seven times ten to the minus six.

DR. POWERS: Which is not a trivial thing.

MR. RUBIN: Not trivial, but it's in there. But it's not something you'd necessarily --

DR. POWERS: And the question you had is what about those that chose to analyze their fires, assuming that all fire penetration barriers were 100 percent effective as a ground rule without putting a failure probability into them and how much have they missed? Based on that example, you would say they may well have missed a lot.

MR. RUBIN: Well, there are other examples, and, true, there were some submittals that did assume 100 percent barrier failure reliability.

DR. POWERS: Most, in fact, assumed it --

MR. RUBIN: Yes.

DR. POWERS: -- 100 percent barrier reliability.

MR. RUBIN: But there were some -- when we did look at the impact of multi-compartment of failures, it was not a dominant contributor. It was --

DR. POWERS: I mean the question is dominant. I mean you come back and tell me, "Well, it's seven times ten to the minus six out of three times ten to the minus five." That strikes me as something that is something that I would want to know.

MR. RUBIN: For most of the plants, of those plants that had contributions from that, it was closer to ten to the minus seventh contribution.

DR. POWERS: Yes. Well, the question is who's right? And I mean it may well have been that the one that gets the 30 percent number, they were overly conservative. But it clearly is something that merits some attention, it seems to me.

MR. RUBIN: It does merit some attention. It's not being ignored. It is a task in the Fire Risk Research Program that's being looked at, both the multi-compartment scenarios --

DR. POWERS: Well, let's hope that nobody uses this rather optimistic view of these results as a basis for ending that research.

MR. RUBIN: I don't think they will.

DR. POWERS: I bet they will if they have a chance.

MR. RUBIN: Continue on with electrical panel fires. Just two comments I wanted to make regarding this subject. One, the panel fire issues are related to the heat release rates given a panel fire, and this is an area which was under discussion with the Fire PRA Implementation Guide. When licensees tended to use low heat release rates, we asked some questions. The other area is some limitations on the analysis of this topic on energetic faults for high energy electric panels that could potentially cause damage external to the cabinet. And this is an area of topic that's also included in NRC's Fire Risk Research Program.

Fixed detection and suppression relates to use of severity factors and the timing in fire detection and suppression. This is also a topic included in the Research Program. There's a draft report on this that's been issued. It's been out for comment. It includes empirical data on reliability of suppression. And that report is an update of some of the work that was done earlier at UCLA.

Analysis of self-ignited cable fires, many submittals and licensees are going along with the five methodologies screened, self-ignited cable fires when they use IPEEE 383 qualified cables. When these cable fires were treated into submittals, the contribution to core damage frequency was generally small, but the topic is also included in the Research Program, the Fire Risk Research Program.

This is a list of the activities in the fire area, both NRC and industry activities. The Research Program that I mentioned had been presented. A draft plan was presented to the ACRS Subcommittee on fire protection, and the full plan was sent to the

ACRS. Tasks include areas such as the fire risk assessment methods development, fire modeling benchmark and validation, which is an international effort that the NRC is participating in, and the fire risk requantification study, which is a joint effort between NRC and EPRI.

In terms of human reliability analysis, there's additional effort to look at the quantification, the assessment of human performance following a fire, and that effort will be factored into the fire requantification study.

I mentioned the supplemental guidance at EPRI issued on the Fire PRA Implementation Guide. And in addition, finally, there's an ANS, American Nuclear Society, is developing -- will be developing a standard PRA on fire that will provide a more detailed analysis for PRA, and I guess it will supplement the NFPA 805 standard, which does not go into the level of detail in a fire PRA.

MR. ROSEN: Alan, when you talk about human reliability research from fires, are you talking about operators or fire brigade personnel or both?

MR. RUBIN: More operators. It's performance of the human operator recovery actions in the event of a fire.

MR. ROSEN: But not of fire brigade personnel?

MR. RUBIN: I don't think so, but we could check on that. Nathan Su is involved directly with that program. He's out on leave today. We can get an answer to that question. But I think it's more of the recovery actions given a fire and the actions to safely shut down the plant. It may also involve the actions to suppress a fire. I'd have to double check.

MR. LEITCH: Do you take a look at any recent actual events to see how operators performed to see if your conclusions are reasonable? There's been a couple of kind of interesting fires in the past six months -- San Onofre, there was one a couple weeks ago at Cooper.

MR. RUBIN: Yes. Typically, those have been transformers, which are fires that have caused serious economic consequences to the plant, long shut downs. But there has been a draft report issued on significant fires that occurred internationally -- I'd have to check on when that's coming out -- looking at human performance, the extent of a fire, and what you can glean from those events, in terms of analysis into a fire PRA, things that might not be factored into the fire PRA. Large turbinal fires, for example, is one thing that -- an area we can get large fires, there's lots of combustible sources for fire. And we've seen events -- in the IPEEEs, we've seen where those can be large contributors to the plant risk from fires.

MR. LEITCH: Even though the balance of plant is involved, it may give insights as to operator performance under those kind of stressful conditions.

MR. RUBIN: Yes. I think in those recent events the plants were shut down safely, but I don't know how much detail is being looked from the fire perspective on that. But there is a report looking at large fires, internal plant fires, probably ten or 12 large fires.

MR. ROSEN: Alan, you promised me an answer to my question about operator fire brigade performance.

MR. RUBIN: Yes. John, will you take a note on that? Or if somebody would working with me.

MR. ROSEN: But I'd like to have the answer that fire brigade performance is also being looked at, because I think it's a very important piece of the plant's response to a fire. And, typically, brigades are fairly effective.

MR. RUBIN: Okay. We'll get back to you on that.

MR. LEITCH: Stephen, are you referring to on-site fire brigades or are you talking about off-site response?

MR. ROSEN: I'm talking about on-site.

MR. LEITCH: On-site.

MR. ROSEN: Yes.

MR. RUBIN: We understand the question, and we'll get back to you. We could have a quick answer if we had Nathan Su here.

As an introduction to the next presentation by John Ridgely on the generic issues, I think it's worthwhile just to go into a brief summary of the processes, how the issues are resolved. There is a new process in the draft management directive 6.4 resolving generic issues, but this is a process for the IPEEE-related issues, as well as other generic issues.

Once an issue is identified and prioritized on a generic basis, it goes through a resolution process. And there are various ways that an issue can get resolved. One, an issue can be resolved because there's an assessment that it's a low safety significance. There could be a high analysis, cost/benefit analysis that the cost/benefit is high, or it could be transferred to another program, and the number of issues that were addressed and transferred to the IPEEE Program for plant-specific validation was how some of these generic issues were resolved.

The next phase is the imposition for the resolution. In this case, for IPEEE, this was the identification of theses issues in Supplement 4 to generic letter 8820 where licensees were asked to address a number of generic issues. Some issues were also included in the IPEEE Program for validation and verification that were not specifically identified in the IPEEE Program generic letter and guidance, and those were discussed at the Subcommittee meeting.

Implementation is done by the licensees' plant-specific analysis. Verification is done by the NRC's review of those IPEEE submittals and analysis.

The issue listed under this first bullet -- and I won't go read them all -- these are IPEEE issues that are already considered resolved. And the IPEEE review is for verification on the plant-specific basis, and no further generic action is required with these issues.

The fire and scoping study issues is a little different. This was not a formal part of the Generic Issue Program, but a number of the fire and scoping studies issues actually did become generic issues. That was GSI-57, the effects of fire protection system actuation on safety-related equipment; Generic Issue 147, which was fire-induced alternate shutdown, control room panel interactions; and GSI-148, which was smoke control and manual fire fighting effectiveness.

There is one issue near and dear to the ACRS, which is the MS -- Multiple System Response Program, GSI-172. This issue is still considered open in the generic issue process, although in the IPEEE reviews and in our review we looked in 80 percent of the plants. We've verified have adequately addressed the aspects of this issue. Typically, commonly, when a generic issue can be resolved, there isn't a look at all 100 percent of the plants. It can be resolved in a much more limited basis taking typical plant designs and addressing those plant designs for resolving an issue. But this issue is one that is going through a generic issue process. There will be a package and formal resolution that will be submitted for ACRS review in accordance with the generic issue procedures that are in place.

So I just wanted to comment that in terms of the generic issues or a letter from ACRS, we're not necessarily looking for a letter to address the generic issue aspects of the Program. The MSRP issues will be followed up later on towards the end of this year.

DR. APOSTOLAKIS: When does the public comment period end?

MR. RUBIN: On the --

DR. APOSTOLAKIS: You have issued the report, right?

MR. RUBIN: Yes. I'm going to get to my conclusions this time, because at the Subcommittee meeting, John originally took too much time, and I didn't get to my conclusions slide. So I want to get to that first before John gets up here.

You've heard this before, and it's in the report, we feel the Program has been successful in meeting any intent of the generic letter. The IPEEE Program has verified resolution of a large majority of the generic issues on a plant-specific basis. Any follow-up actions on the plant-specific issues will be addressed separately from the IPEEE Program. Public comments are due on the report July 31, at the end of this month. To date, we have not received any public comments. We expect they'll come in at the end of the month, in a couple of weeks. And our schedule is to issue a final report in October of this year. And that concludes my presentation unless there are further comments or questions.

DR. APOSTOLAKIS: So this Program -- I mean, again, the connection with the GSIs.

MR. RUBIN: Okay.

DR. APOSTOLAKIS: You are not resolving any GSIs right now. You may be using some insights from here to do it later, but --

MR. RUBIN: Formally, except for the MSRP issues, they're considered, quote, "resolved" in the generic issue process. There's no formal generic activities that are needed to resolve that. The IPEEEs were a verification that on a plant basis they were addressed. So on a plant basis, if there's some follow-up activity, that will be done separate from the IPEEE Program. The MSRP issue, however, is going through a more formal resolution process and a resolution package.

MR. LEITCH: Did I understand you to say that GSI issues are typically considered resolved or closed when, in many cases, the number is less than 80 percent of the plants have complied? Is that what you said? I wasn't sure --

MR. RUBIN: That's what I said, yes. When a generic issue comes up, it's not addressed on a plant-specific basis, generally, for the resolution of generic issues. And Harold Vandermolen is here. He can correct me if I say something incorrect. But do you want add something?

But, typically, we might look at a cost/benefit analysis on a number of plants or plant types -- BWR, PWR -- different containment types, different designs -- Westinghouse, B&W plants -- and then see if there is a trend or pattern. And if the trend or pattern shows that there's low risk or high cost/benefit, then a decision can be made that it's really not worth the limited resources from the staff to pursue it further, and the issue can be closed. So I think on the IPEEE Program, we're going into a lot more depth and detail in actually verifying the resolution of an issue than is typically done.

Harold, you might want to add something on that.

MR. VANDERMOLEN: This TV set over my head is supposed to add to clarity of -- I'm Harold Vandermolen. I run the Generic Issues Program in the Office of Research. Just amplifying what Alan has said, for generic issues under the original or classic process that these issues still fall under, yes, an issue is resolved -- generic issues are resolved by taking a regulatory action; that is, they're intended to look for whether or not we need to change our regulations or the reg guides and other documents that go along with them, that sort of thing, going all the way to verification of things happening in the plant.

We don't do -- well, first of all, going almost to enforcement actions, that's not something we do in the Office of Research, nor is it necessary or considered necessary to do this for 100 percent of the plants for all issues. That's more of an enforcement action that we would leave to our compatriots in the other building. That's really how it works.

At that resolution stage, once the agency has decided what it's going to do, then the action is handed over to another office. It doesn't mean nothing happens, but it's no longer directly part of the Generic Issues Program. We'll still be aware of what's going on. I hope that's answering your question.

MR. LEITCH: Yes. Thank you.

MR. RUBIN: Okay. We'll get into more specific generic issues with John Ridgely.

MR. RIDGELY: Good morning. My name's John Ridgely. I work in the Office of Research. I work for Alan Rubin. And once again, I see that I have been given an abundance of time for the few slides I have, so I will need to proceed through at a leisurely pace.

DR. APOSTOLAKIS: We have to wrap this up by 9:45.

MR. RIDGELY: Yes, I know. The generic issues were identified -- some were identified in the generic letter that went out and in our NUREG 1407. They specifically identified these five issues that the licensees were supposed to address. The licensees' submittals, the NRC believed, would be adequate if they provided a good submittal to resolve other generic issues which were not called out. And these four issues are GSI-147, 148, 156, and 172.

The process for reviewing the submittals and evaluating them, the staff took the position that the licensees' IPE, if it was complete with regard to the unresolved safety issues and generic safety issues coverage, and the licensees assessment would demonstrate an in-depth knowledge of the external events aspects and the plant characteristics related to the issues discussed. The licensees' assessment results are reasonable given the design, location, features, and operating history of the plant, that this would verify that they had indeed done all they need to do with respect to these issues.

DR. POWERS: The definition of in-depth here, is it satisfied by a bounding and scoping analysis?

MR. RIDGELY: I think the answer is yes to that, because usually with a bounding analysis they're using higher numbers than they would be if they were trying to do a detailed or realistic analysis. And so the answer would probably wind up with, for example, like a higher CDF than they would otherwise get. And if using that bounding analysis and the higher CDF is still low enough, then it should be adequate.

DR. APOSTOLAKIS: What's the difference between a USI and a GSI?

MR. RIDGELY: Harold?

DR. APOSTOLAKIS: Oh, I thought it was a trivial question, but it's not. We need an expert.

MR. VANDERMOLEN: The difference, basically, is that all USIs are GSIs, but the reciprocal is not true. USIs are generic issues that are considered exceptionally important, which has never been defined in terms of anything specific. However, the existence of USIs is actually written into the legislation that created the agency. So that's why you will always find a USI program here.

DR. APOSTOLAKIS: I still don't know, Harold.

MR. VANDERMOLEN: Well, we have struggled with that question ourselves. If it is exceptionally important, we would --

DR. APOSTOLAKIS: It's a USI.

MR. VANDERMOLEN: Then it is a USI as well as GSI.

DR. APOSTOLAKIS: So USIs are much more important then.

MR. VANDERMOLEN: Yes.

DR. POWERS: Harold, just tell him what the USI stands for.

MR. VANDERMOLEN: Unresolved safety issue.

DR. POWERS: As opposed to a generic safety issue.

DR. APOSTOLAKIS: See, I don't understand that.

DR. POWERS: Well, it's like beauty -- you'll know it when you see it.

MR. RIDGELY: I may save a copy of the transcript as a reference of that. That's a pretty good definition.

DR. APOSTOLAKIS: The Agency's striving to resolve both USIs and GSIs.

MR. VANDERMOLEN: Yes.

DR. APOSTOLAKIS: And we are giving more importance to the USIs? In what way?

DR. POWERS: By giving them the USI label rather than the GSI label. That's what does it.

DR. APOSTOLAKIS: Mr. Duraiswamy, you wanted to say something?

MR. DURAISWAMY: They are safety related. For example, I can give a USI --

DR. APOSTOLAKIS: Both of them are safety related.

MR. DURAISWAMY: No, but they have more impact on the safety than the -- some GSIs might not have that impact like USIs.

MR. VANDERMOLEN: Yes. The definitions --

DR. APOSTOLAKIS: Right, but how does that affect our actions? I mean these are --

MR. VANDERMOLEN: Functionally, the difference is not as significant as it once was. These definitions pre-date the introduction of PRA techniques into the process. They were devised before we had measures -- they actually came about the time of WASH 1400. Now, when we use quantitative techniques to evaluate the importance of these issues in that quantitative sense, it's not as important to make this sort of distinction.

DR. POWERS: There's an item of history towards the -- the USI, as Harold said, is -- it's actually in the Atomic Energy Act. It says that the Agency will address those things, especially with its research program. The GSI list is actually an invention of the ACRS, and it used to be that the generic safety issues list was kept by this body. And the staff started keeping their own, and then the decision was made to meld the two, and the GSI Program went on from there.

DR. APOSTOLAKIS: Was there a director of some division at one time --

MR. VANDERMOLEN: Yes, there was.

DR. APOSTOLAKIS: And he resolved safety issues?

MR. VANDERMOLEN: There was once an entire division that worked on these.

DR. APOSTOLAKIS: You know, this Agency speaks about risk communication all the time and makes blunders like this. I still remember years ago David Dawkins was sending a letter here to somebody, and the secretary typed the envelope at UCLA to the Director of Unresolved Safety Issues, Nuclear Regulatory Commission, and the woman was panicked. She said, "What does it mean that you have unresolved safety issues in the nuclear business?" I mean can you imagine how a third person outside sees these things and this terminology, "unresolved safety issues from the Nuclear Regulatory Agency."

DR. POWERS: You need to write to your congressman, not to this staff.

DR. APOSTOLAKIS: Well, this is a good time to say these things.

MR. VANDERMOLEN: There's little we can do to change it.

DR. APOSTOLAKIS: I know, I know; it's not up to you. It's really ridiculous terminology.

MR. RIDGELY: Well, the importance of this --

DR. APOSTOLAKIS: Unresolved issues, though, they have to be safety issues.

MR. RIDGELY: Yes. Thank you. The importance of this slide really is just to show the list of the different that was looked at and how they relate to the generic issues and how a particular issues crosses into several different generic issues. And the ones I want to talk about today are the four that are highlighted there.

First one is the unresolved safety issue, A-45, shutdown decay heat removal requirements. The objective of this issue is to determine whether the decay heat removal function is adequate and whether cost-effective improvements could be identified. The components that were needed for this were identified in NUREG 1289, and the internal events aspects of this in the PRA was performed for the IPE, and that's documented in NUREG 1560. The IPEEE was considered with how the external events could adversely affect the decay heat removal capability.

In the seismic findings, we found that the seismic PRAs included this decay heat removal systems and components in their PRA. The seismic margin analysis included the systems and components as part of their safe shutdown equipment list. And for the equipment on this list, they developed a high confidence of low probability of failure values, and this was compared with what they were assigned by a plant in NUREG 1407. They did seismic walkdowns, and this walkdown information was used as part of this review.

Weaknesses were identified in different plants, such as weaknesses in RHR heat exchange or anchoring. And plant improvements were implemented to resolve these issues. No vulnerabilities were found.

DR. POWERS: That statement always -- and it shows up in a lot of view graphs -- always kind of interests me. We don't have a definition of what a vulnerability is --

MR. RIDGELY: Right.

DR. POWERS: -- except everybody can choose their own. The licensees find weaknesses, but they don't find vulnerabilities.

MR. RIDGELY: Right.

DR. APOSTOLAKIS: They also find anomalies.

DR. POWERS: So I mean what significance are you attributing to no vulnerabilities were found?

MR. RIDGELY: Well, I think the answer to that is that the licensees have not identified a component or system or what not that plays a large role that could adversely affect the plant's abilities, in this particular case, to remove decay heat.

DR. POWERS: What you're saying is though weaknesses were found, the system probably would have worked just fine.

MR. RIDGELY: Probably.

DR. POWERS: And that this is just a little extra assurance is what you're saying.

MR. RIDGELY: Because what we're looking at in the IPEEE is beyond the value basis.

DR. POWERS: For those institutions that found weaknesses, did you or somebody in the staff go back and rigorously go through the system and say, "Yes, they found them all"?

MR. RIDGELY: Well, what we did was the staff looked at and the Senior Review Board looked at it to see if there was anything that stuck out as something that they might have missed.

DR. POWERS: How about Project Manager?

MR. RIDGELY: The NRR Project Manager was also part of the review process as being usually in attendance during the Senior Review Boards.

DR. POWERS: So he may well have thought about it or at least looked at it.

MR. RIDGELY: And so at least in a number of the meetings that I went to contributed to the staff's understanding of the plant and how it worked.

DR. WALLIS: You know, in a risk-informed world, I would expect a weakness to be something with a CDF bigger than ten to the minus seven or something. And the vulnerability would be a CDF bigger than some number, ten to the minus six or something. There would be a measure of these things. They would be classified on the basis of risk significance or something, rather than by describing them.

DR. APOSTOLAKIS: It's implicit, Graham.

DR. WALLIS: Well, it's implicit, but it's not actually done?

DR. APOSTOLAKIS: It's a qualitative assessment of probabilities.

DR. WALLIS: Well, I don't know what that means.

DR. APOSTOLAKIS: That's what it is.

DR. WALLIS: Well, that's -- I mean -- let's not get into that one.

DR. POWERS: It's a qualitative quantification of a system, Graham. As we talked yesterday, they qualitatively quantified it.

DR. WALLIS: Qualitative means you can argue about it forever.

DR. APOSTOLAKIS: Yes. That's what it means.

MR. RIDGELY: I think with numbers you can argue about it forever too, but anyway.

DR. APOSTOLAKIS: But many of these programs were instituted ten years ago?

MR. RIDGELY: That's right.

DR. APOSTOLAKIS: When the world was not

risk-informed at the time. So now we are looking at the results of that -- quantitative risk.

DR. WALLIS: Well, is there any correlation between what one person thinks is a vulnerability and what somebody else thinks is a vulnerability? Is there some sort of an agreement about what's a vulnerability?

MR. RIDGELY: I think overall that there was a general agreement, more or less, that they didn't have a plant vulnerability by virtue of not finding anything that was deemed to be a significant contributor to a problem. But there are also those -- there was one plant at least that I can think of that if they found anything at all that was greater than ten to the minus six, they termed it a vulnerability. And even though their total core damage frequency was just some small number times ten to the minus six, they had applied it that way. Where other plants with higher core damage frequencies would have the same thing, and they would not identify them as vulnerabilities. So anything they found that went above their screening criteria, they determined it as a vulnerability, but that wasn't -- that was more like anomalies and weaknesses that every other plant had used. So there's not a uniform agreement.

DR. WALLIS: Well, I can see some management saying, "Go out and make a study. Find some weaknesses, and fix them so that we don't have any vulnerabilities."

MR. RIDGELY: With the findings in the fire area, the licensees performed the fire PRA which would include portions of the IPE models for decay heat removal. Licensees also looked at the fire areas by screening criteria qualitatively. They would leave an area out if the area neither initiated an event nor caused the loss of safe shutdown functions. Quantitatively, they would screen it if a contribution from a fire in that area was less than ten to the minus six.

And any areas that remained after that, they would look at on a case-by-case basis to ensure that at least one method of safe shutdown and decay heat removal was available. Frequently, this revolved around Appendix R systems and functions. Fire walkdowns were used, and the information was applied here. And, again, no vulnerabilities were found.

DR. POWERS: A great deal of significance seems to be attached to the use of walkdowns. What is the reliability, I guess is the word I'm looking for, of a walkdown in discovering things?

MR. RIDGELY: Well, the walkdowns were done usually by a team, and depending upon what the function of the walkdown was for, there would be at least one knowledgeable person on that subject.

DR. POWERS: Now, most of the people on this team walked past the places they're walking past every day, frequently.

MR. RIDGELY: Now you're asking about the makeup of the team that did it, and I'm not sure I can --

DR. POWERS: Well, in general, you would expect -- they're plant personnel is my point.

MR. RIDGELY: Some of them were plant personnel, some were contractors that they would hire, some would be consultants --

DR. POWERS: Okay.

MR. RIDGELY: -- that would be knowledgeable, like in fire if it was for a fire walkdown, this kind of thing.

DR. POWERS: So it's more diverse than I was thinking.

MR. RIDGELY: Yes. It's more than just plant personnel.

DR. POWERS: Oh, okay. And do we -- I mean has NRC ever tried to compile some sort of database and say, "Okay, if you -- when people do a walkdown, they will generally successfully find these kinds of things, and they will not find these kinds of things"?

MR. RIDGELY: I'm not aware of anything like that.

DR. POWERS: What is the significance of the walkdown?

MR. RIDGELY: Well, during the walkdowns, they have found a lot of things that they might not have found otherwise. For example, during walkdowns, they would find gas cylinders that were not properly secured. They would find trash or paper combustibles that they would not necessarily otherwise have known about being stored in a location. They would look at anchorages of equipment and find maybe there was a bolt missing or a bolt was loose or something. So the walkdowns, I believe, played an important role.

In the HFO area, particularly in flooding, for example, they would look and find that roof drains were plugged or there was a hole and the seal was missing, this kind of thing. So I think the walkdowns played an important part in reviewing for the IPEEE.

MR. ROSEN: Are these walkdowns typically conducted in accordance with written procedures?

MR. RUBIN: I don't think NRC procedures but I think plant had their own checklists. There was some guidance in other documents on the walkdowns.

MR. ROSEN: So there were checklists and guidance.

MR. RUBIN: Yes.

MR. ROSEN: Were the people trained, typically, to perform walkdowns in accordance with the checklists and guidance?

MR. RIDGELY: Well, some of the people, at least, on these teams would be experts in the areas that we're talking about -- experts in fire, experts in seismic and that kind of thing. And so while they may not be -- you know, from a plant standpoint, they may not have unique information about the plant, but they would know what -- should know what they're looking for when they're walking through the plant for the particular issue that they're looking.

MR. RUBIN: And, typically, there would be systems people also making the walkdowns.

MR. RIDGELY: In the HFO area, the safety-related equipment is protected from high winds, tornados, and tornado-generated missiles. The external flooding induced failure was prevented by watertight structures. If it wasn't, leakage would be limited to prevent damage or they reviewed the equipment operability for submerged operation. If none of this was satisfied, then they would provide an alternate means of achieving that function.

Other external events were found to be insignificant contributors to core damage frequency, and walkdown information was used, and no vulnerabilities were identified.

DR. POWERS: Can you explain to me a little more about lightening? When people do an assessment of lightening's contribution to the core damage frequency, I can believe that they probably know something about the number of lightening strikes per unit of time on the site. Now what do they do? I mean what's the next step in the assessment process?

MR. RIDGELY: Well, the one that I'm most familiar with, what they did was they looked at, as you say, the frequency of strikes, the number of strikes they would get in a unit area. And they were particularly concerned with the control room at this particular plant. And they --

DR. POWERS: When they get the frequency -- I mean you know how often you have storms and you get a lightening strike, and you know the area of the site. How do you know the lightening strikes on the part that's vulnerable? You just divide by the area?

MR. RIDGELY: No. They looked at the surrounding buildings in this case, because the buildings give you a cone of protection from a lightening standpoint.

DR. POWERS: So, effectively, they're looking at the potential function or something like that? Maybe qualitatively without calculating it.

MR. RIDGELY: Well, there is formulas and guidelines and standards for providing lightening protection for structures and what not. And they would use that information to review the plant. And they would look to see then, "Okay, then what's the probability of actually hitting it?" Then they looked at the structure of the control building, for example, and said, "Well, that's got lots of rebar in there," so the chances of lightening hitting the control structure and getting through the rebar and then doing damage to something important was not a significant contributor. So that's the way at least one plant had handled it.

MR. RUBIN: May I make just a general comment, add to what John is saying? Typically, issues like the other external events, such as lightening, plants screened them out as they met their standard review plant criteria. So, generally, there was not a detailed analysis of lightening, but they were screened on other basis that was acceptable for IPEEE purposes. And lightening is mostly the effect on losses of off-site power and station blackout events, sequences, so that's --

DR. POWERS: And, certainly, my approach would do -- say, if I complied with the standards --

MR. RUBIN: Yes.

DR. POWERS: -- then I've screened it out and forget about it.

MR. RUBIN: That was what was done for a large majority of the plants.

MR. RIDGELY: The inclusion for A-45 is that all plants had provided adequate information to verify they've done what they were supposed to do. All the plants have identified at least one method of removing decay heat, and no vulnerabilities were found.

MR. LEITCH: John, in your table, in the remarks column, it says, "EX" opposite this --

MR. RIDGELY: That means we were looking only the external event aspects of that generic issue.

MR. LEITCH: It's seismic, fire, and --

MR. RIDGELY: And HFO.

MR. LEITCH: -- HFO. But then this generic issue remains open for other issues?

MR. RIDGELY: Well, the internal event aspect was verified using the IPE Program.

MR. LEITCH: Right.

MR. RIDGELY: So I believe that this issue now would be adequately verified.

MR. LEITCH: Okay.

MR. RUBIN: There's another report on the internal events and the IPE Program. There's a separate report that's going to be issued, it's not out yet, on the IPE-related generic issues. There were much fewer number in the IPE Program than there were in the IPEEE Program.

MR. LEITCH: Okay.

MR. RUBIN: But there will be a report, and A-45 is part of the IPE report as well.

MR. RIDGELY: I have --

DR. APOSTOLAKIS: Let me understand this, because I know you have others, but -- so regarding the USI A-45, back to ten, you concluded all plants have provided adequate information. They identified at least one method of removing decay heat, no vulnerabilities. So is this then the resolution of this issue?

MR. RIDGELY: It is the verification of the issue.

DR. APOSTOLAKIS: Verification.

MR. RIDGELY: The issue was resolved by the imposition of what the staff decided to do, which was, for the external events, was to fold it into the IPEEE Program.

DR. APOSTOLAKIS: So at some point, the staff decided that this issue would be resolved within the IPEEE issue -- program?

MR. RIDGELY: Well, it would be verified through this Program.

DR. APOSTOLAKIS: Verified. Verified means that there was -- it was resolved already?

MR. RIDGELY: Technically, yes.

DR. APOSTOLAKIS: Let me put it a different way. After your slide 10 -- yes, let's go back to your 10. This particular issue does not exist anymore for the Agency since all these things are no, no, no? Is it closed now?

MR. RIDGELY: Harold is getting up to answer the question from a generic perspective.

DR. APOSTOLAKIS: Okay.

MR. VANDERMOLEN: The answer is, yes, it is closed. We are not --

DR. APOSTOLAKIS: It is closed because of this.

MR. VANDERMOLEN: Yes. The issue was -- terminology is always confusing when it comes to these generic issues. The action imposing new requirements on the plants, that's the resolution. And then that's what we do with generic issue. It results in generic regulatory action, not necessarily people going out to every plant. This is a verification effort. That's all it is.

DR. APOSTOLAKIS: And this applies to all of these? We lost the speaker.

MR. RIDGELY: Yes, it does, except for Generic Issue 172, which you will get a package on.

DR. APOSTOLAKIS: Okay. So all the issues, the USIs and GSIs, that you are talking about in the report, except this one that you mentioned, are closed after this study.

MR. VANDERMOLEN: Yes.

DR. APOSTOLAKIS: Okay. That makes it clear.

MR. VANDERMOLEN: Yes.

DR. APOSTOLAKIS: Okay.

MR. VANDERMOLEN: No more plants to spend more resources on.

DR. APOSTOLAKIS: Okay, okay, okay.

DR. WALLIS: I presume there's a feedback loop. If it's not verified, you go back to resolution or something? Or do you always verify?

MR. RIDGELY: I believe that there's always some amount of verification.

DR. WALLIS: But then if you're not satisfied with the verification, you've got to go back and do something, haven't you?

MR. RIDGELY: Yes. I believe that's true.

Now, my time has --

DR. APOSTOLAKIS: Yes. There is no time for --

MR. RIDGELY: Right.

DR. APOSTOLAKIS: I mean the others you draw similar conclusions.

MR. RIDGELY: Right. So if it's all right, then I'll skip the other three and go to conclusions.

DR. WALLIS: The only question I have on 11, which you put up and then took away, there have been instances where the fire suppression system has had water hammers which have led to flushes of water flowing out and damaging safety. It doesn't seem to be part of your list of things here.

MR. RIDGELY: Not for the IPEEE; no, it's not.

DR. WALLIS: But it has happened.

MR. RUBIN: That was an internal flooding issue.

DR. WALLIS: This is -- really, you're saying here damaging effects caused by the fire -- activation of the fire suppression system.

MR. RUBIN: Right.

DR. WALLIS: And one of the things that can happen is the fire suppression system itself has a water hammer.

MR. RIDGELY: And that would have been handled, I believe, through the IPE Program. Now, what we're looking at is the activation and effects from seismic. If you have a seismic event, will that start the fire protection system?

Because of the time, let me jump to the conclusions. But you do have the rest of the slides there. There were 31 IPEEE-related unresolved safety issues and generic safety issues. Nine were explicitly discussed in the generic letter, in the NUREG; 22 were not. We consider that this Program is a major achievement and is verification of a large majority of these issues. Forty-four licensees provide sufficient information to verify all 31 USI and GSIs. Twenty-five submittals had one or more generic issues or sub-issues open or partially verified. Saying that a little bit differently --

DR. WALLIS: You're really verifying the resolution, aren't you?

MR. RIDGELY: That's correct. From the submittals that we have, we have verified 100 percent of A-45 GSI-131, 156, and the other numbers here.

DR. APOSTOLAKIS: Now, you did not, though, verify the licensees' verification.

MR. RIDGELY: We reviewed the documentation that they provided.

DR. APOSTOLAKIS: But you didn't send people to the plant.

MR. RIDGELY: Not for this, no. Now, there were four site visits, but that was not for the purpose of verifying that they had done what they said here in this.

DR. APOSTOLAKIS: Are the resident inspectors involved in any of this? I mean would you let the resident inspector at the plant know that this particular problem, GSI-172, claims that they have verified resolution GSI-172 so that the inspector will do something and, say, send a message back, "Yes, that's correct."

MR. RUBIN: Let me try to answer that. We sent the draft report to all the resident inspectors for their information. We're not awaiting nor did we ask for them to go back and walkdown or verify, from their perspective, each of these issues.

DR. APOSTOLAKIS: Are they expected to verify this?

MR. RUBIN: No.

DR. APOSTOLAKIS: Is it up to them?

MR. RUBIN: Verification in this sense, when I talked about what was in the IPEEE review process, the staff and I review, and we send our process with the Senior Review Board. We did not validate quantitative results. We looked at the reasonableness and completeness. So in that same vein, we looked at the reasonableness and completeness as a licensees' process to address these issues, to look for weaknesses and vulnerabilities in our IPEEE review.

DR. APOSTOLAKIS: Well, that's the IPEEE's --

MR. RUBIN: Yes.

DR. APOSTOLAKIS: -- function.

MR. RUBIN: Yes.

DR. APOSTOLAKIS: But then, you know, the inspector may have other things to do. In declaring a GSI as resolved, it's not your job, but maybe the inspector can use your report now to actually say, "Yes, it is resolved." But I guess that's not the case.

MR. RUBIN: It's not the intent, but they certainly have the information in the report and can --

DR. APOSTOLAKIS: If they want to pursue it.

MR. RUBIN: Yes.

DR. APOSTOLAKIS: That's a really interesting way of closing GSIs.

MR. MARKLEY: This is Mike Markley. Normally the Inspection Program Office creates a temporary instruction, or through the regional offices they do, and they go out and do a customized inspection for that site based on the issues that are identified in the GSI translated to the temporary instruction. And they close it out within the inspection process for that site. This is doing it on an across the industry basis, not an individual site. So each site had to go through that under the Inspection Program, and it's documented in the inspection reports what the findings and follow-up issues or things that may have still existed along those lines.

DR. APOSTOLAKIS: So each inspector then or each region would -- well, has already received your report. They will follow up. They will --

MR. MARKLEY: That's right.

DR. APOSTOLAKIS: -- create those temporary instructions.

MR. MARKLEY: Correct.

DR. APOSTOLAKIS: And there will be verifications.

MR. MARKLEY: That's right.

DR. APOSTOLAKIS: Okay, okay. Well, that makes --

MR. RUBIN: At least I'm not aware of that, Mike, maybe, but it's worth checking on.

MR. MARKLEY: Well, I had to do them, so --

MR. DURAISWAMY: So did I. So we have done that.

MR. RUBIN: Okay. All right.

DR. APOSTOLAKIS: Two to one, Alan. No, they may not come back to you at all, and that's fine.

MR. RUBIN: Yes, okay.

DR. APOSTOLAKIS: Because you have provided information to them. But it's the region's responsibility, actually. And that makes much more sense, that you have an unresolved safety issue, and there is a final word that somebody inspected and said, "Yes, it's resolved." And that makes much more sense.

MR. MARKLEY: For that site.

DR. APOSTOLAKIS: For that site, yes. That's good.

MR. RIDGELY: And so the conclusions --

DR. APOSTOLAKIS: I'm glad I'm not the only one who doesn't seem to understand very well how the Agency works.

MR. RIDGELY: The conclusions of this is that we find that we don't believe that a potential vulnerability was missed. Any GSI that wasn't verified was identified as a weakness in the plant's specific staff evaluation report. And any need for plant-specific actions would be taken up outside of the IPE Program. And the final slide shows it for all of them. This shows, I believe, that we've had great success in verifying the unresolved and generic safety issues.

DR. APOSTOLAKIS: So we're going to hear

about the unverified ones sometime in the future?

MR. RIDGELY: No, this is it, as I understand it. But you will, as I understand, get a package on GSI-172.

DR. APOSTOLAKIS: But if they are unverified, what happens?

MR. RUBIN: Well, that's what I mentioned earlier. We're going to take a look for those plants to see if there is some additional action that is needed.

DR. APOSTOLAKIS: Okay.

MR. RUBIN: That is not being falled through the cracks. We'll go to the ACRS. No plan right now except for the MSRP issue 172.

DR. APOSTOLAKIS: Is this it?

MR. RIDGELY: That's it.

DR. APOSTOLAKIS: Any comments or questions from the members? We are five minutes behind. I don't want to make it six. Otherwise do the members have questions? Anybody else. Thank you very much. Appreciate you coming here.

We are now scheduled for a break until five minutes after ten.

(Whereupon, the foregoing matter went off the record at 9:51 a.m. and went back on the record at 10:05 a.m.)

DR. APOSTOLAKIS: Okay. We're back in session. The next item is "Proposed Resolution of Genetic Safety Issue 191: Assessment of Debris Accumulation on PWR Sump Pump Performance." Calling on the member is Mr. Leitch.

MR. LEITCH: Okay. As has been stated, this issue concerns the assessment of debris on PWR sump performance. What we're going to hear today is a summary briefing of a contractor's report. And I understand that in September there will be a final additional presentation, after which time we will be expected to write a letter on this topic, but no letter is expected as a result of today's presentation.

Mike Mayfield is here to have some opening remarks and introduce the presenters. Mr. Mayfield?

MR. MAYFIELD: Thank you. I'm Mike Mayfield from the Division of Engineering Technology and Research. We are here to present a summary presentation of the results of some work done to look at the evaluation or the technical basis for resolving generic safety issue 191. It is more a summary briefing and a status of where we are, rather than a detailed discussion of the proposed resolution. We do expect to come back in September with that proposed resolution.

We are going to meet with the public and the industry on July 26 and 27 to discuss this report and see if there's any additional information that we can glean that might influence the proposed resolution. Depending on the outcome of that meeting, we'll be in dialogue with NRR on the proposed resolution and bring that back to you in September.

Mike Marshall from the Engineering Research Applications Branch has the Project Manager for this piece of work, and he's going to provide you the technical briefing. Mike?

MR. MARSHALL: Thank you. Good morning. In the package, my slide package, there's no background slide per se, so I'd like to cover a little bit of background. I believe a number of the members are already familiar with this issue and the work that was done under unresolved safety issue A-43 and the work we recently completed in the 1990s with the regards to the BWR strainers.

Originally, this was addressed back in 1985 under A-43. It was resolved. No new rules or requirements were imposed on industry. Additional guidance was provided that came out of that effort.

In 1992, there was an event at a BWR in Sweden called Barseback, and it raised a lot of questions about the work that was done under A-43, enough questions that the NRC actually started looking at the BWRs. And the conclusion from our look at the BWR is that additional action was required, and they put in larger strainers.

But based on that work, we were curious and decided to also go look at the PWRs. There was enough difference between the Ps and Bs that we didn't think what we did with the Bs was directly applicable to the PWRs. And a couple years later, we started working on PWRs and that's some of the work I'll be talking about today.

And just to let you know, what we're going to be covering in about an hour today we have two days set aside at a public meeting at the end of this month to go through it in greater depth. And if there's anything I cover today that you would like us to cover in more detail in September, just please let us know and we'll do that.

DR. UHRIG: Could you just quickly in a few couple of sentences summarize the difference between the work that was done on the BWRs and why it was not applicable?

MR. MARSHALL: Mainly we looked at the

BWRs, and it boiled down to the transported debris. Once you had it generated from a bray. With the BWRs, from the dry well to the wet well, all the gases and a lot of debris would just be forced right away down into the wet well, and then the wet well, with chugging and condensation oscillations, it kept it well-mixed, and you got -- and the BWRs started recirculation immediately through the strainers. And so you got transport much more quickly in the BWR. There was enough energy keeping things mixed up that you didn't have time for things to settle, so you got the accumulation there.

. With the PWRs, you had the water refueling storage tanks so you have about 20 to 30 minutes before you actually switch over to recirculation. And also once you switch to recirculation, it's not nearly as energetic as the conditions for the BWRs. So our biggest question mark when we started this, and our main focus when we started this work, was looking at transport of material, because that's the biggest distinction between the BWRs and the PWRs.

DR. UHRIG: Thank you.

MR. MARSHALL: My second slide is just a statement of the study, and we're interested in once debris is generated it transports to the floor of the containment and thus to the strainer and accumulates on a sump screen. Will it cause a problem? And the problem we're looking at is creating a resistance to flow it across the strainer -- the sump screen, and would that resistance be great enough to take away the net positive suction margin to the ECCS pumps, drawing suction from there?

And another focus was, again, because a lot of this work goes back to A-43. Once we look at this time, is there something that wasn't done in A-43 that we need to look at this time around?

DR. APOSTOLAKIS: Would you change the slide then since you're talking about the --

MR. MARSHALL: Oh. Thank you, sir.

DR. APOSTOLAKIS: And explain the figure there a little bit.

MR. MARSHALL: The figure is just a sump.

DR. APOSTOLAKIS: I see we need the --

MR. MARSHALL: This is an ideal --

DR. APOSTOLAKIS: Wait, wait, wait, wait. You need the microphone.

MR. MARSHALL: Oh. Excuse me, gentlemen. Okay. And I won't touch the screen. I'll point but not touch.

(Laughter.)

DR. APOSTOLAKIS: Now you can touch.

MR. MARSHALL: Okay. This is an idealization of a sump. Actually, from the work we did, we did a survey early on. There's no -- we haven't quite found two sumps quite alike.

DR. POWERS: I've been there. Been there, done that.

(Laughter.)

MR. MARSHALL: But on the sump -- well, I'll start from outside working my way in -- there's usually something called a debris curve, and that's just a curve about, at most, 12 inches but typically closer to about four inches. And that's to stop larger debris that just travels along the floor. And as you approach the sump, you have a trash rack, which is usually a course mesh about the size of floor grading. And that's to catch your larger debris. And then you have a finer screen after that, which we call the sump screen, and this is typically a quarter or one-eighth-inch openings in it.

Then on the other side of that, you have the suctions for the ECCS pumps. And sometimes the plate on the solid is either a course screen, like a floor grading, or a solid plate. And this just represents typically after you have -- after the access and by the time you switch to recirc, this structure is usually submerged under water, but that's not always the case, as we learned during this study.

I'll just give you a quick overview of how we approach the study. We started by trying to identify debris sources. What are the likely equipment and the containment to be damaged following an accident or during an accident and would that lead to material that's transportable that would actually reach the sump screen? Once we identified that material, looked at how much of it we would get generated --

DR. POWERS: When you look at something, though, as a candidate debris source, did you look at that in terms of gas velocity over only or were other things taken into account in deciding whether something could be a debris source?

MR. MARSHALL: What was taken into account, essentially, was the characteristics of the debris once we thought it would be created. For instance, with thermal insulation, that would be broken up into different sizes, and would it be broken up into sizes that the gases would transport? Would it be broken up into sizes that the flow we would expect on the containment floor would transport? And that became a legitimate debris source, and that's when we went through further investigation.

DR. POWERS: Well, I guess what I'm fishing for is that during the blowdown process you may have high gas velocities assuredly, but you also have a lot of vibration and things like that that equipment vibration and what not figure in defining something as a debris source?

MR. MARSHALL: No, it did not.

DR. POWERS: Okay. So it's strictly a velocity kind of --

MR. MARSHALL: Right. Just from the jet.

DR. POWERS: Okay.

MR. MARSHALL: Just from the jet.

DR. WALLIS: Is there a kind of conservative assumption, you assume that if something might break loose, then the whole thing breaks loose?

MR. MARSHALL: No, we don't do that at all. That gets to the second block of estimating amount of debris, because once we identify the source, we had some testing and testing that was done by the BW Owners' Group over in Sweden and Germany, and we'd see how much of that material would be damaged into a form again that would lend itself to transport.

DR. WALLIS: So they assimilated a LOCA

and then --

MR. MARSHALL: We simulated a jet. Since we have a ruptured disk at the end of a nozzle -- at the end of a piece of pipe and blast a piece of material at different distances and see how much debris is generated from that.

Then after we got a good feel for how much debris would be generated, we looked at how well it would transport once it got into a pool of water.

DR. POWERS: This is the point that, in your draft, I guess it's a letter report, didn't seem to go into the, at least I didn't see, a discussion of how you did that transport calculation.

MR. MARSHALL: I will touch on that later.

DR. POWERS: Okay. Drag coefficients and things like that?

MR. MARSHALL: No. Actually, I'll go into that later, but, no. Short answer to your question is no right now.

DR. WALLIS: Is the paint part of your debris, paint flakes?

MR. MARSHALL: We considered paint flakes as a debris source. And we broke paint into different --

DR. WALLIS: Is the containment painted,

the containment?

MR. MARSHALL: Yes, it is. It has a coating on it. And the floor has a coating on it.

DR. WALLIS: Does that containment coating remain in tact during a LOCA?

MR. MARSHALL: Answer to that, from the direct impingement, we think it will come off. And then we looked at it from the environment and the containment, whether it would come off. There's a separate program looking at that explicitly. And there are certain conditions. You actually have to have a rather --

DR. WALLIS: It's being looked at, but there's a lot of area that comes off. There's a lot of stuff there that comes off.

MR. MARSHALL: Yes. That would be a very large volume. That's one reason we had actually a separate study to look at coatings.

DR. SHACK: But in this report it's only in the zone of influence kind of model.

MR. MARSHALL: It's only in the zone of influence that we're looking at it in here.

Okay. And once we got to the accumulation on the screen, we looked at the head loss, and we used the correlation that we developed during the BWR work for that calculation.

DR. WALLIS: It's a tautology. I mean you can -- it's all where this stuff comes off, and so you look at the zone of influence to figure where the stuff comes off.

DR. POWERS: I guess I don't understand. Why don't you look beyond the zone of influence?

DR. WALLIS: But by defining the zone of influence, you can restrict it to almost anything you like, unless you have some really good criteria for determining --

DR. POWERS: Experiments.

DR. SHACK: And then assumed it was a sphere.

DR. WALLIS: Gee whiz, spherical debris?

MR. LEITCH: Those marks on the cartoon there on the left, are they -- is that just the depiction of debris or do those particular locations indicate --

MR. MARSHALL: It's a cartoon just to who a depiction of debris. That's the break, and we expect it to go in all directions, unlike the BWRs. It's not all being driven straight down to the floor. As been estimating that material, when it gets to the floor, where does it end up in the sump? In the red box, there's the depiction of where the sump would be.

DR. POWERS: I'm still a little confused about the drag coefficient business and the transport calculation. I mean how do you do that?

MR. MARSHALL: Well, I'll address it -- I'll talk about that now. In this report here, in our parametric analysis, we didn't directly look at transport -- address transport directly. It's rather difficult. And another is it would be difficult to do parametrically in this structure here transport overall because of the variability of the containment designs. It actually makes a big -- the BWRs from this point we could all treat them similar. The PWRs, again, we can't treat them similar. It's almost like a custom calculation each time.

DR. WALLIS: Doesn't it go up in that hot plume? Doesn't it go up in a hot plume into the containment, because the buoyancy of the plume lifts up the debris?

MR. MARSHALL: Some debris will go up, and then when spray comes on there's a chance that it will also be washed back down.

DR. WALLIS: So you need a model. If you're going to do it, you need a very fancy model for containment flows.

MR. MARSHALL: Well, let me finish addressing Dr. Powers' question. So what we did here, since we didn't directly address transport -- and, actually, if you don't mind, I'll probably jump ahead to a slide. We're jumping to slide 7. And I'll remember to come back and cover some of this other material. And, actually, on slide 7, I might end up covering some of the other material, but we'll go back and make sure I didn't miss anything.

So the approach we took in this evaluation was -- the first step we took was identifying the debris. The second step was identifying -- well, the first step was identifying the case we're dealing with, then identifying the debris. And the first step we did was to calculate this curve here. And what this curve represents is for a given sump size, given surface area for the sump screen, given whole size net positive suction head margin and the flow rate you have for whether it's a small LOCA, medium LOCA, large LOCA, what's the capacity of that sump to accumulate debris without causing degradation and net positive suction head margin. And you could do that calculation without knowing transport. So it just tells us what the capacity of the sump is. And usually you get a feel for how much debris that will cause you.

Then the next thing we did is we calculated a box here. And one part embedded in that box, again, is the type of debris, essentially the characteristics of the debris, and how well it transports. That's what this box represents, and also how much do you think will get to the sump screen. And what we did here was looking at the work we've done and the work that others have done is we looked at transport from the zone of influence, and we said from the zone of influence to the sump screen, from all the work that we reviewed, it looks like at the very least you'll get about ten percent of the material. And at most you would get is about 25 percent of the material.

So this edge of the box represents ten percent of the material from the zone of influence getting to the sump screen and 25 percent of the material from the zone of influence getting to the sump screen. And we could do this for all 69 cases relatively easily. It simplified the problem for us.

DR. APOSTOLAKIS: Why aren't there any numbers on the axis?

MR. MARSHALL: I was going to use this just to explain what we did. If you turn to Appendix

B in the report we have, all those have the numbers on them. And this is K-17 out of that report. But I just wanted the opportunity to make sure --

DR. APOSTOLAKIS: Why does the curve go like that? Is there something I don't understand?

MR. MARSHALL: This point here represents -- we have two materials here: fiber material and particulate debris. In particulate debris we're talking about something like the grains of sand when we talk about particulates. And this point here represents if you only had the fiberglass, this is the amount of material that the capacity of the sump screen.

This point here represents the least amount of fiber you need and the particulates you need to exceed the net positive suction margin. And, essentially, the line just goes straight, because there's a finite amount of material and it doesn't get any worse if we add more particulate to it at that point. It doesn't go to infinity, because, again, there's a finite amount of material. Somebody asked me that question earlier.

DR. POWERS: What George may not recall is that one of the findings in your BWR study was the synergism between fibers and particulate.

MR. MARSHALL: Right.

DR. POWERS: That's what causes the --

MR. MARSHALL: And on this study, again, one reason we tend to -- in the report we present the results with fiber versus particulate is that combination from the work we continue to do tends to be the most problematic combination of debris sources.

DR. WALLIS: But it matters probably which comes first. If the fiber comes first, then it makes a mat into which the particulates can stick.

MR. MARSHALL: Right.

DR. WALLIS: If the particulates come first, then the mat isn't there.

MR. MARSHALL: Right. Some of the particulates will just go through. So if you just had particulates, you have nothing to build a fiber bed, you have no filtration that will occur. And so particulates by themselves will go through the openings. Now the only exception to that is one insulation type, which is called calcium silicate. And the reason is it's mostly particulate, but it has a fiber binding, so it comes with its own fiber and particulates packaged together. And that's used quite a bit in the PWR population.

DR. WALLIS: It looks like your debris is way more than you need to clog the screen. Is that --

MR. MARSHALL: Yes. That's what this shows.

DR. WALLIS: What does very likely mean?

MR. MARSHALL: Actually, let me go start my presentation --

DR. WALLIS: Sure.

MR. MARSHALL: -- back over again, and we'll get to that.

(Laughter.)

DR. APOSTOLAKIS: You're coming to 11.

MR. MARSHALL: Let's go back to the slides.

DR. APOSTOLAKIS: Don't start over too many times.

MR. MARSHALL: Oh, no. I'm going to go back to slide 4.

DR. POWERS: He's just managing his reviewers, that's all. And doing a good job of it.

(Laughter.)

MR. MARSHALL: Go back to four. I just want to make -- we use the shorthand of something we call sump failure. When we say sump failure, we don't mean the sump collapses or it breaks. Essentially what we mean is the resistance across the screen exceeds the net positive suction head margin. And for a few cases, for a few plants -- well, cases, the screen's not going to be fully submerged, and so you're just looking at the height of water needed to overcome that resistance. And that's the criteria we used for saying the sump failed.

Just to go on a little bit more about how we went about doing the study, we started out with individual plants, and we had a survey, and we collected information on their sump screens, what's the size, what's the area, what flow rates you might have, what's the net positive suction head we got from responses to generic letters to the NRC? And so we had a good feel for the variety of the -- the range of variables in industry. And instead of starting with a base case then varying a particular variable, what we did is we created cases based on each individual unit. And we did that for, again, the large LOCA, medium LOCA, and a small LOCA.

And we wanted to get a feel for generically if this is something that's -- I guess the way we looked at it originally, is this a credible concern for PWRs?

DR. APOSTOLAKIS: Now, in the first line, you mean the formal analysis that will demonstrate generically whether debris accumulation will --

MR. MARSHALL: Yes, yes, whether.

DR. SHACK: I noticed you had a typo. I was really impressed --

MR. MARSHALL: Oh, where is it?

DR. SHACK: -- by a draft report that said you did 1,350 break locations for each three-foot pipe segment.

(Laughter.)

MR. MARSHALL: Oh, not for each three, no. That was the total after going three feet each.

DR. SHACK: But now I find that was -- the amount of work you did just went down by orders of magnitude.

(Laughter.)

MR. MARSHALL: Yes, it did.

DR. SHACK: In your large break LOCA, I noticed you had this very wide range in distribution. Is that because you did pipe sizes from six inches -- you did break sizes all the way from six inches on up to the largest pipe?

MR. MARSHALL: Yes. What we built -- we have two reference plants, which gave us more information than we collected from the survey. And we started out building AutoCAD model evolver piping in the containment. And then we put that into a MATLAB model. And, essentially, what we do is tell MATLAB to go every three feet, then calculate for that zone of influence what material is in that volume.

So if you have a large pipe with very few targets around it, the only material you'll get is on that pipe. But if you have a large pipe with a lot of -- when I say targets, other piping, other pieces of equipment -- so if you have a large pipe that's surrounded by a lot of piping, that's when you get the larger volumes of material.

DR. WALLIS: If you have a large pipe which is covered with boron stalactites, do the stalactites become the debris?

MR. MARSHALL: We didn't look at boron stalactites.

DR. POWERS: But the boric acid is water soluble.

DR. WALLIS: Instantly?

DR. POWERS: Oh, very quickly.

MR. ROSEN: Especially in hot water.

DR. POWERS: Especially in high water.

MR. MARSHALL: I believe I touched the other points on that slide already. But, no, we didn't look at boron.

DR. WALLIS: So there's no precipitate from chemical reactions that becomes part of the debris?

MR. MARSHALL: We considered that, actually. But one thing we could show from the work we've done here is if you just -- again, we're looking at mainly the thermal insulation, and then we took what's called other particulate sources, and we used the minimums that the BWR Owners' Group recommended. But just looking at the thermal insulation and not considering some of the other debris sources, we still get a large number of what we call very likely for sump failure cases. And so once we got said -- and, again, we're looking is this something credible to pursue later? If we get it without counting all the debris sources, we think that makes our case.

DR. POWERS: If you harken back to TMI and the sumps there, the sump's kind of interesting in that it's kind of cold water at the top, but as you go deeper and deeper, it becomes progressively murkier until in the lower foot of it, it's a sludge and it's fibrous kinds of materials and things like that.

There is a precipitate for the boric acid. It does react with calcium to form a gelatinous precipitate. I don't think it changes your study.

MR. MARSHALL: Yes. Instead of calling it gelatinous, we started using the word "flocculent," which I'm still not.

DR. POWERS: Yes.

MR. MARSHALL: But we did look at those other debris sources. And, again, I think I already the covered the cases when I went to the other slide, but let's see if there's anything I missed. One thing, again, each case was based on an individual PWR unit. Most of the information was from the survey. One important part is our two reference plants, those were both four-loop Westinghouse units. And so even if we were dealing with a two-loop unit or a C unit or a Babcock & Wilcox unit, that's the model -- that's the information we used to estimate debris. That's what we call a limitation in the study later on.

DR. POWERS: We harp a lot on that in the draft report. How big of an issue do you think it is?

MR. MARSHALL: Actually -- and, DV, correct me if I'm wrong -- but started doing -- we treated both reference plants like we did all the other plant -- cases, sorry, cases in here. And we started going to look at the individual reference plant from where we know where the material is instead of the way we assumed the material would be distributed here.

And we found one interesting thing when we went to the small LOCA for one of the reference plants. And that is here, in this calculation, we have fiber content in our small LOCA volumes. When we look at that plant by itself, we don't get the fiberglass in the small LOCA. So, actually, knowing the location of the debris -- it's not debris at that point -- of your debris sources is very important.

And because we're limited to our two reference plants here, and that's one reason we started calling them 69 cases instead of 69 units, because that can make a big difference. We're unable to address generically how the location of the material will affect it, but we are able to see from the sump design, if you look at the sump, we varied all those conditions and got a good feel for how this would work with that.

And another point is -- if you look at the next slide, another important thing we've learned from here, and we call it one of the insights on the last slide, is by looking at the results this way, we're able to identify what's the minimum amount of material that's necessary to cause sump failure? And if you go through the report, you'll see some of these values are down to a couple cubic feet. We're not talking very large volumes of material necessary for some of the cases, for some of them to reach the point of what we would call sump failure.

Now, to explain the likely, possible, and very likely. Essentially, it's quite -- it boils down to if you're on the right of this curve, we labeled the results "very likely."

DR. APOSTOLAKIS: Which curve?

MR. MARSHALL: This curve here; sorry, sir. This curve here.

DR. APOSTOLAKIS: That means very likely clogging will result?

MR. MARSHALL: Some failure. Very likely you'll have some failure.

DR. APOSTOLAKIS: It doesn't mean a likely event. It means likely clogging.

MR. MARSHALL: No. Likely -- yes. Unlikely, if the box was completely on this side, and we have a number of those cases, we said, "You're unlikely to have sump failure." Then we looked at the cases that straddle the line, where you would have the favorable conditions on one side and the unfavorable conditions on the other side. And we took a harder look at each of those. And if the case had a large

RMI -- RMI is fiberglass and particulates, the most problematic. If you're looking at the least problematic, you're talking about your metallic insulations.

And so if the survey information said there was 75 percent or 90 percent reflected metallic insulation and let's say fiber was only five percent, we would label that possible, because the material would dictate that it's less likely to occur. But if it turned out that that was 100 percent fiberglass for that case, we would have called it likely, because, again, there's a chance that enough material would get there. You're closer probably to the unfavorable conditions than you are to the favorable conditions.

DR. WALLIS: Now that box of range of expected debris is ten percent to 20 percent of all the debris that's generated in the zone of influence?

MR. MARSHALL: Ten to 25 percent.

DR. WALLIS: All right. So there's a point there which is all the debris somewhere off the top there, which would be where all the debris is simply ten times the ten percent.

MR. MARSHALL: Yes. We didn't think all the debris would go, but --

DR. WALLIS: But there is a point there.

MR. MARSHALL: Yes. What I gather from this is that the particulates are the problem, that you have to reduce the particulates by a factor of about 100 in order to get down into the unlikely region. You have to slide that box down by a factor of 100.

MR. MARSHALL: Well, even if you only had fiberglass, you'll be along this line.

DR. WALLIS: That's right. But I mean the particulate's the biggest one.

MR. MARSHALL: Yes, exactly.

DR. WALLIS: You pull it all the way down.

DR. APOSTOLAKIS: So one-thousandths of the particulate is enough to give you a major problem.

MR. MARSHALL: It boils down to a filtration problem, and so once you have the filter there and you start filling up the pores, and that's what the particulate does, it starts filling up the pores.

DR. WALLIS: So maybe you need an active screen shoveling device that keeps it clean or something.

MR. MARSHALL: Well, that's been considered. The BWR had decided that wasn't the best approach. What they wanted was --

DR. WALLIS: Rotating screens or something.

MR. MARSHALL: -- rotating screens. Actually, it was a problem actually getting them to work right, so that idea was abandoned.

DR. KRESS: Would you repeat again? I'm afraid I wasn't listening closely on where the ten percent and the 25 percent came from. Those were estimates of what would get transported?

MR. MARSHALL: Yes, from the zone of influence.

DR. KRESS: Yes. And how did you make those numbers? Those come out of what kind of an analysis?

MR. MARSHALL: It comes out of, essentially, a review of the work that's been done and calculations factored into that.

DR. KRESS: This had stuff in it like the flow rate and how the particulates would move with the flow and how far they had to go and stuff like that.

MR. MARSHALL: Well, the part to work with the transport and water, that's true for that.

DR. KRESS: Oh, okay.

MR. MARSHALL: Because that was -- we have that information, and we had not only other programs, in this program we spent a lot of work.

DR. KRESS: But there was a lot of judgment involved in this particular --

MR. MARSHALL: But from the transport and the volume itself, there's a lot more judgment in there and looking at some testing that was done over in Sweden to sort of get a better feel for that.

DR. KRESS: Okay. Thank you.

MR. LEITCH: Looking at the drawings here, the charts related to the various plants --

MR. MARSHALL: What page?

MR. LEITCH: For example, page 132 of the report. It doesn't seem to have any boxes on it. Versus page 133, I can clearly see the boxes you're talking about.

MR. MARSHALL: Oh, my. The short answer to that is it's probably hidden under the label, and they didn't move the label.

MR. LEITCH: Okay.

MR. MARSHALL: Sorry about that. That's a problem. We missed that.

MR. LEITCH: Okay. Thanks.

MR. MARSHALL: Okay.

DR. WALLIS: Sorry, your code with the likely and unlikely and the one you just showed us, when people designed this sump, they presumably did some sort of similar calculation. I guess that Westinghouse or someone would have a box which is in a very different location from your box, otherwise they would never would have designed it the way they did.

MR. MARSHALL: We don't think they did. The guidance that the NRC originally had for the sumps was essentially make it twice as big as you think you actually need it. What the assumption was in the original reg guide, rev 0 of the reg guide, was if you had 50 percent of the sump blocked, would it cause a problem? Would you lose net positive suction head margin?

So, essentially, all you would have to do is take your sump, cut out a piece of plyboard, paste it up there, cover 50 percent, and see if you would still have adequate flow and you wouldn't have high resistance, excessive resistance. And some result was that was just make it twice as big as we think we actually need it to be. I don't think explicitly the debris was taken into account. I'm pretty sure it wasn't taken into account from our reviews.

The tally of all the cases is on slide 8 here. And, again, for the small LOCA, medium LOCA, and the large LOCA, and the report defines how we defined those and how we thought the progress of the event, the accident would occur. With the large LOCA, because of the volume of debris you generate, 57 cases came out being very likely. The cases down here with the large LOCA that are unlikely, most of those cases had large RMI content. And that is actually another difference nobody -- between back in A-43 and now is there's a lot more RMI use back in A-43, and that would form part of the rationale for how they resolved that issue the way they did.

DR. POWERS: It seems to me we had a gentleman before us that had looked at some high pressure flows on the reflective metal insulation and saw some fragmentation of that.

MR. MARSHALL: Yes.

DR. POWERS: And I never heard what the resolution on that issue was. RMI breaks up and goes to the sump? It doesn't do anything?

MR. MARSHALL: Oh. With RMI, especially in the cases with the PWRs, is it doesn't transport as well. And it depends on the -- there's two different types of RMI, major types of RMI.

DR. WALLIS: What is the design?

MR. MARSHALL: Oh, sorry, reflective

metallic insulation. It's a thermal insulation made completely out of aluminum or stainless steel. And there's one type that has a bunch of small components inside of it, so that lends itself to a lot of fragmentation. A lot of others is just sheets, and when you rip the sheets off and they get into a pool of water, they don't travel so well.

And once you -- another thing we use in our -- from looking at transport and what gets to the screen, is things that tumble or a sliding transport or tumbling transport that's along the floor. The curbs are pretty effective in removing that type of debris from concern. So if you have a debris source that tends to travel on the floor and not suspended in a liquid, the curbs are very good to have. So you eliminate a lot of the heavier RMI types of debris that way. So that's another reason why it's less problematic for the PWRs.

DR. WALLIS: But if you do get a sheet of that stuff, it's pretty dramatic, isn't it? It goes up, it could flatten against the screen.

MR. MARSHALL: If it gets that far, but chances are it wouldn't get that far. Okay.

The only major point we wanted to make here, and Dr. Powers mentioned we sort of make the point quite often in the report, is we think this work gives us a good feel for whether this is a credible concern for PWRs by looking at it with all the variables we varied and all the different cases we produced. But because of the limitation and one of the biggest ones is where is the debris, we can't go and look at each case and say, "This case, we know, was built on this unit. And since it's very likely, it's going to be very likely there." We only have two units that we have that much detail on where we know where the location of the materials is. But based on that limitation overall, this, we think, the work says this is a credible concern.

DR. UHRIG: Where do you draw the line there?

MR. MARSHALL: Of?

DR. UHRIG: Very likely or likely?

MR. MARSHALL: What do you mean by "draw the line"?

DR. UHRIG: Well, you've got four categories there, and at some point, let's just take for a large LOCA there, if you draw the line between possible and likely, you've got 61 of the 69 plants that you have a potential problem with. Do you draw it between likely and very likely?

DR. WALLIS: And does it matter?

MR. MARSHALL: Actually --

MR. MAYFIELD: This is Mike Mayfield. I can -- in response to your question, we have tried to not draw that line yet. We're looking at this. My personal view is that, by and large, once you start migrating into the likely category, you start wanting to ask more questions, and that's, by and large, where we are as we've moved into an area that we, as Mike characterized it, is enough that we think it's a credible concern. And there are enough plants in -- or enough cases in those two categories for all three LOCA sizes that motivates us to continue to be interested in the issue.

DR. UHRIG: The largest group are within the large LOCA, which is less probable than the others.

MR. MAYFIELD: Yes. And we have some ongoing work now looking at risk significance, same kind of problem with that analysis that Mike and his colleagues have faced here. You need a lot of plant-specific information to try and put risk numbers to it, but we're seeking some insights as to what this might or might not mean and the likelihood of the various break sizes gets to be a factor.

DR. WALLIS: What sort of risk significance do you come up with to do that?

MR. MARSHALL: We haven't finished that work yet.

DR. WALLIS: But you must have done something. I mean you can look at some sort of typical to make an estimate of --

MR. MAYFIELD: That work -- our PRA folks are continuing that work literally as we speak, and I just don't have an answer for you today.

DR. WALLIS: What does this do? This makes high pressure injection not function after a certain time or something?

MR. MAYFIELD: Yes.

DR. WALLIS: Oh. So you have to go and look at the whole --

MR. MAYFIELD: In recirculation.

DR. WALLIS: You have to deal with all the calculations to estimate the effect of that.

MR. MAYFIELD: In the recirculation mode. So that this is a recirculation issue.

MR. MARSHALL: The next slide --

DR. WALLIS: Well, at least it means that some function, which is specified in the plant specification is no longer functional, isn't it?

MR. MAYFIELD: That's what it would imply; yes, sir.

MR. MARSHALL: The next slide covers some of the limitations. And as the first bullet says, most of it's due to lack of plant-specific information. And another root for some of the limitation was with the small LOCA. Some of the small LOCAs, conceivably you don't need to go to recirculation. Then others we're not sure how uniform individual utilities would respond to a small LOCA if they would all behave similarly. We defined how we thought the progression would go, but we're not clear of the deviation from unit to unit. With the medium LOCA and the large LOCA, there's much more uniformity on how we expect plants to respond to those.

And I already mentioned the first sub-bullet there, which was the location of the different debris sources. One reason transport wasn't directly addressed in this analysis was there's such a large variability in the containment designs we just didn't address it. We tried to address it indirectly with the curve and the location of the curve to the expected box.

There's another point that's also -- the net positive suction head margins that we use we drew from licensee responses to a generic letter. And we're pretty sure most of those responses were, what, licensing basis and not necessarily what the plant expected to have in the net positive suction head margin. So some of the cases might not accurately reflect the net positive suction margin and the different units.

And the last bullet essentially repeats what I mentioned earlier is that we mixed actual debris-expected cases and some licensing information. We took the information that was available to -- readily -- best available to us and what we could collect during the first year of the study. And there are certain gaps that we just couldn't fill as far as making it expected conditions. And that was one of the criteria placed on me for the study was it had to be as close to what we expected in the plant. It couldn't be a bounding or conservative analysis, and this is the driving force.

And the last slide just covers, again, I already mentioned this, but I'll touch on it again, for sumps with very large -- for the cases, rather, where we had very small net positive suction head margins and very small screen areas, and that usually translates to very high approach philosophies, it took very little fiber and particulate combination to reach sump failure. Most of the large LOCA cases, again, because of the volume material generated, turned out it's very likely you'll have sump failure. And just some of the small LOCA, because of the much smaller amount of material that's generated, likely to get sump failure.

DR. SHACK: Wasn't the original argument that the PWRs, by and large, had rather large sump screen areas compared to --

MR. MARSHALL: The first year of the study we did a survey, and we found out the PWRs -- there's some that do have very large areas, but there's also some that fall under what the BWRs had. Actually, in the report on page 61 -- page 64, we have a listing of the sump areas, and they range from 11 square feet to I think the high was 400 and something.

MR. LEITCH: Yes, I was surprised at the variability in the design.

MR. MARSHALL: But many of them, a good number of them, was under 100 square feet. And at one time, we thought all the PWRs were above that. That was one surprising thing we learned from the survey. The other surprising thing was the variability amongst the plants, we didn't think it would be that great.

Our original approach was to essentially look at the -- collect the survey information, pick three, maybe five at most, plants that would represent the entire population and do calculations just for those five instead of parametrically like we've done here. And we found out we couldn't bin them. We couldn't bin them by AE, we couldn't bin them -- you could, but it wouldn't be very defensible by grouping them by containment, reactor type, AE or sump design. There was not enough of them alike that we could get a small enough group where we could do representative calculations.

DR. BONACA: What's going to be next step? I mean you have enough information to know that at least for some plants recirculation may not be effective.

MR. MAYFIELD: Again, as Mike's characterized it, there are a number of, we believe, limitation sites. It gets to be problematic to say, "Plant X has or doesn't have an issue." But I guess it's easier to say when they don't have than when they do. So the next step is this meeting with the public on the 26th and 27th to discuss in some detail the report, the basis -- I should point out that the industry has been very actively involved up to the point that Mike and his colleagues started doing the calculations. At that point, we took a step back, did the work, and we're now prepared to present the results and discuss them in detail.

If there is additional information that can -- if there's something we've missed, we wanted to have that dialogue, discuss the results, see if there is additional information, insights that should be brought to the table for the staff to consider in developing a generic resolution -- or a resolution to the generic issue. That's the dialogue that we'll have over the next month or so, and come back to the Committee in September with a proposed resolution.

And I got to tell you, today I am not prepared to even speculate as to where we might go with this. It's something where we -- there's enough uncertainty in the plant-specific information that you would need to do this analysis that we just don't have access to. But if additional information can be brought to the table to help us sort this out, it could have significant impact on the response the staff might propose.

DR. BONACA: In the report, it seems there are three pieces that ought to be done, and two you could possibly do a generic evaluation. The third one, you want it very clear that you couldn't possibly have a generic evaluation or resolution of it. You have to have a plant-specific evaluation. And for how long are you going to be taking the lead in gathering information and attempting to, you know -- it seems to me, at some point, it has to get on the other side and get the licensees involved in addressing the specifics that you cannot do by yourself.

MR. MAYFIELD: That's correct. And that's -- we have colleagues from NRR behind me and beside me. We have been in discussions with them on this issue. The meeting on the 26th and 27th is actually a meeting that they organized and are hosting. But the subject of the meeting is to present and discuss the report results. And they -- I think I can safely say they are very interested in what responses and additional information we may get from that meeting on the 26th and 27th. And we'll be in discussion with them about next steps from there.

DR. KRESS: For those plants that plant-specific analysis show they may have a problem, it looks to me like the simplest fix is a bigger surface area of screen.

MR. MAYFIELD: Sure.

DR. KRESS: Is that possible in all cases or is there a problem with that?

MR. MAYFIELD: I guess I would be hesitant to speak for the licensees, but you would think so. But I don't know that for a fact.

DR. POWERS: If I owned a plant and was concerned about this, can I call up Mike and get the calculation and procedure to evaluation my plant, because I know all the specific information?

MR. MARSHALL: You mean could they?

DR. POWERS: Yes, yes. I mean is there something you could hand me and I could off and follow this script, and I can come up with a number like you have, except I would have specifically the information you don't have.

DR. KRESS: You could put a dot in first for your plant.

MR. MARSHALL: Yes. Yes, we could provide that information.

DR. POWERS: It's a fairly straightforward calculation and what not. I don't need to run a cray or anything like that?

MR. MARSHALL: No, you don't need to run a cray.

DR. POWERS: Can I run a spreadsheet?

MR. MARSHALL: Actually, yes.

DR. POWERS: Okay.

MR. MARSHALL: The way we did it here.

DR. UHRIG: What experience, incidents where pumps have been put into operation, there must have been, over the years, a number of cases where water has been pumped out. I know specifically Crystal River had 400,000 gallons at one point in the basement. Has there been any other incidents that you know of where you could determine how much debris might have been picked up there, just as a validation point?

MR. MAYFIELD: The answer is I don't know. I don't know if Mike has any --

DR. BONACA: I don't think there was the impingement that you would have from --

DR. UHRIG: There was no impingement on this, but --

MR. MAYFIELD: I think the impingement is the thing that drives it.

DR. UHRIG: Drives it, okay. So this would not be a valid piece.

MR. MAYFIELD: I don't think you can go back to that and infer what you'd get if you had a LOCA -- a pipe break and you started pealing insulation off.

DR. UHRIG: Okay.

MR. ROSEN: I'm interested in a little dialogue you had a moment ago with Dana about the chemical reactions that occur in the formation of this flocculent type of gel, I think, you talked about. What is actually going on there, and what is the effect of that on the flow rate? Does it make it worse or better or what?

MR. MARSHALL: I'm not sure. I'm trying to make sure I understand your question. When you say make it worse you mean once it accumulates on the screen, the flow rate?

MR. ROSEN: This is gel formation of some kind you mentioned.

MR. MARSHALL: Right.

MR. ROSEN: I'd like to know what that is. But just for the moment we'll just assume that this gel forms on the screen. Does that make some of these cases that are okay not okay or is this --

MR. MARSHALL: We didn't look at that. We didn't include the flocculence in here. This is only the thermal insulation -- the particulates, the cal sil, RMI, and fibrous material in insulation.

DR. WALLIS: Can we talk about chemistry a bit more? When we talk with Westinghouse about AP

600, we had a discussion what would happen to these sort of metal pieces which were supposed to sink to the bottom of the pool. If you take something like foil and put it in a pool, which is acidic, and it produces gas evolution, it doesn't take many bubbles to make a piece of foil buoyant. And I think we made some calculations about that. Is not gases evolved by chemical reactions in the sun?

MR. MARSHALL: We didn't look at gases produced from the chemical reaction.

DR. WALLIS: Because they make particulates buoyant, and then they wander around.

MR. MARSHALL: And one thing we did notice with the buoyant materials, things that trapped air or trapped gases, they tended to travel on the surface, and when they got to the screen they didn't readily go under the surface to accumulate.

DR. WALLIS: It depends what the level is, doesn't it?

MR. MARSHALL: Well, yes, if it was one of the partially submerged. But, Dr. Rosen, may I get back with you with regards to your questions on the chemical formations and the flocculence?

MR. ROSEN: Sure. You've got a perfect chemical reaction machine if you have a LOCA in one of these containments. It's got high temperature, lots of stirring, and if you've got chemical reactions going on between the materials that are available that can make the situation more adverse than you have portrayed it, I think we all need to know that.

MR. MARSHALL: Okay.

DR. POWERS: I can tell you what I know or what I think I know. Any of your aluminum is going to react, form gibbsite. It's aluminum hydroxide, fairly gelatinous material. Boric acid's going to precipitate as mineral, which I think is cordorite, which is a calcium borate. Those are the ones that most quickly happen and seem to be the ones that we see in the TMI sump.

MR. ROSEN: Does that make the situation worse or better, Dana?

DR. POWERS: Well, I think these gelatinous materials, when coupled with the fiber they do the same thing as the particles do. When you don't have the fiber, then they can actually be sucked through most of the screens.

MR. ROSEN: Just pumped like -- if you have the fiber, you have what we -- being a chemical engineer, I suffer from some knowledge of how --

DR. POWERS: Well, you're just looking at a filter aid.

MR. ROSEN: -- a chemical engineering unit operations proceed, one of which is -- one of those unit operations is filtration, and one of the kinds of filtration is pre-filtration with laying down a bed of fibrous material before you try to filter out a particulate material.

DR. POWERS: Yes. Any kind of filter aid is just that, it's a fibrous material. That's what they found in their BWR work. Fibers and particles are much worse than fibers alone or particles alone.

DR. WALLIS: I haven't read your report; I'm just looking at it now. It seems to me that what might be the weakest is to split the leads to the ten percent box up there. If I were a licensee, I might try to hire some experts in multiphase flow to try to prove by CFD or something that the stuff really wouldn't get into the sump area the way that you say it does. And is this based on this casanova? What's the source of the --

MR. MARSHALL: Casanova --

DR. WALLIS: Is this casanova --

MR. MARSHALL: -- concerned debris generation model.

DR. WALLIS: -- a theoretical thing or is it a recent experiment?

MR. MARSHALL: It's empirical. The way casanova works are debris generation models. Essentially AutoCAD converted over into a MATLAB model. We have the entire piping and containment structure digital. And based on the testing, debris generation testing, we go and say, "For this size pipe, so many L over Ds, this amount of material will be damaged." And we tell the casanova model at MATLAB that, "For this material, that corresponds to ten L over Ds."

DR. WALLIS: So you get the amount of debris generated, but the transport is the bit which is --

MR. MARSHALL: Correct. The transport is the weakest part.

DR. WALLIS: -- the weakest part, right.

MR. MARSHALL: We're very good, I think, with debris generation. We're very good with the head loss and accumulation. I think we're very --

DR. WALLIS: And the transport is based on some integral experiment or something somewhere?

MR. MARSHALL: Different experiments.

DR. WALLIS: Because I just see sort of five percent, ten percent stuck in a table, but where does that come from?

MR. MARSHALL: We didn't discuss that in this report. One other thing we have to do is a lot more documentation of our work. We haven't published our transport testing and our ongoing debris generation testing. The main purpose of this was just to tell people what we did. And in the public meeting, again, since we have so much more time, we will go into the details of where some of these values came from.

MR. LEITCH: Are there any more questions?

MR. ROSEN: One more point I'd like to make, because I'm a little suspicious of easy answers to hard questions. And one of the easy answers we've got is, "Well, we'll just double the sump screen size, area," when we're talking about potential fixes. If you have significant chemical reactions going on which could exacerbate the sump blockage phenomena, that might not be enough. And so we need to hear -- I need to hear a whole lot more about how effective these things are as filters in this situation, including the chemical reaction part of it so that we have some sense of what fixes might be like given the true nature of the blockage.

MR. MAYFIELD: We didn't mean to suggest

that we would propose simply doubling the size. That was earlier regulatory guidance. Today, I think if somebody was going to increase the screen size, there would have to be a lot more information addressed. So we agree with you completely. And that's why the staff went away from the earlier regulatory guidance.

DR. KRESS: With respect to the chemical reactions, if it were me, I would first try identify what those chemical reactions are and try to judge their rate, the kinetics, and compare with the kinetics with the kinetics of the accident itself. You may be able to exclude the significant contribution by that process without -- if you could exclude it, why then you've got an easier life. If you can't, then you've got to do something else.

MR. MARSHALL: One thing I'd like to mention is in this work here we didn't cover all the debris sources. And one reason why was because from just the thermal insulation we thought we could make a good case that this is something that needs to be or doesn't need to be addressed. If somebody was going to redesign their sump screen or try to -- let's say somebody was required to fix this, they would have to address a larger variety of debris than we did.

It wouldn't be a calculation that's as

simple. It would be complicated by looking at the larger variety of debris. Then also once you have this different variety of debris, you have the sump screen, what actually is the head loss with that material there? And that's going to be different than a combination of fiberglass and particulates. The work we did here was to more or less, again, show if this was a credible concern. It wasn't to devise a fix.

MR. LEITCH: Any other questions? Did you have any concluding remarks? Mike?

MR. MAYFIELD: No, sir. Just we wanted to thank the Committee for letting us have this opportunity to come brief you.

MR. LEITCH: Then, Mike and Mike, thanks for the presentation. Mr. Chairman, back to you.

DR. APOSTOLAKIS: Thank you, Graham. We'll recess until 11:15.

(Whereupon, the foregoing matter went off the record at 11:06 a.m. and went back on the record at 11:15 a.m.)

DR. APOSTOLAKIS: Back in session. Okay. Next topic, "Potential Margin Reductions Associated with Power Uprates." Professor Wallis, this is your topic. Graham?

DR. WALLIS: We have an hour, Mr. Chairman?

DR. APOSTOLAKIS: We have one hour.

DR. WALLIS: The way I propose to proceed is to present to you a summary of Subcommittee meeting, and then we'll hear from the NRC staff about the question of whether there's a need for MSRP, which is one of the questions raised in our Subcommittee meeting. Do we have a quorum?

DR. APOSTOLAKIS: Yes, we do. What, we lost it again?

DR. WALLIS: We don't have a quorum.

DR. APOSTOLAKIS: We don't have a quorum. Okay, now we do.

DR. POWERS: You're a pivotal member; you can demand all kinds of things from him.

DR. APOSTOLAKIS: He just did.

DR. WALLIS: I think it's interesting that we should have a quorum, because one of the questions is going to be do we write a letter, and we felt that --

DR. APOSTOLAKIS: Among other things.

DR. WALLIS: -- one of the reasons the Subcommittee feels that we should not write a letter is that this was a Subcommittee study; it's not been a full Committee study, and full Committees write letters. The other reason we don't think a letter is appropriate is we don't feel that enough of the story has been put together for it to be the basis for a letter at this time.

The Subcommittee on Thermal Hydraulics met with General Electric, the NRC staff, and fellow Gus Korenberg, who made a presentation on June 12. And we learned that GE has devised a method for increasing BWR power by the order of 20 percent. How much is actually plant-specific, the plant has to make its own calculations to justify a plant upgrade -- power upgrade.

This is achieved by flattening the neutron flux profile and increasing the steam and feed water flow and otherwise changing as little as possible. So GE's contention is that very little has been changed. There's no increase in burn-up, most of the LOCA ATWS analysis remain the same, except perhaps for time of operator response. And, therefore, there is no change in safety margins, and they stay within established regulations.

The written material we got from GE was a topical report on constant pressure power upgrade, and we found this to be composed mostly of words, no analysis, and mostly concerned with classifying what is generic and what is plant-specific.

Now, we heard from the NRC staff. We heard from Ralph Caruso. And from that point of view, approved methods are continuing to be used for safety analysis. As long as the results fit in within the existing regulations, they can approve a power upgrade. They have few concerns. One is that result of the power upgrade increases the instability region in the flow versus power map. And, therefore, the operators have to be more aware of this and rely on the Solomon-GE method for maintaining stability, and they have to work around the instability region.

Another concern of the staff is that the use of a code could be tracked to generate a database in order to establish a correlation for boiling transition for GE fuel bundles, GE-XL14. Whether it's appropriate for a code to generate data is the question.

We also heard from NRR about risk. Now, this submittal is not risk-informed, but the staff follows the guidance of RG 1.174 in order to ensure that there are no significant risk changes. They concluded that there is an increase in CDF of about nine percent and in LERF of about 16 percent. This is almost entirely due to the decreased operator response time and ATWS events.

Now, we had put together -- ACRS has put together six questions, six specific questions. You may remember those, my colleagues, and I propose to very briefly give the staff's answers to those questions. We asked about power uprates leading to increased frequency release of small amounts of radioactivity, which are not reflected increases in CDF or LERF. Do we need to have additional risk-informed acceptance criteria? And the conclusion of the staff that we need no additional risk metrics to assure that the risk impact is consistent with the Commission's safety policy statement.

The second question was, the power uprates can be accommodated by reducing margins between calculated values and limits. Can the licensee use up all these margins? The conclusion of the staff, I think it's also the conclusion of the Subcommittee, is that there are rules, such as staying below 2,200 degrees F, Appendix K. As long as the licensees stay within this box defined by these limits, they may use up the margin to those limits. That's the margin we're talking about. I think our conclusion and the staff's conclusion is that that particular margin belongs to the licensee.

We had a question about power uprates leading to significant increases in burn-up, and do we reflect this in our PRA evaluations related to core melt behavior for efficient product release? The answer here is that delta LERF is used, and the consequences have changed. There is increased sufficient product release from increased core power, but this is not a concern.

Will power uprates change sufficient product source associated with gap release and iodine spiking? The conclusion of the staff was that power uprate has no direct impact on gap fraction and that the 500 spike multiplier will continue to compensate for uncertainty in the iodine spike rate.

Now we had a concern about the times required and times available after power uprates for operator actions. Yes, indeed, there is a shorter response time available, particularly in the ATWS situation, and this does increase the --

DR. APOSTOLAKIS: How much more is it?

DR. WALLIS: Gee whiz, I have to look it up. It's significant.

MR. BOEHNERT: I think for Duane Arnold it was two minutes. It went from six to four or something like that. That's what I recall.

DR. WALLIS: Yes, something like that. I remember it was about a 30 percent change.

MR. BOEHNERT: Yes.

DR. APOSTOLAKIS: Six to four. That's really the important thing.

DR. WALLIS: So there are larger AGPs, larger human error probabilities. And this is reflected in delta CDF.

DR. APOSTOLAKIS: Well, I'm very curious how they did that.

DR. WALLIS: And we had a question about the need to evaluate the live start risk study. And the conclusion there was, yes, indeed, there was a two percent increase in live start from these increased AGPs due to operator response time. The increase, because of the increased burn-up, would increase by 25 to 25 percent. But the overall risk remains small and within the Commission's objectives. And, therefore, things were okay. So the picture we got from the staff was that things are okay.

Now, we also heard from RES, and Jack Rosenthal presented a very extensive research program to assess the effects of operation and synergistic effects in particular, though in fact they proposed to look at all kinds of effects of upgrades. This work would take two FTEs and 850k in FY '02. It's a very broad program, and it's sort of interesting that everything is fine. The operates are proceeding in September. We have to make a decision on Duane Arnold, and now we're starting a research program to see if there might be problems.

What was the response of the Subcommittee? Well, we heard from Gus. He made a presentation, which this Committee has heard. Gus' conclusion was that there was a need for the NRC to make independent calculations to check the validation of the licensee contentions. He felt there was a need for an SRP. We're going to hear about that from the staff, including acceptance criteria, that the staff was proceeding, though they hadn't sort of spelled out what they were specifically looking for or specifically with regard to operates and were there any criteria that needed to be focused on. And Gus also felt there was a need to evaluate the potential for diminished margins. He did make some estimates. The margins, in most cases, had not changed very much.

What were the members' concerns? Members had some concern about this SRP issue. They felt that the staff should have laid out more of the plan for how they were going to evaluate uprates. The members felt that many of the presentations were very general. There was very little analysis or data presented. There was a sort of qualitative feeling that everything was okay, but we didn't see much in the way of hard evidence.

And members had some concern that I've already, I think, mentioned, that the ACRS is coming in at a very late date to get answers. We're supposed to sign off on Duane Arnold in September, and we have a feeling there might be some issues, but we're not quite sure what they are yet.

We believe the operate does indeed decrease safety margin, it almost has to, and we're concerned -- some members are concerned about allowing the licensees to use up all the margins when the GDCs call for sufficient margin. And yet I think we also feel that as long as they stay within regulations, that particular type of margin can be used up. And one of our members had a concern about whether the stability monitor was adequate for dealing with the new power distribution within the corps.

So there we are. It looks, from NRR's standpoint, GE's standpoint, everything is straightforward. Some of us have an uneasy feeling that there might be some technical questions to be addressed, materials questions, for instance, but we don't have a very good knowledge of what those questions might be.

I think some of the members who are here now who are not members of the Subcommittee had some concerns about our uprates, which led us to ask some of these questions earlier, and that may have stimulated the RES research program. Maybe it's time now to hear from NRR.

MR. ZWOLINSKI: Good morning. I'm John Zwolinski. I'm the Division Director for our Division of Licensing Project Management in NRR. I have not had the opportunity to meet with you in some time. My counterparts are Gary Hollohan and Jack Strosnider. We work directly for Dr. Sharon. I'm interested in some of the comments that have been made, because as we do go forward with our technical reviews, it would strike me that those would certainly be areas that we would want to ensure our staff is focused on, although I have high confidence that the Systems Division, especially, which Ralph Caruso and others are working, feel very confident that they have an approach that is very defensible. And I think we'll have an opportunity to get into that, as we bring that before this body.

With me, I have the senior executive responsible for power uprates, Mr. Singh Bajwa, and Claudia Craig is the Section Chief responsible for this area. And Mohammed Shuaibi is our Lead Project Manager for the effort, and he coordinates and ensures uniformity and consistency across our review activities as a Lead Project Manager and ensures that activities with the project's organization are undertaken consistently.

We're here at your request to discuss the staff's views on the need for an SRP section for power uprate reviews. However, before we get into that, I'd like to take this opportunity to highlight some recent correspondence related to power uprates and some staff activities in this area.

As you may already know, in a staff requirements memorandum of May 24th, 2001, the Commission directed the staff to make power uprates a high priority, noting the situation throughout the country as far as the need for power. I surmised that was part of the genesis of directing the staff to assure we conducted business in a timely and effective and efficient manner. The Commission also directed the staff to work with stakeholders to identify potential areas for improvement in the current power uprate review process to assure that these processes do not impose needless requirements. This comes back to one of our key pillars of unnecessary regulatory burden.

Earlier this week, Dr. Travers signed a Commission paper documenting the staff's response to the staff requirements memorandum. I believe that was late Monday. The Commission paper provided a status of ongoing activities in the area of power uprates, including plant-specific reviews, generic topical reviews, and ongoing and future work related to improving power uprate processes; that is the actual review itself.

In summary, we told the Commission that we considered power uprate applications to be among the most significant actions being conducted and reviewed by the staff, and we will, to the extent practical, accelerate review schedules, assigning additional staff where appropriate in an attempt to ensure that we fulfill the Commission's expectation of maintaining the focus on these being a high priority.

We also told the Commission that we are evaluating the review process for the measurement uncertainty to capture uprates to improve the effectiveness and efficiency of these processes. This is the small, typically on the order of about 1.5 percent, uprate. Some of us struggle, is that really a power uprate or is that a flow uncertainty elimination, and thus we're more accurate in measuring flow.

DR. WALLIS: Yes, we've already considered that one. I think that the Committee is in agreement that this is a good idea.

MR. ZWOLINSKI: Okay, very good.

DR. WALLIS: We did that, I think, about a year ago that one.

MR. ZWOLINSKI: We did have topical reports in from a number of vendors on this particular issue, and that particular measurement device has been in use for some time.

We will be conducting a similar evaluation of the review processes for extended power uprates following the completion of the first few that are currently under review. And this was alluded to earlier. That's Duane Arnold, Quad Cities, and Dresden. In other words, once we've got these technical reviews completed, we will go back and ask ourselves, are there efficiencies that can be identified or garnered or areas that we may or may not need to look as deep into? So scope and depth of review and the areas that we review will be at least challenged by us.

DR. WALLIS: So that's the time that if you -- I think you're proposing if you did devise an SRP, that you would do it then after you've learned from these three reviews.

MR. ZWOLINSKI: We really do want to have the lessons learned of these reviews. And as we get into some of the presentation, I think you'll see the flow of thought.

The staff, as you said, is scheduled to present these reviews of these applications in the September and October time frame.

Contained in the paper, which is, as I said, a status paper to the Commission, are enclosures, and it's interesting to note that we did survey the industry. This is a very interesting concept, especially for the boiling water reactors. But we are doing some reviews of power uprates, albeit much smaller than -- something as much as 20 percent for the PWRs.

With the economics and the deregulation and various factors that are coming into play, it's not surprising that we found a considerable number of licensees contemplating some amount of power uprate, whether it was simply the uncertainty power uprate or something a little bit more than that. A fair number of licensees, on the order of 40 to 50 percent of the industry, is looking at this issue very hard.

By the way, there have been a lot of power uprates that we have reviewed and approved over the last 20, 25 years, and so there's learning from those that led to a fairly extensive study that was performed following the issues that arose at Maine Yankee. And out of the issues of small break LOCA and things of that sort, the staff did do a rather rigorous analysis of prior power uprates, and thus that led to the process and procedures and review methodology that we're currently using today.

Mohammed's going to get into this. I'm stealing a little bit of his presentation, but I felt it was important to say that we had baselined our technical work, and I'm confident that was part of the basis that led people such as Mr. Caruso and others to speak. So with that, unless there's questions --

DR. WALLIS: While you're giving the overview, power uprates are also part of the industry interest in risk informing some of the regulations, I think. They're hoping that risk-informed regulations will give an opportunity to justify some power uprates.

MR. ZWOLINSKI: Yes, sir.

DR. WALLIS: So you folks are also following that line, I imagine.

MR. ZWOLINSKI: Yes, yes, very much so.

MR. SHUAIBI: Thank you, John. Again, we're here today to talk about the staff's views on the need for the SRP section for power uprates. I would like to just add one more thing to what John said about the comments earlier. When we came here, we did say that the reviews for the Duane Arnold, Dresden, and Quad Cities were still ongoing. We didn't have a lot of detailed information at the time, because we're still conducting our reviews. Those are not done. And we have received some questions from ACRS, and we're looking at those now, going back to see that we have all bases covered. And if there were additional questions to the ones that we had identified, we're going to be asking the plants to address those. Those questions were specific to Duane Arnold, but we did send them out to the other PMs as well, project managers, to make sure that in their review of the Quad Cities and at Dresden they also look at those areas as well.

With that, I'd give you an overview of the presentation today. What I'm going to do first is I'll give you a brief background on how the idea for an SRP section came about. Following that, I'll talk about what use today for current guidance for power uprate reviews. I'll get into ongoing activities that have the potential to change the power uprate review process. And some of that came out of the Commission direction in the SRM. And I'll conclude with the staff's views on the need for a power uprate and also the timing -- I'm sorry, a power uprate SRP and the timing for putting one together if we should decide to do that.

As far as background goes, in December of 1995, we received an allegation that the Maine Yankee licensee used inadequate analysis for their power uprate. Following that, in January of '96, we ordered the Plant to be limited in power level to the original power level that was licensed that was prior to the uprate in question. In April of '96, the NRC formed a Maine Yankee Lessons Learned Task Force, and the purpose of the Task Force was assess performance in three key areas: One was code reviews, the other was the power uprate review process, and the third was really staff interfaces related to issue closures and document generation.

The focus of this presentation is on the second item, which is the power uprate review process. But let me say that on the code reviews, we have actually drafted and issued a draft SRP section and a reg guide, which I believe the ACRS was involved in. We received comments from the public, and we're in the process of evaluating those comments.

DR. WALLIS: Since you mentioned those, we have been waiting a long time for those to be finalized. I think ever since I've been on the ACRS this has been coming, and it seems -- we just don't want to get it stuck somewhere and forgotten about. We'd like to see it finished.

MR. SHUAIBI: Well, I think we have actually issued them for public.

DR. WALLIS: They've been out for public comment --

MR. SHUAIBI: Yes.

DR. WALLIS: -- for quite a while.

MR. SHUAIBI: Yes. We're in the process of evaluating public comments, but I'll take that back as you'd like to see that accelerated.

DR. WALLIS: Yes. Don't divert the effort to somewhere else and then forget about those.

MR. ZWOLINSKI: As a memo, we should be able to provide the Committee with current schedule and bring some closure to that particular question, and we'll do that.

MR. SHUAIBI: We'll take that back. On the last item on the -- as far as staff interfaces and document generation, we have gone back since Maine Yankee and reviewed some of the TMI action items related to the Maine Yankee experience. And we also have added guidance to the reviewers of updates to the SRPs -- I'm sorry, updates to the FSAR sections and plant documentations to make sure that power uprate-related material gets reflected in the updates to the FSARs.

After the Main Yankee Lessons Learned Task Force in July of 1996, and independent safety assessment was conducted at Maine Yankee. In October of '96, the Independent Safety Assessment report was issued, which recommended that we go back and review our process for the power uprate reviews. In November of 1996, we were directed by the EDO to address the recommendations in the Independent Safety Assessment report. In December of 1996, the Main Yankee Lessons Learned Task Force issued their report, and that also recommended that we go back and look at the review processes for power uprates. And, finally, in April of 1997, NRR committed to develop a standard review procedure for power uprates. So that's how this came about, the idea for --

DR. WALLIS: So you don't want another situation like this where as a result of, let's say, a future uprate, you get a similar situation where --

MR. SHUAIBI: No, we certainly don't want that.

DR. WALLIS: -- someone says, "You should have had an SRP. That's why you got into this mess."

MR. SHUAIBI: That's right. No, I'm going to talk about what we do today, which has a lot of --

DR. WALLIS: So you had a talk in '97 to do something, and it hasn't yet appeared, is that the case?

MR. SHUAIBI: Well, that's not totally true. I mean we have a process that incorporated the lessons learned from Maine Yankee. I'm going to get into that, and I'll actually go through an example of how that works with you. We're pretty confident that what we're doing today is --

DR. WALLIS: So you have a sort of pseudo-SRP, is that what you call it?

MR. SHUAIBI: Yes.

MR. ZWOLINSKI: Before Mohammed goes on, I was deeply involved in a lot of this activity, either leading or co-leading much of these efforts. One of the sensitivities had to do with our indexing and maintaining a currency as far as our knowledge of all the codes that we rely on in the Office of Nuclear Reactor Regulation. There are a lot of codes that go beyond thermal hydraulics.

For example, over in the Engineering, in Jack Stresnider's Division, we have a wide variety of codes that were part of this overall comment that came out of this Lessons Learned Task Force. In so many words, does the Agency have a good means to understand which codes have been reviewed/approved and which codes are being used by the industry? And we found that we were -- we needed to improve in the area of thermal hydraulics. We concluded that many of the codes were used more in the Engineering area had much better documentation.

So this was a very broad effort that narrowed into the thermal hydraulic area. So while we share with the Committee kind of a one-liner, this had a lot of horse power and a lot of effort behind, and it was quite a broad activity.

DR. BONACA: These are the codes that you used to evaluate the performance of the plant, right?

MR. ZWOLINSKI: Yes, sir.

DR. BONACA: And the condition it's on.

MR. ZWOLINSKI: Yes.

DR. BONACA: Now, at some point, since I was not on the Subcommittee, one point of I've expressed is typically evaluation consists of analyzing outcomes of events and accidents and so on and comparing to set the limits. And what you do for a new plant you compare against the design limits of components for that particular application. What I mean is that if you're evaluating the blowdown forces or stress on a component, you compare that with the capability of the component for that stress level.

When you do a power uprate, you do an evaluation using the same hydraulic codes, but it seems to me there is an implicit assumption that those design limits you're comparing to don't deserve any evaluation to address issues, such as, for example, aging. And that's one of the concerns we have expressed, I think, in more specific examples. I just would like to know from you, at some point in the presentation, whether in fact you are asking a licensee to give you, for example, a summary of the operating experience of the plant?

You know, we have seen for BWR we looked at some components we have compared things for had to be replaced, because they were found to be cracked or possibly cracked. Certainly, those components were not capable of their original design capability. So that raises the question of whether or not when you increase the power plant by 25 or 30 percent, there should be also an assessment of the design capability of certain components, which now are much close or somewhat closer to the performance of the plant in case of accidents.

MR. ZWOLINSKI: I think I understand your question. Can I ask that Mohammed continue with his presentation --

DR. BONACA: Oh, yes, please.

MR. ZWOLINSKI: -- and if we don't answer, I'll be more than happy to revisit that.

DR. BONACA: Yes. If there is a way, at some point, where we can talk about that.

MR. ZWOLINSKI: Yes. Okay. Very good.

MR. SHUAIBI: As far as current guidance, what we use today we have four approved GE topical reports. We have two for stretch operates, one from 1991, one from 1992, and two for extended power uprates. One was approved in '96 and the other in

'98. These are only for BWRs, but they do provide guidance for the staff in terms of what areas need to looked at for a power uprate and the depth of review that has to be done. And I believe ACRS was involved in the reviews of those topical reports.

DR. WALLIS: I guess our criticism, or the criticism I've voiced on behalf of this Committee, was that many of these reports are full of words. Do you go thoroughly into sort of the technical basis for these words when you review the reports?

MR. SHUAIBI: Let me -- can I just continue, and after I'm done with this slide, I may addressed your question. But we can come back to it right after I'm done with this slide.

In addition to those topical reports, we have implemented the use of template safety evaluations. We have a safety evaluation for Monticello and one for Farley, which were both done in 1998. Both of those incorporated all the lessons learned from Maine Yankee, so we felt that those were very good safety evaluations, and we use those as templates for reviews of any of our power uprates today.

In addition to that, when our reviewer gets into a section, whether it's because a GE topical report included it or whether it's included in the safety evaluation for these plants, and the reviewer needs further guidance on the area they're reviewing, they would go to the applicable sections of the current SRPs.

Now, to address your comment in terms of how this gets done, a reviewer could pick up the safety evaluation and see the scope of review that has to be done and what has to be done. They also see from the write-up the level of detail that they have to address or how deep they have to go. And they could either use a safety evaluation for one of these plants or if they need more guidance, they can go to the SRP, and the SRP would have that guidance for them.

DR. WALLIS: So the assumption is that you already know enough to do this. There isn't something about these extended power uprates, which are fairly large, that take you beyond some region of knowledge or judgment that you used in the past.

MR. SHUAIBI: Well, we recognize the recent submittals at Duane Arnold, Quad Cities, and Dresden and Clinton now as first-of-a-kind power uprates. And we will be learning from those. There may be areas where we may need to focus more effort.

DR. WALLIS: Maybe after they've done the power uprate and the correct experience with --

MR. SHUAIBI: Well, I think as we're going through them, hopefully not after the fact. As we're going through them.

DR. FORD: I guess the frustration here is that in the topical reports, for instance, from General Electric, there's numerous references to the increased flow rate will not have an effect on carbon steel, for instance. Whereas we know phenomenologically that it will have an effect. But there are no data to support the contention in the reports. That is the frustrating part, and we are being asked to sign on that, "Hey, everything is fine." We've got no data to --

MR. SHUAIBI: Are we talking about the new topical report that's been submitted?

DR. FORD: Yes.

MR. SHUAIBI: I think what I'd like to do is go back to the topical reports that have been approved a little bit. In there, I think what GE tries to do are two things: They try to propose a way or a format for submittal for the plant to come in, and then they propose a second topical report which gets into the technical details of what is to be submitted. So in the first case, yes, GE would say, "This is the kind of information that you have to provide." The second report would get into the technical discussions of what that information is.

On this new CCPU topical report that you're talking about, actually that one has been put on hold. We've given them a lot of comments back on that report, and they've asked us to stop work on it. So I don't know that we're at the point that we want to discuss what that report's going to look like at the end. We don't know what's going to happen with that topical report.

DR. WALLIS: I noticed quite a bit in that topical it leaves quite a bit up to the licensees. So maybe some of the sort of question that my colleague asked here is not to be answered by GE; it's got to be answered by Duane Arnold or whoever it is.

MR. SHUAIBI: That's correct. Again, we will identify those areas. In most cases, we will go back to the -- we do go back to the safety evaluations, for example, for Monticello, and then the SRP and use as guidance for how we would do those reviews. But, yet, there are plant-specific areas that GE isn't going to analyze or put in their topical reports.

MR. ZWOLINSKI: This most recent issue that arose where we asked Duane Arnold a set of questions and then we passed also along to the other licensees, we don't believe those individual licensees are going to be able to answer those questions. I think it's targeted to General Electric. So we get to General Electric through the licensee so that we place the burden on the licensee to --

DR. WALLIS: And they go right back to GE, because GE has the expertise to answer the question.

MR. ZWOLINSKI: Well, the vendor needs to undertake work, at least in the set of questions that were just generated. We're aware that they have done a lot of work. And to make a long story short, we believe that they can answer the questions. We'd like to see what the answers are.

DR. WALLIS: I think some concern is that maybe -- whether the old questions you've been asking are adequate for the new situation. That's the bit of concern we have is that you're extrapolating your judgment and knowledge from lower power and so perhaps assuming or judging that there's nothing new that you have to worry about.

MR. SHUAIBI: Well, I think, to go back to an older point that was made earlier, when we do these power uprate reviews, we don't just review the, for example, Chapter 15 analyses. We do component reviews to make sure that those components can still operate in the same fashion that they're described in the submittal. So I think all that gets addressed.

Now, are there any new areas? I think research, like you said, is to undertake a study to see if there are any new areas. I think some of the synergies that were mentioned during the last meeting had to do with things that aren't being done in parallel here for these power uprates. But we do look at not just the Chapter 15 analysis; we look at components to make sure they can work in the uprated condition.

DR. WALLIS: These research results may come in after all the GE plants have been uprated.

MR. ZWOLINSKI: I believe that was a two-year program --

MR. SHUAIBI: Yes.

MR. ZWOLINSKI: -- and the number that we'll be processing over the next two years is not a large number.

DR. WALLIS: It's not a large number?

MR. ZWOLINSKI: No. And by the way, I would also suggest that we've encouraged Research to ensure that they've given a healthy look at PRA methodology to look across these facilities as to changes that have been made over time. And now this touches on a myriad of different areas within a plant and to what extent does it affect the PRA? So I think this -- I view the research initiative to be one of complementing the staff's activity and independent validation of our review process.

DR. WALLIS: It's very striking if you look at some of the PRA results. It seems that nothing has changed except for this operator response to ATWS. And it seems remarkable. Maybe it's just a function of the excellent design of the plant, but that's the only thing that changes.

MR. SHUAIBI: In some areas, they are changing the way that these plants are being operated. I know one example is a plant that's using more feed water pumps for full power operation than what we use today. And our PRA folks are looking at that to make sure that that --

DR. WALLIS: Where balance of power changes.

MR. SHUAIBI: That's right. That's right. And that would be reflected in their risk assessment.

DR. WALLIS: And that's plant-specific,

isn't it?

MR. SHUAIBI: Yes.

MR. ZWOLINSKI: And that's why I think the PRA can be of great use.

MR. SHUAIBI: I think I've done this already, but I'll walk through it anyway. What I have here is an example of how this process would work. Again, I randomly pick containment system response. I actually opened the Monticello safety evaluation to a page and said, "I'll just use that one." You could do it with, I believe, anything in there. For a boiler, I take the Monticello safety evaluation -- a reviewer would take that in his area or her area. They would be looking for containment system response. They'd look in there and see that, yes, that has to be addressed, and it would have a discussion to give you an idea of the depth of review that has to be performed. For BWRs and BWRs only, we have the GE topical reports as well. So if a reviewer also looks at the GE topical report, he'll see that they need to review that area.

DR. WALLIS: So, I'm sorry, what you're saying is that someone who's reviewing Duane Arnold, instead of turning to an SRP to say what shall they do, turns to the precedent of Monticello and then goes with that.

MR. SHUAIBI: Well, if we were today to write an SRP section for power uprates, what we would have to do is identify the areas that have to be reviewed for the power uprate and then provide the guidance that goes along with that area. Now, we wouldn't go back and rewrite the SRPs. What we would actually do is identify the areas that have to be reviewed and then point the reviewers to the right sections in the current SRPs unless those need to be modified, which I don't think they would.

So what the Monticello SE effectively does is that. I mean you've got an SE that outlines the areas that have to be reviewed, and then the reviewer can go to the SRP for further guidance.

DR. WALLIS: So you're saying that there already exists an SRP and that we would have to --

MR. SHUAIBI: That's why I agreed when you said pseudo-SRP, yes.

DR. WALLIS: All right. And you don't need add substantially to it or maybe you don't need to add to it at all. You just need to point to sections of it.

MR. SHUAIBI: Right.

MR. ZWOLINSKI: And then the question is

if we've got pointers to a myriad of different sections of our standard review plan, do we need to construct an overarching power uprate SRP that has these pointers and any other -- and for lack, I think, of a better term -- synergistic effects or effects that would not be considered individually but more as they accumulate. Those types of things, I would think, would be the part that would actually be in the SRP section if we were to develop it, along with all these pointers. I don't want the Committee to think that we're not using the existing standard review plan extensively. As you go through the safety evaluation, you will find the pointers into our SRP. We call this particular type of review the template review.

DR. BONACA: Could I ask you for the percent power increase that you had for Monticello and Farley?

MR. SHUAIBI: I'm sorry?

DR. BONACA: What was the power uprate --

MR. BOEHNERT: Monticello was about 6.6, and Farley I don't remember. That was below five, wasn't it?

MR. SHUAIBI: Yes, I believe that was five.

MR. BOEHNERT: Yes, five, which we didn't look at it.

DR. BONACA: Does the extent of the power uprate have any bearing on the guidance that you need to provide?

MR. SHUAIBI: The areas you would look at would be the same. I mean the SRPs and what we would be reviewing are the same. Now, the extent of the power uprate is obviously going to have an effect on the analyses and the results of the analyses. And possibly even, when you change the operation of the plant, like the example I gave earlier, where you have more feed water pumps required to run the plant, yes, we would be looking at that. But that's part of the review today. When we look at the risk impact, we look at how the plant will be operated and how that is reflected. And when we look at the analysis, we do look at what effect does this increase in power have on it? Now, whether it's a one or a 20, we would still be looking at that effect.

Again, this process was implemented following the Maine Yankee experience to address the Maine Yankee's lessons learned. So we see this as a pseudo-SRP, as was said earlier.

What I'd like to talk about now are potential changes, ongoing work that has the potential to change the current review process for SRPs. I think John already talked about the staff requirements memorandum of May 24 this year, where the Commission directed the staff to make power uprate reviews a high priority, assure that our review processes don't have any needless impediments, and to not unnecessarily delay licensees' plans for implementing power uprates. We responded to that SRM, and John already talked about that, so I'll just move on to the different power uprates and what we're doing in those areas.

DR. WALLIS: So you have an incentive to proceed quickly.

MR. SHUAIBI: Yes.

DR. WALLIS: And when one proceeds quickly, there's always a risk that one forgot something. But I agree that this is appropriate.

MR. ZWOLINSKI: What we said in the paper, and I think it will be released in the near-term, is that the Agency has performance goals for licensing actions. And we see this as the type of action that should be completed within about a year's time. Direction to our staff is to ensure it's carried as a high priority item. So staff will be made available to conduct the reviews to meet that type of review schedule, which is not abnormal.

I will say some of the previous power uprate reviews possibly took on the order of 18 months and even a little bit longer. But had we dedicated our staff, they would have been much shorter reviews. We're assuring our staff is targeted to complete the review in about a year's time.

MR. SHUAIBI: And to address your point about moving quickly and what happens when you move quickly, we recognize and stated in the paper that the Duane Arnold, Quad Cities, Dresden, and the big power uprates are really first of a kind. And we said that improvements to that process, as far as gaining efficiencies, we will look at that following our review of those applications.

My bullet on this slide, the measurement uncertainty power uprates, we're currently reviewing the process for those. Again, those are the ones on the order of one and a half percent. We're looking to see where we could gain efficiencies in that. And we also have a GE topical report that addresses the small power uprates.

With respect to extended power uprates, we're currently reviewing, again, first of a kind. We recognize the first-of-a-kind submittals from Duane Arnold, Quad Cities, and Dresden. We've also received an application from Clinton, which I believe you're aware of, for a 20 percent power uprate. All of these are for uprates greater than 15 percent, and will be presented to the ACRS soon. I think the Duane Arnold will be presented in September, Quad Cities and Dresden are coming in October, and Clinton is probably next year. It's not -- it just came in.

DR. UHRIG: Which plants are the BWR-3, 4, 5?

MR. ZWOLINSKI: I think the Clinton is BWR-6.

DR. UHRIG: Six. What are the others?

MR. SHUAIBI: Threes? Threes.

DR. UHRIG: They're all threes, okay.

MR. ZWOLINSKI: Yes, these are all threes.

DR. UHRIG: All threes. Okay. Thank you.

MR. SHUAIBI: Well, following reviews of the Duane Arnold, Quad Cities, and Dresden, we are planning to have a lessons learned workshop with industry to share our lessons learned from those reviews, possibly areas where we will need to get into, areas where we could gain efficiencies, that kind of information, and looking for feedback from them on how we could improve.

We will also conduct a review of the

process following the reviews of the Quad Cities, Duane Arnold, and Dresden to see what we can do in terms of gaining efficiencies. And we did have the GE topical report on CPPU power uprates, like I said earlier, that we were asked to stop work on that because of comments that we gave back to GE, but we'll be meeting with them soon to discuss their plans on that.

MR. ROSEN: What's CPPU?

MR. SHUAIBI: Constant pressure power uprates, I'm sorry.

DR. FORD: Given the time content that we've got here that we're going to be asked to decide upon Duane Arnold or give comment on Duane Arnold, is there any way at all that we can see what the questions are that you are giving on, for instance, the CPPU report, so at least we can give our advice on the adequacy of those questions?

MR. SHUAIBI: We haven't issued any REIs on the CPPU topical report. That was a separate effort from the Duane Arnold activity. As far as Duane Arnold, Quad Cities, Dresden, and now Clinton, I think we've provided ACRS with all the incoming and REIs that we have to date. If you would like the comments that we shared with GE on the CPPU topical report, we could look into getting that for you. But those are separate activities.

DR. WALLIS: But these are uprates that use the CPPU idea, constant pressure.

MR. SHUAIBI: Well, they don't use the topical report. Now, remember, the topical --

DR. WALLIS: The issues would be the same. The method of achieving the power uprate is as described in that report.

MR. SHUAIBI: True, but I think what you're getting into on the CPPU topical report is, again, the GE -- usually, again, GE comes in with two types of reports. The first one lays out the format of a submittal. The second one talks about the technical discussion -- you know, provides a technical discussion of the uprate. The CPPU topical report was more on formats. A lot of the comments were on format. As a matter of fact, many of the comments was on their approach of a checklist.

DR. WALLIS: Yes, it's in regulatory space; that's not in technical space.

MR. SHUAIBI: That's right. Many of the comments are in that area. I don't know if they would help. That's why these are separate efforts. I think Ralph Caruso wants to make a comment.

MR. CARUSO: This is Ralph Caruso. I just want to let you know with regard to the Duane Arnold, Quad Cities, and Dresden, I believe that those were done in accordance with one of the earlier topical reports. The two that are used most often are ELTR-1 and ELTR extended. Something licensing -- Extended Licensing Topical Report 1 and 2. Both of those reports have been presented to ACRS, and we've discussed them with you. And these three uprates, and I believe also Clinton, are in accordance with those two topical reports.

MR. SHUAIBI: I mean they may be constant pressure, but the CPPU topical report was mostly on what the licensee presents in terms of content or in terms of format. The CPPU --

DR. WALLIS: This is a problem that I think ACRS, or I always have with these things, is the scent of a paper trail. In order to find out if there's any technical issue we ought to worry about, you have to find out which report refers to which report, which refers to which report, who's really relying on what. And that can be a lot of work.

MR. SHUAIBI: For the Duane Arnold, Quad Cities, Dresden, and Clinton, those should point to the 1996 approved topical report and the 1998 approved topical reports, which are called ELTR-1 and ELTR-2, not the CPPU topical report.

DR. WALLIS: We saw those before. I remember them, yes.

MR. SHUAIBI: Okay. Yes.

DR. UHRIG: One other question. Going back to the uncertainty recapture power uprates, these are all ultrasonic measurement devices or are they the correlation?

MR. SHUAIBI: Ultrasonic.

DR. UHRIG: Ultrasonic. Do you know if this is a four-channel, single-pass system or the X?

MR. SHUAIBI: What we have approved to date is the single-pass system, and there has not been a submittal for the --

DR. UHRIG: The new one.

MR. SHUAIBI: -- for the new one.

DR. UHRIG: Okay.

MR. SHUAIBI: We understand that some of the plants would like to use the new one, but we have not approved that yet. We would have to review that submittal first.

DR. UHRIG: Okay. Thank you.

MR. ROSEN: Do you have any corresponding activity such as this on the pressurized border reactor side for extended power uprates?

MR. SHUAIBI: As far as the template reviews, we do use the Farley, which is a PWR. Reviewing the process, we're reviewing the process for all, not just for BWRs. As far as topical reports, we don't have an approved topical reports for a PWR. If they want to submit a topical report, we would review it, but we don't have one approved today.

MR. ROSEN: And there are no licensees who have come in -- PWR licensees.

MR. SHUAIBI: Not for 15 or 20 power uprates, no. No, they're not at that --

MR. ZWOLINSKI: It's our understanding that PWR community is looking at the feasibility of trying to provide the staff a topical report, but I think if you stop and assess each of the PWRs, there are -- the likenesses that you find in the boiling water reactor device -- the pressurized water reactor, they're going to have some difficulties in making that a broad, generic-type report. Whether we talk to various venages or we get into various manufacturers or two or three flow, it's just a lot of different issues that will probably make that effort very difficult.

DR. UHRIG: It's also not likely to be

talking 20 percent either.

MR. ZWOLINSKI: I agree with that.

DR. UHRIG: Maybe five.

MR. ZWOLINSKI: Many of the power uprates that we've approved over the past several years have been for very small power uprates, typically less than five percent for the PWRs. And those were part of the review when we did the Maine Yankee lessons learned. Did we do a quality review -- and I'm going back in history now -- when we approved any power uprate prior to 1996? And that led to the template that we're talking about that we used for Monticello and Farley.

DR. UHRIG: Well, there were many plants that were -- the analysis was done at one level, and then their initial license was a lower level. And then they went up to the higher level. We went through this in St. Lucy.

MR. ZWOLINSKI: Yes, you're correct. Their analysis is essentially at a higher power level, and for a variety of reasons they operated at some number less. And then they ask to be able to go back to the higher number. Those types of reviews were not very extensive. They're predicated primarily on --

DR. UHRIG: Because the original review was done on that basis.

MR. ZWOLINSKI: Exactly.

MR. BOEHNERT: Bob, ANO has a review in-house for a 7.5 percent uprate. Yes. And Point Beach announced that they're going to be seeking a 10.1 percent uprate.

DR. POWERS: If the staff were asked to approve the 1994 decay heat standard, what kind of power uprates do you think would be feasible for PWRs?

MR. SHUAIBI: I don't know. I would have to get back to you on that. I don't know if Ralph has an answer, but I don't.

MR. CARUSO: This is entirely speculation on my part, but I don't think decay heat is what's limiting the PWRs. I think it's steam generators, and that's why the power uprates, the ten percent power uprates are the plants that are replacing steam generators. They can't get the heat out.

DR. BONACA: And flow. They're flow-limited too.

MR. CARUSO: Right.

DR. BONACA: I mean, simply, you just have -- there in PT envelope in DMB in a good portion of the operating range.

MR. ROSEN: They're RCS flow-limited.

DR. BONACA: Sure, RCS flow-limited, yes.

MR. ZWOLINSKI: In fact, I'm reminded on the Arkansas docket they did just replace their steam generators, and in fact we are finding as licensees replace their steam generators, many are not exactly like for like. They are going to larger steam generators. And Ralph accurately characterized that's the probably unequal component. Very expensive uprate.

MR. SHUAIBI: I guess the last bullet --

DR. BONACA: I had -- okay, I'm sorry.

MR. SHUAIBI: No, I'm sorry, go ahead.

DR. BONACA: I asked the question before, but I didn't get an answer yet. So before we get to conclusion, I would like to hear an answer.

MR. SHUAIBI: Okay.

MR. ZWOLINSKI: If I could go back to the review processes that we intend to undertake, I don't want to predict what the results of that will be. It could lead to additional review in selected areas or it may modify the scope and depth of the review in some areas. It would be premature to speculate the outcome. We are looking for efficiencies in our processes.

DR. BONACA: I understand that. The question I asked was purely to do with the fact that since the plants are aging, wouldn't it be -- and you're pushing the plant closer to these operating limits. Wouldn't it be prudent to look at past history, try to understand if in fact all those components which are being compared are still capable of what they were capable when they were designed.

MR. SHUAIBI: Power uprate reviews involve a lot of different branches within NRR, and you have the Chapter 15 analysis, which reactor system DSSA does, and you have the component analysis, which DE does. And when we review power uprates, we do look at component's ability to function at the operated power level. So we do look at that. We do rely on ISI, IST programs, as well, to feed back into the process, make sure that, you know, as far as history goes, IST, ISI will provide that kind of information.

I don't know if that fully answers your question or not, but we do --

MR. ZWOLINSKI: Just as I believe there is an integrated effect when you make changes to your plant, the Agency's appropriate response would be there's an integrated regulatory effect, including our inspection program, but also the fact that through our oversight program there's a number of areas we continuously probe, and during the license review there's a variety of areas that we are probing.

Some of these we have come to the conclusion the best vehicle or device that we have to assess more macroscopically might be use of the PRA. But that will not necessarily get me to is my equipment qualified to perform over the next 40 years, which could be a question. We're faced with those kinds of questions, for example, in license renewal. We're essentially asking ourselves, "Do we need to ask those kinds of questions during this review?" And as appropriate, we do.

DR. BONACA: Okay. I think I got an answer, and the answer includes an answer satisfactory, in part, because my main concern was that this would not become, when you get to this kind of power uprates, just simply checking certain components against a checklist.

MR. SHUAIBI: Oh, no. No. And maybe when we come and talk about some of the applications that we're reviewing now, maybe we could talk -- maybe pick an example and go with that. Maybe that will give you a better feel for what we do in those areas. But we do review the components that we rely on for the analysis to make sure that they will operate at the higher power level and provide the functions that they're relied upon.

DR. WALLIS: Are we ready to move to conclusions?

MR. SHUAIBI: My last bullet, though, I'd like to say that we will issue guidance based on these reviews or whatever changes we make. We have a risk process where we could issue guidance through a risk. We may also put things on the NRC's external web site to make sure everybody's aware of the results of these activities.

In conclusion, I guess using the template safety evaluations, approved topical reports for the BWRs, and the current SRPs, we believe that sufficient guidance exists for the reviewers to conduct power uprate reviews. On the bigger power uprates, of course we'll be looking at that as we're doing the reviews of those applications to see if there's anything that needs to be added or areas where we can improve.

We're considering explicitly identifying the Monticello and Farley safety evaluations -- those are the ones that we use as templates -- in the project managers' handbook. What that will do is it will identify to a project manager for a plant that when he gets a power uprate review to go back to the

Monticello or Farley, and maybe even include it on the work request that goes to the technical branches. Everybody's aware of those, but we could formalize that by putting it in the project managers' handbook.

Again, the processes may still change. They are changing. We expect the measurement uncertainty power uprate process to change. There may be changes as a result of the first-of-a-kind applications for the major power uprates. So the process is still dynamic. If we were to write an SRP section, I don't know if this is the right time to do that.

Resources right now are really needed for reviewing the current applications that we have. If we were to write an SRP section, we would have to take the experts working on those applications to develop the SRP or make sure that it's done correctly. And we need those reviewers on the applications that we have. And we can always reevaluate. We will reevaluate the need for an SRP section in the future, especially when we do the review of the process.

DR. WALLIS: Is there any other questions?

MR. LEITCH: Your arguments are compelling, but John and I were both deeply involved with the Main Yankee situation, and then there was, as you indicate, a Maine Yankee lessons learned. And one of the outcomes from that lessons learned was that a standard review procedure would be developed. And I guess what I'm hearing is that that has not been done.

And I guess one of the benefits of any procedure is to document and formalize your institutional learning so that you have a structured way to go through a particular process and benefit from the experience and so forth. And I just hope we're not digging ourselves down in that same hole that we were in at Maine Yankee again. And I mean this conclusion was definitely coming out of that report, and yet we're saying now that, well, we're not going to do that now.

MR. SHUAIBI: Yes. I don't think that we're quite saying that we don't need it. What we're saying is the concerns that the Maine Yankee lessons learned recommendations were after was a scope and depth of review when it came to the review process. What is it that you want to review and how deep do you need to go when you're reviewing it?

Now, following that, we have implemented this template review. You know, we didn't have this template review process before Maine Yankee. So we see it as, yes, we have taken some action. We haven't actually written an SRP section, but to address the scope of review, in terms what you look at, and the depth of review, in terms of how deep do you go when you review it, I think that those template safety evaluations probably capture that pretty good.

Now, again, if I were to go and write an SRP section for review of power uprates, what would I want to do to address scope and depth? Probably the same thing that these templates do. It would be in the SRP. That would be the only difference. It may not include as much of the text in the safety evaluations, because they're plant-specific reviews, but, essentially, you'll get the same thing. I mean that's the argument.

DR. WALLIS: The material is there already, you're saying. The material that you need is --

MR. SHUAIBI: Yes.

MR. ZWOLINSKI: If I can help bridge the gap just a little bit. We looked at all the power uprates that we had done, and we looked at what technical branches contributed to those power uprates. So if this power uprate had four branches and this one had seven branches, and this one had three or nine, we asked ourselves, "What is the appropriate set of review sections in the standard review plan?" And that ultimately was codified and used in the Monticello docket and on the Farley docket. So we took the areas that were reviewed and not reviewed, the plants of yesterday, and going forward laid out a list that was much more detailed and very extensive that we asked our staff to look at each one of those individual areas. So that's a fairly complex and lengthy review list.

For the uncertainty reviews, we don't believe it's necessary to review all those various areas. We've actually gone back to our technical staff and requested that we don't believe it's necessary, and we think there's justification that can be provided to not review every section that we are asking to review, for example, on a more complicated review. But that's formed the basis, and I think we've captured the thought that we have all the sections. It just hasn't been codified into a particular single section called "Power Uprate."

DR. WALLIS: Are we ready to wind up this discussion? Then I'd like to thank our presenters for giving us a far more in-depth discussion of this issue than we were able to have with the Subcommittee. It's been very helpful. Thank you.

MR. SHUAIBI: Thank you for having us.

DR. APOSTOLAKIS: Thank you. Okay. We will recess until 1:30.

(Whereupon, the foregoing matter went off the record at 12:23 p.m.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on Reactor Safeguards

Docket Number: (Not Applicable)

Location: Rockville, Maryland

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

John Mongoven
Official Reporter
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