replace something, you put a barrier there or you do some operating things in there, some events. The program requires them to evaluate to determine whether the qualified life remains what it was 20 years ago when the equipment was qualified.

MR. MAYFIELD: This is Mike Mayfield. Let me take you to -- Jose's provided, I think, a good summary on the technical side. The process, we'll transmit our findings and recommendations to NRR for the implementation based on our discussions with Jose and the Management. I think the anticipation is this will go into their generic communication process and, like you say, will go to some voluntary action. I think that's prejudging a bit. I'm not quite sure today what will come out of that process, but I think the expectation that they have expressed is it will go into their generic communication process and play out from there.

MEMBER LEITCH: So would the expectation be that we would hear another presentation once we know what those actions are?

MR. CALVO: It all depends how much you want to know about EQ. That will be fine. We'll be happy to do it.

MR. MAYFIELD: I think if the Committee

asked for that, then the staff would be prepared to support that request as well.

MEMBER LEITCH: I see. Fine. We're running -- we have three more minutes to go here.

MR. AGGARWAL: Okay. I'll do 30 seconds. The industry practices, as described by NEI in their letter, in the staff's opinion, seems to be educate but the plant-specific practices are not known to us. Again, as I stated earlier, walk down to look for any visible sign of degradation we find can be proven useful and effective, as compared to nothing.

MR. CHOKSHI: Okay. I think just to the summary, and already we touched on this, and I think Mr. Mayfield described, our recommendation is to the NRR, and we have been discussing this with NRR, is to look at the dissemination of this information while they generate a communication process. And I think it's important to, as itemized here, the results of the tests and potential implications so that the licensees can evaluate the results of the tests for themselves a summary of Okonite.

And I think that one of the things is all of this information the last item, the importance of the knowledge of operating environment and hot spots is really critical to address many of these issues by doing reanalysis, understanding the remaining margins, remaining life. So I really think that information needs to get out and then the communication process should determine the level of the communication or any other subsequent actions. So it is, as noted in the transmittal memo to you and in the technical assessment, we are following this to NRR with a recommendation that they use the generic communication process for dissemination of our findings. So that's the overall presentation with the technical assessment and where we stand.

MR. AGGARWAL: And, certainly, we look forward to receiving a letter from you in terms of your advice, comments which we will cooperate and finally submit to the Director of NRR.

MR. MAYFIELD: That concludes our presentation.

MEMBER POWERS: I have to say that in some sense this is the kind of research you wish NRC had more time to do, where you can go through and do a technical assessment in the field, not necessarily coming up with anything regulatory but saying, "Hey, guys, these are the things that we worry about, maybe you ought to worry about them." It's kind of a nice thing for a regulatory body to be able to do, summarize a field, show some data, show some concerns and show some ways of handling it. It's kind of nice.

MR. AGGARWAL: I wish we have unlimited funding and unlimited time.

MEMBER POWERS: Yes, yes.

MEMBER LEITCH: Any other questions?

MEMBER POWERS: Well, have you thought about mining the heavy section steel funds?

(Laughter.)

MEMBER LEITCH: Mr. Chairman? I turn it back to you, Mr. Chairman.

CHAIRMAN APOSTOLAKIS: Thank you, Mr. Leitch. Thank you, gentlemen. Appreciate you coming here. Our next -- we're supposed to continue with this. I don't like that. We'll take eight minutes and be back at 2:50.

(Whereupon, the foregoing matter went off the record at 2:41 p.m. and went back on the record at 2:51 p.m.)

CHAIRMAN APOSTOLAKIS: The next item is the development of reliability/availability, performance indicators and industry trends. The cognizant member is Dr. Bonaca, so Mario, please lead us through this maze.

VICE CHAIRMAN BONACA: Well, in order to

identify and evaluate potential new PIs, the Agency's conducting a pilot program, monitoring the unavailability and the unreliability of several risk-significant systems identified through the Phase 1 performance indicators. The pilot includes an attempt to integrate unavailability and unreliability for each set of the system, train into a risk-informed PI called Pilot Mitigating System Performance Indicators. I hope I quoted it correctly.

We received an update on this issue at the Subcommittee last Thursday. The staff is here to present this work. They have pointed out to us that this is work in progress. This is the first of several updates, two or three updates they plan to give us. At this stage, don't expect a letter from us, but this is an important update for us. I believe during this presentation the staff will also discuss performance and accountability reports determination, that no statistically significant adverse industry trends in the performance that are identified for 2001.

With that, I'll pass the presentation to Mr. Baranowsky.

MR. BARANOWSKY: Okay. Thank you, Dr. Bonaca. Let me go to the first viewgraph. As you said, the purpose of this presentation that I'm going to give, which is going to be divided into two parts, one that I'll give and one that Tom Boyce will give. The first one is on an overview of the reliability and availability performance indicator pilot program, which is being done for the reactor oversight process, as led by NRR and supported by the Office of Research. And it's an informational briefing. I've identified in this first viewgraph what the content of this discussion will be, a little bit on the background, some of the problems that we're trying to solve, some insights that we derive from studies that were done on risk-based performance indicators, a very brief discussion of the technical approach that we're taking.

We're also going to mention the issues that were raised at the Subcommittee because we want to make sure we're capturing those for when the next time we come we want to address those properly. And then we'll talk about some conclusions and the implementation schedule.

Just briefly on the background, SECY 99-007, which is sort of the base document for the reactor oversight process, did identify that the performance indicators that were proposed and promulgated as part of that paper had some limitations in them because they were put together in basically a few-months time frame, and they borrow heavily on existing performance indicators which were known to have limitations in terms of their risk-informed characteristics.

During the first couple of years, the reactor oversight process and a number of technical issues came up that have to do with how the indicators are formulated and deal with incidents in their accounting. And, as such, a working group was formulated and the Office of Research participated in this working group and suggested that some of the technical work that we had done in the performance indicator project could be used to solve many of the problems, but not necessarily everything.

So the reliability and availability performance monitoring approach that was selected for the mitigating systems can be described as but one aspect of an area of improvement in the reactor oversight process, and so we're looking to at least move forward step-wise in making some improvements there.

The problems that we are trying to address in this project are as follows: The current performance indicators, in particular for the mitigating systems, include design basis functions along with the risk-significant functions, and that sometimes provides improper importance to the design basis functions that are not risk-significant, and so there's a desire to make a correction there. The thresholds of performance used in the current performance indicators are generic, one-size-fits-all, and there have been a number of problems identified about the lack of being risk-informed in that regard because of the variation in risk from plant to plant, especially for different mitigating systems.

The demand failures were accounted for as an unavailability of sorts in the so-called fault exposure hours, and they end up, in many cases, providing an overestimate of the risk significance of what the demand failures actually result in in terms of their impact on plant risk. And there are no performance indicators currently in the ROP that are directed toward the support systems.

The unavailabilities of the support systems are currently cascaded onto the unavailabilities of the monitored system. And the concern there is that the monitored system is being, in terms of its unreliability and unavailability, is being dominated by the support systems, or at least it can be. And so we're looking for an indicator that can give us information about the monitored system in addition to the support systems.

VICE CHAIRMAN BONACA: Now, isn't there a major problem with the PIs, the fact that the thresholds that are risk-based are kind of unrealistic because one single PI has to raise the core damage frequency by a significant amount.

MR. BARANOWSKY: Yes.

VICE CHAIRMAN BONACA: And we know in real life that doesn't happen. I mean it's usually a combination of things.

MR. BARANOWSKY: Right. Actually, part of that problem has to do with the selection of the PIs, and the other part has to do with the formulation. The one in particular that you run into that problem the most with is the initiating event performance indicator where all reactor trips for all plants are treated equally. Well, if you look at the risk significance of different initiating events that involve reactor trips, you can easily see orders of magnitude difference in their risk significance.

And if you want to capture that correctly, you have to have a more risk-based formulation to reflect that such that the more risk-significant failures would have a less tolerance than the less risk-significant ones, and you wouldn't put equal weighting on them. And then you would come up with a different threshold, if you will.

And the approach that we're taking on the mitigating systems could actually be used on the initiating event systems. We might look at that in the future to correct that one. I'm not sure we run into the same thing on the mitigating systems, but that's a correct point.

So let me just cover some of the problems that we are trying -- that we think that these modified performance indicators will correct. First of all, we worked to make sure that the risk-significant safety functions are the ones that are captured in the performance measurement. Now, the performance indicators, the way they're formulated, they account for a plant-specific design and operating characteristics through the use of available risk models and data. And available risk models are basically the site-specific PRA for the licensee, and I think I'll mention later that the NRC will be doing parallel analyses using our own risk models in the form of the standardized plant analysis risk models or

SPAR models.

The demand failures are now accounted for correctly in the reliability formulation. They allow for the accumulation of failures to be more appropriately counted in the performance indicator. The performance indicators are going to now include separate indicators for the cooling water systems that provide support to the mitigating systems for which we currently have performance indicators, and that will eliminate the cascading problem and sort of an unfair count, if you will, of the indication of performance in those other frontline systems. But it will also treat the support systems according to their risk significance in the model.

The other thing I want to mention is that we believe that this pilot addresses at least some of the things that were raised by the ACRS, maybe not every single question. But the issue of the plant-specific thresholds is addressed. The technical basis for the choice of sampling intervals, we believe that was covered primarily in our risk-based performance indicator report, but we still will provide additional basis to have a complete package in this application.

And there was also an indication that the action levels should be related explicitly to risk metrics, such as CDF and LERF, and I think we have at least an improvement in that area from what we had before.

Okay. Just to quickly go over the insights from the Phase 1 study of the risk-based performance indicator report, because that was the technical foundation even though the formulations are a little different now, but that was the technical foundation for what we're proposing in these performance indicators.

We identified that there were enough risk-significant differences amongst the plants that we had to have plant-specific thresholds for both unavailability and unreliability, and the mitigating system performance indicators will handle that. The unavailability and unreliability indicators were found to provide an objective in risk-informed indication of plant performance. And by that I mean they're logically connected to risk. You can actually trace what element of risk is associated with these indicators fairly directly.

And they provide broader coverage of risk than the current indicators, which we mapped out in that report, which I believe was NUREG 17.53. We mapped out the coverage that the performance indicators gave in terms of systems equipment and accident sequences. Do I have that right? And we looked at this for an example of 44 plants, so we have a pretty good feeling that we have good coverage there.

We did find that doing performance indicators for component cooling water and service water systems were a problem. But the formulation that we're proposing now using importance measures solves the problem of having many complex models to deal with, and I think it's really a step forward that allows us to incorporate a simple formulation to represent a more complex situation.

And the last thing is we did use some data analysis using Bayesian update approaches, which, based on our statistical analysis, we were able to I'll say minimize practically the likelihood of false positive and false negative indications. What we're interested in there is if there is a performance issue that's because of statistical issues is not showing up but that could be, say, read in the current oversight process, we have a very, very, very small likelihood that we would miss that performance issue.

On the other hand, if there is not a performance issue, there is a relatively small, not quite as small, but a smaller likelihood that we're going to call it a performance issue. I mean you have to make some balances on these things. You can't get them to be all completely small. And we looked at different approaches. And in fact that's still an open issue, but it's an item that I think is the strength of looking at some of the statistics involved when you go through these formulations.

Now, the mitigating system performance index, or indicator, was formulated a little bit differently from that which we used in the risk-based performance indicator project in that we're directly looking at a change in cord damage frequency as an index. And it's an index because it's incomplete but it accounts for the elements of plant design and operation and risk that are accounted for in the current indicators, at least, as a minimum. They might account for more, but at least accounts for those. It's primarily at the Level 1 from a PRA point of view, full power.

Also, the indicator has two elements to it, the unavailability and unreliability, which during the risk-based performance indicators, when we worked with the metrics of unreliability and unavailability, defined properly, we had trouble combining them in other than a complex model, almost a full PRA. When we came up with a similar formulation, we were able to combine them in something that's at least easy to look at, even if the bases behind the weighting factors is -- well, it's a little bit complex.

And also we're baselining performance similar to the principles espoused in SECY 99-007 wherein we are trying to look at the 1997 time period as a baseline. And that's still an issue to be covered in future studies and presentations to this group as we move along.

So just to move down on this particular next chart, you see that the mitigating system performance index is an unavailability index plus an unreliability index, and one of the nice characteristics of this is it allows some balancing of unavailability and unreliability or if both are declining, then they're properly accounted for, instead of having separate indications looked at independently, as if one's frozen and looking at the other, and this matches up with the maintenance rule. So it was -- one of the major concerns that we have about the maintenance rule was accounting for unavailability and unreliability differently and then the combination of these things differently, and I think we've solved most of that here.

MEMBER ROSEN: And it's attractive to me too, because you can have a system that's perfectly available but highly unreliable because you run it all the time and you haven't maintained it, or one that's totally reliable and completely unavailable because you never run it and you're always maintaining it. But here -- and, clearly, the licensees have to make that balance. And, clearly, this indicator, because of its mathematical formulation, allows you kind of -- it portrays the balance.

MR. BARANOWSKY: And the other thing that's nice about breaking these two things out is, as we discussed at the Subcommittee, the unavailability indicator covers maintenance downtime and corrective actions, whereas the unreliability one covers whether it performs as indicated when it's tried. And that helps you focus any look, if you will, as a regulator in terms of what kind of follow-up actually it would take if, let's say, this indicator were to go over some threshold. And it's also, I think, useful for licensees to look at it that way, which they do in the maintenance rule, so it's consistent with that.

The next chart just shows a list of the systems. Basically, we have -- for boiling water reactors, we have three cooling water systems that are more or less what I would call your front line ECCS type systems: The emergency diesel generators, which are part of the emergency AC power system, and then the support system cooling, which in most cases involves systems with the name emergency service water, reactor building closed cooling water or turbine building closed cooling water systems or their equivalent. And then for the PWRs, we have injection systems represented by high-pressure injection and the RHR for low pressure considerations, the auxiliary feedwater system, again the emergency diesel generators and again the support system cooling functions with some different names.

Now, let's talk a little bit about the limitations of performance indicators, because we spent a long time, I mean months, going over what can and can't be captured by these performance indicators. The performance indicators are meant to look at an accumulation of information over a period of time, one to three years or so, and then draw some inference about performance. Individual incidents are meant to be covered by a risk assessment type indication. So what we did was we identified the types of individual --

VICE CHAIRMAN BONACA: The STP.

MR. BARANOWSKY: The SDP, for example. SDP Phase 2, Phase 3 type activity. And so what we did was we went over, well, what are the kinds of things that can and can't be reasonably captured and have good statistical characteristics for us to measure performance with? And we have this list here, like common cost failures. We know that they have a risk significance, but we can't track enough years to get common cause failure into the reliability formulation, but over time the common cause failure impact on the risk-importance measure, whether it's Fussell-Vesely or Birnbaum, will show up.

So it's counted for in time, and it's instantaneous, if you will, implications in the reactor oversight program inspection process will be captured through the SDP. And the same goes with passive failures. And there's a few systems components that are highly reliable. The system is highly risk-significant, and single failures over a period of one to three years don't have very good statistical characteristics to them, and those also would be looked at as if they were a rare event in risk space.

Okay. Now --

MEMBER ROSEN: If you're done talking about the limitations

MR. BARANOWSKY: No, I'm not done. Well, I'm done with that limitation. I'm going to talk about some of the -- we're going to look at a number of technical issues, which we don't -- we wouldn't say they're limitations but they're still open in terms of how to make a final formulation on them.

MEMBER ROSEN: Well, of all the limitations that you've mentioned, the most important one is one you really didn't call out as a limitation. And that to me is that this only covers at-power situations. Risk doesn't go on a holiday when you take a plant off the line.

MR. BARANOWSKY: Yes.

MEMBER ROSEN: And so the shutdown risk is important, even though there are people in this Agency who don't think that. It's my view that it's fairly important. And depending upon exactly what you do during shutdown, PWRs and mid-loop, for instance, create a lot of risk during that period.

MR. BARANOWSKY: Yes. I think --

MEMBER ROSEN: If you don't go to mid-loop, well, okay, maybe you don't have a risky outage. But mid-loop operation especially hot early mid-loop is a risk configuration. So I think when you're setting up an index program like this, if you're not looking at shutdown risk, you're not showing the whole scope, and that's one of the -- to me that's the principal limitation.

MR. BARANOWSKY: Okay. That's an excellent point, and we looked at that in our risk-based performance indicator study. And one of the things that we found that was a problem with the current indicators and even the current maintenance rule implementation was that the performance of equipment during shutdown was being overlaid on top of the performance of equipment during power, and the risk metric being used was the at-power risk measure, which really is erroneous.

We did a fairly good look at this and concluded that we don't have enough data during shutdown to look at reliability and unavailability in the cumulative sense that we do in these performance indicators, but that we could look at what occurred during shutdown and the different modes that occur during shutdown, including like mid-loop, as you said, and make a judgment call about the risk implications of shutdown operations that could improve the way the significance determination process, as opposed to performance indicators, can take a look at the implications of shutdown in the reactor oversight process.

So we're working with NRR now to take those insights and try and get them into the shutdown significance determination process. If we had the shutdown risk models, we could use risk metrics for unavailability and unreliability that were appropriate for shutdown, but we don't have those.

MEMBER ROSEN: I don't think I want to tell you how to do this, because I don't know, but I do know that it's a big hole and that you ought to be working towards ultimately including risk during shutdown in these programs.

MR. BARANOWSKY: We're going to have shutdown risk models for SPAR because we need it for the Accident Sequence Precursor Program. As you say, you get enough risk during shutdown that we have to be able to evaluate that. I suspect that -- and that won't take a long time. I think it's a couple of years to have pretty good models, at least in terms of what we know today about shutdown risk, maybe not some new stuff. But we should be able to look -- first, we'll have the reactor oversight process, significance determination process incorporate the insights from the risk-based performance indicator study in this area, and then, if it's appropriate after discussions perhaps with this group and others, we'll look at whether other performance indicators make any sense if we have the risk models to set the thresholds by. Otherwise I don't have a way to do it. I can't set them with the at-power models, which is really all we have available.

MEMBER ROSEN: Well, I don't think you should have -- let the excellent be the enemy of the good in this case. You should try to find something rational to do to begin to measure risk during shutdown and try to put that into the program. Maybe it's something as simple as duration in hot early mid-loop.

MR. BARANOWSKY: Yes. That's exactly right.

MEMBER ROSEN: And time runs from subcriticality, some kind of index like that.

MR. BARANOWSKY: Are you sure you didn't read our report? Okay. Why don't we cover that at the next ACRS Subcommittee meeting, because I think we did a nice job in looking at that and see if it answers your questions or if you have other issues that you think we need to look at.

MEMBER ROSEN: You say you're going to cover it when?

MR. BARANOWSKY: At the next Subcommittee meeting, which we're going to have -- proposing in November.

CHAIRMAN APOSTOLAKIS: He's proposing two more.

MEMBER ROSEN: Good.

MR. BARANOWSKY: We had so much fun at the last one.

CHAIRMAN APOSTOLAKIS: One of the few staff members who loves us.

MR. BARANOWSKY: I'll bring the doughnuts.

MEMBER ROSEN: We can do something to get him not to love us.

MR. BARANOWSKY: That would be hard. Okay. The next -- so we're going to look at a lot of things during the next several months, and we're going to report back to you on that. Let's go to the next one.

Just quickly, let me summarize here what I think were the highlights of the Subcommittee meeting that we had on May 30. You were looking for the reasons and justification for the selection of the baseline values that we had. That was an issue that was discussed quite extensively. There were questions raised about use of the thresholds that are currently in place and we derived from SECY 99-007. We're going to talk about that.

And then also there was quite a bit of discussions about the formulation that we had for the PI, including the use of Fussell-Vesely in different parameters in that equation, and we're going to put that all together in a white paper of sorts before -- if you'll allow us to have another Subcommittee meeting, we'll do it then, and you'll see in my schedule we're shooting for a November time frame.

CHAIRMAN APOSTOLAKIS: Good.

MR. BARANOWSKY: And we'll also be able to report on some of the initial implementation activities and issues that come from the pilot, presuming it gets off the ground at that point.

So to conclude, I think the maintenance of the mitigating system performance index approach is based on risk insights, and one of its strengths is that it accounts for plant-specific design and operating characteristics through the use of the available risk models and the data. Currently, we're using the Fussell-Vesely importance measure. We might look at Birnbaum and some other possibilities to see if they have better characteristics.

We're treating demand failures in an unreliability context. We're using Bayesian update to get the best statistical treatment that we can. The risk-significant safety functions are now a significant focus for the success criteria in determining what's a failure and what's not a failure that goes into the performance indicators. And we're going to be able to, we think, incorporate the cooling water systems that provide support to the more front line systems. We can balance unreliability and unavailability or if they both go up or both go down, the indicator covers that. It's a fairly objective indication because of its link to the risk model.

We've identified limitations. You've brought another one up here. We're wide open to hear more and see if we can either address them or make sure that they're accounted for in the significance determination process. And we believe that this indicator provides the right vehicle for making an appropriate risk characterization of performance that's related to reliability and availability of equipment.

So we have a schedule, as indicated here. We're going to have a workshop to go over how one can implement the formulation that's been proposed. We're going to try and start the pilot around August 1, somewhere around there. We think that around November, depending on your concurrence, we might be ready to come back, talk about some of these technical issues and how things are going. The pilot will end, the data collection and sort of online trial period, if you will, in February. We'll take about six months to assess that, but in that six-month period, we'd like to have another briefing to let you know how things are coming, because I think, ultimately, we would like to get some kind of a letter from the Committee, and that's probably around the summer of 2003.

CHAIRMAN APOSTOLAKIS: You'd like some kind of a letter or a good letter?

MR. BARANOWSKY: Some kind of good letter.

(Laughter.)

That's all I have to say.

CHAIRMAN APOSTOLAKIS: Any --

MEMBER ROSEN: You have another plant participating in the pilot --

MR. BARANOWSKY: Oh, sorry.

MEMBER ROSEN: -- slide. You don't want to put that up.

MR. BARANOWSKY: Right. Go ahead and show that if you want.

MEMBER ROSEN: Because it reminds me of the punchline in Casablanca, "Round up the usual suspects."

MR. BARANOWSKY: Some of them are there.

MEMBER ROSEN: Well, when are we going to see a list of people participating in the pilots with another name on it, other than "usual suspects?" I'd like to see some spreading a little bit.

CHAIRMAN APOSTOLAKIS: Palo Verde is there, South Texas is there.

MR. BARANOWSKY: Actually, South Texas is just -- is a relatively recent addee, because we have been working this group of pilots, and South Texas wasn't there on the first list.

MEMBER ROSEN: Yes, but it's one of the usual suspects. But I'm talking about seeing some plant that's new to the game.

MR. BARANOWSKY: Davis-Besse?

MEMBER ROSEN: Perhaps.

MR. BARANOWSKY: But I think this group will be --

MEMBER POWERS: Let me -- I'm not sure I understand the question. I look at this list and I say, hey, this is a pretty good cross-section. I got Hope Creek and Salem on one end and I got Palo Verde and that damn thing off in Texas someplace on the other end. That's a fair cross-section.

MEMBER ROSEN: Well, I'm just talking about some plant that has not participated at developing new capabilities and getting into the -- you know, I'm just railing at the idea that it's always the same plants that --

MEMBER POWERS: I mean just to have somebody participate that's for participation sake doesn't strike me as very useful.

MEMBER ROSEN: Well, it has much more to do with --

MR. BARANOWSKY: Tom Houghton from NEI would like to address that.

CHAIRMAN APOSTOLAKIS: We have a comment from the industry.

MR. HOUGHTON: Tom Houghton, NEI.

MEMBER ROSEN: Is there a law against that?

MR. HOUGHTON: Actually, comparing pilots before -- Limerick's new, they haven't participated; Millstone's not participated; Surry has not participated, Braidwood has not participated, Palo

Verde, San Onofre and South Texas have not been pilots. None of those have been pilots before, so we do have quite a different --

MEMBER ROSEN: You're talking about here in this particular program.

MR. HOUGHTON: Well, in the reactor oversight process.

MEMBER ROSEN: I'm talking about the use of risk techniques in general.

CHAIRMAN APOSTOLAKIS: He's broadening the issue.

MEMBER ROSEN: And Dana accuses me of prosteltizing, and I plead guilty. The idea being that the more people get involved in the formulation of these kinds of things, the more likely we are going to have smoother implementation, more broader implementation.

MR. BARANOWSKY: Tom, what about the --

MR. HOUGHTON: We also do have, I don't know whether it's a good name to use or not, but plants that are shadowing this process, so we will have probably I would guess an equal number of plants that are going to play along with the process but not be officially in it. So it will be quite broader.

MR. BARANOWSKY: And we expect the

workshop to have a large spectrum of participants, and probably when we have summary meeting afterward to go over issues and how they're resolved, I think not only these shadow plants but others will be involved.

Okay. So we'll, with your agreement, come back in November or there abouts.

VICE CHAIRMAN BONACA: Thank you. That was a good update. And now we have the report on no statistically significant adverse industry trends.

MR. BOYCE: Good afternoon. I'm Tom Boyce of the Inspection Program Branch of NRR, and I'll be presenting the industry trends portion of this briefing.

We're going to be covering today some of the background for the program, how we communicate with stakeholders, the process for identifying and addressing industry trends, other results for fiscal year 2001 and where we're headed in the future.

As background, one of the performance goal measures in the NRC strategic plan is that there be no statistically significant adverse industry trends in safety performance. That was put in place in about 1998/1999. NRR picked that up in 2000 from research, and we implemented the ITP in 2001. One of our key outputs is to make sure we address this performance goal measure.

CHAIRMAN APOSTOLAKIS: So the key words here are "statistically significant," right?

MR. BOYCE: Well --

CHAIRMAN APOSTOLAKIS: Because you can have a single event that is risk significant, but then that's because it's a single event it will not fall under this, would it?

MR. BOYCE: Right. There's a second performance goal measure which we think would capture that on the Accident Sequence Precursor Program.

CHAIRMAN APOSTOLAKIS: Yes, that ASP.

MR. BOYCE: Right. And so in terms of reporting to Congress and addressing the issue, that would be covered. It would remain to be seen the contribution of that individual event to changes in the industry indicators.

CHAIRMAN APOSTOLAKIS: Yes, but then we wouldn't call that a trend if it's a single --

MR. BOYCE: That's correct. It would probably be an outlier, which I think was your -- I think you brought that up in the Subcommittee, the Davis-Besse example.

CHAIRMAN APOSTOLAKIS: Within four days I can be consistent.

MR. BOYCE: The two purpose of the program are align with the NRC strategic plan and the first is to provide a means to confirm that the nuclear industry is maintaining the operating and safety performance of nuclear power plants. And the second is by clearly communicating that performance to enhance stakeholder confidence in the efficacies of the NRC's processes.

Speaking of communications with stakeholders, this is how we do it. We put the industry indicators up on the NRC's web site. Those were first put in August of last year. They were taken down temporarily post-9-11, and they're back up as of a few months ago. We provide an annual report to the Commission. We've provided two reports so far. One was in June of 2001 and one was April of this year. I believe you have copies of both of those Commission papers.

We provide an annual report to Congress as part of the NRC's performance and accountability report. And, finally, these indicators are presented at various conferences with industry. A most recent example might be the Regulatory Information Conference in March, the American Nuclear Society presentations and several others I'm aware of.

This slide depicts the process for identifying and addressing industry trends. In general terms, we apply statistical techniques to each of the indicators in the program, and we look for what amounts to an upward trend in any of the trend lines. If we saw an upward trend, we would take a look at the underlying issues and assess the safety significance. For example, if SCRAMS were to go up, as Pat alluded to earlier, there's many reasons for SCRAMS to go up, but that would be our first indicator that we need to go take a look at the underlying causes.

Based on what we found and the safety significance of what we found, we would then take the appropriate Agency response in accordance with our processes for addressing generic issues. These processes are the generic communications process in NRR and the generic safety issues process in the Office of Research. Finally, there's an annual review as part of the Agency action review meeting, and this is a group of senior managers of the NRC.

This is a snapshot of the results of the ITP for fiscal year 2001. Bottom line, we have identified no adverse trends based on eight indicators that were developed by the former Office of AEOD as well as the Accident Sequence Precursor Program. We are trying to develop additional indicators that are derived from the plant-specific information submitted as part of the ROP. They would cover all the cornerstones in the reactor oversight process. We initially kicked off this program in April of 2000, so we do not yet have four years worth of data. However, we did --

MEMBER POWERS: You mentioned the ASP Program, that you didn't find any trends. Did you happen to look to see if there was any trend for shutdown accidents to be more or less prevalent than they had in the past? The ASP important accident events.

MR. BOYCE: I'll take the first cut and then perhaps Pat will fill in. As part of the industry trends program, we use a single indicator which is total counts of ASP events, and so shutdown events would just be a small subset of that, we hope. And there was --

MEMBER POWERS: A big subset of that?

MR. BOYCE: Well, actually, I don't know because we didn't look into it, but Pat's group produces a separate SECY paper for the ASP Program, SECY 02-041, I think, was the most recent one. I don't know whether that issue was addressed as part of that Commission paper.

MR. BARANOWSKY: Yes. We do look at shutdown events in more of an ad hoc manner, because we don't have the tools for shutdown analysis that we have for the at-power conditions.

MEMBER POWERS: Why don't you have those good tools?

MR. BARANOWSKY: We're trying to develop them based on resources available.

MEMBER POWERS: Why don't you have more resources available?

MR. BARANOWSKY: You would have to talk to the powers that be.

MEMBER ROSEN: He is the powers that be.

(Laughter.)

MEMBER POWERS: What particular suite of language should appear in our research report that would say these guys have been struggling along unable to analyze shutdown precursor events with any kind of adequacy, and they need the tools to do that better, and therefore should have resources to do that better.

MR. BARANOWSKY: To be fair about it, if that was said a few years ago, we probably would have the tools now, but we are embarked on getting those tools in place. I don't know that we could go any faster than we can right now, because we have to have people who can manage the work and who can do the work, and there's just limits to who's available.

MEMBER POWERS: I've heard that story for four years, Pat.

MR. BARANOWSKY: I don't think so.

MEMBER POWERS: We're working on this stuff, we're working on this stuff, we're working on this stuff.

MR. BARANOWSKY: We actually have schedules now.

MEMBER POWERS: And I've got Steve over there telling me that the world -- the spin angular momentum of the Earth is about to come to an end if we don't put better attentions to shutdown risk.

MEMBER ROSEN: Dana always exaggerates the importance of my remarks. I'm grateful but it's not quite the spin angular momentum that's --

MR. BARANOWSKY: The shutdown risk, from what we've seen, is not 50 percent of the accident sequence precursors, and I'm fairly confident that it's not that high.

MEMBER ROSEN: What did you say?

MR. BARANOWSKY: I don't believe it's 50 percent.

MEMBER ROSEN: Of what you've seen so far.

MR. BARANOWSKY: Of what I would see if I did even a really complete accident sequence precursor analysis.

MEMBER ROSEN: Your zero information guess it would be one-sixteenth of the set of ASP events. So I mean if it's anything more than a sixteenth, Steve's probably right.

MR. BARANOWSKY: Yes.

MEMBER ROSEN: The spin angular momentum of the Earth is --

MR. BARANOWSKY: It's about 20 percent or so, it looks like.

MEMBER ROSEN: I've got a calculation for you right now. It only applies -- the real risk is PWR. Two-thirds of the plants are PWRs. It's half of the risk of two-thirds.

MR. BARANOWSKY: I'm saying around 20 percent.

MEMBER ROSEN: That's two-twelfths, right?

CHAIRMAN APOSTOLAKIS: Two-sixths.

MEMBER ROSEN: No, two-sixths, right, half of the risk of two-thirds.

CHAIRMAN APOSTOLAKIS: Which is one-third.

MEMBER ROSEN: One-third.

MR. BARANOWSKY: Which is well within the uncertainty.

MEMBER POWERS: Yes. And the zero information guess would be six percent.

MEMBER ROSEN: Right. Define high. I say it's six times that.

MEMBER POWERS: Yes. So you're saying it's six times that. And these guys don't have the tools to analyze it exactly. I mean, you know, if I were you, I would really complain. You're just not getting the support you need.

MR. BARANOWSKY: Well, as I said, we are developing the tools now. I believe the Commission has pretty much said we need to get on with developing the accident sequence analysis capabilities and SPAR models for the spectrum of capabilities --

MEMBER SIEBER; When do you shutdown?

MEMBER POWERS: When do we see the shutdown?

MR. BARANOWSKY: I believe so because we've provided that in our budget discussions, and there seems to be support for it.

CHAIRMAN APOSTOLAKIS: Shutdown and fire what?

MEMBER SIEBER; Shutdown and fire and

operations is, in my opinion, guessing -- a third, a third, a third.

MEMBER ROSEN: That's the whole --

CHAIRMAN APOSTOLAKIS: Is that what the Commission said, Jack.

MEMBER SIEBER; That's what I'm saying.

CHAIRMAN APOSTOLAKIS: Oh, you're saying that.

MEMBER SIEBER; So fire and operations.

MEMBER POWERS: Let me ask a question. Where would I go to look at the program plan for developing these tools?

MR. BARANOWSKY: That's excellent. I believe we've supplied, but we'll supply you again, with the SPAR model development plan, which includes this information, and I can guarantee you'll have that shortly.

MEMBER POWERS: And I'll be just delighted and thrilled.

MR. BARANOWSKY: You'll call me up you'll be so delighted.

CHAIRMAN APOSTOLAKIS: And the spin angular momentum of the Earth will be preserved.

MR. BARANOWSKY: Preserved.

MR. BOYCE: All right. Thanks for

fielding that one, Pat.

MEMBER POWERS: Now, wait, you don't get away scott-free here.

MR. BOYCE: Oh. Well, I'm sure there will be other opportunities.

MEMBER POWERS: Okay. What about the inspection force? What kind of information do they get?

MR. BOYCE: Well, you're right, I didn't want to draw fire, but I did want to say that we're not just doing PIs as part of our oversight of licensees. We do have inspectors that go out in the field and are looking very closely at these things, and we do have inspection procedures that are tailored to shutdowns. Part of that inspection process --

MEMBER POWERS: Okay. So they find something now. They want to do a significance determination process. What do they do?

MR. BOYCE: Well, there is a shutdown SDP. There are many deficiencies in that shutdown SDP.

CHAIRMAN APOSTOLAKIS: Based on what? How did they develop it?

MR. BOYCE: Perhaps we can come back on this before I --

CHAIRMAN APOSTOLAKIS: Yes. Okay. I

think we should.

MR. BOYCE: -- get in trouble here. But --

MEMBER POWERS: Well, I think you should -- you and Pat ought to get together and go complain to the powers that be. You're not getting the support you need.

CHAIRMAN APOSTOLAKIS: Well, if there has to be any complaints to the powers, I want to add a couple things.

(Laughter.)

CHAIRMAN APOSTOLAKIS: Whoever has the most power will maybe have a meeting about complaining.

MR. BOYCE: Let me point out another, perhaps, weakness in our program right now. The performance goal measure talks -- really only looks at trends, and if you look at the indicators that we have right now, they start in about 1998 -- 1988, excuse me. And those trends, most of them show an exponential type of decay, and some of the indicators might be approaching asmototic limits in terms of improvements in performance. It's very difficult to say that for sure, but that's what it looks like it appears. And so it's inevitable that at some point we'll have a trend line that goes up. And what we're trying to do is rather than be tied to our process that would have us react to something that may or may not have safety significance, we're trying to establish thresholds based on the safety significance.

An example would be SCRAMS. Right now, we're averaging about 0.85 SCRAMS per plant per year, whereas back in 1988, plants were averaging on the order of two and a half to three SCRAMS per plant per year. So if there was an uptick of 0.85 to one, we're not sure that that would be a change in the safety performance of the plants, and so we're trying to establish a rational basis. And that's most of the development work that's ongoing, and I'll get to that in just a second.

If we are able to develop these more risk-informed thresholds and get them in place, it would enable us to change the performance goal measure to something similar to what the Accident Sequence Precursor Program uses, which is something like no more than one ASP event per year. It would mean no more than one indicator exceeds a certain threshold per year, just to provide an example of our current thinking.

Finally, we're also developing additional indicators that we might be able to use in the program. An example is we developed on the order of 15 initiating event indicators. Those were provided in SECY 02-058, which I think you have a copy of. And we're taking a look at those and seeing the applicability of the program. One of the -- for example, steam generator tube ruptures is a very infrequent event that you can't really monitor well on a plant-specific basis, but you can do a lot better monitoring them on an industry level, so we're taking a look at those.

MEMBER POWERS: And it's really remarkable, because when you look at that -- and, like you say, you can't ask real detailed questions because it doesn't happen often enough to do that -- but if you take broad integrals, it's constant. It's a constant rate of steam generator tube ruptures. I mean it defies logic. I mean you would think it would go up as steam generators get old, but it doesn't seem to.

MEMBER ROSEN: Well, that's because a lot of steam generators are being replaced. They're not getting older, on average.

MEMBER POWERS: But there was a period of time they were.

MEMBER ROSEN: Well, that's true.

MEMBER POWERS: And it didn't change.

MEMBER ROSEN: But that's because the industry made heroic efforts to avoid those kinds of things in that time period.

MR. BOYCE: And I think the NRC oversight helped and contributed, just to put in a plug.

(Laughter.)

MEMBER ROSEN: This had something to do with it and that's the degree of heroism required.

MR. BOYCE: A lot of these initiating events were based on the work that was done earlier in NUREG 57.50, if you're familiar with that NUREG. And we're also trying to bring up to date some of the system reliability and component reliability studies that research has done in the past.

The rest of this presentation describes where we are in terms of threshold development, and what we'd like to do is just give you an introduction here and then come back sometime this fall to give you more details on where we are. We would probably piggyback with the MSPI work that's being done. I'm not sure we need at least two more presentations, as Pat talked about, but we'd definitely like to come back.

CHAIRMAN APOSTOLAKIS: In November.

MR. BOYCE: Probably the most important bullet here to take away is that industry thresholds differ from plant-specific thresholds in that while we're working on models for each of the plants and we're getting there, there isn't an industry-level model right now, and so the challenge is to come up with a rational way to get an industry-level risk.

MEMBER POWERS: Maybe I didn't follow. Why would I want to have this?

MR. BOYCE: Well, what we're trying to do is get to the -- if you have a model to use -- well, we don't have a model, but what we're trying to get to is risk-informed thresholds.

MEMBER POWERS: But why wouldn't I want to make those -- I mean I'm surprised that Dr. Apostolakis isn't climbing down your throat right now saying, "The one thing that we've learned in all of our risk studies is it's very plant-specific." Why aren't you climbing down his throat, Dr. Apostolakis?

CHAIRMAN APOSTOLAKIS: I wasn't paying attention.

(Laughter.)

MR. BOYCE: Well, I think I --

MEMBER ROSEN: Let me suggest a different strategy perhaps or a strategy. But is it not true that the risk of the industry today, a snapshot, is the sum of core damage frequencies over all the plants divided by the number of plants?

MR. BOYCE: That's, in essence, really what he's talking about, and that's why, for instance, when you trend steam generator tube ruptures, you know, they're made of all individual plants and hardly any of them have tube, but you want to know what's happening in the industry, you look at the collection, but it has to be in a risk context so that when you count these things you don't weigh things way out of balance incorrectly. So I'm agreeing with what you're saying. I don't have all those models in place. I think I was agreeing.

MEMBER POWERS: He's just giving you a real nice model. He says get the industry by doing the plant-specifics and selling.

MR. BOYCE: Actually, that is one of our options that I'll get to. Some of this is a --

MEMBER POWERS: Why would you want to do anything different?

MR. BOYCE: Timing. We need something in place sooner. The SPAR models aren't going to be available, and licensees, PRAs may give slightly different results than the SPAR models, and we need to come to agreement with all the stakeholders as to what constitutes the appropriate model to use. So we're trying to get thresholds sooner. It may be that we do get to exactly what you just described.

MEMBER ROSEN: I'm not sure I understand your -- I don't know whether your answer -- understand your answer. I mean after all, you can call up the risk supervisor at each plant and ask him what his current CDF is. Of course, it changes as they do Bayesian updates, but you could get a snapshot. He'd say -- and you'd have to make your question quite specific. You'd say, "Give me your best shot at your internal events plus shutdown where your interval events, if it includes fire, not giving a separate fire number." So the guy gives you three numbers and you add them up and you do that to the next plant. Now, there are some plants that are not going to give you all those numbers. You have to have a little asterisk in your column where you make an estimate maybe, but at the bottom of the line, you're going to -- at the end of this, you're going to construct a table and you're going to press a button and it's going to add it up --

CHAIRMAN APOSTOLAKIS: Isn't that already in the IPE?

MEMBER ROSEN: IPE, so, you know.

CHAIRMAN APOSTOLAKIS: Well, we start with that, but then we make the phone calls.

MEMBER ROSEN: Yes, you make the phone calls, because IPE is so far out of date, you know, that was 1988. It's 20 years --

CHAIRMAN APOSTOLAKIS: That's when the letter came out, the IPEs were done later. But you're right, I mean there will be updates and so on. But the point is that you can have a table tomorrow.

MEMBER ROSEN: Yes.

CHAIRMAN APOSTOLAKIS: And then start calling people to --

MEMBER ROSEN: Well, yes. You could have a table from IPE tomorrow or you could have -- in two weeks, you could have this other table.

CHAIRMAN APOSTOLAKIS: That's correct.

MR. BOYCE: Okay.

CHAIRMAN APOSTOLAKIS: My experience with this thing is that it takes about two and a half to three years for people to go to plant-specific stuff. I don't know why. Look at the ROP. Now they're talking about plant-specific. This is a semi-empirical observations.

MEMBER ROSEN: But what is it that takes two and a half years? I'm asking.

CHAIRMAN APOSTOLAKIS: They initial the system.

VICE CHAIRMAN BONACA: If we keep this way, it will take two, three years to finish this up.

CHAIRMAN APOSTOLAKIS: And that will be -- okay, let's move on.

MR. BOYCE: The other thing I'd like to point out is this approach lends itself most readily to the initiating events in mitigating systems cornerstones. There's five other cornerstones where we do need to develop some sort of indicator, and those other cornerstones, as examples, are things like occupational radiation exposure, public radiation exposure, emergency preparedness, safeguards and physical security. And the approach that we're talking about here it would not be applicable in those cornerstones.

So having said that, what we're going to try and do is develop a -- jump ahead on my slides -- develop an expert panel where we would build on the work done in the initiating events and mitigating systems cornerstones and see how it might apply to the other cornerstones and try and look for consistencies in approach, not just risk approach but also statistical approach.

So bear with me and let me complete the presentation. In concept, we're looking at a couple of different kinds of thresholds. The one we've talked about up to this point could be termed an action threshold. It's where we actually take an Agency response, a preprogrammed Agency response and we would also report it to Congress. We could also contemplate more of a lower threshold which would give us more of an early warning that there is something developing. And this might -- we're not really sure how we might use it, but it might lead to information notices sent out to industry or perhaps generic safety inspections by the staff. In addition, we may continue to monitor trends so that we can identify issues before it manifests themselves as safety problems in our indicators. Next slide.

Here's some of the characteristics we'd like in thresholds. Next slide. This slide talks about the process for establishing the thresholds. The important element here is we're going to establish an expert panel, give them inputs from risk and statistical information. We're going to have experts on that panel in each of the cornerstones, and we're going to try and come up with a rational basis for establishing the thresholds.

CHAIRMAN APOSTOLAKIS: You know, as part of the input to the panel, you can do what Mr. Rosen suggested, develop the table, plant-specific stuff, and give it to the panel and let them process it.

MR. BOYCE: Right.

CHAIRMAN APOSTOLAKIS: That would be a simple thing to do. If they decide to come back with generic thresholds, then that's their judgment, but I doubt it. But they probably could --

VICE CHAIRMAN BONACA: You'll have apples and oranges in that table. That was the only --

MEMBER ROSEN: Yes. There's a lot of apples and oranges now.

CHAIRMAN APOSTOLAKIS: What if you have generic thresholds, then what do you do? You take the apples and oranges and make a fruit salad.

VICE CHAIRMAN BONACA: I understand. All I'm saying is if you get an expert panel, let them -- hopefully they'll be expert enough to try to sort out --

CHAIRMAN APOSTOLAKIS: But they don't have access to this information. Not every expert reads the summary reports. This is just an additional input and let them take care of it.

MEMBER ROSEN: One comment on apples and oranges. The peer certification process is making it more like apples like two kinds of apples: Granny Smith apples and red delicious apples. Because it's forcing a convergence of the numbers, so that's a good thing.

MEMBER POWERS: Yes. Well, I think George would argue that it's forcing a convergence to crabapples.

MEMBER ROSEN: Well, having gone through one recently, I know for sure that it's forcing improvements. Now, if it's forcing improvements as much elsewhere as it was in the plant that I'm familiar with, then that's a good thing.

MEMBER POWERS: The ones I'm familiar with you're right, it's certainly forcing some people to make some -- I mean I think everybody ends up having to make some changes and improvements in their PRA. But I think George would argue it's improving to a consistent level of mediocrity.

MEMBER ROSEN: I don't think so. Hossein, what do you think? You know the peer process pretty well.

MR. HAMZEHEE: I'd rather be quiet today.

(Laughter.)

MEMBER ROSEN: I don't want you to. You know too much. I'd like to hear what you think.

MEMBER POWERS: I mean I think the point that George would make if he weren't being so quiet over there --

CHAIRMAN APOSTOLAKIS: Shy, I'm shy.

MEMBER POWERS: -- uncharacteristically quiet, retiring, is there is not yet such a strong incentive for the licensee to lean forward in the trenches in PRA technology, because the benefits are not so transparently coming to him.

MEMBER ROSEN: Yes. I think that's true about leaning forward in the trenches, doing new things, and that's a little bit why I was proselytizing about the selection of the usual suspects in previous presentations. But as to coming up to the level that's expected in the peer certification, that is happening, so there's a push there or a pull up to that level. Beyond that, yes, you're correct, there's not a whole lot of incentive to --

VICE CHAIRMAN BONACA: On the other hand, we have groups of plants out there, okay, where if you go and look at their stuff, they have to support the development and dimensions of the PRA. They have roughly one person here or less oftentimes versus this program, some of them have had four people assigned to one plant for ten, 15 years. And that is not changing. That's where I'm saying --

MEMBER ROSEN: That's where you're wrong. I think what's happening in the industry is there is more manpower going into this across the board.

VICE CHAIRMAN BONACA: I'm not denying it is increasing but just two years ago we went to see a plant and we had one person there. And we're talking about Davis-Besse, and now you're about to bring Davis-Besse into this process.

CHAIRMAN APOSTOLAKIS: It was amazing the kind of stuff he was promising to do.

VICE CHAIRMAN BONACA: Yes. It was amazing what they promised that they would do by October, including the update and everything else. What I'm trying to say -- and I don't want to make point of Davis-Besse -- what I'm saying is there's an unevenness there that still are --

MEMBER ROSEN: Yes. It's clear that there's an unevenness, but I think that the trend is in the right direction across the board. There will be places where it's very uneven. And it's to the point that it's a Level 3 with one person. When you get two people, then you realize you can only do a Level 2. You get six people, then they start complaining they really can't do the Level 1 right.

CHAIRMAN APOSTOLAKIS: It goes back.

MEMBER ROSEN: And when you have South Texas with a dozen people, then the whole thing's a mess, because that's when they find all the problems.

CHAIRMAN APOSTOLAKIS: We are really running out of time here.

VICE CHAIRMAN BONACA: Can we please -- yes, let's complete this presentation.

CHAIRMAN APOSTOLAKIS: Do you have any conclusions?

MR. BOYCE: That we'll come back to? These are some of the technical approaches. Some of them are statistically based, some of them are PRA-based. One intriguing one is to follow the example set at the MSPI and perhaps, and Pat alluded to it, we develop a roll-up indicator for the initiating events. We have right now on the order of 15 initiating events, and we may be able to roll them up into a single index. That's tipping our hand a little bit. We're exploring that heavily right now. Or some combination of the above. And we'll get back to you.

CHAIRMAN APOSTOLAKIS: Good.

MR. BOYCE: Here's some of the technical questions. I won't go through them, but there are several questions that have been brought up as part of this forum that we also need to look at.

CHAIRMAN APOSTOLAKIS: Why does Congress want this information?

MR. BOYCE: Well, I'm not sure I have the background answer to that question, but --

CHAIRMAN APOSTOLAKIS: What do they do with it?

MR. BARANOWSKY: I can answer it. It's required of all agencies through the performance and accountability reporting requirement to pick agency-wide performance indicators that are a measure of how well we're doing.

CHAIRMAN APOSTOLAKIS: Oh, so it's just an --

MR. BARANOWSKY: For instance, the FAA might have certain accident or near-miss rates that they track. We track precursors, we track performance of plants and other things, there's a lot of things. And so we're required by law to do that.

MR. SATURIUS: And we picked them. We did it to ourselves. We picked the no significant adverse trends as a reporting requirement.

CHAIRMAN APOSTOLAKIS: Okay.

MR. BOYCE: That's part of the GPRA, Government Performance and Results Act of 1993. My answer was why does Congress want to know about all the details that we're providing at a high level if we exceed one of these thresholds, and it's to keep them aware of what's going on in the nuclear industry.

CHAIRMAN APOSTOLAKIS: Okay.

MR. BOYCE: All right. Schedule? This you've not seen before. At the Subcommittee, we didn't have this particular slide. But we've asked Research to give us thresholds for the first two cornerstones by the end of July. We would digest those, interact with stakeholders from industry, we'd come back to the ACRS and we would try and use those and, as I said, expand the approach as it can be applied to the other cornerstones.

We think we'll have thresholds for the other cornerstones in about the September time frame. We're going to be looking at changing the performance goal measures sometime this fall. That would be part of the budget process. Somewhere in here we're going to be coming back to the Subcommittee, and, again, that would be piggybacking on the MSPI. We've got our annual Commission paper in March of next year, and we think we'll have final thresholds developed an in place sometime during FY '03. That would conclude my portion of the brief.

VICE CHAIRMAN BONACA: And we'll be glad to have an update in the fall, piggyback on the other one, performance indicators. Thank you for the presentation. Any questions? If none, back to you with ten minutes.

CHAIRMAN APOSTOLAKIS: We did? Okay. Thank you very much. We'll recess until 4:10.

(Whereupon, the foregoing matter went off the record at 3:56 p.m. and went back on the record at 4:12 p.m.)

CHAIRMAN APOSTOLAKIS: Quiet. The last topic of the day is technical and policy issues related to advanced reactors. Dr. Kress will Chair the session.

MR. KRESS: Thank you, Mr. Chairman. The fact that we have such high-powered and respected people here attests to the importance of this issue. You know, with the new technology in advanced reactors, it may be difficult to figure out how to fit them in to the current licensing system. And in the process of doing so, there are a number of policy and technical issues that will have to be faced up.

And, you know, I've articulated a number of these in the past, and the staff is making some studies to I think go to the Commission with, and say, "These are the policy issues that we need to resolve before we can proceed to license or certify these advanced reactors." So we're going to hear about the -- I guess it's still a preliminary document this time, and I guess either Ashok or Farouk is going to start us off.

MR. ELTAWILA: I see that Ashok is the lead presenter, so I'm here to support him.

(Laughter.)

MR. THADANI: Not correct. We'll take care of that in a moment. Farouk is actually going to go through the presentation. But I do want to share some thoughts with you. We had a -- we briefed the Commission on March 19 on research programs and again towards the end of May, and Tom participated in that meeting -- Commission brief on advanced reactors. One of the things I noted during our brief was the absolute importance of making sure we lay out, particularly for non-light-water reactor technologies, we lay out a clear understanding of what our expectations are in terms of safety. And you'll hear a little bit about safety goals, their incompleteness and a number of issues related to the whole concept of defensing that.

And I indicated that the point that it would take great deal of intellectual capital to be able to develop these things, and they would require -- my view is they would require interaction and discussions with a number of people who have had considerable experience in sort of thinking about these safety principles and where is the country going. What is really meant by this expectation that the future reactors would be safer than the current class? What does that really mean?

So we've just started. We're looking forward to, I think, considerable dialogue with you, and we'll be talking to others. We're looking at some options of what sort of help we need to get to go forward in this particular area. And then there are the technical issues. Our intention is to get some information up to the Commission fairly soon, but we do need to get the research plan to the Commission I think it's fall of this year. And before we do that, we would like to have some of your thoughts reflected in the paper that we'd like to send to the Commission.

With that, I think Farouk is going to

raise all the key points.

CHAIRMAN APOSTOLAKIS: When is the paper going up, Ashok?

MR. THADANI: I think fall of '02.

CHAIRMAN APOSTOLAKIS: The fall?

MR. THADANI: Do we have a date?

MR. ELTAWILA: The final paper is last day of fall, so December 22. Christmas.

(Laughter.)

CHAIRMAN APOSTOLAKIS: This is the only ACRS meeting?

MR. ELTAWILA: No, no. This is what we send you a pre-decision, a copy of that paper for your consideration. That paper is going to the Commission this coming June just to try to scope the problem and the issue that we are working on. And then we'll have public workshop, discuss the issue in public workshop, have another discussion with you.

So just to start wit the discussion here, this is an outline of my presentation. I'm going to start with the purpose of the briefing and give you some background about some of the advanced reactor issues that we are working on. And as Ashok indicated, the Commission has certain expectations about enhanced margin of safety for advanced reactor, so I'm going to touch on that briefly. And I'm going to discuss relationship to international center.

In this presentation and in the paper that you have, we focus on five policy issues that have technical basis, but there are a lot of other policy issues that are addressed in other Commission papers. I'm going to touch on them, but I'm not going to get into them in detail.

The five policy issues here, the reason we group together in this paper, because they are all interrelated. If you work on one of them or any decision that we make on one of them will affect the other decisions. That's why we would like to address them in group. And then I will discuss our future plan later.

MR. KRESS: Farouk, I presume among those five issues assume among them would be the role that PRA and high-level risk acceptance criteria might play. That's cross-cutting through all of them.

MR. THADANI: Yes. And it is one of the major issues.

MR. ELTAWILA: That's the first issue, event selection and role of PRA that's embedded in that issue.

MR. KRESS: That's embedded, yes.

MR. ELTAWILA: And we have Scott Newberry and Mary Drouin here to help me if I stumble on anything.

The purpose of the briefing, I think we -- originally, we thought that we are going to wait until we finished the pre-application review of the Exelon PPMR before we go to the Commission on Policy Decisions. With the cancellation of the PPMR, we recognized that I think that these policy issues are of vital importance to the advanced reactor type of the gas reactor type, the PBMR and GT-MHR. And we have done work in the past in this area.

So based on the work that we have done thus far with Exelon and the work that we have done in the '80s and '90s on other advanced reactor type like the CANDU and MHTGR, that's the old GE design, we believe that we have sufficient information right now to go to the Commission with our recommendation on the policy issue.

CHAIRMAN APOSTOLAKIS: But did the Exelon action have any impact on the policy issues that you are proposing? I mean it seems to me that you have more time now, don't you?

MR. ELTAWILA: We don't believe -- we have more time, but I think it will be much better if the

Commission makes its expectation clear. If we make our expectation clear, what is this future design going to look like, what's the capability that we require of this design, the designer will be able to cope with that and incorporate them in their design. If we wait until we have a design here to review, our decision might impact them and cause a backfit and things like that. So it's better.

CHAIRMAN APOSTOLAKIS: It's better because you have more time to think about it.

MEMBER WALLIS: Well, I think it's very appropriate that you set the rules before the design.

MR. ELTAWILA: That's what we're trying --

MEMBER WALLIS: Because the safety would be enhanced, because they will design to the rules, not to try to fix them after.

CHAIRMAN APOSTOLAKIS: You used the word, "cancellation." I'm not sure that's what Exelon used.

MR. THADANI: No, it's not cancellation. It's that they're getting out of this business. But let me -- I'm glad -- the points that Graham are very important. You recall we talked to you about the vision and mission of the Office of Research some time ago, and in that is one element which is making sure the Agency is prepared for future challenges and is not an impediment to any specific technology in terms of saying -- someone comes to the table and we say, "Well, it's going to take us seven years." So it is essential for us, we believe, to go forward and for us to be setting some ground rules, which the designers, as Farouk noted also, can take advantage of. There would be -- I think this actually is a much more stable way to go forward.

CHAIRMAN APOSTOLAKIS: Yes. But my point is that if you had an application, say, coming in the next year or so, then you look at these policy issues perhaps with a different eye, and say, "Well, gee, how much of the current system can I use, " and so on. And now that you have a little more time, it seems to me the policy issues should be a little different, and they should be really what they ought to be.

MR. THADANI: Yes. And one other piece of information I want to give you is I have talked to the Department of Energy to get their sense of what they see future is going to look like.

CHAIRMAN APOSTOLAKIS: Right.

MR. THADANI: And they continue to tell me, I've had discussions with Bill Magwood. He continues to tell me that he sees the gas cool technology in the future for this country. So he still believes it's an important element.

MEMBER POWERS: Ashok, Magwood's just come down with his definition of what his Gen-4 reactors are, and he's come up with six. He's got a gas coolant fast reactor, he's got a -- are you ready for this, Tom?

MR. KRESS: I know what you're saying.

MEMBER POWERS: A molten coolant reactor.

MR. KRESS: Yes.

MEMBER POWERS: He's got a --

MEMBER ROSEN: Liquid metal reactor.

MR. KRESS: Yes.

MEMBER POWERS: -- metal reactor. He's got something called a lead battery, which is kind of hilarious. Super critical water reactor, and then he's got the one that's the cat's meow of them all, a very high temperature gas reactor.

MR. KRESS: Right.

MEMBER ROSEN: Remember, those are reactors that their Gen-4 Program has been studying and for implementation into 2030. This is not next year.

MR. THADANI: That was going to be my point. There's a distinction here, and Bill Magwood made a presentation recently, I think to the

Commission also, and he pointed out what he believes over the next ten years is likely to happen. And then Generation 4 basically is 2030 to 2050 is what --

CHAIRMAN APOSTOLAKIS: Just about the time when we'll retire, right?

MR. THADANI: I want to enjoy a few years of my life.

(Laughter.)

MR. KRESS: But I think the policy issues that you selected address all those reactor types.

MR. THADANI: That's exactly right.

MEMBER WALLIS: George, you can tell your grandchildren then that you had a role in making this possible when it happens.

CHAIRMAN APOSTOLAKIS: What do you mean? I'll still be on the ACRS.

(Laughter.)

CHAIRMAN APOSTOLAKIS: Let's go on, Farouk.

MEMBER ROSEN: But I want to be sure -- before you go on, I want to be sure that the outcome of that is, I understand, is that we're going to move forward in a way to enable those things to be possible, not just look at gas-cooled pebble bed reactors. Is that correct?

MR. THADANI: Yes. I think a lot of this will really aid, not just in terms of gas-cooled technologies but other technologies as well, yes.

MEMBER ROSEN: It should.

MR. ELTAWILA: I want to make a point here that these five issues are not new. We have interacted with these issues with another ACRS committee in the '90s and the Commission, and we issued the SECY 93-092, same five issues. And the Commission approved the staff recommendations in an SRM dated July 13, 1993, but because of the change in Commission, the ACRS, the staff and our experience with risk-informed regulations, all of these led us to go and revisit these issues, put them back in front of you. We'd like to get your feedback and then go to the Commission with either the same recommendation or different recommendation, but they are not new issues.

MR. KRESS: Yes. The resolution of those issues were LWR-specific, as best I remember, back in '93.

MR. ELTAWILA: And they were written in terms of the CANDU, the MHTGR, or whatever it was, and the Pius. So they were really for the advanced reactor in general, not for the light- water reactor. We would like to have a continuous interaction with you. For example, at this stage, what we'd like for you to see if we identified this issue, provide enough clarity about them and what is your views about them? Eventually, it will come back to you after we have interaction with the stakeholder and discuss our final recommendation to the Commission. Whether you send us letter now or towards the end, that's completely up to you.

CHAIRMAN APOSTOLAKIS: At the end, you will want one.

MR. ELTAWILA: We definitely will want one at the end, but if you want to send us one right now to help us, that would be --

MR. THADANI: We would appreciate it, certainly, even if you have any views that you want to put forth, be they in our discussions or if you want to advise the Commission if you disagree with anything that we say here or in the paper.

MR. KRESS: We can certainly do that. I don't know if we can address that third sub-bullet under the third bullet yet, but we can give you comments on the first two sub-bullets.

MR. ELTAWILA: Okay. That would be great. As I indicated earlier, we have other activities where we are developing a risk-informed performance-based regulatory framework. That will be a technology-neutral framework so we can use it for any kind of reactor design. I'm not going to talk about it here, but it's going to be a part of the RIRIP updates that's due to the Commission in June of this year.

MEMBER SIEBER; I would hope that it's not a two-stage either/or system between deterministic and risk-informed for advanced reactors. I would like to see it just risk-informed to sort of force the context into that kind of thinking as opposed to giving alternatives.

MR. ELTAWILA: It's not alternative. It's together, I believe, that's whenever it's possible that you can use the performance-based regulatory framework --

MEMBER SIEBER; That would be the requirement to use that.

MR. THADANI: I think, certainly, there will have to be some sort of high-level risk-informed approach.

MEMBER SIEBER; Right.

MR. THADANI: But that -- when you go to some specific designs --

MEMBER SIEBER; There will be determinants.

MR. THADANI: -- you might find there is such limitations --

MEMBER SIEBER; Right.

MR. THADANI: -- in trying to meet those high-level goals that you may have to resort to some other considerations.

MR. SALSBERG: No, but you won't have alternative rules.

MR. THADANI: No. Our intention is not to have alternatives.

CHAIRMAN APOSTOLAKIS: And there will be no two-track system.

MR. THADANI: No.

CHAIRMAN APOSTOLAKIS: Two-tier system.

MR. THADANI: That's not the intent.

MR. ELTAWILA: Just for background information, we completed the preapplication review for the AP-1000, PBMR preapplication activities. We are continuing to work with Exelon, trying to close out and document where most of the information that we received on our request for additional information. We expect additional preapplication activities, like GE is meeting with us sometime this month about GE-ESBWR, which is a 1,200 megawatt electric, which builds on the ABWR and on the SBWR that was under review here at the Commission a few years ago. And Framatome is proposing SWR1000 and another is NG-CANDU, which is new generation CANDU. So all these are preapplication that's on the horizon, so the staff will be --

CHAIRMAN APOSTOLAKIS: Why do you say they're possible? Do you have any indications of anybody that they might actually come?

MR. ELTAWILA: They are all -- GE-ESBWR is coming to discuss --

MR. THADANI: They sent a letter in April.

MR. ELTAWILA: Yes, they sent a letter in April. We have a meeting with them this month. We had already a meeting with Framatome, and we're planning to have another meeting with them in August. NG-CANDU, or AACL, they are coming June 19.

CHAIRMAN APOSTOLAKIS: Oh, so there is already contact.

MR. ELTAWILA: There is a contact with these --

CHAIRMAN APOSTOLAKIS: What does ESBWR stand for?

MR. ELTAWILA: European Simplified Boiling Water Reactor, but eventually it will become Economics Simplified Boiling Water Reactor.

(Laughter.)

CHAIRMAN APOSTOLAKIS: So they will apply for a green card, I assume. The European reactor will apply for a green card?

(Laughter.)

MR. ELTAWILA: That's one of the policy issues that we need to discuss.

CHAIRMAN APOSTOLAKIS: It's a policy issue.

MEMBER ROSEN: We'll ask them if they have any business here, and they'll say, "No, not yet." And we'll say, "Well, come back when you do."

MR. ELTAWILA: Again, many of the issues that developed in the course of our review have resulted in generic policy implication, like the legal and financial issue, and we issued a SECY paper. We are planning to provide the Commission in the June time frame with a technical paper in conjunction with the policy papers. So to facilitate a policy decision, we want them to see the underlying technical basis for our recommendation.

VICE CHAIRMAN BONACA: What is the NG-CANDU?

MR. ELTAWILA: New generation CANDU. That's --

MR. THADANI: As I understand, it's slight enrichment -- I think they're moving away from natural uranium. And we would certainly be interested in getting better understanding of things like the coefficient and so on.

VICE CHAIRMAN BONACA: Yes. That was the one that has to be no good.

MEMBER FORD: I have a question. With all these reactors coming up for reapplication, how many of them can you in fact address, given the people, the resources you have?

MR. THADANI: Let me -- right now, there is a significant issue about budget. Obviously, the Commission has not made any decisions about 2004 budget, and they may want to make some changes even in 2003 budget before the Appropriations Committee does its thing for 2003 budget. Our plans currently do not include consideration of -- review of any designs other than an HGDR and AP-1000, and we have some limited resources we've identified in the outyears. I think it was -- Farouk, you'll have to correct me -- Iris, I think we put some in the outyears, some resources.

MR. ELTAWILA: That's correct.

MR. THADANI: So we could discuss with

Westinghouse and others the key thermalhydraulic issue and the testing issues upfront. So we put some resources for that. If ESBWR or SWR1000 or NG-CANDU come in, the Commission is going to have to make some decisions about how to do allocation of resources.

CHAIRMAN APOSTOLAKIS: But you have to respond if they come in. I mean it's not --

MR. ELTAWILA: That's correct.

MR. THADANI: Yes.

CHAIRMAN APOSTOLAKIS: You can't tell them we can't do it.

MR. THADANI: Well, we can say we can do it, but it seems to me one option would be to get in the line and maybe it will take us longer time because of resource considerations.

CHAIRMAN APOSTOLAKIS: That's the last thing you want to do. I mean --

MR. THADANI: I'm not suggesting that that's what -- it's a Commission decision in the end.

CHAIRMAN APOSTOLAKIS: Right.

MEMBER ROSEN: Is there a problem, to some degree, ameliorated by attempting to do things generically, to set some criteria generically?

MR. KRESS: Oh, yes, that would help tremendously. I think we're off the subject, though.

I mean this is your guy's business, you can figure that out.

CHAIRMAN APOSTOLAKIS: Maybe we can go to the issues at some point. Thank you, Farouk.

MR. ELTAWILA: You're welcome. I think one of the -- well, that's the important issue here, the Commission expectation about enhanced safety, what we mean by enhanced safety.

CHAIRMAN APOSTOLAKIS: Shouldn't we quantify them first, though, the margins, instead of talking about them?

MR. ELTAWILA: That's a very good question.

CHAIRMAN APOSTOLAKIS: Are you going to have it somewhere there to quantify the margins of safety?

MR. ELTAWILA: Not during this presentation. Hopefully, as part of our work, we will be able to try to come up with methodology to quantify the margin of safety.

CHAIRMAN APOSTOLAKIS: Yes. I mean I remember when we were discussing Option 3 here, Mary and your colleagues, what was it, a year ago. They agreed also that that would be something useful to do. In fact, you write it in the report. It's in the report that the margins of safety should be quantified.

MEMBER WALLIS: First of all, you have to --

CHAIRMAN APOSTOLAKIS: Because then you can have the --

MR. THADANI: That's right.

CHAIRMAN APOSTOLAKIS: Sorry?

MR. THADANI: First you need to -- when we talk about some high-level safety principles, it seems to me that they will have to incorporate within them some discussion of what sort of confidence level one is looking at at that level. If one were to define that, then one has to go forward and try and understand what the margins are and what do we really mean by certain level of confidence. And the thinking that we've gone through so far is that is the general path that we're going to have to at least consider and hear options and so on. As to where we end up, I don't know.

CHAIRMAN APOSTOLAKIS: In PRA, what we have really quantified so far is the defense in-depth measures.

MR. THADANI: Yes.

CHAIRMAN APOSTOLAKIS: But we have not

touched the safety margins.

MR. THADANI: Correct.

CHAIRMAN APOSTOLAKIS: We have taken the success criteria, as given to us by the vendor, and then we work with those.

MR. THADANI: That's right.

CHAIRMAN APOSTOLAKIS: Okay?

MR. THADANI: That's right.

MR. KRESS: When the Commission talked about enhanced safety margins for the advanced reactors, I think they had in mind a better safety status. It's not the margins we normally talk about.

MR. THADANI: I wanted to come back to George's point, because one of the things we don't do well -- whoops, I think I turned off something.

MR. KRESS: An SBO.

MR. THADANI: Nice to have some control here. In PRA, George, I guess common uncertainties are sometimes done well.

CHAIRMAN APOSTOLAKIS: Right.

MR. THADANI: But the model uncertainties are not done well at all. And what we're trying to do, and not just in the context of the advanced reactors, but we're trying to make sure that we have efforts underway to try and understand what sort of model uncertainties exist. And one of the issues that I'm exploring, the staff is looking at now, Farouk's staff is looking at, is if we want to modify 50.46 to look for functional reliability of ECCS, I suppose we establish some criteria, ten to the minus X, whatever it is. And we say but you should do realistic analysis, which is good.

Now, let me take you to another event path, if you will. I don't want to assume any systems failing, but I want to understand what things can go wrong in terms of the implicit models in the code. How much confidence do I have in that? Shouldn't there be some relationship of what one might call model uncertainties to establishing some system reliability requirements? And Jack Rosenthal in Farouk's division is going forward to take a look at that.

We're making slow progress, but those are the kinds of things I hope we'll take advantage of as we go forward on these new designs.

MEMBER WALLIS: Ashok, in a totally risk-based world, you wouldn't need margins of safety. I mean they would be inherent in your choice of the risk basis and you might -- you would be able to trade off margin here against margin there --

MR. THADANI: Exactly.

MEMBER WALLIS: -- that the risk basis would give you. And then you would be able to tell the public really that we're assuring a certain level of risk. And how it's done by the industry is up to them.

MEMBER ROSEN: But a totally risk-based world is impossible, because -- in principle, because model uncertainty, things that you don't know about, can't be included.

MEMBER WALLIS: I'm sorry, risk-based regulations can form. Not the world, it's the regulations, they can be risk-based. Then you have to deal with these uncertainties.

CHAIRMAN APOSTOLAKIS: In any case, the issue of margins is right now outside the PRA, essentially. I mean we are really working with the defense in-depth measures and we're quantifying them. If we have redundant systems, we know how to do that. We do this, we do that. We are not including, of course, passive areas, but it would be nice to have all those so we'll be able to make tradeoffs and have a better idea how well we meet the goals.

MEMBER ROSEN: I think some future reactors will have to --

CHAIRMAN APOSTOLAKIS: And these are future reactors.

MEMBER ROSEN: And we'll have to treat passive failures in future reactors in PRA --

CHAIRMAN APOSTOLAKIS: Sure.

MEMBER ROSEN: -- because of the nature of the design.

VICE CHAIRMAN BONACA: Although, I mean for new reactors you have such -- there's a challenge because databases are not available. A lot of information there is not, so there will be very large uncertainties.

CHAIRMAN APOSTOLAKIS: So we've had a long discussion on a slide that Farouk has not even described yet.

(Laughter.)

MR. ELTAWILA: So the Commission has expressed expectation in the advanced reactor policy statement and in the severe accident policy statement, for example, and both of them indicate that they expect the new design to have better margin or better safety than existing reactor.

Just to highlight two points that for the advanced reactor the Commission encouraged the simplified reactor inherently safe and use passive feature, although that's very good but it poses a tremendous challenge to PRA, because now the system is responding to phenomenology rather than a component failure. And we really don't have experience in doing that work so that the passive system reliability becomes an important issue.

CHAIRMAN APOSTOLAKIS: Let me come back to the previous sub-bullet.

MR. ELTAWILA: Okay.

CHAIRMAN APOSTOLAKIS: I guess B, "Safer than current reactors." You have to be very careful with that. And the reason why I'm saying this is several years ago DOE had an office and their highest priority was to build a new production reactor. That was before Mr. Gorbachev came to Washington to meet with Mr. Bush. And DOE being very ambitious, said that our new production reactor will be safer than the commercial reactors. Then when it came time to actually implement that they had a big problem. What does safer mean? Is it supposed to be safer than the best reactor out there? Is it supposed to be safer than the average? What does it mean?

And what was at stake was millions of dollars, okay? Because all it takes is a very progressive utility with an excellent reactor and so on to reach very low levels of core damage frequency, and then the new production reactor had to be safer than that. Okay? And they had the restrictions regarding the sites. One was Savannah River, the other one was somewhere else. Well, you know, the seismic risk was more or less there, so you have to be a little careful when you phrase these things.

MR. ELTAWILA: I agree with you. I'm going to give you my own --

MR. KRESS: That's exactly what he meant by this being a policy issue is what did the Commission mean by statements like that?

MR. THADANI: That's the point here.

CHAIRMAN APOSTOLAKIS: Well, then I'm just elaborating on it.

MR. THADANI: Let me read you something from I think this is the severe accident policy.

CHAIRMAN APOSTOLAKIS: This was a real case, though.

MR. THADANI: As you know, there are three relevant policy statements. One is severe accident policy statement, the other is advanced reactor policy statement and then the standardization policy statement. Those are the relevant policy statements that we're talking about. And I'm just -- let me quote from I think it's the severe accident policy statement. "The Commission fully expects that vendors engaged in designing new standard plants will achieve a higher standard of severe accident safety performance than their previous designs."

And the point here is there is some sort of expectation of improved safety. What does that mean? And that's the same question we asked, Tom was there, of the Commission. We need to be able to articulate what that really means.

MR. KRESS: And the Commission said, "You tell us."

MR. THADANI: Yes.

CHAIRMAN APOSTOLAKIS: Well, usually they would like to see some options, and then they pick around. What I'm saying is there was a real case where people were enthusiastic, it will be safer than the -- and then they had to eat their words. They just couldn't afford to be safer.

MR. ELTAWILA: As a minimum, provide the same degree of protection as current plants, and I think that's the second part. And I really think the issue of safer, and that's my own interpretation, is that there were a lot of uncertainties in the severe accident at that time and the expectation that by resolving this severe accident issue you will be able to understand them better and you can make a better safety case.

MR. KRESS: They can provide a higher level of confidence in your review of your safety.

MEMBER POWERS: When we started looking at probablistic approaches to, "Oh, we want to make plants safe," we very quickly realized that if you look at prevention systems, you can only go so far with them. Eventually, you get to the point where having redundancy and even diversity in systems actually starts costing you safety rather than helping. And so you had to have what has come to be called a balance between prevention and mitigation. And that became pretty much a pretty good guide for what we were trying to do in the area of safety.

Now we see people coming forward with more advanced reactors, and one that comes immediately to mind are the AP series of reactors. What you're saying, "Gee, we've done this PRA analysis on this thing, and our prevention systems are tremendous and they give us CDFs of ten to the minus seventh and things like that." And, you know, how do we react to that?

You can look at their probablistic risk

assessment, and if it's like most probablistic risk assessments, there are things you can quibble on, but you don't find things that say that this absolutely wrong, that the prevention systems just aren't this good. But, quite frankly, you don't believe it. And so do we still have to -- I mean do we have to evolve this concept of a balance between prevention and mitigation or are we just changing the balance between prevention and mitigation? Where do you see this going here?

MR. ELTAWILA: Again, that's one of the policy issues that we are asking the Commission, and I think I'm -- how about if we wait until we get to that issue and see the question that we're asking are the right questions and we'll see where we develop the technical basis for that.

MR. KRESS: I'd like to point out on the third bullet to the Committee that these guys have been listening to us. You could probably find every one of those in one of our letters or another.

CHAIRMAN APOSTOLAKIS: What does RIRIP mean, risk-informed rest in peace?

(Laughter.)

MR. ELTAWILA: That's exactly what it is. That's Commission definition of that.

VICE CHAIRMAN BONACA: On the question of should a higher level require that, I think simply by placing some requirements for containment for severe accidents from the current generation, you would already, in a qualitative sense, set up a higher level of expectation in safety. Right now we see everything which is severe accidents beyond design basis to make some portions of that part of design basis.

MR. THADANI: I think it's useful to touch Dana's point, it seems to me. AP-600, for example. I mean we had a clear path, clear guidance from the Commission as Part 52 of our regulations, and then referring to Part 50; that is, you meet our regulations, that you address all unresolved safety issues and high- and medium-priority generic safety issues, that you conduct a PRA and if it identifies areas for enhancement, you conceded those.

And then we went beyond and we looked at their words about reliability of decay heat, both in the context of core damage and containment response. And we looked at some challenges to containment, particularly early challenges, to see what sort of features could be added to significantly reduce those threats. And there's no question, at least in my -- well, in addition to that, obviously, the rule says they need to meet our safety goals also.

Now, one can always use that approach, but is that the most efficient way for new designs? And my own sense is that there is a better way to go at it. But it needs to be borne out through some real work, and we're just at the beginning of that.

MEMBER POWERS: I mean your first policy issue hints at the problem. We can go ahead and say, meet the safety goals and they'll have exactly the same problem the current plants have, and it's very difficult to tell whether you are or not, so you end up using a surrogate. And you raise that question of the current metrics, and I've seen a lot of people raising that question, and for the life of me it puzzles me. Because I look at CDF, core damage frequency, and I say, well, some of these reactors don't undergo core damage the way I look at core damage, but I sure as hell know what a core damage event in them is as much as I do one in a zircalloy clad oxide fuel one. I mean it didn't strike me as a tremendous leap of imagination has to be gotten to change that CDF into -- I mean you're just changing the letters a little bit, but then number's about exactly the same.

MR. THADANI: I think the point here is

more than just the CDF itself. Do we want to stay with the same value of LERF that we've been using? Do we want to stay with the statements we made for AP-600 and others, 24-hour containment integrity for those certain threats? Is that what we want to stay with?

MEMBER POWERS: Yes. Now, that's -- those are real questions, because --

MR. THADANI: Yes. And those are the things we're talking about.

MEMBER POWERS: And the containment versus confinement debate comes up.

MR. THADANI: Yes.

MEMBER POWERS: And, you know, some of the words I've seen on that have been interesting to me, and I'd just point out that the Savannah River reactors were designed with confinements, and those confinements, when we think about confinements and terrorist or sabotage acts, sometimes we think they're orthoginal with those confinements, were designed to take an airburst from a nuclear weapon. So you can design a confinement to be perfectly robust. It's just a different approach than a containment, and --

CHAIRMAN APOSTOLAKIS: Also, it seems to me the words, "prevention" and "mitigation" refer to a particular point, in this case, CDF, I mean core damage. You want to prevent it, and then if it happens, you want to mitigate the consequences. What if you don't have a core damage pivotal event, but you now have a frequency consequence, I mean release curve? Again, it's not obvious to me what prevention and mitigation means in that case because you will have different frequency regions.

MEMBER POWERS: Well, I think, George -- I think -- when I said it didn't take a big leap for me to translate CDF to something applicable to, say, a coded particle fuel reactor in a large graphite block, it seems to me that the only thing that counts is when you release fission products.

CHAIRMAN APOSTOLAKIS: Yes.

MEMBER POWERS: If the only thing we did was damage core, we wouldn't care. And, of course, that's one of the great attractions, the molton salt reactor. You could probably the damage the core a lot and not release any fission products at all, because they'd absorb into the molten salt.

And when you look at frequency consequence curves, I mean, yes, in reality, they're nice, smooth curves and whatnot, but they have a sharp cliff, and when you go over that cliff you know that that's different than when you're just slowly degrading down.

CHAIRMAN APOSTOLAKIS: And also it depends on where you're releasing. It could be outside, could be somewhere inside.

MEMBER POWERS: But it only counts if it gets to the great out outdoors.

CHAIRMAN APOSTOLAKIS: If it isn't outdoors, it doesn't matter.

MR. THADANI: But that is not the point. I think we're going to have to think this through to balance and design. I think that's -- I believe you said that, and let me use an example: Reactor pressure vessel today. We want to be sure, have pretty high confidence that it's very, very unlikely that you'll fail reactor pressure vessel. What are potential challenges to the integrity of the pressure vessel? Should you somehow divide the balance and design? Does that mean that you have frequency of challenge and the conditional probability of vessel failure? Do you have to build that in in the vessel to get balance because you're trying now kind of two different things.

MR. KRESS: Sure, you're allocating among sequences, and I think you --

MR. THADANI: That's why I think frequency consequence --

MR. KRESS: Yes, yes.

MR. THADANI: -- you still have to think about other factors.

MR. KRESS: You do, but I think this question of prevention versus mitigation has to be rethought. In the first place, we don't have any guidelines on what that balance ought to be. If you look at the current plants, you get some conditional containment failure probabilities of 0.8. That's like not having a containment at all. And then, by the other token, you get some down around 0.01. So we don't have good guidance on what that ought to be, and in my view, some of the concepts, the molten salt, for example, or the tri-cell coated fuel particle taps do both their prevention and mitigation in one concept. And I think that ought to be a way to think about it.

And I really think the overall view ought to be do we meet high-level risk acceptance criteria at a sufficient level of confidence? And the way you build defense in-depth in that, in my mind, is to talk about the uncertainties, and what you want to do is balance that uncertainty across all these frequency ranges.

CHAIRMAN APOSTOLAKIS: But the uncertainty --

MEMBER POWERS: The problem I've always had with that, you know, "Let's talk about the uncertainties," is that's great but you guys won't. The only uncertainties that ever get discussed -- usually uncertainties aren't discussed at all. All we get is point estimates, even from you guys, Ashok. Today we didn't.

MR. THADANI: I accept the criticism.

MEMBER POWERS: But when we do get uncertainties, all we get these mamby-pamby little various -- this adhesion coefficient or something like, nobody coming in and asking really where the uncertainty is and whatnot. And so whereas you're right, perhaps, though I don't actually agree with you, but I will concede you have a point in principle, I think in practical fact it can't be done. And you're forced to come where I'm much more comfortable is saying, what if the codes and analyses are wrong? And that's where you start addressing defense in-depth.

CHAIRMAN APOSTOLAKIS: And margins, I think, not just defense in-depth. They go together, although defense in-depth is the first thing that comes to mind.

MR. KRESS: My view is --

MEMBER POWERS: I won't argue with you on that.

MR. KRESS: My view, Dana, is that the uncertainties are a measure of how wrong the codes are if you could quantify them.

MEMBER POWERS: It's a measure that you never make.

MR. KRESS: Yes. We ought to be able to do it better.

CHAIRMAN APOSTOLAKIS: No, but you see I think what happens --

MEMBER WALLIS: If you haven't made up to now, it's going to be made.

CHAIRMAN APOSTOLAKIS: But what's going to happen, guys, is the typical thing that engineers and scientists do. Even if they try to quantify them, they will quantify the uncertainties in the hardware, in the processes, perhaps, and so on. I'm willing to bet that nobody will come here and say, "And if we build this reactor and we have these regulations, the licensee will ignore this particular program and that will lead to all sorts of problems," because we don't think that way, and yet that's a major uncertainty.

MEMBER POWERS: Well, I mean what are the chances we're going to build one and say, "And I bet you this guy let's the boric acid chew through the head."

CHAIRMAN APOSTOLAKIS: Well, that's what I meant, that we heard today that the inspection program -- that was a conclusion of the root cause analysis -- was good enough. It's just that it was not implemented right, and the AIT report concludes the same thing. That's its first conclusion, in fact. They said it was pretty good, but if you don't have the -- now, do you design the reactor with that kind of uncertainty in mind? I doubt it very much; I don't think anyone would do that.

MEMBER WALLIS: You have the same thing with codes, and we know that when we say thermalhydraulic code, different people get different answers depending on how they use it. So you've got the human factor there too, someone who's careless use of a code, predicts something which is really not a good answer and then uses it is just as careless as the guy who let's boric acid sit --

MR. KRESS: We design reactors now with our general design criteria and our design basis accidents, and we take account of that by talking about single failure criteria, but we don't deal with it in there. Where we deal that is in the other parts of the regulations having to do with the reactor oversight, inspection. I don't see a reason why we have to change those parts of the regulations. I think what we're dealing with here is trying to design a regulatory system that helps a reactor design get certified in the first place. And then these other issues I can deal with them in other parts of regulatory space.

CHAIRMAN APOSTOLAKIS: Maybe you want to use different words there that will be safe enough.

MR. KRESS: Oh, safe enough, yes.

CHAIRMAN APOSTOLAKIS: And also realistic. You know, it pains me to admit this, but I think there is some point to the structure of this interpretation of Defense in-depth, because people are wrong. I thought it was a joke but people do make mistakes.

MEMBER POWERS: Not at MIT.

CHAIRMAN APOSTOLAKIS: Well, but we don't design them, unfortunately.

The second conclusion of the AIT report was tat a BNW owner's group underestimated the rate of corrosion by at least a factor of two. Now who would have said that in a study, in a PRA, that they will do these calculations but they may also be wrong with some probability? You can't say that. First of all, people will be all over you. But it's something that's inconceivable, and yet people do do those things.

MEMBER WALLIS: You figure that in. Certainly, I use the code example. I mean you know something about the accuracy or uncertainty in the predictions of codes, and you do build it in.

CHAIRMAN APOSTOLAKIS: See, that's the thing --

MEMBER WALLIS: But it's not formulated in a quantitative way. You certainly bring it into your consideration when you're making a decision, but it's not formulated. What you're asking for is some quantitative measure.

CHAIRMAN APOSTOLAKIS: Well, I'm not asking for it. I think it's some uncertainty that we don't even think of.

MR. KRESS: Anyway, I think this --

CHAIRMAN APOSTOLAKIS: Make the system more robust because you never know what's going to happen, that kind of thing.

MR. KRESS: I think this discussion points out a lot of formidable challenges these guys have.

MR. ELTAWILA: Mr. Chairman, I'm less than one-third of my presentation, and I have 15 minutes.

No, I need guidance. There is no way I can go through the whole -- are you allowing me time or you want me to finish at certain time?

CHAIRMAN APOSTOLAKIS: Use your judgment and skip some things.

MR. ELTAWILA: I will skip something, but I'd really like to highlight here on that viewgraph is that the Commission had expectation that new reactor will have containment equivalent to large, dry containment. Of course, they meant light water reactor. They did not mean at that time gas core reactor. And the basis for that they approved a confinement versus a containment in the policy paper. So I'm bringing it upfront here.

Some of the policy issues that Mary's going to address in her Commission paper are should we be looking at different cornerstones in our regulatory framework? For example, radiation protection for worker, security and safeguards. These are a couple of the issues. Should we be considering lead contamination as part of our -- the metrics of the --

MEMBER POWERS: Cornerstone issue. I could imagine that you might have well to enhance your safety and security just because of the current environment, but let me ask you, do you think that you're getting enough mileage out of the known risk-informed cornerstones that you have, that you need to look for others of those? You know, radiation protection, health security, things like that. I mean they're the stepchildren of the cornerstones as it is. Do you need more stepchildren?

MR. ELTAWILA: No, but that's all. The Commission said no before, yes?

MEMBER POWERS: It seems to me I would not waste a lot of time on that. The lane contamination really is something that they need to decide, but I think we know what the answer is going to be.

MR. ELTAWILA: Yes. I think the issue of defense in-depth I think Tom alluded to it. When you have the tri-cell particle that performs both the function of prevention and mitigation and the fuel can't stand very high temperature for a long period of time, assume this is true. Can we allow the length of time as a barrier, as a defense in-depth. These are some of the questions that we'll be tackling in the future.

MEMBER ROSEN: Well, before you get off that slide, there's one I -- the Generation 4 Program has pointed at that's not there, and that is the need for off-site evacuation.

MR. ELTAWILA: It's in there.

MR. THADANI: It's coming.

MR. ELTAWILA: These additional policy issues -- I'm going to address the emergency planning as part of this.

CHAIRMAN APOSTOLAKIS: But these are related also to the others. If you bring up the issue of international standards, for example.

MR. ELTAWILA: Quickly, since these designs, or most of them, are done overseas, we really need to look at the senders overseas and see if we can capitalize --

CHAIRMAN APOSTOLAKIS: Yes, but for example, the Europeans don't really have safety goals; we do. So I don't know how you --

MR. THADANI: Well, I think if you go back and let me use EPR. If you go back and look at the EPR safety principles, they include probablistic considerations.

CHAIRMAN APOSTOLAKIS: Not the way that our Commission has -- I don't think they say this is a goal, do they?

MR. THADANI: Well, they establish some probablistic considerations --

CHAIRMAN APOSTOLAKIS: For what?

MR. THADANI: -- which then drive them to certain designs, for example, in terms of core damage severe accidents.

CHAIRMAN APOSTOLAKIS: But we have it at --

MR. THADANI: Ten to the minus X they have.

CHAIRMAN APOSTOLAKIS: Yes, but we have it at a level of individual risk.

MR. THADANI: Oh, yes, yes, they don't.

CHAIRMAN APOSTOLAKIS: They don't do that.

MR. THADANI: You're right. You're right.

MR. KRESS: With respect to this, Ashok, Farouk, I may be a maverick on this issue because I think it be well to understand what the safety requirements are in other countries and IAEA, their principles and stuff like that. But I find it perfectly reasonably to say different countries that have different have high-level risk acceptance criteria. That's because they have different citing characteristics, they have different values. They might value nuclear more than we do because it's the only option they have. So it's perfectly reasonable to me that we'd have a different set of safety standards than some of the countries.

CHAIRMAN APOSTOLAKIS: At the health and safety level, yes, but the core damage or equivalent level, I'm not sure that's a wise way to go. Because one accident somewhere kills everybody.

MR. KRESS: Well, I don't think that's necessarily true either. I think that's a misnomer.

CHAIRMAN APOSTOLAKIS: I think we've used the argument that that design is different from ours to the limit. I don't think the American people will buy that.

MR. THADANI: I think that there's so many different variables that I think there are different forces that would push certainly western Europe in some directions that we may not want to go.

MR. KRESS: That's exactly my point. I don't think it's true that an accident anywhere is an accident everywhere, especially for some of the new plants.

CHAIRMAN APOSTOLAKIS: I think you're going to have a hard time convincing me --

MR. KRESS: Only philosophically.

MEMBER POWERS: But from a practical point of view, I think you're right, Tom, that we had a major accident in Russia with a plant design that was very different from ours. And it had a remarkably little impact on the United States nuclear power program. Big impact on Europe's but remarkably little in Japan. So I think, yes, once the designs are distinct enough, you're probably right.

CHAIRMAN APOSTOLAKIS: But my argument is that -- the argument that the designs were distinct enough was accepted last time. I'm not sure how many times the American people will accept that.

MR. KRESS: They also didn't look very close either.

(Laughter.)

MEMBER SIEBER; A more important factor may have been the fact that they're far removed from us and people, when something happens thousands of miles away, don't see it as --

CHAIRMAN APOSTOLAKIS: I really don't want anybody to have a reactor with a core damage frequency of ten to the minus three or two. I don't care where it is, I don't care what their needs are.

MEMBER POWERS: There are a couple of them.

CHAIRMAN APOSTOLAKIS: They should --

MEMBER POWERS: Already.

CHAIRMAN APOSTOLAKIS: The West is doing something about the ones I know about.

MEMBER POWERS: They would try to bomb them.

CHAIRMAN APOSTOLAKIS: Okay, Farouk.

MR. ELTAWILA: The first policy issue that we are putting in front of the Commission is the event selection and safety classification of system structure and the component. And as I mentioned earlier, that this passive system the traditional PRA will not work the same way --

CHAIRMAN APOSTOLAKIS: What do you mean by better selection? You mean design basis?

MR. ELTAWILA: Yes, the design basis and beyond design basis. So these are the -- yes, design basis selection. And the selection of these, for example, they will be generally low probability event, but they are going to be responding to different uncertainty. So assessing the reliability of this system and try to quantify the core damage frequency or LERF based on these phenomenological uncertainty will be extremely difficult. So sheds doubts about the usability of PRE.

That issue was raised in front of the Commission long time ago and in the 1993, and the staff at the time said that we are going to use a blend of deterministic and probablistic approach.

We'll use the deterministic as it exists right now and supplement it with risk information. And the Commission found that to be acceptable at that time.

CHAIRMAN APOSTOLAKIS: Well, that was nine years ago, but I would say -- well, first of all, is your -- does your second bullet imply that maybe we will not have design basis accidents at all, that we'll have some other approach that maybe some people can come up with or a test to -- we have to have them? Maybe not in the --

MR. ELTAWILA: The approach that was proposed by the PBMR have some design basis approach, but, again, they are selected using PRA.

CHAIRMAN APOSTOLAKIS: Right.

MR. ELTAWILA: You know, that they were not really deterministic. They said that these are the design requirement that we are going to design the plants for.

CHAIRMAN APOSTOLAKIS: Because there is value to having specific accidents and accident sequences, because then it eases communication. There's no question about it. At the same time, you may not want to treat them the way what is in the LWRs.

MR. THADANI: If you go, for example, the concept of frequency and consequences, if you go to that concept, consequences starting with nothing happening all the way to some significant releases, if you go to that, the point here would be you can do that in absence of a specific design, you can lay out some things. But then when you go to the specific design, you still need to -- maybe using that concept, you still need to, as you were saying in terms of communication, analysis and so on, need to identify what are those events that you need to --

MR. KRESS: You have a copy of my viewgraph that I gave to the Commission?

CHAIRMAN APOSTOLAKIS: Yes. I don't like the word, "supplemented," excuse me.

MEMBER WALLIS: I don't see how you can set deterministic requirements for a reactor concept which doesn't yet exist. You can always set probablistic sort of requirements and safety goals, but you cannot set deterministic goals.

MR. KRESS: I was proposing an iterative process in my slides to the Commission in which you have some sort of -- you always are going to have a design concept. You don't have anything unless you start out with a design concept. And you can select initiating events for those concepts, and you can establish some sort of initiating event frequency. Now, that's going to be the tough part, but the question is now which of these events and at what frequency level are you going to cut off and say these are design basis and these others aren't? Well, you could do it iteratively in the way that I proposed, and you would have to adjust the design, but you have to have a PRA to do this.

MEMBER WALLIS: That's right. You'll be --

MR. KRESS: And you have uncertainties in it, and you have to have high-level acceptance criteria.

MEMBER POWERS: Tom, the difficulty I have is that's great if I'm designing the reactor. But when I'm in the business of regulating the reactor, and you've gone through all that, do I care?

MR. KRESS: Once the design is fixed, that's the basis for certification.

MEMBER POWERS: No, no, no. Why should I care? Why shouldn't I say the basis of certification is this plant has an expectation value of the risk of such and such a value at such and such a confidence limit, and I really don't care what particular accidents the designer worked to try to knock down at very low levels?

MR. THADANI: If you take that in conjunction with other requirements like, for example, source term, containment fuel, quality and things like that, you can make that determination.

MEMBER POWERS: Yes.

MR. KRESS: Dana, I think this is back to my rationalist defense in-depth concept, and what it has to do with is you focus on individual sequences, and this is a way to do it. And you assure yourself that individual sequences meet two criteria: One, they don't contribute overly to the overall risk, and they don't contribute a huge amount to the uncertainty. That's why you do it in that manner.

MEMBER POWERS: Well, we've debated this before. I mean I don't care if my risk is ten to the minus eight and it's 99.9 percent due to one sequence, that's fine with me.

MR. KRESS: Yes. But you wouldn't want 99 percent of your uncertainty be due to that sequence. That's my point.

MEMBER POWERS: If the uncertainty is only ten percent, I don't care.

MR. KRESS: Well, that's true too. That's a sliding scale.

MR. ELTAWILA: The Commission actually addressed part of that issue in the '90s. For example, the air intrusion that was very low probability event, but the Commission said, "Don't have arbitrarily cut off at the exact frequency." Consider that issue, even though it's a very low probability, look at the consequence in that issue --

CHAIRMAN APOSTOLAKIS: Right.

MR. ELTAWILA: -- and incorporate it in the --

CHAIRMAN APOSTOLAKIS: The PRA.

MR. ELTAWILA: -- in your decision.

MR. KRESS: You have to look at all sequences.

VICE CHAIRMAN BONACA: In Option 2 right now we're struggling with the issue of having just one criterion, okay, to throw things into Risk 1, 2, 3 and 4, and we have in fact discussed the possibility of having -- well, the FSAR has different criteria, has a set of criteria, generally. What are we going to use here? Are we going to intermediate criteria for the --

CHAIRMAN APOSTOLAKIS: I think it's covered by his earlier comment that -- what was it?

MR. THADANI: It was the issue of

classification.

CHAIRMAN APOSTOLAKIS: The cornerstones, additional cornerstones. You may want to add additional. But I really don't like the word, "supplemented,"

VICE CHAIRMAN BONACA: But I think certainly we don't want to get into a situation, as we have right now, for Option 2 where --

MEMBER POWERS: I mean "supplemented" is what they said.

MR. ELTAWILA: That's what the Commission said. I think what we responded to Exelon we indicated there's going to be a blend of both real deterministic and probablistic analysis.

CHAIRMAN APOSTOLAKIS: Okay. That was in 1993, wasn't it?

MR. ELTAWILA: Yes. It's just a statement.

CHAIRMAN APOSTOLAKIS: I think from the whole discussion here in my view there will have to be deterministic requirements at least for the ease of communication, but these should be based on probablistic arguments as much as possible.

MEMBER POWERS: George, we're all Bayesians now.

(Laughter.)

CHAIRMAN APOSTOLAKIS: It's not this Committee that worries me.

MR. ELTAWILA: With probablistic arguments, with the robust consideration of uncertainties.

MEMBER POWERS: Yes, I'd like to see that happen.

MR. KRESS: That's our mantra now.

MR. THADANI: But you know, you've got to keep pushing. I think we cannot --

CHAIRMAN APOSTOLAKIS: But, you know, Ashok, it's very disappointing what's happening in real life. I mean the reactor safety study 25, 27 years ago quantified parameter uncertainties. We ought to be discussing now model uncertainties. And what's happening? People are not even doing the parameters anymore. It's really very discouraging.

MR. THADANI: I know Mary's just itching to get and react to that statement, but I can tell you that there's really a fair amount of effort -- let me make sure. Maybe we have not been here talking to you as to what it is we're doing to move in that direction. I think your observation is reasonable that I've seen more studies recently over the last few years which have had less discussion of uncertainty than I used to see many years ago.

CHAIRMAN APOSTOLAKIS: That's right.

MR. THADANI: So I think that --

CHAIRMAN APOSTOLAKIS: And you know why? I've talked to industry about these things. You know what the answer is? The NRC staff doesn't want them. I'm sorry, but that's what they told me: Why should we do it? Anyway, let's go on.

MR. ELTAWILA: The issue of fuel performance and qualification is one of the most important issues, and I think the policy decision that we would be seeking guidance from the Commission is regarding the test requirement. You know, we traditionally stopped at design basis requirements, so what is the role of beyond design basis? Should we stop -- they can demonstrate that the fuel will keep the temperature of 1600 degrees. We would like to require additional test that will go beyond that and look at the failure point and so on and when you can release the fission product.

MEMBER WALLIS: This is a deterministic thing which is thrown out in the air. It depends upon what the fuel is, what the accidents are, what the risks are. You can't just pick a number like 1600 degrees C.

MR. ELTAWILA: I did not pick that number.

MEMBER WALLIS: But you can't.

MR. ELTAWILA: I think because they have qualifications --

MEMBER WALLIS: You put it down there. Someone --

MEMBER POWERS: I think Graham is raising a general point here, and not just the fuel, but the general point is that why wouldn't you treat this just the way you treat many of the things now in looking at a safety analysis report? A guy has come to you and he's said, "Gee, I've got a reactor here. It's ten to the minus eighth reactor, and I proved it with this analyses." And you go through that analysis and you say, "Okay, one of your assumptions is that the fuel is good to 1600. It doesn't even hint at releasing fission products at 1600 for three and a half days. Prove that to me with test data and things like that." And you would just go through other things but following the assumptions that he made when he had done his analysis of the risk. I mean why focus just on fuel? I mean it would be all of the major assumptions. It may be up to some discretion and guidance from the staff on which ones they wanted to go after.

MR. ELTAWILA: Again, Dana, because as I indicated earlier, that the decision on any of these issues will affect the other decisions. So if you are going to say that there will be no fission product released ever, then you want to be sure that this decision is not at 1650. You're going to start seeing a release in fission product.

MEMBER POWERS: Everything comes out.

MR. ELTAWILA: So it's again because the importance that was given to the fuel as a prevention and mitigated feature that you want to have more assurance that we have done in the traditional fuel design.

MEMBER SIEBER; Okay. I guess when I see you said the burnups and temperature requirements in a deterministic way, you're really putting a box around what the fuel cycle will look like, which sets the cost.

MR. ELTAWILA: I apologize. This was Exelon proposal. I should have made that clear. This is the proposal that will be running at 80,000 megawatt day per metric ton and is going to be with a stand temperature of 1600 degrees C. That's not our requirement.

MEMBER SIEBER; Okay. I don't think we ever should make a requirement like that.

MR. KRESS: This may be an issue specific to gas cool reactors.

MEMBER ROSEN: Right. But I'm known to think about these things generically. Should you qualify for fuel's performance? Absolutely, but it may be different for different designs. Should fuel qualification testing be completed prior to granting a mine operating license? Excuse me? I wish we would just all rise at once and say, "Of course." I mean we didn't do that before but that was then, this is now.

MR. KRESS: Wait a minute. Suppose I told you that I have a fuel that I can't qualify?

MEMBER ROSEN: Well, I'd say you have a problem convincing me to license your reactor.

MR. ELTAWILA: What would you say that we have a fuel that was produced based on the same manufacture and process, like in Germany, but even you cannot prove to anybody that you are going to be following that process?

MR. KRESS: That's exactly --

MR. ELTAWILA: And there is a qualification, there are wealth of database on the Germany fuel, but the technology itself they have not produced that fuel using this process for a long period of time. So can you rely on this old data or you want the current processing of the fuel be tested to prove that this condition will be attained?

MEMBER POWERS: It's a cute question because you know what the answer is. They're not even close to reproducing the German fuel. I mean it's appalling how far away they are.

MR. KRESS: And not only --

CHAIRMAN APOSTOLAKIS: Just have the Germans do it then, make it?

MR. KRESS: But not only that if they do get the process down to where they've got the same quality fuel, and then you're going to take so many billion of those things and stick it in your reactor, to say that each one of those now has that quality based on the fact that I know how they made it, there's no way, in my mind, you can statistically prove that fuel has the quality that they said it has. And that's your issue here. You have to focus on process rather than product.

MEMBER POWERS: Well, don't worry, Tom, they're so far away now they can statistically prove they ain't there.

MR. KRESS: Well, right now, but they can prove they're not there, but when they want to hit their target level they can't prove it. But I suggest that it's because you can't stick enough of this fuel and take it to that burnup level, at that temperature long enough in a test reactor, there's no way you can get the statistics out of that. What you have to do is test all the fuel at the same time.

MEMBER POWERS: And what's --

MR. KRESS: And the only way to do that is stick it in your reactor and, as installed, during startup and initial operations, you look to see how much fission products you get in your primary system. This should be a measure of at least how many faulty fuel elements you have. It's just like -- you know, we measure the quality of the fuel now by looking at how much activity is in the thing. You're going to have to develop that kind of concept for these, I think. And it ought to be part of the licensing provision.

CHAIRMAN APOSTOLAKIS: Isn't it completely inconceivable that I can have some damage to the fuel but then I have other means to contain it?

MEMBER SIEBER; Yes.

CHAIRMAN APOSTOLAKIS: Why?

MEMBER SIEBER; We usually put a reactor

pressure vessel around it.

CHAIRMAN APOSTOLAKIS: So then why do I need -- I mean I can provide other measures. Contain, let them clean it up.

MR. KRESS: Well, you can, you can.

MEMBER POWERS: We kind of do that right now.

CHAIRMAN APOSTOLAKIS: So, again, we're going back to the picture of the reactor as a whole, of the plant. It's not just --

MEMBER SIEBER; You've essentially removed one of the barriers of your risk --

CHAIRMAN APOSTOLAKIS: But I may have installed another one.

MEMBER SIEBER; Yes. You may just put more and more barriers.

MEMBER POWERS: Well, you're right, George, in the sense that we have much the same problem that we were discussing in connection with Yucca Mountain. We all agree that there are going to be multiple barriers. Now, the question is do we put our constraint on what the totality of those barriers are? Or do we go in and say, "Okay. The totality has to be hits," but no one barrier can be more than 30 percent of this.

CHAIRMAN APOSTOLAKIS: Absolutely, absolutely.

MEMBER POWERS: And that's a very interesting question to get into, and every time I persuade myself that I don't want to dictate what the barriers do, you come back with an argument on why I should.

CHAIRMAN APOSTOLAKIS: Farouk, you are going too slow here.

(Laughter.)

MR. ELTAWILA: I'll try. Okay. The issue of the source term is one of the -- traditionally, we use the TID 14844 or NUREG 1465 as a generic source term. The pebble bed and all advanced reactors try now to have a scenario-specific source term. And that I raise a question about the experimental database to support that, the fission product release and transport and the models and so on. We raised that issue in front of the Commission in '93, and they found there is no problem in using a mechanistic source term for the specific scenario, provided the database is adequate to address that issue. And as a matter of fact, in that regard, they said that we should be including their intrusion scenario.

The next issue is the containment

performance issue. I'm sorry?

CHAIRMAN APOSTOLAKIS: We discussed this already. Didn't we discuss this?

MR. ELTAWILA: I'm sorry.

CHAIRMAN APOSTOLAKIS: I thought we discussed most of this.

MR. ELTAWILA: That's true and so we can move on. Same issue with the --

MEMBER POWERS: Well, I think for our discussion purposes, sometime, just between us girls here, we're going to have to come down to some agreement on how we're going to handle the sabotage versus the more classical thing. Are we going to just set that aside and say we'll deal with sabotage and terrorist threats aside or are we going to continue to mesh is together? Because it really causes confusion, in my mind.

MR. ELTAWILA: It is an issue that --

MEMBER POWERS: I mean in the end you're going to have integrate it all together, but for discussions purposes --

MR. ELTAWILA: Yes. It is an issue that we're going to have to address, period.

MR. KRESS: That's another reason to change our thinking on the balance between prevention and mitigation. I think the more you put on the front end the less vulnerable it is to sabotage. That's a personal opinion. I think that, for instance, a pebble bed reactor is probably much less vulnerable to sabotage than an LWR.

MEMBER POWERS: Oh, I think it's much more.

MR. KRESS: Well, we'll have to debate it.

CHAIRMAN APOSTOLAKIS: Emergency.

MR. ELTAWILA: The next issue, Mr. Rosen, is the emergency evacuation, and the issue was addressed again in 1993 about reducing the EPZ and looking for it based on the small source term and so on. And the Commission at that time did not feel that we had enough information to reduce the EPZ, but at the same time told the staff to keep an open mind about this issue and come to us when you have additional information. We are keeping an open mind about this issue, and we're going to address it in totality with the rest of the other issues as part of the --

CHAIRMAN APOSTOLAKIS: Which may lead to an increase in EPZ --

MEMBER POWERS: Well, especially when you have --

CHAIRMAN APOSTOLAKIS: -- depending on the reactor design, right? It's part now of the total risk profile.

MEMBER POWERS: I think you've got another thing to take into account. You've got a societal thing to take into account.

CHAIRMAN APOSTOLAKIS: That's exactly right.

MEMBER POWERS: Because you've got a bill in Congress right now that says make the EPZs 20 miles.

MR. THADANI: Well, I don't think the bill says to make EPZ 20 miles. I think it talks about KI.

MR. KRESS: Yes. It's a planning and --

CHAIRMAN APOSTOLAKIS: But I don't think we should focus our discussion on reducing the EPZ. I think everything else we have discussed today is that we should look at the system as a whole --

MR. ELTAWILA: We should look at the whole thing as in development.

CHAIRMAN APOSTOLAKIS: If meeting the safety goals requires a larger EPZ, so be it.

MEMBER ROSEN: Right, but nobody's designing new reactors with a goal of having a much larger EPZ.

CHAIRMAN APOSTOLAKIS: That's their business. We are regulators.

MEMBER ROSEN: The business end of the business is attempting to provide an attractive product, and one of the most attractive products is one where you can put a reactor someplace and say, "See," to the public, "this reactor is so safe we don't even have an off-site emergency plan."

MEMBER POWERS: But you can say that -- I mean I could say that right now. You've got to persuade the public that they agree with you.

CHAIRMAN APOSTOLAKIS: Yes.

MEMBER ROSEN: Because the next sentence is not that it's so safe that -- you don't stop with, "It's so safe that we don't need an off-site emergency evacuation plan." You say that, and you say, "Because," and then you give a cogent answer that people can understand.

MEMBER POWERS: I think I would believe you more if you said, "It's so safe that we don't need an EPZ, and it's so safe that we don't even want Price-Anderson indemnification."

CHAIRMAN APOSTOLAKIS: All we need today is a process for determining these things. We don't have to convince anybody. We have to convince people that our process is rationale and science-based. That's all.

MR. KRESS: Clearly, if you had high-level risk acceptance criteria and had appropriate PRA with uncertainties that showed that at particular confidence level you meet those without any emergency response at all, the question I would raise is that would be a nice goal to have but wouldn't you want an emergency plan anyway, even though you had that?

MEMBER POWERS: That's right, because you might be wrong.

MR. KRESS: Because I might be wrong. And there might be other considerations, like sabotage and things like that.

MR. THADANI: The Commission has -- we've had some requests, as you know, to reduce EPZ in some cases. I guess when EPRI came to us in the requirements development, ALWR document, that was one of the issues. They wanted to reduce the EPZ. And, basically, what we told them then, and I recognize this is several years ago, what we said was that emergency planning is considered yet another layer of defense in-depth outside of the design considerations. But as I think George was saying, these are all linked issues, and come out where it does and the Commission

-- we just need make sure we give Commission the relevant information.

VICE CHAIRMAN BONACA: Okay. That's it. Thank you.

MEMBER POWERS: The plan is that Mary is going to be the lead author on this document?

MR. ELTAWILA: I'm sorry?

MEMBER POWERS: May Drouin is going to be the lead author on this document?

MR. ELTAWILA: Which document? The policy paper is Tom King. And Mary has the policy paper --

MEMBER WALLIS: Tom King?

MR. ELTAWILA: Yes. He's --

MEMBER POWERS: You remember him.

MR. ELTAWILA: -- back.

MEMBER WALLIS: I have a comment on this whole thing.

MR. KRESS: We'll open the floor for comments at this point.

MEMBER WALLIS: What I see here is a whole series of questions, and I see very little in the way of confidence that you guys have the answers.

MR. ELTAWILA: We don't.

MEMBER WALLIS: The ACRS has been sitting here trying to get some answers, but that's just our game. I mean it's your job to come up with answers.

MR. KRESS: Their job right now is to define what the questions are.

MEMBER WALLIS: So I have a lot of doubt about you meeting anything like a deadline by fall 2002.

MR. ELTAWILA: No. I think maybe we present you with the same Commission -- the same question that we asked in 1993. There was a decision taken by the Commission. The staff made the recommendation to the Commission. So we know the answers to most of these questions. All what we are doing right now revisiting this question to see if we are changing our mind because of information that we have or because of new policy change or something like that. But I think we feel very confident that all these questions will be addressed satisfactory by the --

MEMBER WALLIS: So all the questions have been answered before and you're just tweaking the answers? Is that what you're doing?

MR. ELTAWILA: Well, I don't think it's tweaking the answers. It's just looking at the additional information that we have, the experience that we gained in risk-informed regulation and see if it changed any of these answers.

MR. THADANI: I think -- let me be careful because I want to make sure we're not missing each other's point here. What we're talking about is a set of issues. As you know, some of the technical issues it's going to take a long time before we get real information. But we want to make sure that the course of action that we lay out for us to follow is agreed to. I mean we're not going to be able to have risk-informed regulatory structure in three months. We're just not going to have that. But what we do need to be sure is that is there buy-in on the part of the Commission? This is a multiyear effort.

MEMBER WALLIS: Well, I'm not --

MR. THADANI: Here are the issues that we need to go forward with. We need to have some confidence.

MEMBER WALLIS: Let me be a member of the public here. I mean just because the Commission is going to make some decisions doesn't mean that they're right decisions. You've got to provide enough information to make darn sure that they make the right decisions. That's what I'm confused about.

MR. THADANI: That's fair. And I would like to think that we have already got some information that obviously would be supplemented by what we learn over the next several months. But we're not going to go to Commission with no information. We're going to lay out what we know and what needs to be developed further, and that's part of the idea behind the research plan.

MR. KRESS: You're not going to them and asking for resolution of these issues at this time, are you?

MR. ELTAWILA: We need --

MR. KRESS: You're just going to say, "Are these the right questions?"

MR. ELTAWILA: Right. Are these the areas -- if the Commission says upfront that, "We just don't want you to pursue high-level safety principles approach," we'd like to know that.

CHAIRMAN APOSTOLAKIS: One of the things that I would appreciate if I were in their shoes is what lessons did we learn from the current regulatory system? Some of them are obvious, of course, but, for example, yesterday we had a marathon Subcommittee meeting of ten hours on CRDM cracking and Davis-Besse and so on. Let's say we license a reactor to 2030. Would there be a subcommittee in 2050 for ten hours looking at something unexpected and trying to fix it?

MEMBER WALLIS: Yes.

CHAIRMAN APOSTOLAKIS: There would be?

MEMBER WALLIS: Yes.

MEMBER WALLIS: Why? Why are you so confident that there will be?

MEMBER POWERS: Because no one has ever gone broke underestimating human capabilities.

CHAIRMAN APOSTOLAKIS: Well, but --

MEMBER POWERS: George, the world is far more complicated than the rationalists think it is.

CHAIRMAN APOSTOLAKIS: This was a major thing with that Voltaire stock, you know.

(Laughter.)

Well, but if that's the case, then the policy decisions that we're making now somehow we'll accommodate for that, which brings us back to the structure as defense in-depth. But how far can you push that? See, that's the real issue.

MR. SALSBERG: Well, I think there's another thing, though. I mean how far do you want to accommodate that in the design, and how far do you accommodate that in a kind of performance regulation?

CHAIRMAN APOSTOLAKIS: And I fully agree with that, but I tell you, before Three Mile Island I was a major player in the PRA we were doing for the industry. If you dared say that the operators would do something wrong, you were out of the project, because the industry did not believe that the operators could make a mistake, period.

MR. SALSBERG: Your PRA is never going to postulate every error that --

CHAIRMAN APOSTOLAKIS: Nobody paid attention to the PRAs. As Rasmussen said, it was a status symbol. Everybody wanted to have the blue reactor safety study but nobody read it except him and Levin.

MEMBER POWERS: George, to think that --

CHAIRMAN APOSTOLAKIS: Well, you're not giving me a warm feeling here that we're going to have these Subcommittee meetings --

MEMBER WALLIS: You can't have a warm feeling, George, it's just the way it is.

MEMBER POWERS: And what you would hope for are one or two of them and not a marathon of marathons.

CHAIRMAN APOSTOLAKIS: Well, I didn't get the answer I wanted, but --

MR. SALSBERG: Let me just ask sort of a practical question, as a pragmatic sort of guy.

CHAIRMAN APOSTOLAKIS: Are you saying that the questions so far have not been?

MR. SALSBERG: If I go with -- everything I hear is PRA and uncertainties. Now, you know, we talk about public acceptance. If I have to come in and defend a PRA down to whatever level I want to get down to, in a public litigation sort of situation, it seems to me that's an endless discussion. One of the things I like about a design basis is there's a very concrete acceptance kind of criteria with limits, and I just have a very difficult time in the sort of judicial approach in the litigation nature of Americans --

CHAIRMAN APOSTOLAKIS: But nobody's proposing that, Bill.

MR. SALSBERG: Well, I hear some things that sound a lot like that.

CHAIRMAN APOSTOLAKIS: No, no. It will be deterministic requirements based on probablistic arguments.

MR. KRESS: And even selection of design basis accident.

CHAIRMAN APOSTOLAKIS: Yes. But you will never go and argue probablistic, because you'll never finish.

MR. THADANI: In the end, that's what we

meant here. Once you go -- if you go with frequency consequence approach, you still -- you can do that in the abstract even --

CHAIRMAN APOSTOLAKIS: Yes.

MR. THADANI: -- without knowing what number sequence. You can do these things. But you still, and Graham's point is valid, that you need design information, you need to -- if you're going to rely on PRA, you need to have some level of confidence in that. And what we're suggesting is once you lay out this plan and once you have confidence in the analysis, you can define certain events that sort of become part of the design base and that you make hopefully more rational decisions regarding the requirements for structure systems and components. That's the thinking. But it's got to go through a process, and I mean we're just sharing with you our early thoughts.

CHAIRMAN APOSTOLAKIS: Yes. Acceptance criteria will have to be deterministic. Otherwise there's no end to this.

MEMBER POWERS: Right. I'll just kick in, Farouk, I think you guys have really come up with a really nice set of questions.

MR. KRESS: Yes. That was my --

MR. ELTAWILA: Well, I really -- I don't want to leave you with that we only have questions and we don't -- I think we have the technical basis and the technical basis is going to be sharpened between now and October.

CHAIRMAN APOSTOLAKIS: We understand that.

MR. ELTAWILA: Okay. Thanks.

MR. KRESS: I think that's --

CHAIRMAN APOSTOLAKIS: Are there any other comments from members of the public or the staff? Thank you very much. Gentlemen, this was very, very informative. It was a little low-key, I would say, but thank you.

MR. THADANI: Farouk took too long. That's the only problem.

(Laughter.)

MEMBER POWERS: As usual.

CHAIRMAN APOSTOLAKIS: We'll recess for eight minutes and come back and give advice to our colleagues on the letters.

(Whereupon, the foregoing matter went off the record at 5:40 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: 493rd Meeting of Advisory Committee on Reactor Safeguards

Docket Number: N/A

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.

/s/ Debra Wilensky

Debra Wilensky
Official Reporter
Neal R. Gross & Co., Inc.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

FOR
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May 9, 2002

SCHEDULE AND OUTLINE FOR DISCUSSION
493RD ACRS MEETING
JUNE 6-8, 2002

THURSDAY, JUNE 6, 2002, CONFERENCE ROOM 2B3, TWO WHITE FLINT NORTH, ROCKVILLE, MARYLAND

1) 8:30 - 8:35 A.M. Opening Remarks by the ACRS Chairman (Open)
- 1.1) Opening statement (GEA/JTL/SD)
- 1.2) Items of current interest (GEA/SD)

2) 8:35 - 10:30 A.M. CRDM Cracking of Vessel Head Penetrations and Vessel Head Degradation (Open) (FPF/MWW)
- 2.1) Remarks by the Subcommittee Chairman
- 2.2) Briefing by and discussions with representatives of the NRC staff regarding issues related to the investigation of circumferential cracks in PWR control rod drive mechanism (CRDM) penetration nozzles and weldments, and reactor pressure vessel head degradation at the Davis-Besse Nuclear Power Plant.

Representatives of the nuclear industry may provide their views, as appropriate.

10:30 - 10:45 A.M. *****BREAK*****

3) 10:45 - 12:15 P.M. Technical Assessment Generic Safety Issue (GSI)-189, "Susceptibility of Ice Condenser and Mark III Containments to Early Failure from Hydrogen Combustion During a Severe Accident" (Open) (TSK/RBE/SD)
- 3.1) Remarks by the Subcommittee Chairman
- 3.2) Briefing by and discussions with representatives of the NRC staff regarding its technical basis and proposed recommendations for resolving GSI-189.

Representatives of the nuclear industry may provide their views, as appropriate.

12:15 - 1:15 P.M. *****LUNCH*****

4) 1:15 - 2:15 P.M. Technical Assessment of GSI-168, Environmental Qualification of Low-Voltage Instrumentation and Control Cables (Open) (GML/TJK/SD)
- 4.1) Remarks by the Subcommittee Chairman
- 4.2) Briefing by and discussions with representatives of the NRC staff regarding its technical basis and proposed recommendations for resolving GSI-168.

Representatives of the nuclear industry may provide their views, as appropriate.

5) 2:15 - 3:30 P.M. Development of Reliability/Availability Performance Indicators and Industry Trends (Open) (MVB/AWC/MWW)

5.1) Remarks by the Subcommittee Chairman
5.2) Briefing by and discussions with representatives of the NRC staff regarding the staff's initiatives to integrate the NRC programs for risk-based analysis of reactor operating experience into the reactor oversight process, specifically the development of reliability/availability performance indicators and industry trends.

Representatives of the nuclear industry may provide their views, as appropriate.

3:30 - 3:45 P.M. ***BREAK***

6) 3:45 - 4:45 P.M. Technical and Policy Issues Related to Advanced Reactors (Open) (TSK/MME)

6.1) Remarks by the Subcommittee Chairman
6.2) Briefing by and discussions with representatives of the NRC staff regarding technical and policy issues related to advanced reactors.

4:45 - 5:00 P.M. ***BREAK***

7) 5:00 - 7:15 P.M. Proposed ACRS Reports (Open)

Discussion of proposed ACRS reports on:

7.1) CRDM Cracking of Vessel Head Penetrations and Vessel Head Degradation (FPF/MWW)
7.2) Technical Assessment of GSI-189, "Susceptibility of Ice Condenser and Mark III Containments to Early Failure from Hydrogen Combustion During a Severe Accident" (TSK/RBE/SD)
7.3) Technical Assessment of Generic Safety Issue-168, "Environmental Qualification of Low-Voltage I&C Cables" (GML/TJK/SD)
7.4) Development of Reliability/Availability Performance Indicators and Industry Trends (MVB/AWC/MWW))
7.5) Confirmatory Research Program on High Burnup Fuel (Tentative) (TSK/TJK/MME)
7.6) Technical and Policy Issues Related to Advanced Reactors (Tentative) (TSK/MME)

FRIDAY, JUNE 7, 2002, CONFERENCE ROOM 2B3, TWO WHITE FLINT NORTH, ROCKVILLE, MARYLAND

8) 8:30 - 8:35 A.M. Opening Remarks by the ACRS Chairman (Open) (GEA/JTL/SD)

9) 8:35 - 10:00 A.M. Proposed Rulemaking to Endorse National Fire Protection Association (NFPA) 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" (Open) (SLR/RBE/SD)

- 9.1) Remarks by the Subcommittee Chairman
- 9.2) Briefing by and discussions with representatives of the NRC staff and the Nuclear Energy Institute regarding the proposed rulemaking to endorse NFPA 805 fire protection standard, and related matters.

10:00 - 10:15 A.M. ***BREAK***

10) 10:15 - 11:15 A.M. Generic Resolution of Voids in the Concrete Containment (Open) (MVB/RBE/SD)

- 10.1) Remarks by the Subcommittee Chairman
- 10.2) Briefing by and discussions with representatives of the NRC staff regarding the generic resolution of the issue of voids in the concrete containment walls.

11) 11:15 - 12:00 Noon. Future ACRS Activities/Report of the Planning and Procedures Subcommittee (Open) (GEA/JTL/SD)

- 11.1) Discussion of the recommendations of the Planning and Procedures Subcommittee regarding items proposed for consideration by the full Committee during future ACRS meetings.
- 11.2) Report of the Planning and Procedures Subcommittee on matters related to the conduct of ACRS business, and organizational and personnel matters relating to the ACRS.

12) 12:00 - 12:15 P.M. Reconciliation of ACRS Comments and Recommendations (Open) (GEA, et al./SD, et al.)
Discussion of the responses from the NRC Executive Director for Operations to comments and recommendations included in recent ACRS reports and letters.

12:15 - 1:15 P.M. ***LUNCH***

13) 1:15 - 7:15 P.M. Proposed ACRS Reports (Open)
Discussion of proposed ACRS Reports on:
13.1) CRDM Cracking of Vessel Head Penetrations and Vessel Head Degradation (FPF/MWW)
13.2) Technical Assessment of GSI-189, "Susceptibility of Ice Condenser and Mark III Containments to Early Failure from Hydrogen Combustion During a Severe Accident" (TSK/RBE/SD)
13.3) Technical Assessment of GSI-168, "Environmental Qualification of Low-Voltage I&C Cables" (GML/TJK/SD)
13.4) Development of Reliability/Availability Performance Indicators and Industry Trends (MVB/AWC/MWW)
13.5) Proposed Rulemaking to Endorse NFPA 805 Fire Protection Standard (SLR/RBE/SD)
13.6) Confirmatory Research Program on High Burnup Fuel (Tentative) (TSK/TJK/MME)
13.7) Technical and Policy Issues Related to Advanced Reactors (Tentative) (TSK/MME)

SATURDAY, JUNE 8, 2002, CONFERENCE ROOM 2B3, TWO WHITE FLINT NORTH, ROCKVILLE, MARYLAND

14) 8:30 - 10:00 A.M. Proposed ACRS Reports (Open)
Continue discussion of proposed ACRS reports listed under Item 13.

10:00 - 10:15 A.M. ***BREAK***

15) 10:15 - 11:30 A.M. Discussion of Topics for Meeting with the NRC Commissioners (Open) (GEA, et al./JTL, et al.)
Discussion of topics for meeting with the NRC Commissioners on July 10, 2002.

11:30 - 12:45 P.M. ***WORKING LUNCH***

16) 12:45 - 1:45 P.M. Format and Content of the 2003 ACRS Report on the NRC Safety Research Program (Open) (FPF/MME)
16.1) Remarks by the Subcommittee Chairman
16.2) Discussion of the format, content, schedule, and assignments for the 2003 ACRS report to the Commission on the NRC Safety Research Program.

17) 1:45 - 2:45 P.M. Proposed Papers for the Quadripartite Meeting (Open) (GEA, et al./JTL, et al.)
Discussion of proposed papers on the following:
17.1) Safety Culture and Safety Management (MVB/DAP)
17.2) Risk-Informed Regulation (GEA/TSK)
17.3) Thermal-Hydraulic Analysis and Code Issues (GBW/VHR)
17.4) Stress Corrosion Cracks in Pressure Retaining Components in Nuclear Power Plants (FPF/WJS)
17.5) Risk Analysis of Spent Fuel Storage (TSK/DAP)

18) 2:45 - 3:00 P.M. Miscellaneous (Open) (GEA/JTL)
Discussion of matters related to the conduct of Committee activities and matters and specific issues that were not completed during previous meetings, as time and availability of information permit.

NOTE:

- **Presentation time should not exceed 50 percent of the total time allocated for a specific item. The remaining 50 percent of the time is reserved for discussion.**

- **Thirty-Five (35) copies of the presentation materials should be provided to the ACRS.**

Ongoing NRC Regulatory Activities at Davis-Besse

Davis-Besse Nuclear Power Station

Ongoing NRC Regulatory Activities at Davis-Besse

Implementation of IMC 0350 at Davis-Besse

- **Reactor Vessel Head Degradation represents a significant and complex technical and regulatory issue**
- **Plant is in an extended shutdown with a regulatory hold in effect (CAL)**
- **IMC 0350 enhances the agency's focus on clearly defining and addressing plant specific issues prior to restart**
- **IMC 0350 provides focused and coordinated regulatory oversight of Davis-Besse**

Ongoing NRC Regulatory Activities at Davis-Besse

IMC 0350 Panel Goals

- Provide oversight and assessment of licensee performance during the shutdown and through restart
- Assure that restart issues are identified and resolved
- Integrate and prioritize agency resources to maximize agency effectiveness and minimize regulatory burden
- Provide a single focus to ensure consistent and effective communication with external stake holders

5

Ongoing NRC Regulatory Activities at Davis-Besse

IMC 0350 Panel Goals

- Continue oversight after plant restart until plant is returned to the routine Reactor Oversight Process

- Create a comprehensive public record of agency decisions and actions

Ongoing NRC Regulatory Activities at Davis-Besse

License submitted Return to Service Plan - May 21, 2002

- Reactor Head Resolution Plan
- Containment Extent of Condition Plan
- System Health Assurance Plan
- Program Technical Compliance Plan
- Management and Human Performance Excellence Plan
- Restart and Post-Restart Test Plan

Ongoing NRC Regulatory Activities at Davis-Besse

Current Inspections

- **AIT follow-up (May - June)**
- **Vessel Head Replacement (May - September)**
- **Extent of Condition - Boric Acid (May - August)**

June 6, 2002

Advisory Committee on Reactor Safeguards
Nuclear Regulatory Commission

Chairman George Apostolakis

Members of the Committee

My name is Ann Harris. I have traveled here today by my personal resources without benefit of taxpayer support or government payroll. I appeared before this committee in November, 1995, prior to your support to the Commission for the licensing of TVA's Watts Bar nuclear plant. I moved out of the evacuation zone to a nearby area.

The fact that we are all here again seven years later to hear staff's offering on the Generic Safety Issue 189 and NRC's recommendation is evidence of how things work with Staff and the industry. The Ice Condenser issue may be a generic issue to you, but you should be aware that it is real people's lives you are talking about. This is not a generic issue to me. It is about the nuclear reactors just down the road from where I live and where members of my family and friends live.

I hope that you are as worried about the time factor as I am. I take it as a positive sign that at least something is going to be done even if it is only talk this time. But do we need more talk? I was in this same room seven years ago arguing that Watts Bar was not ready for prime time. That didn't do any good since most of the problems were never fixed, just forgiven. Will we be back talking seven years from now when TVA and Staff admit that safety is still not a prime factor? I think not. TVA will be in the nuclear weapons production business at Watts Bar and Sequoyah because Staff has never seen an industry license amendment request it did not like.

At the meeting in 1995, one of the subjects I heard about was whether the hydrogen igniters would work. My transcript of that meeting shows that committee member Ivan Catton tried to raise questions about hydrogen igniters and whether the igniters at Watts Bar were adequate to prevent the containment from leaking from hydrogen explosions. In fact, he was asking questions about whether the igniters were located in the right locations in the containment, and now here you are seven years later talking about the same thing. These meetings are like seven year locust visits. They just keep coming.
Committee Members, talking just isn't good enough anymore. Your talking has put lives at stake. It appeared at that 1995 meeting that Mr. Catton was truly interested in whether Watts Bar was safe enough but he was cut off and shut up by the chairman at that time.
What we did not know at that meeting was that the person at Watts Bar responsible for making sure the ice condenser was working correctly before startup had discovered that the screws holding the ice baskets up were defective. TVA devised a scheme to hide Curtis Overall's discovery, then get rid of him, therefore obtaining the Watts Bar license by lying to this Committee and the Commission. After years of investigations and court proceedings the NRC has been forced to levy a fine against TVA. TVA has had so many fines for employee abuse they shed them like water off a duck's back. No big deal!

The most troubling fact is that inspections of the ice baskets that Overall wanted (and was abused for) were never done. We still don't know if they'll stay put if there is an accident at the plant. I have never told anyone that I am an engineer. But I do have common sense. From what I understand, NRC seems to be finally facing up to the fact that ice condensers won't really work------won't protect the public during an accident. Their idea to fix the problem is to get a little portable generator, from Home Depot or Lowe's, put it on a pick up truck, roll it up to containment, and plug it in. I worked in TVA's nuclear program for 16 years, fourteen at Watts Bar. I have seen some crazy, silly, childish and outlandish things done in the name of safety but I believe this one could take the blue ribbon! I keep having this cartoon run through my head of what would be going on if this generator is needed. There's a hurricane, a severe lighting storm, a terrorist attack, a flood, it is dark, no lights, and no backup power. The shift supervisor has just sent someone to the little shed outback containing the Honda generator with a copy of the combination to the padlock. People living down stream are depending upon this person to know the combination without hunting the paper it was written on. The rain is wetting the paper. His glasses are covered with water. The wind blows the paper away and he starts back inside for another copy. When he gets back, he unlocks the shed, rolls the generator to the containment building, plugs it in and proceeds to get it running. I think that our lives and our property values deserve a little more concern than this NRC proposal. Why are you only recommending this blue light special approach?

I feel that the people who live near these plants are getting short-changed, run over and made expendable. The NRC recommendation seems to say the backup power doesn't have to work if the accident is caused by a flood or an earthquake or a terrorist attack. How do you think this kind of accident is going to happen? Merlin conjuring?

Committee Members, the people living in these communities are real live people whose lives are being talked about here this morning, not just numbers and statistics. Those same people trust the NRC to protect their interests.

I wouldn't be surprised if NRC gets pressure from industry about making changes to the ice condensers to make them actually work. I imagine you will be pushed to pick numbers to re-do your calculations making it impossible to solve the problem that fixes the containment. I am speaking as much to licensing people in the audience as well as this committee and research staff, to keep in mind the interests of the real people living near these plants. Think twice about trying to make industry happy with analyses that say they don't have to fix anything. It is good that NRC has made a start, but so many times good starts end up as dead ends.

I think you should be careful about plans to fix the ice condenser plants depending upon the good will, and good intentions, of the plant owner. Some of the proposed changes, like the cheap portable generator idea, seem to be planning on not having the inspections that you have for other safety equipment. I don't know about other utilities but I know TVA well enough to know that if NRC leaves it all up to them, the generator will not have a motor or a receptacle for the plug. If there's neither inspection nor enforcement, that backup system is not going to be there when it's needed. You see the bigger danger is to have a lot of back and forth talk leading people to think that something's being done to fix the problem. But you and I know that's not true. And there in lies the problem, misleading is worse than doing nothing.

I would ask that you recommend to the Commission that these ice condensers be fixed to protect the public NOW!   You should advise the staff that they should be bending over backwards to protect the public's safety, not bending over to avoid trouble from the industry.

Thank you

Respectfully Submitted

Ann P. Harris
341 Swing Loop
Rockwood, TN 37854
(865) 354-4559

By copy of this statement I request that my statement be made a part of the official record.

Kenneth D. Bergeron, PhD
17 Tierra Monte NE
Albuquerque, NM 87122
e-mail: kenberg@flash.net

June 3, 2002

Advisory Commission on Reactor Safeguards
ATTN: John T. Larkins, Executive Director
U.S. Nuclear Regulatory Commission
Mailstop T-2 E26
Washington, DC 20555

Dear Members of the Committee,

Subject: ACRS Review of NRC/RES Proposal on Resolving Generic Issue 189

I have been involved, in one way or another, in the issue of the vulnerability of ice condenser PWRs to Station Blackout events (SBOs) for almost 20 years, beginning with work on NUREG-1150, followed by my managing Sandia's support to NRC's Containment Performance Improvement program in the late 1980s, and continuing with my involvement in the effort to resolve the Direct Containment Heating (DCH) issue for ice condensers in the late 1990s. In regard to this last effort, I was a co-author of "Assessment of the DCH Issue for Plants with Ice Condenser Containments," NUREG/CR-6427, and I carried out the CONTAIN code calculations for the final version of that report. Shortly thereafter, in 1999, I retired from Sandia (though I imply no cause and effect relationship there). Since then I have followed with interest NRC's efforts to deal with the remarkable vulnerability of ice condenser containments to SBOs.

In his transmittal of NUREG/CR-6427 to NRR, Ashok Thadani, NRC's research director, concluded that the study had, in effect, closed the DCH issue for ice condensers but had also brought to light the high vulnerability of these plants to containment failure (primarily from hydrogen combustion) in SBO sequences. He suggested at the time that this vulnerability be addressed through the ongoing efforts to risk-inform 10 CFR 50.44. I will admit to some skepticism about his suggestion at the time, since the vulnerability in question had been well known for at least fifteen years. But NRC's research effort on Generic Safety Issue 189 (GI-189), recently made public by Farouk Eltawila's May 13 memo to the ACRS, has impressed me and my skepticism has abated somewhat.

It has been less than a year since the NRC's Executive Director for Operations announced to the Commission in SECY-01-0162 the establishment of GI-189 to deal with the vulnerability of ice condensers and BWR Mark IIIs to SBOs, and less than six months since the Commission established a high priority on resolving it. The RES staff has accomplished a great deal within these compressed timeframes and should be congratulated on their efforts (and those of the tireless contractors at ISL, BNL, and SNL). Their preliminary work has set the stage for an expeditious resolution of GI-189 and, hopefully, a timely implementation of the needed containment improvements to ice condenser PWRs.

I would very much have liked to attend the ACRS meeting at which GI-189 is to be discussed (June 6-8, 2002) and present my views on the ice condenser-related issues, but previous family commitments during that time frame make that impossible. In this letter, I will summarize some of my viewpoints. David Lochbaum of the Union of Concerned Scientists has offered to present some highlights of my assessment at the meeting, for which I am greatly appreciative, though I hasten to take responsibility for any errors in my review (political or otherwise).

My most important comment is that, while the contractor reports provide a basis for supporting a variety of the backfit options that were evaluated, Mr. Eltawila's letter appears to recommend only the low-cost portable electric generator to power only the igniters. I have long believed that a fix to ice condenser vulnerability must include, in addition, power to the air return fans. Nothing in the NRC's recent analyses has changed that belief. I will provide a detailed explanation of my views below, but I would first like to put that discussion in context by stepping back and looking at some overarching issues related to containment improvements.

Why are containment improvements so problematic for the NRC?

It has become apparent to me over the course of my many years of support to NRC that there is an asymmetry between what can be accomplished in the way of improved power plant safety in the 'front end' versus in the 'back end.' There has been no shortage of conflict between the regulator and the industry over improvements to the primary system and associated safety systems, but over time there have been many important safety upgrades as well. Compared to before TMI, we have better pump seals, better system reliability, better steam generators, better water chemistry, and the list can go on and on. By contrast, little has been done to improve containment performance, at least in the past decade or so.

Certainly there have been many changes related to the containment, and some have been based on risk analysis. But almost all such changes are some form or another of regulatory relief. Certainly there have also been innumerable cases of straight regulatory relief for the Nuclear Steam Supply System and its associated support systems, but in addition there have been many 'front end' changes that cost money but improve safety. And those changes continue. Not so for the containment system, in my belief. With very few (and minor) exceptions, risk-based changes to the containment and its operations have been strictly for relief, not improvement. It has become a one way street.

I believe the reason for this difference is simple. The plant owner has much more of a shared interest with the regulator in avoiding conditions that lead to severe accidents.

Doing so not only protects the public, but it also preserves the power plant as a source of revenue to the owner. As with TMI-2, a severe accident almost assuredly ends the life of the reactor as a productive capital asset regardless of whether the containment fails or not. This simple fact gives the licensee a double incentive to work with the regulator to reduce the core damage frequency. There is no such double incentive to reduce the conditional containment failure probability.

I think that at one time the NRC implicitly recognized this difference when it introduced the Containment Performance Improvement program in the 1980s. However, the virulence of industry's reaction to proposed improvements to BWR Mark I containments brought that program to an untimely end around 1990, and since then there has been no significant action, as far as I know, related to improvements in containment performance. That is, until Mr. Eltawila's May 13 memo.

I do not say this to put the industry in a bad light. I say it because it is important for NRC to take account of this asymmetry in its approach to containment improvements. It is inevitable, given the differences in industry's incentives, for it to be more difficult to gain industry consensus on containment improvements than on improvements to the front end. This doesn't mean the NRC should be satisfied with less progress. Defense in depth is important, and the meaning therefore is that NRC should work harder to accomplish such improvements, expect more resistance from licensees, and bring a firmer resolve to the deliberations.

Having now exercised my private citizen right to express my views, soapbox style, I will turn to the RES recommendations on GI-189.

The low-cost backfit option recommended by RES is inadequate and possibly counterproductive.

The Eltawila memo provides in its three attachments a preliminary technical basis for evaluating potential backfits to ice condenser containments (as well as Mark III containments, but I will have no comments on the Mark III issue). Attachment 1 is a brief cost study by Information Systems Laboratories, Inc. (ISL) of four basic options for adding equipment to provide backup power to containment safety systems during SBO conditions. Attachment 2 is an assessment by Brookhaven National Laboratory (BNL) of the averted costs (or benefits) that might accrue from implementation of a containment fix for the SBO vulnerability, which evaluates the dollar value of the benefits for a matrix of cases involving different plants and different analysis assumptions. Finally, Attachment 3 is a very preliminary report from Sandia National Laboratories (SNL) on MELCOR code calculations of the effectiveness of some of the backfit options.

Certainly one thing that is needed is a more integrated presentation of these disparate results, and I would hope that RES plans to prepare such a report in the future. However, given the time pressure for addressing GI-189 I can understand the decision to make available the research results in this fragmented form at this time.

By studying the BNL and ISL reports together, one can see that a number of the backfit options for ice condensers easily pass a cost benefit test for a range of analysis assumptions. For example, in Table 2-12 of Attachment 1 we see that the option involving pre-staged emergency backup power for igniters and air return fans has a total cost of $313,300 for a single unit of a dual unit ice condenser plant. Table 6 of Attachment 2 gives lifetime benefits ranging from $404,000 to $6,730,000, depending on analysis assumptions. That it is cost beneficial to fix the ice condenser containments is not surprising to me, since the inadequacy of these plants in SBO conditions is notorious, and the risk significance of SBOs is high (at least for some plants). What is surprising is that Eltawila's memo, which is the only place any integration of the three reports occurs, seems to recommend only the low-cost option labeled "1b," which involves an off-the-shelf portable generator to provide backup power to the igniters only. Several other options that also have favorable cost/benefit numbers are not mentioned in the recommendations. Knowing that there will be resistance from industry to any of these proposals, I find it hard to understand why RES would choose to endorse only the 'el cheapo' option.

More important, I believe the low-cost option is inadequate to deal with ice condenser vulnerability to SBOs. In this, I agree with Duke Power's decision in their SAMA submittals on McGuire and Catawba to evaluate backup power to igniters only in conjunction with backup power to the air return fans. At a public meeting between the Nuclear Energy Institute and the NRC in September 2000,* industry representatives criticized NRC's assertion that powering igniters only would be sufficient—they said you need to power *both* igniters *and* fans to control the hydrogen burn threat in ice condensers, and they were right.

Far too little importance has been attributed in the RES analysis to the possibility of detonations in the ice chest. What I am worried about is the possibility that in the absence of forced mixing via air return fans, a typical SBO scenario would lead to the following conditions: very high hydrogen concentrations (say, over 20%) throughout much of the ice chest; quite low concentrations (under 5%, say) in the upper plenum and containment dome because there has been little leakage through the upper deck doors until this point in time, and steam inerted conditions in the lower compartment. Then, when the concentration in the upper plenum finally becomes combustible, one or more burns occur there, resulting in upper deck doors opening and closing, perhaps in succession many times, which brings out a plume of much more combustible gas into the upper plenum from the ice chest. This plume would then ignite and carry the flame back to the ice chest, where the deflagration would transition to detonation because of the wide variety of channeling and reflecting surfaces there. A global detonation over most of the ice chest is something I don't even want to think about. Containment failure could occur either through missile generation or dynamic overloading of the containment structure.

* "SUMMARY OF SEPTEMBER 28, 2000, PUBLIC METING WITH NUCLEAR ENERGY INSTITUTE (NEI) AND OTHER INTERESTED STAKEHOLDERS REGARDING RISK-INFORMED CHANGES TO 10 CFR 50.44", Memo from Alan S. Kuritzky, NRC/PRAB to Mark A. Cunningham, chief NRC/PRAB dated February 28, 2001.

I am not the first person to worry about this scenario, of course, but my point is that I don't think today's calculational tools can help NRC develop the confidence it needs to order a mandatory igniters-only backfit. I am glad NRC has commissioned Sandia to carry out a broad matrix of code calculations on hydrogen distribution, because they shed light on the overall issue, but there are some aspects of the problem that I believe defy accurate computational analysis. This means that even an expanded program of calculation will still leave substantial residual uncertainty about the potential for highly destructive detonations. The aspects that are problematic are the following:

1. Control volume codes like MELCOR and CONTAIN are not suitable for predictive modeling of natural convection in open regions that are larger than the characteristic dimensions of the circulation patterns. The governing equations ignore the convection of momentum, for example. Such codes are notoriously incapable of reliably modeling stable stratification, because they artificially diffuse mass in the absence of any driving force (an effect that some people call numerical diffusion). Results are highly sensitive to nodalization, far more so than with true Navier-Stokes solvers. For these reasons I have always been privately skeptical of NRC's use of control volume codes to address hot leg failure due to natural circulation in SBO-induced core meltdowns. It is true that skilled analysts can devise nodalizations that reproduce flow patterns resembling those seen in experiments, but I don't think that leads to *predictive* capabilities for shapes and scales far different from the tests.
2. The unique phenomena occurring in ice chests make such calculations even more uncertain. Hot air/hydrogen/steam mixtures will be affected dramatically and in numerous ways by the ice: first through condensation of steam, which creates a bulk flow towards the ice surface called Stefan flow; second through cooling, which affects buoyancy-related flow; and third through changes to the mean molecular weight of the gas mixture due to condensation of steam, which is intermediate in molecular weight between the lightest of the gases, hydrogen, and the heavier gases that are the principal components of air (nitrogen and oxygen). These various effects will either reinforce each other or oppose each other, depending on conditions. And the processes are occurring over a complex spatial distribution of ice surfaces, not just a simple boundary.
3. One might argue that these effects will serve to increase mixing compared to the corresponding hydrodynamic problem in the absence of ice, but it is also possible that under some conditions the effects might be to stabilize stratification, inhibit the formation of large convective loops, and in general reduce vertical mixing. Similarly, the pressure pulses originating from releases from the primary system are dampened by the effects of the ice chest to the extent that the upper deck doors do not open as often or as far as would be expected in the absence of ice. The result is increased isolation of the upper plenum (where the igniters are) from the ice chest (where most of the hydrogen is if the lower containment is steam inerted).
4. The problem is further complicated by the fact that the ice/gas boundaries are, over time, responsive to the gas flow, resulting in highly uncertain spatial

configurations of unmelted ice. The Finns have reported considerable unevenness of melting in their ice condenser test facilities when mixing processes are weak. The industry has long discussed 'channeling' and 'melt-through' as issues related to the design basis accident—one of the important roles of the air return fans is to insure relatively uniform melting.

These difficulties combine to create very large uncertainties in code predictions of hydrogen concentrations, with or without power to the igniters. With backup power to the air return fans, the NRC has a wonderful opportunity to reduce the uncertainty, and at a cost much cheaper than building a code that can accurately calculate the problem!

When I argue that there is residual uncertainty, I am not saying that there might be a 1% or 10% residual failure probability; I am saying that this fix might be ineffective 50% or 90% of the time. There is little way of knowing what its effectiveness will be *unless you ensure mixing.*

The low-cost option endorsed by RES might even make the accident worse, by causing a detonation-induced containment failure to occur many hours earlier than it might have in the absence of forced ignition. I would guess that the effect of this possibility on the risk picture would be modest, but I don't know. I suspect RES would not feel very comfortable asking one of its contractors to evaluate this downside of a mandated backfit—it could very possibly be used as an excuse to oppose the change. As with medicine, the first rule should be 'do no harm.'

The arguments in favor of providing power to the air return fans are compelling, I believe. The cost benefit numbers look good if reasonable assumptions are made about averted costs. The fans are already there, and they play the role of allowing the ice and the igniters to successfully accomplish their functions. Moreover the potential that the accident is exacerbated by the 'fix' is substantially eliminated.

I strongly encourage the ACRS to endorse the overall approach RES has initiated, but to insist on the additional assurance provided by backup power to the air return fans in ice condenser containments.

The claim in the Eltawila memo that analyses in NUREG/CR-6427 are bounding is false.

Page 3 of the Eltawila includes the statement "Note that in Attachment 2, the ice condenser averted cost estimates used relevant information from NUREG/CR-6427, and it appears to provide upper bound estimates as compared to plant-specific best estimates." This statement is untrue and misleading.

NUREG/CR-6427 was part of a long program (initiated around 1992) intended to resolve the DCH issue at U.S. nuclear power plants. Throughout that program the approach was best estimate and plant specific. Having been intensely involved in the ice condenser

DCH project for several years, and as a co-author of NUREG/CR-6427, I can say that there was a mix of assumptions used for the analyses that ranged from conservative to optimistic, and the end results can't be characterized as occupying any particular point in the spectrum.

For example, the plant-specific containment fragility curves (which dramatically affect the bottom line, of course) were taken from industry IPEs, which have never been audited by the NRC and which are almost certainly optimistic. (I say this because NRC's test program on containment failure has amply demonstrated the sensitivity of code results to nodalization details concerning penetrations, weldments, and other important locations for stress concentrations. It would not be expected that the industry's analysts would intentionally make assumptions that would exaggerate the potential for failure of their containments.)

In addition, certain assumptions about initial conditions in the core were also probably optimistic. Other assumptions, such as our treatment of steam spike, were probably pessimistic (or conservative), having been performed under severe time pressure. While I certainly wish that there had been time and funding to do more thorough analyses for the project, it is simply untrue to characterize the results as bounding or even conservative, regardless of how unpopular some of the results are with industry. The overall picture that emerged from NUREG/CR-6427 about ice condensers' vulnerability to SBO was qualitatively no different from the results of many earlier studies. It is because of that fact that GI-189 was established.

In the September 2000 meeting mentioned earlier, industry representatives complained that NUREG/CR-6427 was only a 'scoping study' and should not therefore be used as the sole basis for deciding on containment backfits. NRC responded that their recommendations were also based on other studies. Both sides were right. But it is inappropriate now for NRC to rewrite history by implying that the NUREG/CR-6427 was bounding in nature.

Final Observation.

While there is a clear need for additional study to support resolution of GI-189 (such as whether backfits that are not qualified for external event-induced SBOs would succeed anyway), I hope that the NRC proceeds into the implementation phase in a timely way. The RES staff has made a good start in establishing the technical basis for resolving this important issue. But I would like them to set aside their pre-conceived notions of what is the right answer and let the scientific facts speak for themselves. In this regard, I reiterate the following Observation from the 1998 ACRS review of the NRC Research program: "The Office of Nuclear Regulatory Research (RES) routinely relies on "assumed" solutions to address technical issues."[†]

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[1]Advisory Committee on Reactor Safeguards, USNRC, "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program", NUREG-1635 vol. 1, p. 30 (June 1998).

There is an old saying, "if it's not broke, don't fix it." I'd like to propose a new version to the NRC: "if you're going to fix it, then *fix it!*"

I would be glad to discuss any questions the Committee or others at NRC might have in regard to these comments.

Sincerely,

[signature]

Kenneth D. Bergeron

Technical Assessment of GSI-189

Advisory Committee on Reactor Safeguards

JUNE 6, 2002

Allen Notafrancesco, Task Manager
Safety Margins and Systems Analysis Branch
Division of Systems Analysis and Regulatory Effectiveness
Office of Nuclear Regulatory Research

GENERIC SAFETY ISSUE 189: "SUSCEPTIBILITY OF ICE CONDENSER AND MARK III CONTAINMENTS TO EARLY FAILURE FROM HYDROGEN COMBUSTION DURING A SEVERE ACCIDENT"

- **Risk-Inform 10 CFR 50.44:**
  - "Status Report" in SECY-00-0198, September 14, 2000
  - "Staff Plans" in SECY-01-0162, August 23, 2001
  - SRM, December 31, 2001.....Resolve GSI-189 Expeditiously

- **GSI-189:**
  - MD 6.4, Passed GI Screening- February 2002
  - Generated Task Action Plan
  - Currently Completing Technical Assessment

AFFECTED DOMESTIC REACTORS

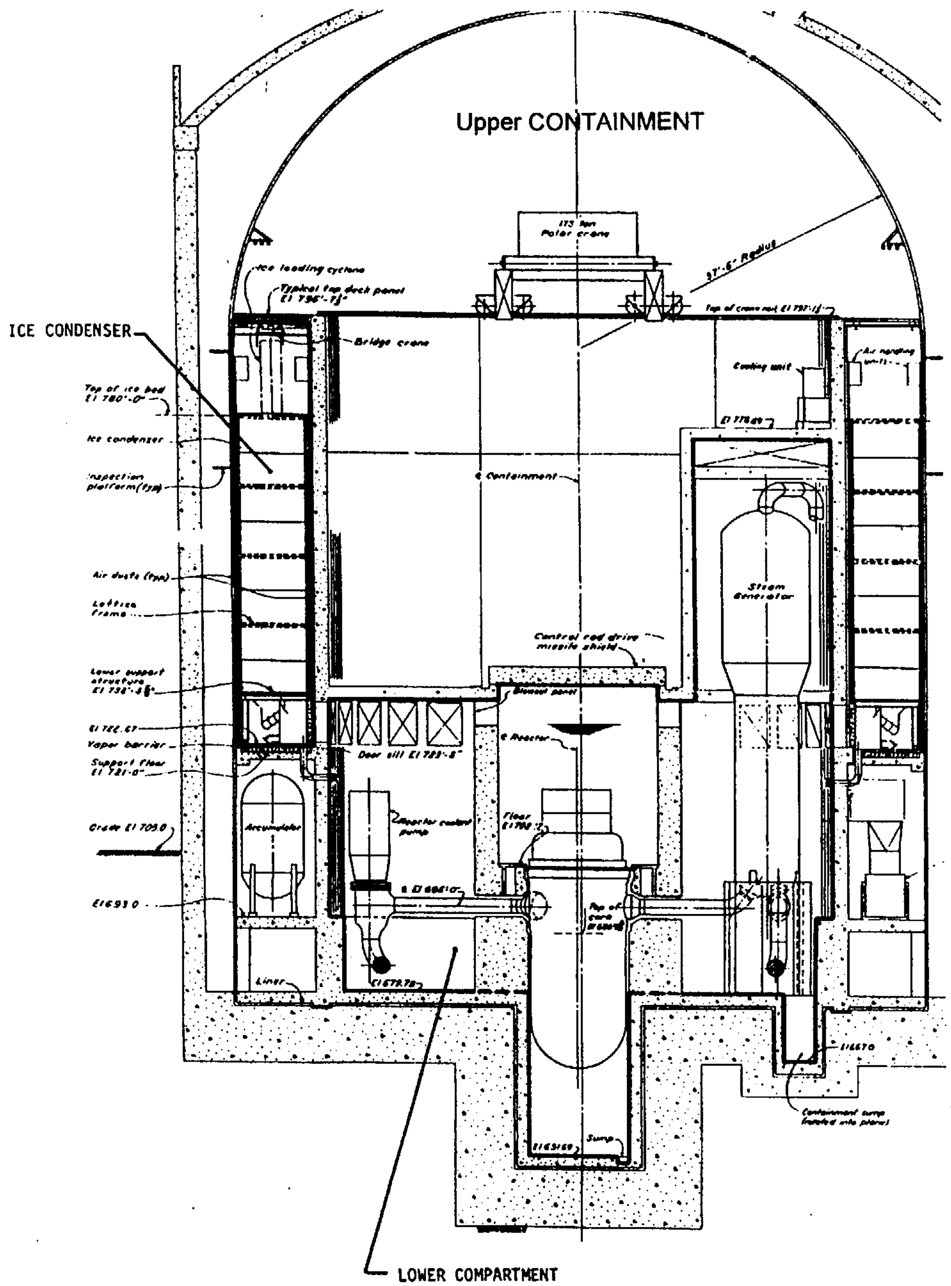
- **PWR Reactors with Ice Condenser Containments:**

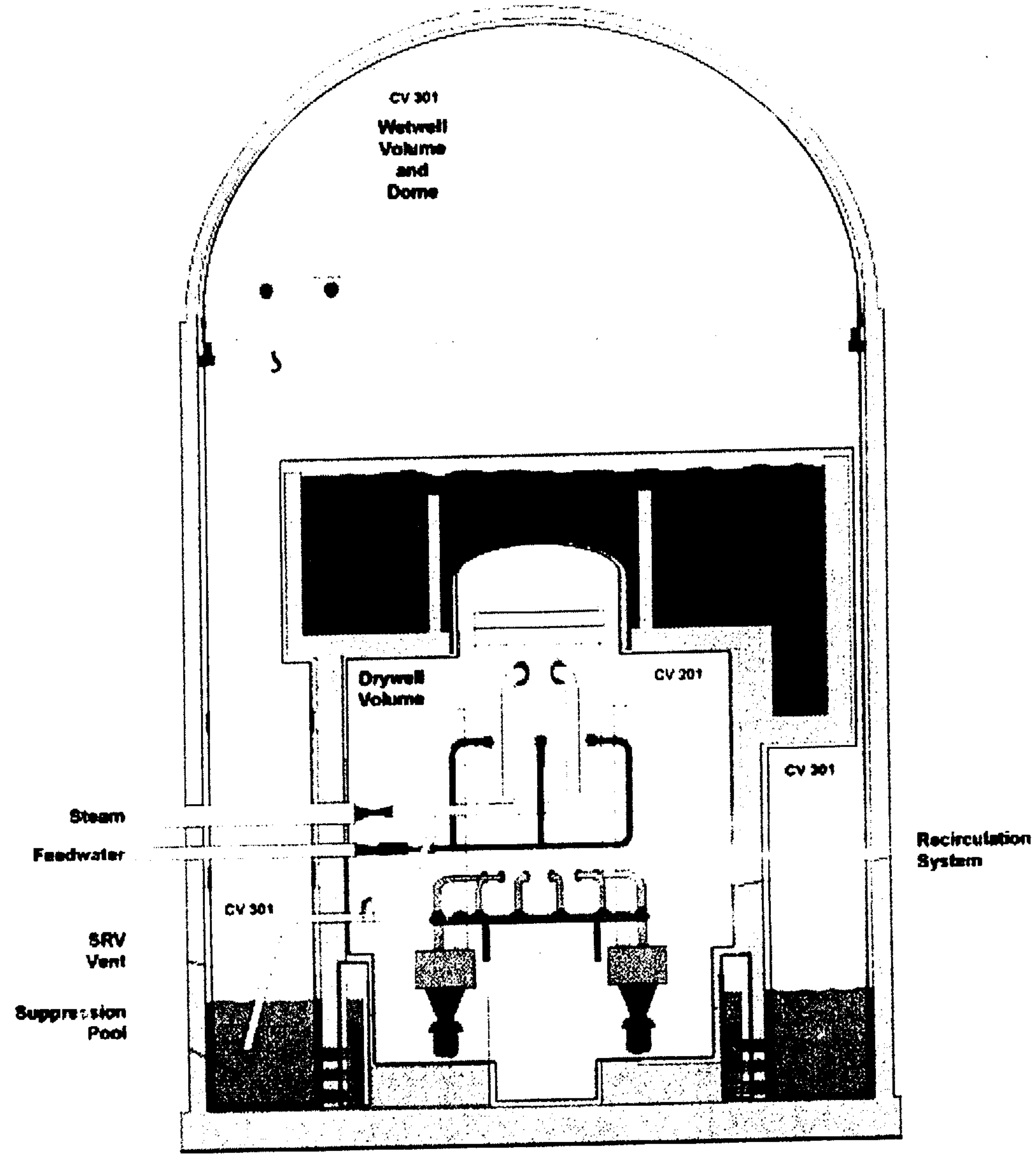
  9 Reactors; four dual unit sites (McGuire, Catawba, D.C. Cook, and Sequoyah) and one single unit site (Watts Bar)

- **BWR Reactors with Mark III Containments:**

  4 Reactors; four single unit sites (Grand Gulf, Perry, Clinton & River Bend)

- **Plants Retrofitted in 1980s with AC Powered Igniters to mitigate the consequences in which copious amounts of Hydrogen are produced (10CFR50.44)**


Upper CONTAINMENT
ICE CONDENSER
LOWER COMPARTMENT


CV 301
Wetwell
Volume
and
Dome
Drywell
Volume
CV 201
CV 301
CV 301
Steam
Feedwater
SRV
Vent
Suppression
Pool
Recirculation
System

GSI-189 Technical Assessment

Objective: For SBO events, determine whether an additional back-up power supply to igniters is justified.

- Perform a Cost-Benefit Analysis guided by NRC prescribed methods
- For Ice Condensers, perform an up-dated severe accident analysis to demonstrate that igniters alone are adequate

- Execute the Task Action Plan
- Brief ACRS
- Send findings to NRR

GSI-189 TASK ACTION PLAN

- Approach for expeditious resolution:
  - Use Existing Studies
  - Assemble Support Team w/contractor assistance
    - Cost Analysis; REAHFB w/ISL
    - Benefits Analysis; PRAB w/BNL
    - Plant Analysis; SMSAB w/SNL

COST ANALYSIS

Back-up Power Supply Configurations Considered:

- <u>Pre-Staged Design</u>
  - Dedicated diesel generator (in its own protected enclosure) and its auxiliary equipment in place
- <u>"Off-the-Shelf" Option (low cost)</u>
  - Use of a portable diesel generator with minimal permanent plant modifications

Results: Low cost option is about 1/3 of pre-staged but may have slightly lower functional reliability, however low cost option may provide greater availability in response to external initiating events.

RESPONSE TO EXTERNAL EVENTS

- PRE-STAGED DESIGN

  -- If designed for external events, cost would double

    -- Expect survivability to be available for a reasonable subset of external events

- LOW COST OPTION

  -- No permanent structure and set-up would occur after the initial impact of the external event

  -- Portable diesel may come from multiple diverse locations

    -- These attributes should allow for increased likelihood of functionability in response to external events

COST BREAKDOWN (ISL Report):

	Low Cost	--------	Pre-Staged	--------	w/Ext-Qual.	--------
Attribute	Ice Cond. Unit	Mark III Unit	Ice Cond. Unit	Mark III Unit	Ice Cond. Unit	Mark III Unit
Industry *	$57-76K	$78K	$135-178K	$193K	$271-350K	$385K
NRC **	$13K	$13K	$13K	$13K	$13K	$13K
Total	$70-89K	$91K	$148-191K	$206K	$284-363K	$398K

*** Variability of ice condensers plants are mainly due to consideration of shared costs relevant to dual unit sites.**

**** Assumed rulemaking is linked to on-going 10CFR50.44 effort.**

BENEFIT ANALYSIS

ICE CONDENSER CONTAINMENTS:

As part of license renewal, severe accident mitigation alternatives (SAMAs) are to be considered;(from NUREG-1437,Supplements 8 & 9)

- Benefits for Hydrogen Control in SBO events, all early failures are averted:

Plant	Based on most recent plant specific PRA*	Based on conditional containment failure probabilities from NUREG/CR-6427
McGuire	$178 - 248K	$678K
Catawba	$236 - 329K	$387K

* Variation in costs due to sensitivities in discount rate (3-7%) and years of remaining life (20-40 years)

- BNL report confirmed that using NUREG/CR-6427, averted costs are somewhat greater

BENEFIT ANALYSIS

MARK III CONTAINMENTS:

- BNL used Grand Gulf for its analysis:
  - SBO CDF from IPE
  - Containment Performance from NUREG-1150
- Benefits for Hydrogen Control in SBO events, all early failures are averted = $40-68K for Grand Gulf (40 yrs @ 3-7% discount rate)
  - Unique Risk Profile; high pressure SBO dominates

BENEFIT ANALYSIS

OTHER MARK III CONTAINMENTS:

Plant Name	SBO frequency ratio	2000 population ratio (estimated)	Product of ratios
Grand Gulf	1.00	1.00	1.00
Clinton	1.31	3.14	4.13
Perry	0.30	7.53	2.27
River Bend	1.81	3.14	5.68

Therefore, benefits for Hydrogen Control in SBO events, could exceed $200K (40 yrs @ 7% discount rate)

COST BENEFIT COMPARISON

BENEFITS:

-ICE COND- [------------ NUREG/CR-6427---------------------

-----MARK IIIs----------

0 $200K $400K $500K

-L/Cost-

--P/Stage-- -w/ExtQual-or w/fans-

COSTS:

COST BENEFIT SUMMARY

(1) Focusing on the plant specific averted cost estimates for ice condenser plants, the low cost equipment option is clearly cost beneficial and provides for more overall flexibility in response to external events.

(2) For Mark III plants, the low cost back-up power supply option is marginally cost-beneficial.

(3) Since the proposed mitigative enhancement passes the back-fit cost beneficial test, we recommend that further regulatory action is warranted.

ICE CONDENSER CONTAINMENT PERFORMANCE

- For non-SBO events, Igniters and Air Return Fan (ARF) functional and/or sprays

- For SBO events, need to investigate the feasibility of only igniters

- Performed MELCOR Scoping Study
  - Use new 10CFR50.44 H2 Source Terms
  - Pursuing key parametric sensitivities

MELCOR SCOPING STUDY CONCLUSIONS

- Igniters alone are effective in controlling Hydrogen build-up
- Marginal improvement if one ARF is included, however fans accelerates time of ice melt-out
- Continuing ice condenser plant response uncertainty study, e.g., H2 source terms, burn propagation, etc.

Response to Letter to ACRS Dated June 3, 2002

Consideration of Adding Back-Up Power to ARF...Basis:

- Arbitrary assumptions of limiting conditions & sequences of events are extreme
- Ease of DDT occurring in the ice chest is not demonstrated

Why Back-Up Power to Igniters Only are Sufficient....

- 30+ igniters distributed through out containment will assure lean ignition and promote diffusive burning

- Direct lower compartment burning may occur; provides for propagation to the ice chest and enhances mixing due to deflagration induced turbulence

- More refined modeling (e.g., CFD) would reveal larger spatial gradients within a compartment than CV codes. Induce earlier lite-off than predicted in CV codes, effectively leading to leaner burns....

- Burning at leaner concentrations will promote gas circulation including the occurrence of diffusion flames in the ice chest

- Ice bed geometry is not conducive to create unconditional DDT; relatively open

- Downside to ARF

    - more rapid ice bed melt-out

    - more complicated and costly addition

MRP Update to ACRS
June 6, 2002

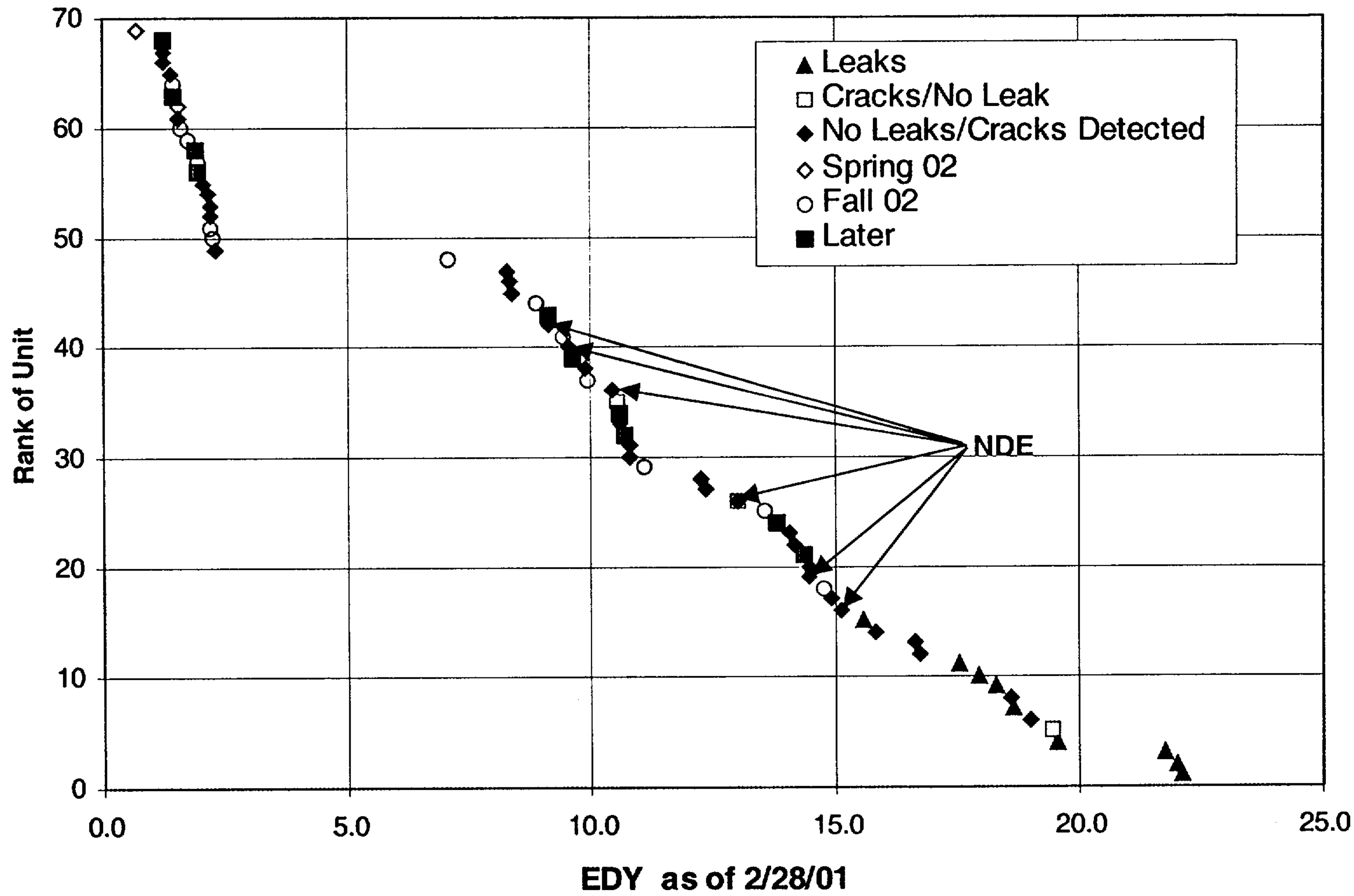
Larry Mathews

Southern Nuclear

Chairman, MRP Alloy 600 Issue Task Group

EPRI

Susceptibility Ranking



EPRI

Crack growth rate for thick-section Alloy 600 material exposed to PWR primary water

John Hickling, EPRI
for the
MRP Alloy 600 Issue Task Group

ACRS 6/6/02.3

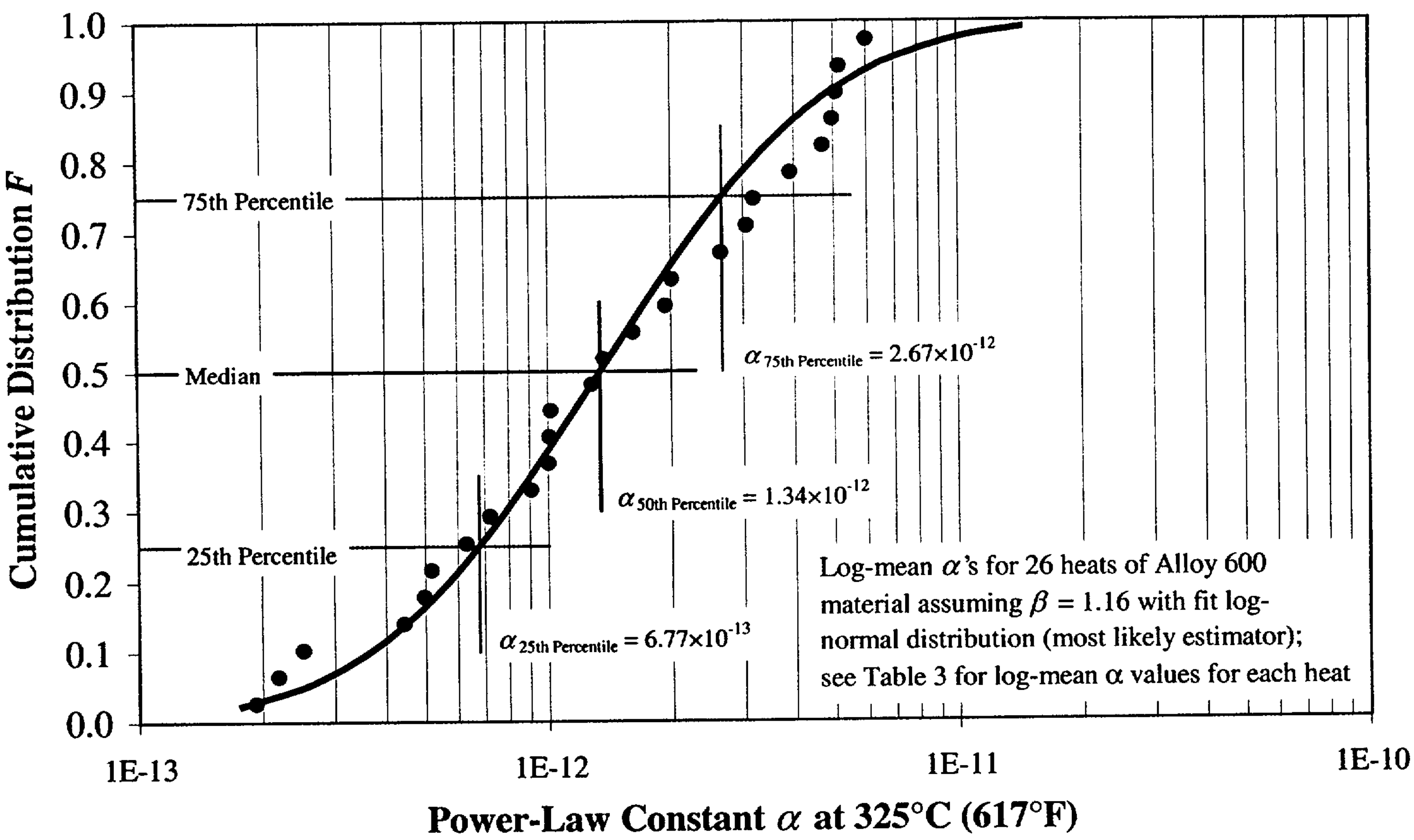
EPRI

Derivation of MRP CGR Curve

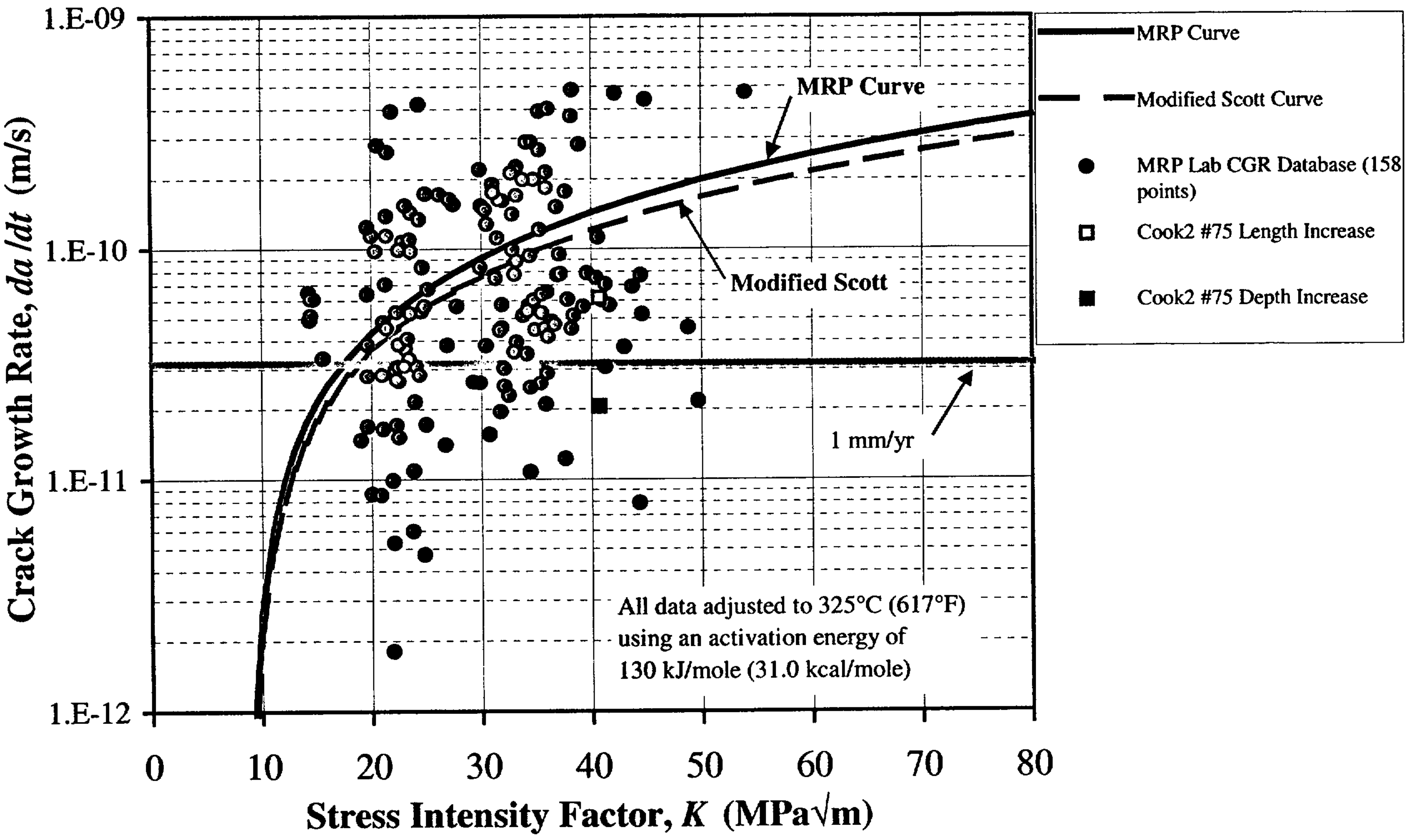
Heat Rank		Material Supplier	Product Form	Number of Data Points	Log Mean Power-Law Constant α at 325°C (617°F) SI Units[1]	English Units[2]
1		Creusot-Imphy	Forged Bar	21	6.01E-12	8.32E-03
2		B&WTP	Thick-wall Tube	4	5.16E-12	7.15E-03
3		French Supplier	CRDM Nozzle	9	5.08E-12	7.03E-03
4		Tecphy	Rolled Bar	7	4.96E-12	6.88E-03
5		B&WTP	Thick-wall Tube	4	4.71E-12	6.52E-03
6		VDM	Rolled Plate	2	3.92E-12	5.43E-03
7		Schneider-Creusot	Forged Bar	1	3.19E-12	4.42E-03
8		B&WTP	Thick-wall Tube	32	3.07E-12	4.25E-03
9		B&WTP	Thick-wall Tube	1	2.65E-12	3.68E-03
10		Arbed	CRDM Nozzle	3	2.01E-12	2.79E-03
11		Creusot-Imphy	Forged Plate	1	1.94E-12	2.69E-03
12		Schneider-Creusot	Forged Bar	1	1.62E-12	2.24E-03
13		Huntington	Thick-wall Tube	1	1.37E-12	1.90E-03
14		Huntington	Rolled Plate	14	1.29E-12	1.78E-03
15		*Not Listed*	Forged Bar	2	1.02E-12	1.41E-03
16		Sumitomo Metal	Thick-wall Tube	1	1.01E-12	1.40E-03
17		Sandvik	Thick-wall Tube	27	1.00E-12	1.39E-03
18		Standard Steel	Forged Bar	1	9.09E-13	1.26E-03
19		Huntington	Thick-wall Tube	12	7.21E-13	9.99E-04
20		*Not Listed*	Forged Bar	3	6.31E-13	8.74E-04
21		Tecphy	Rolled Bar	1	5.18E-13	7.18E-04
22		Huntington	Plate	1	4.97E-13	6.89E-04
23		Creusot-Ondaine	Forged Bar	4	4.44E-13	6.15E-04
24		Inco	Rolled Bar	1	2.51E-13	3.48E-04
25		Sandvik	Thick-wall Tube	2	2.18E-13	3.03E-04
26		Huntington	Thick-wall Tube	2	1.93E-13	2.67E-04
			Log-Mean for All Data Points	158	1.96E-12	2.72E-03
			Log-Mean of Heat Log-Means	26 Heats	1.34E-12	1.86E-03

EPRI

Derivation of MRP CGR Curve



Derivation of MRP CGR Curve



EPRI

Application of MRP CGR Curve

- The MRP recommended curve is intended for disposition of detected PWSCC flaws in thick-walled Alloy 600 components exposed to normal PWR primary water
- Thus it is directly applicable to **axial ID flaws** detected in CRDM nozzle pressure boundary base material and to flaws below the J-groove weld
- Its use at low crack-tip stress intensity factors (< approximately 15 MPa√m) would involve assumptions not currently substantiated by actual CGR data for CRDM nozzle materials
- In practice, however, K values will already be above this

Probabilistic Fracture Mechanics Analysis of CRDM Nozzles

Presented at:

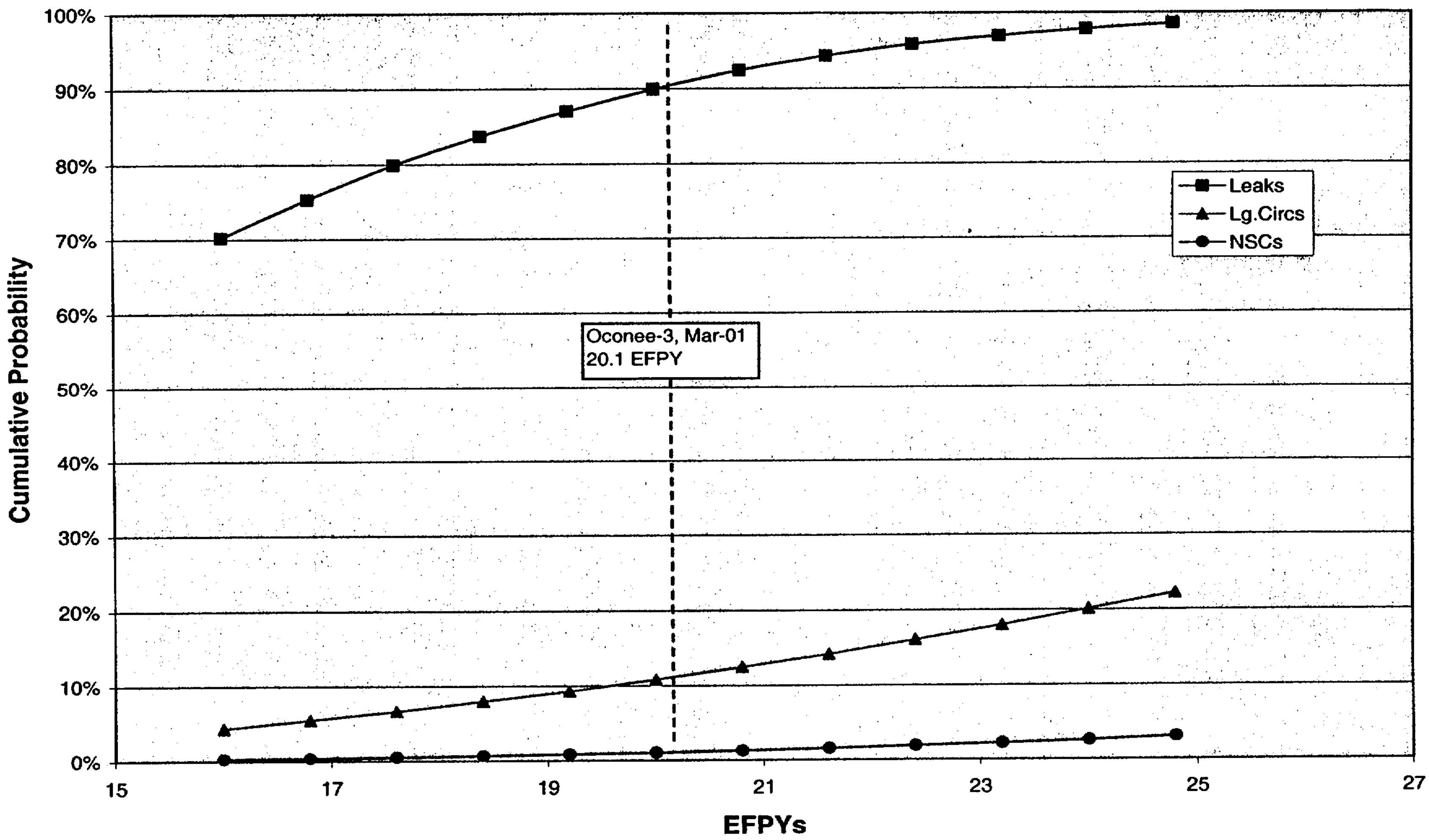
ACRS Meeting
Rockville, MD

From Presentation by:

Dr. Peter C. Riccardella
Structural Integrity Associates

Structural Integrity Associates, Inc.

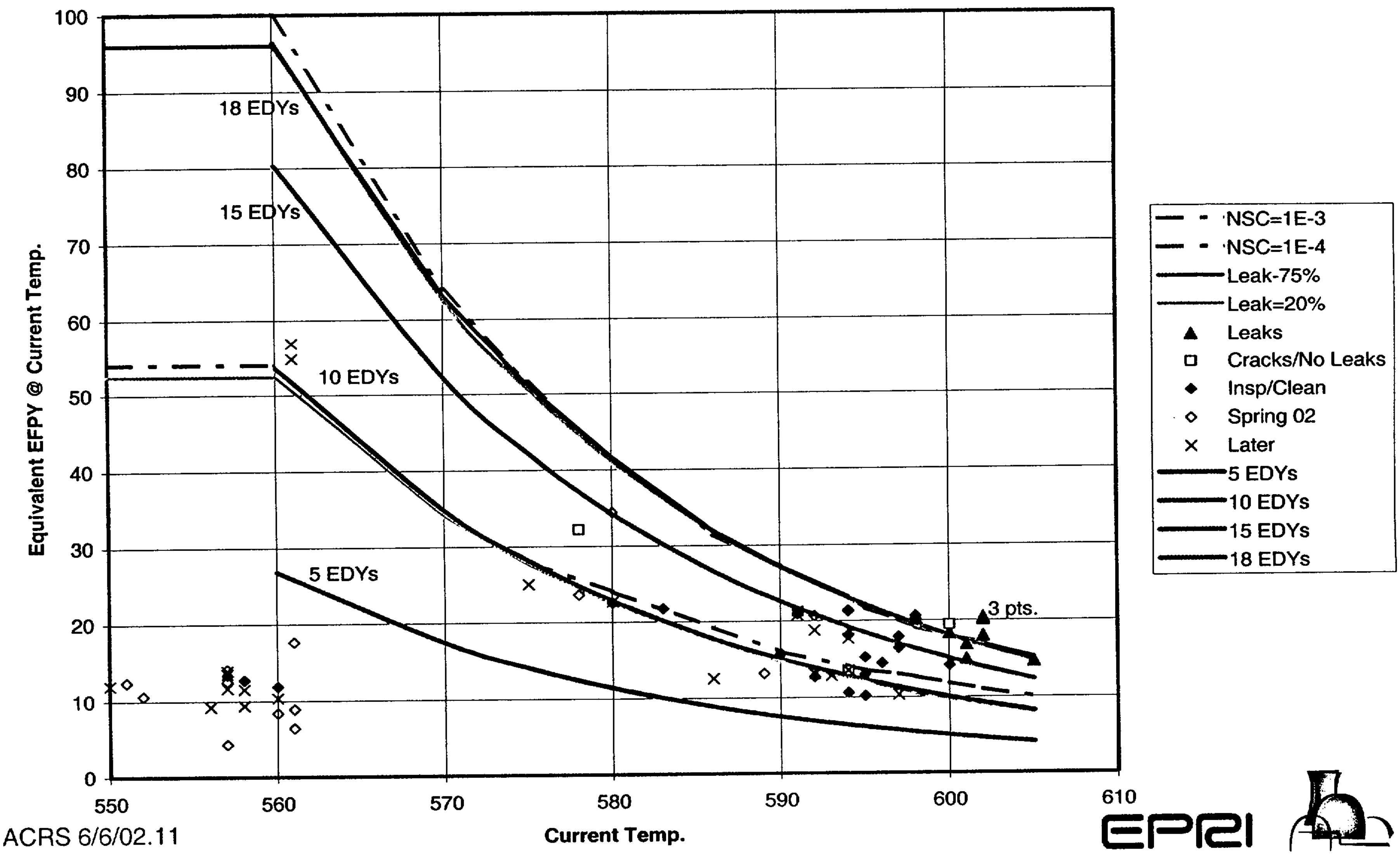
Benchmarking of PFM Results with respect to B&W Plants



Technical Basis for Inspection Plan
- Basic Concept -

- Start with "benchmarked" analysis parameters from B&W plant analysis
- Analyze plants at various head temperatures
- Set risk categories based on probability of Net Section Collapse (per year) and cumulative leakage probability
- Set inspection intervals based on effect of various inspections on probability of Net Section Collapse (per year)

Correspondence of Susceptibility Categories to EDYs



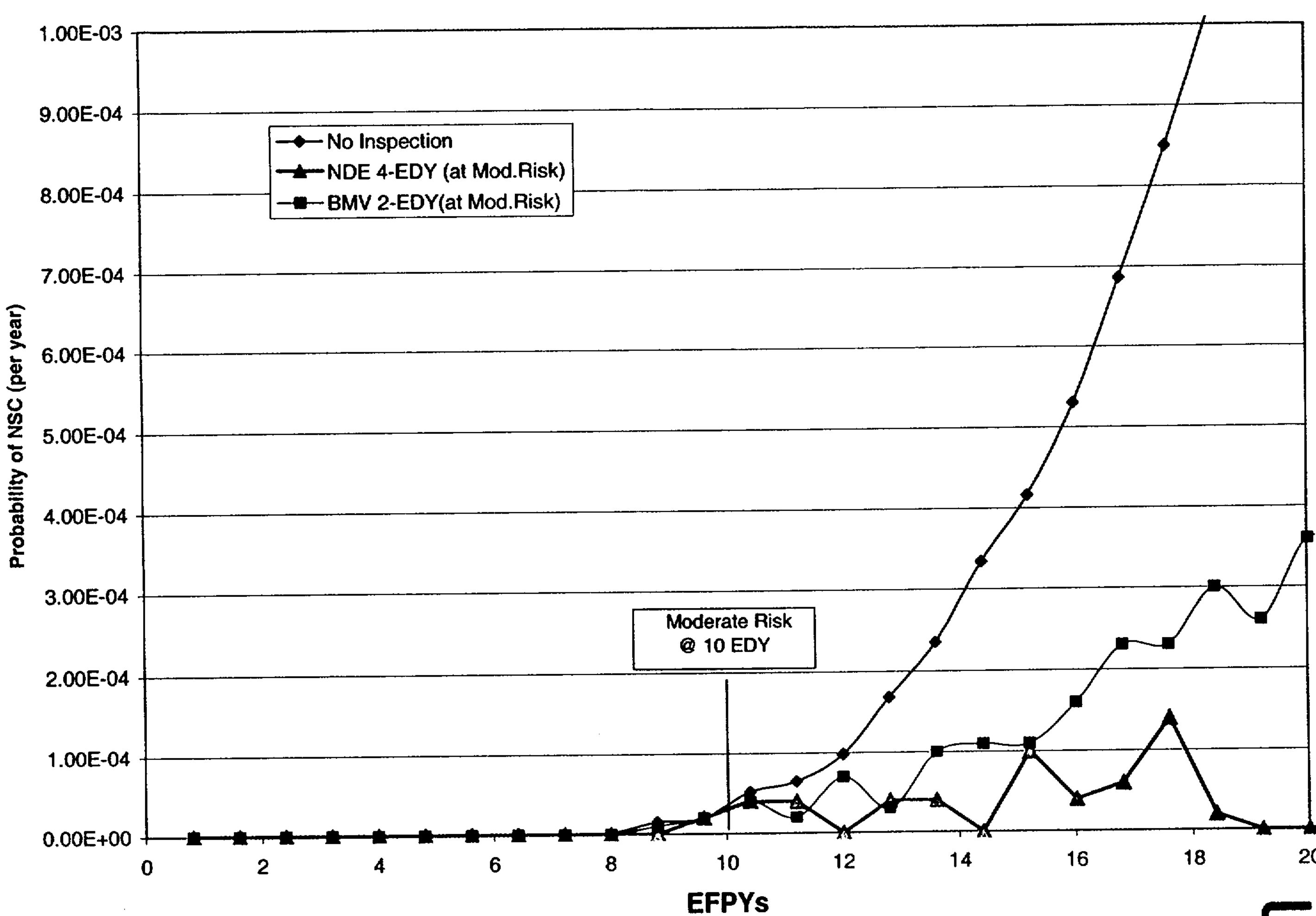
EPRI

Inspection Frequency Runs: Probabilities of Detection

- Bare Metal Visual Inspections (BMV)
  - Initial POD = 0.6
  - POD for Subsequent Exams = 0.2 x Initial POD (when Leakage missed)
- Non-Destructive Examinations (NDE)
  - POD = f(crack depth) per EPRI-TR-102074[1]
  - 80% Coverage Assumed

[1] Dimitrijevic, V. and Ammirato, F., "Use of Nondestructive Evaluation Data to Improve Analysis of Reactor Pressure Vessel Integrity, " EPRI Report TR-102074, Yankee Atomic Electric Co. March 1993

Effect of Inspections upon Entering Moderate Category



EPRI

Technical Assessment of Davis-Besse Degradation

Prepared by:
G. White
C. Marks
S. Hunt
Dominion Engineering, Inc.

ACRS 6/6/02.14

EPRI

Purpose

- The purpose of the technical assessments is to complement plant experience in answering the following questions:
  - If a significant amount of RPV head material loss occurs, will it be detectable visually from above the head (either directly or through the presence of deposits)?
  - Is there a period of time following initiation of a through-wall leak for which there is assurance that no unacceptable reactor vessel head corrosion will occur?
- In addition, the technical assessments also address current questions regarding the progression of material loss mechanisms (i.e., understanding of degradation progression)

Approach

- The basic approach is to examine how the various potential material loss mechanisms vary as the leak rate is increased from 10^{-6} to 1.0 gpm and the initial tight nozzle annulus becomes a large cavity through material loss. Evaluations focus on:
  - Thermal-hydraulic environment
  - Chemical environment
  - Properties of boric acid and boron compounds
  - Relevant experimental results and plant experience
- The leak rate is expected to be the key parameter:
  - Expansion cooling increases with leak rate, potentially permitting a liquid film to reach the top head surface
  - Increasing leak rates result in higher velocities and potentially erosion or flow accelerated corrosion

Approach (continued)

- The leak rate also determines the amount of boric acid deposits that exit the pressure boundary
- The results of corrosion and erosion rate evaluations are used to bound:
  - The timeframe for significant degradation
  - The volume of low alloy steel material loss versus the volume of deposits produced

EPRI

Degradation Progression
Leak Rate is Main Controlling Parameter

PRELIMINARY

Increasing Leak Rate →

Nozzle/Weld Condition	leak path to annulus	leak path to annulus	leak path to annulus	likely crack in nozzle wall reaches above top of weld on OD and ID	crack in nozzle wall reaches relatively high above top of weld on OD and ID
Annulus Condition	hypothetical clogged annulus	possibly some opening up of annulus	likely some opening up of annulus	may require some opening up of annulus	likely requires some opening up of annulus
Leak Rate	hypothetical zero leak rate	< on the order of 0.001 gpm	roughly between 0.001 and 0.01 gpm	roughly between 0.01 and 0.1 gpm	> on the order of 0.1 gpm
Liquid Velocity Exiting Crack	0 ft/s	less than on the order of 0.01 ft/s	roughly between 0.01 and 0.1 ft/s	roughly between 0.1 and 1 ft/s	> on the order of 1 ft/s
Local Temperature	600°F	Close to 600°F	at least roughly 500°F	roughly between 212 and 500°F	Close to 212°F
Liquid Location	fills annulus up to hypothetical blockage	all liquid vaporizes close to bottom of annulus	liquid film unlikely to exist high in annulus	liquid film may cover much of annulus walls	liquid film covers local top surface of head
Possible Significant Mechanisms	• none	• possibly very minor galvanic	• possibly some galvanic corrosion; • erosion until annulus opens slightly	• likely some galvanic corrosion; • minor erosion and FAC; • possibly aerated BAC if annulus is opened enough	• aerated BAC on top of head; • possibly molten BAC, galvanic corrosion, erosion, or FAC
Pounds of Boric Acid Deposits Released in 2 years	at least small amount extruded	< on the order of 7 lbs	roughly 7 to 70 lbs	roughly 70 to 700 lbs	> on the order of 700 lbs
		all or most other leaking CRDM nozzles	EPRI & CE Annulus Tests	EPRI & CE Annulus Tests	Davis-Besse Nozzle #3

Inspection Plan

PWR Reactor Pressure Vessel Head Penetrations

ACRS 6/6/02.19

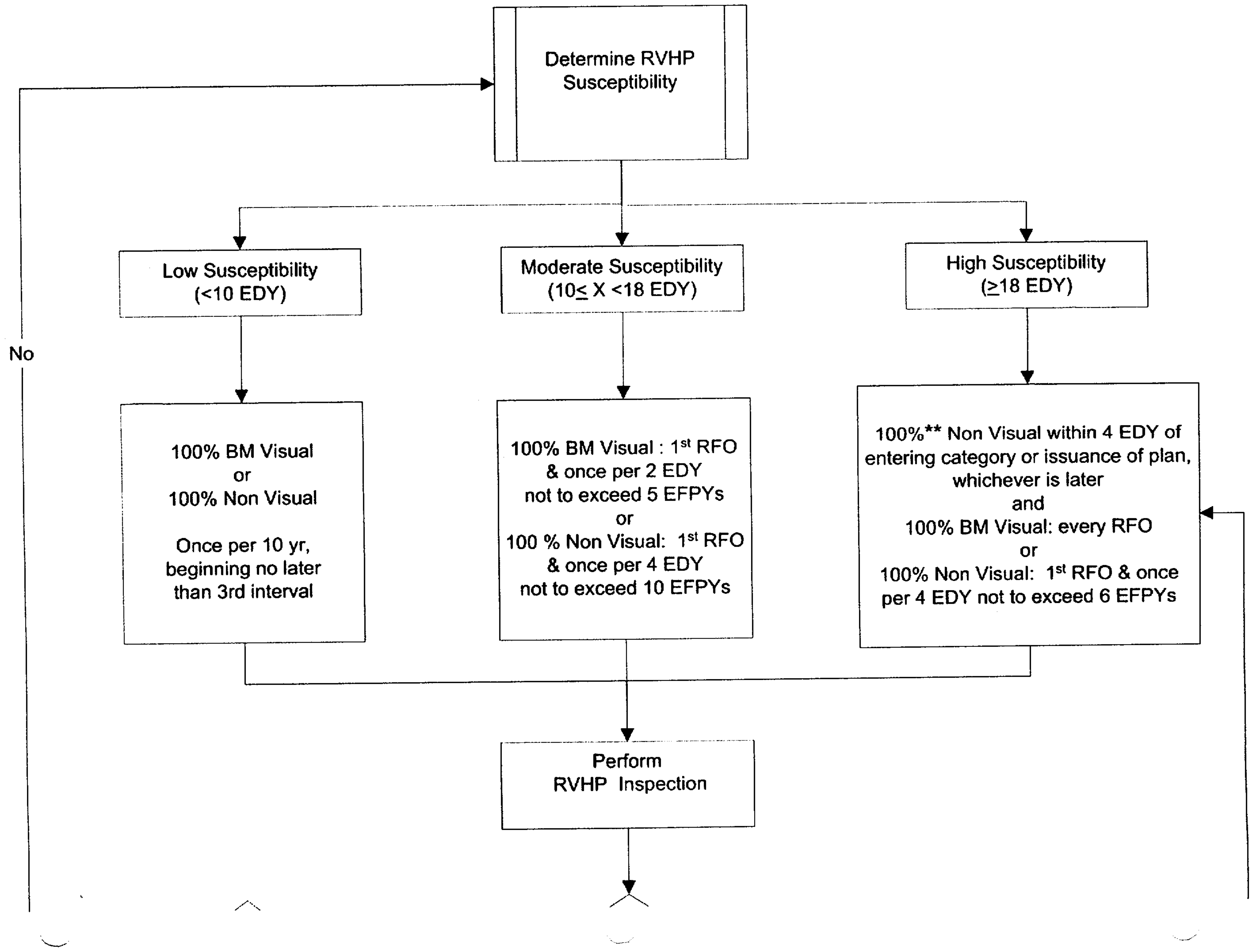
EPRI

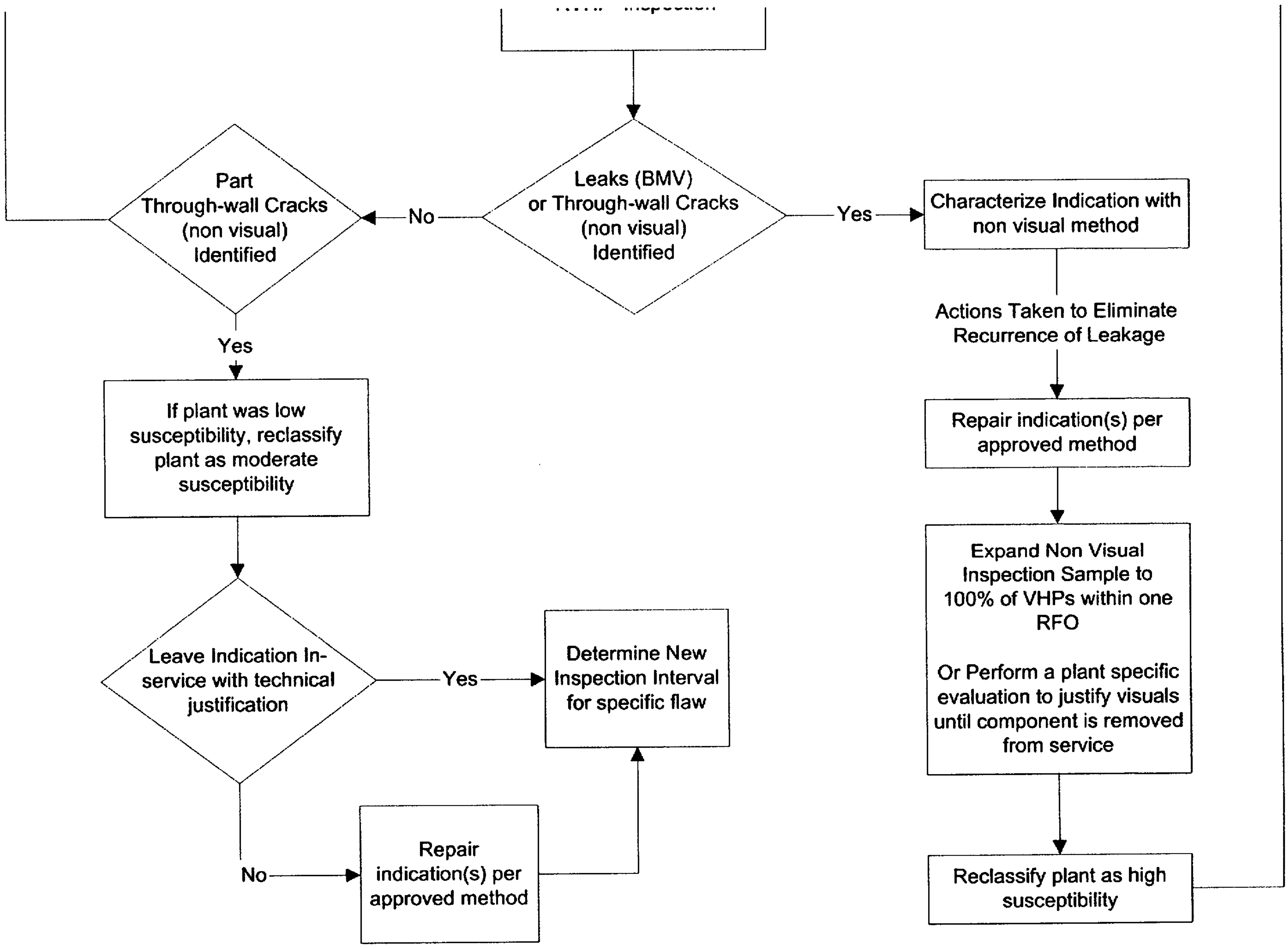
Status of Inspection Plan

- Inspection Plan and technical bases were presented to NRC staff on May 22
  - Technical Bases documents will be provided to NRC in June 2002.
- Comments received in following areas
  - Plan should address inspections for both wastage and nozzle ejection issues
  - Timeframe for wastage development
  - Leakage past tight interferences
  - Policy issue of detecting degradation through leakage
  - Address replacement head

EPRI

PWR RPV Head Penetrations Inspection Flowchart



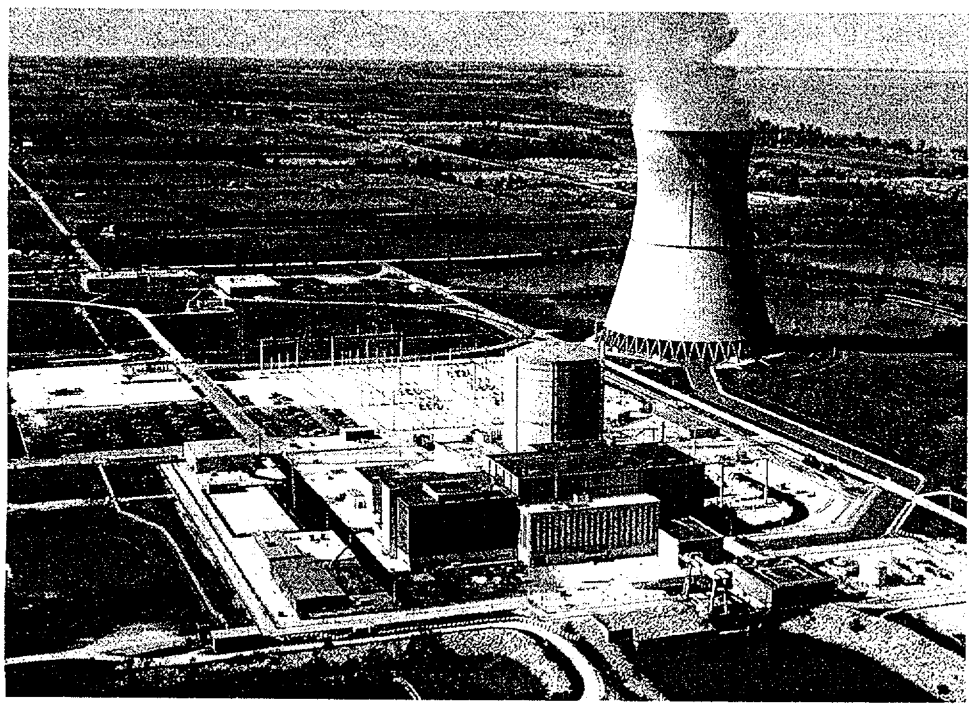


** 100% of the CRDM/CEDM penetrations and associated J-groove welds or portions thereof that can be examined without incurring undue hardship

Advisory Committee on Reactor Safeguards Update of the Davis-Besse Nuclear Power Station Reactor Pressure Vessel Closure Head Activities

June 6, 2002

Agenda



<u>Introduction</u>
- Jim Powers

<u>Update of RPV Closure Head Field Activities</u>
- Mark McLaughlin

<u>RPV Closure Head Replacement</u>
- Bob Schrauder

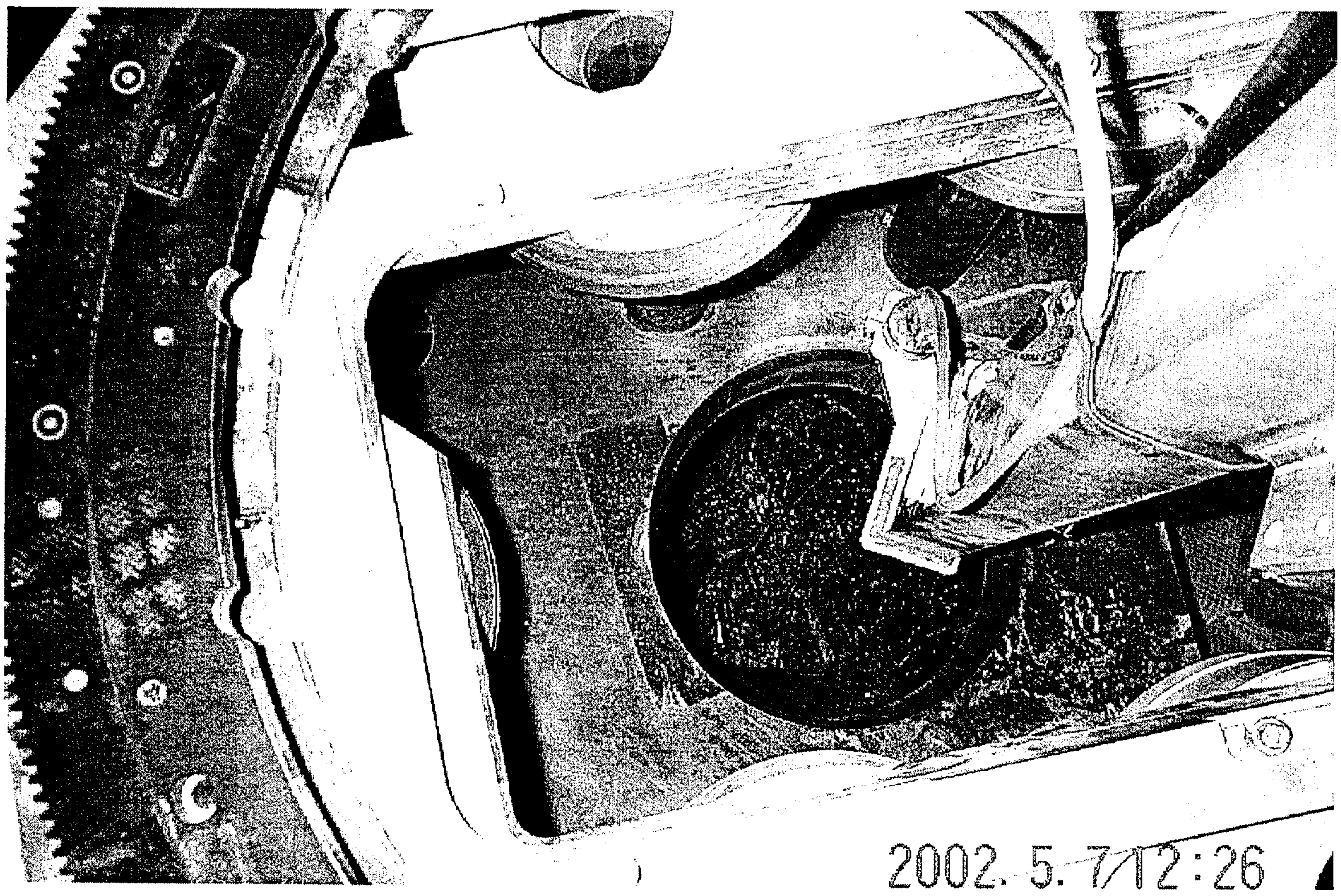
<u>Root Cause Analysis</u>
- Steve Loehlein

<u>Concluding Remarks</u>
- Jim Powers

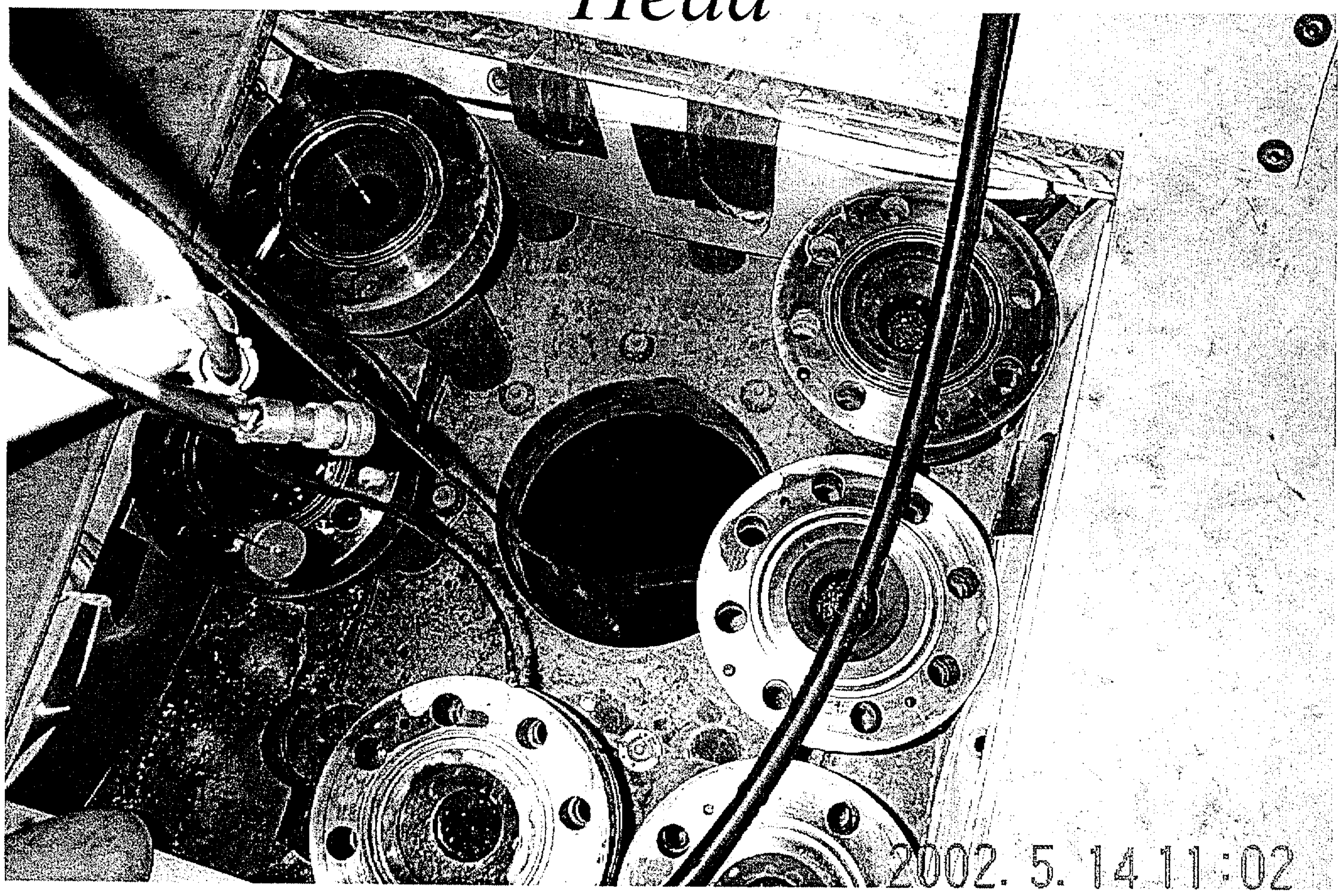
Update
of RPV Closure Head
Field Activities

Mark McLaughlin
Field Activities Team Leader

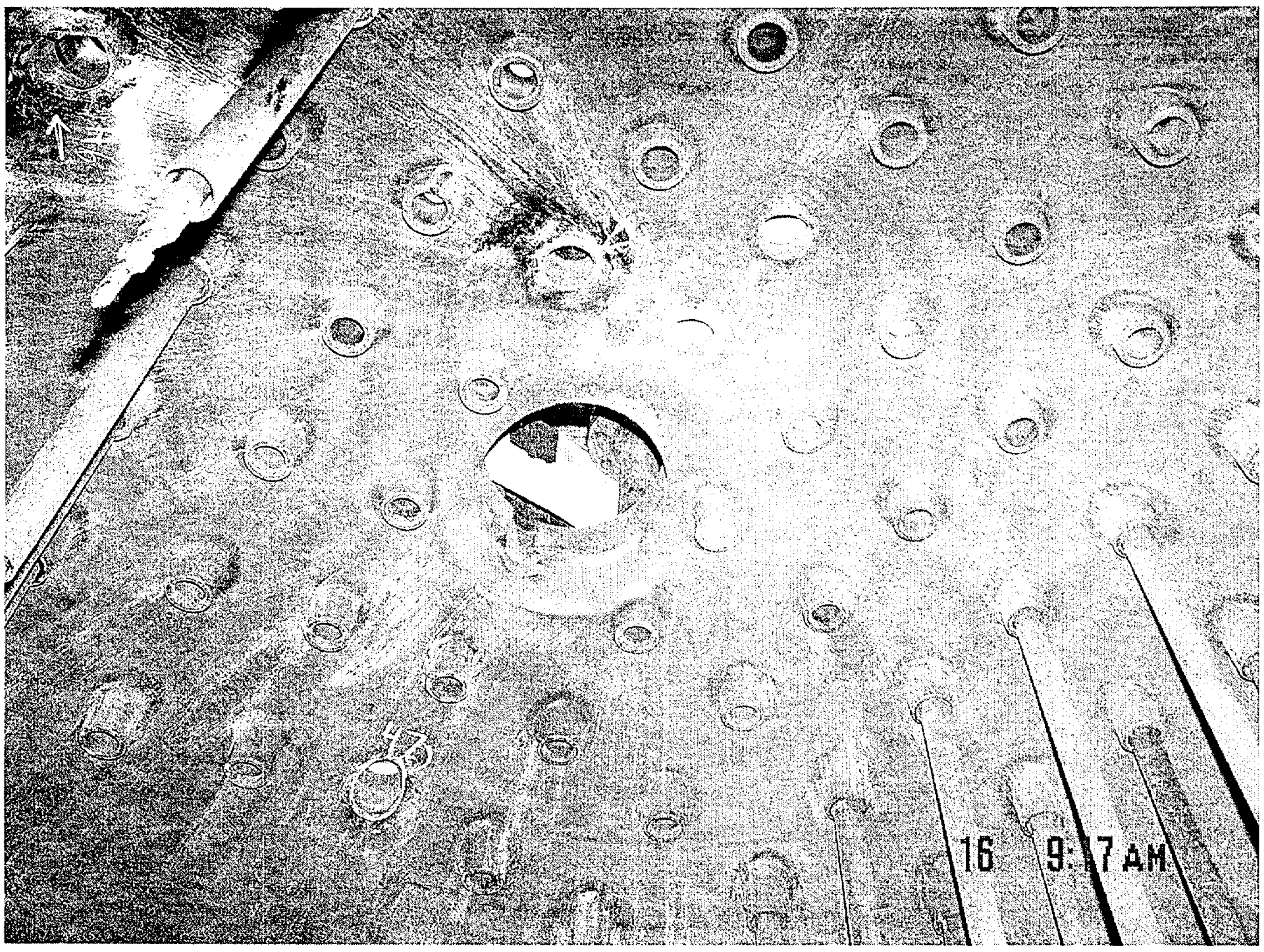
Abrasive Water Jet



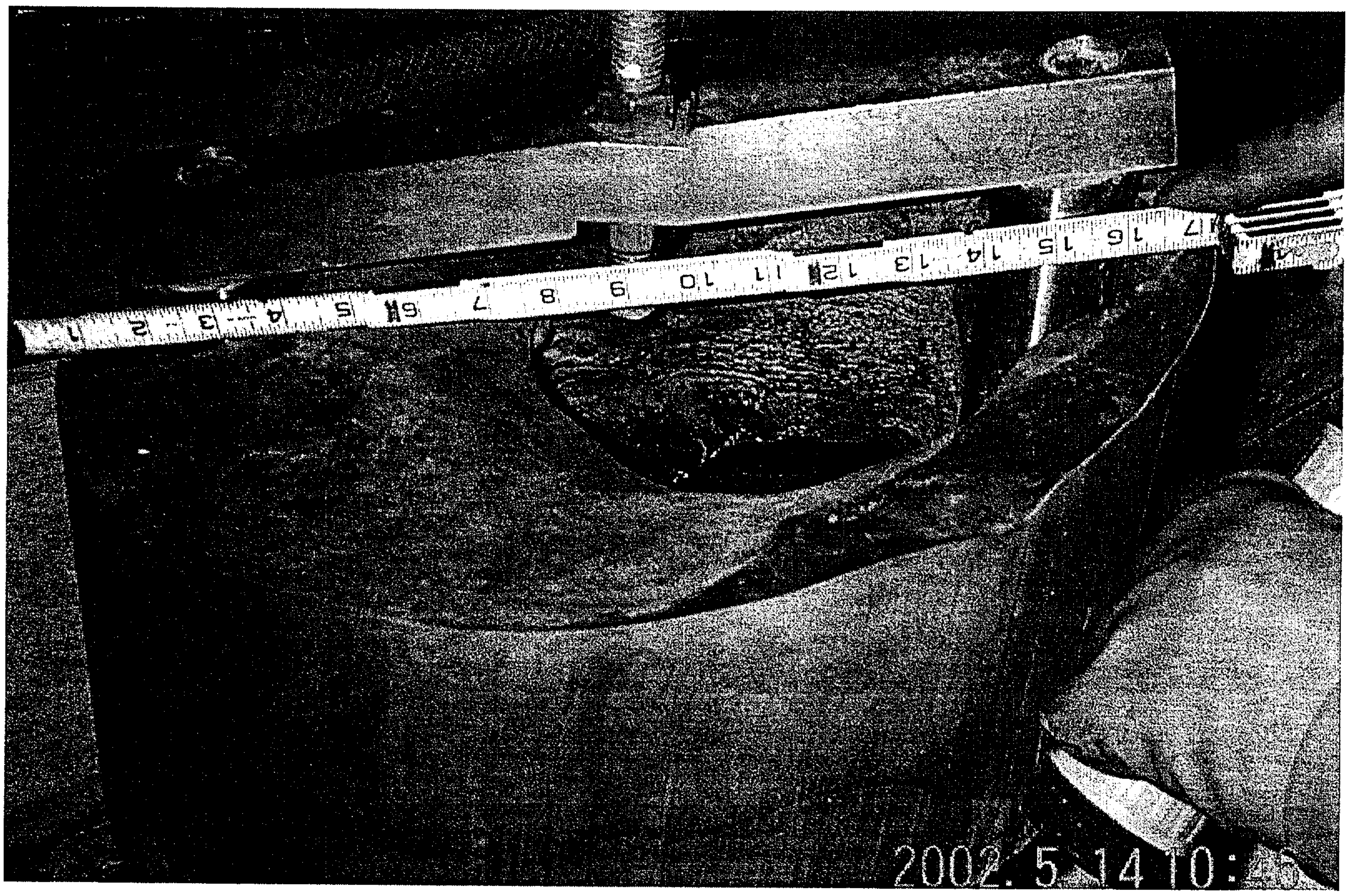
Area Removed from RPV Closure Head



Underneath RPV Closure Head



RPV Closure Head Cutout

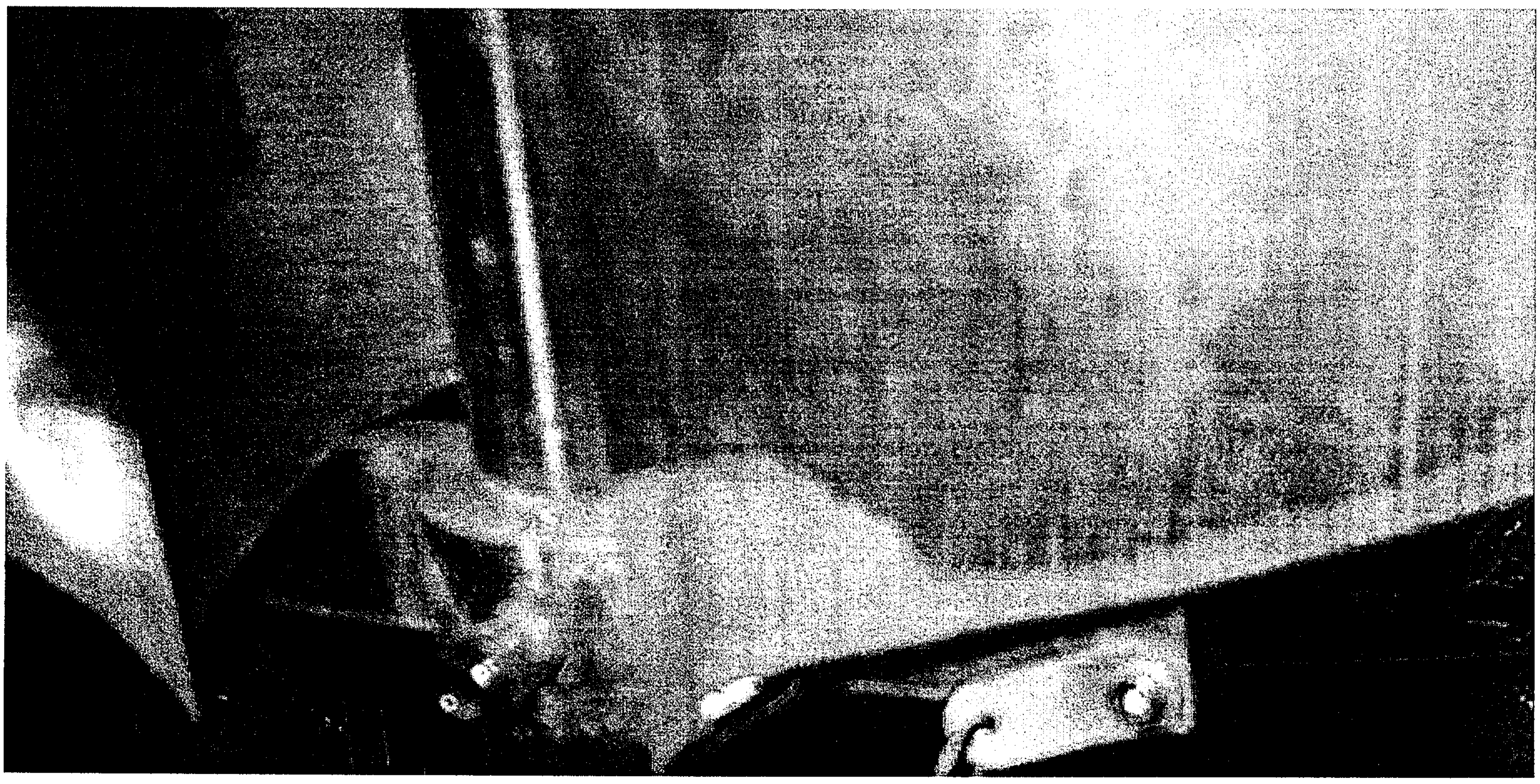


Sample Plan

- Phase 1
  - Corrosion products/boric acid deposits from top of head
  - Deposits scraped from CRD nozzle 3 below the flange
  - Draft report issued for Davis-Besse review
- Phase 2
  - Corrosion products/boric acid deposits from nozzle 2 removal
- Phase 3
  - Nozzle 3 and nozzle 3 corrosion area
  - Nozzle 2

RPV Closure Head Cutout

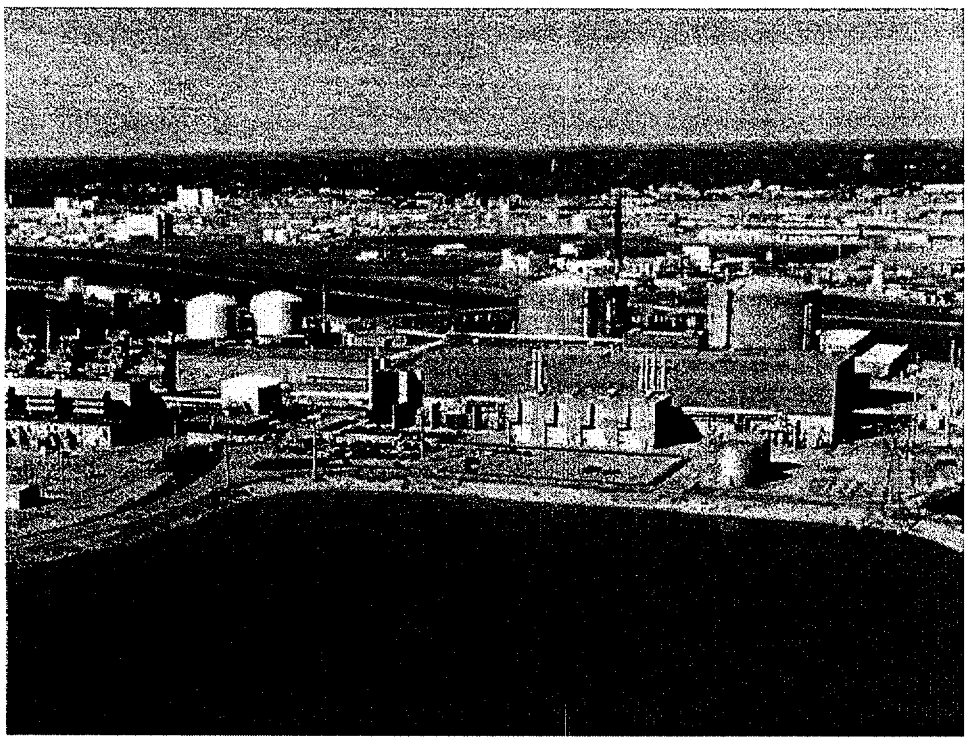
Nozzle 3 Cutout
Cladding Interface



Reactor Pressure Vessel Closure Head (RVPCH) Replacement

Bob Schrauder
Engineering Services

RPVCH Replacement Considerations



- The Midland RPVCH is
  - Similar in design to the Davis-Besse RPVCH
  - Readily available
  - Not contaminated

Replacement RPVCH

- Midland RPVCH was fabricated by Babcock and Wilcox
  - Manufactured to ASME Boiler & Pressure Vessel Code Section III, Code Class A, 1968 Edition, Summer 1968 Addenda
  - Accepted by Consumers Power and an Authorized Nuclear Inspector as an acceptable ASME component
  - Hydrostatically tested at 3125 psig per ASME Code Requirements

Replacement RPVCH

- Framatome-Advanced Nuclear Power (FRA-ANP) has purchased Midland RPVCH and is compiling/validating the ASME Code Data Package
- FRA-ANP is reconciling the Midland RPVCH against Davis-Besse design requirements
- FRA-ANP activities are governed by their safety-related Quality Assurance program, including 10CFR21 reporting

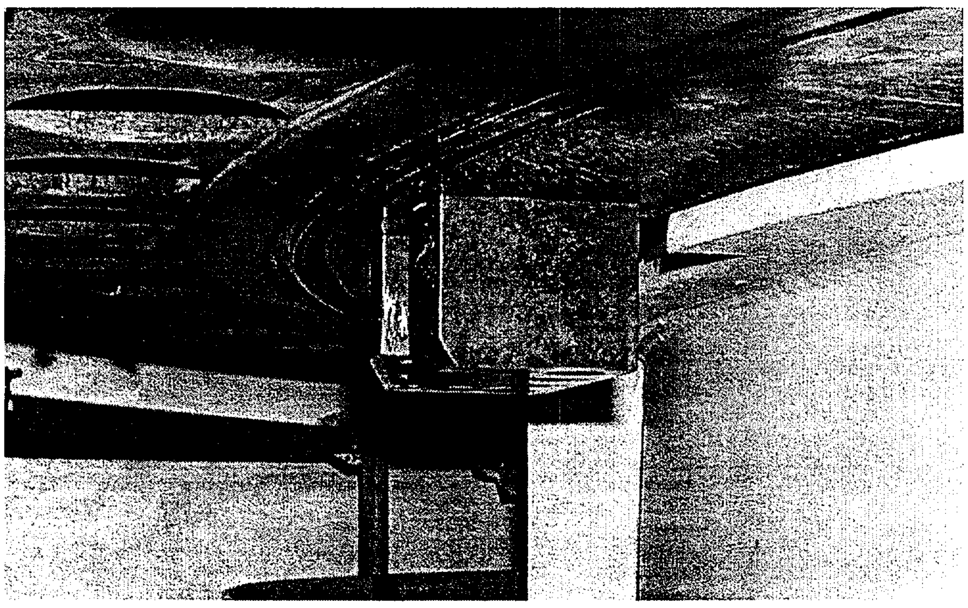
Replacement RPVCH Comparison to Davis-Besse RPVCH

	Davis-Besse	Midland
Material of Construction		
Closure Head	SA-533, GR B Cl 1	Same
Closure Head Flange	SA-508, Cl 2	SA-508-64, Cl 2
CRDM Nozzle	Inconel SB-167	Same
CRDM Flange	SA-182, F-304	Same
Design		
Pressure	2500 psig	Same
Temperature	650 degree F	Same

Replacement RPVCH CRD Nozzles

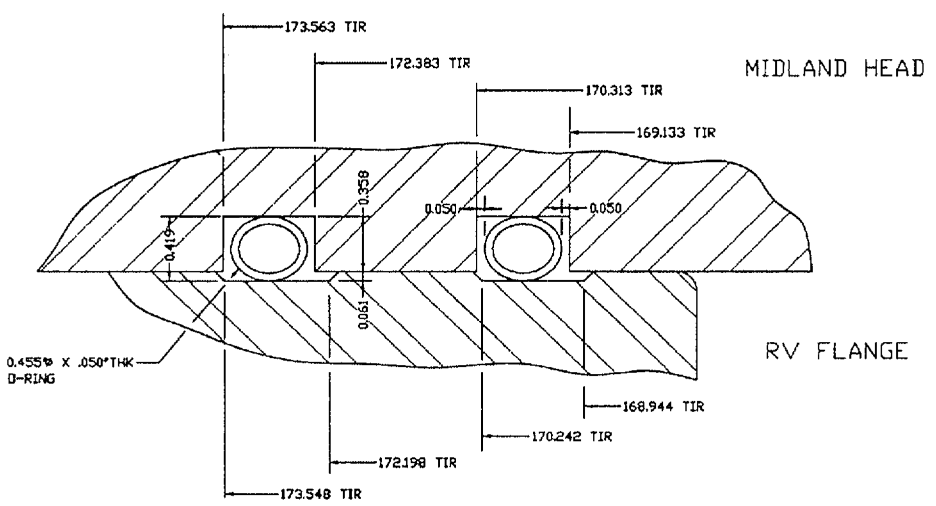
- Midland's Control Rod Drive (CRD) nozzles are similar to Davis-Besse
  - 68 Nozzles: Material Heat M7929
  - 1 Nozzle: Material Heat M6623
- Alignment of control rods to RPVCH nozzles is consistent with original Davis-Besse design

Replacement RPVCH



- Minor machining of 4 out of 8 vessel-to-head key-way surfaces is required
- The Midland CRDM flange indexing pin hole locations will be modified to match the proper Davis-Besse azimuth-orientation

Replacement RPVCH

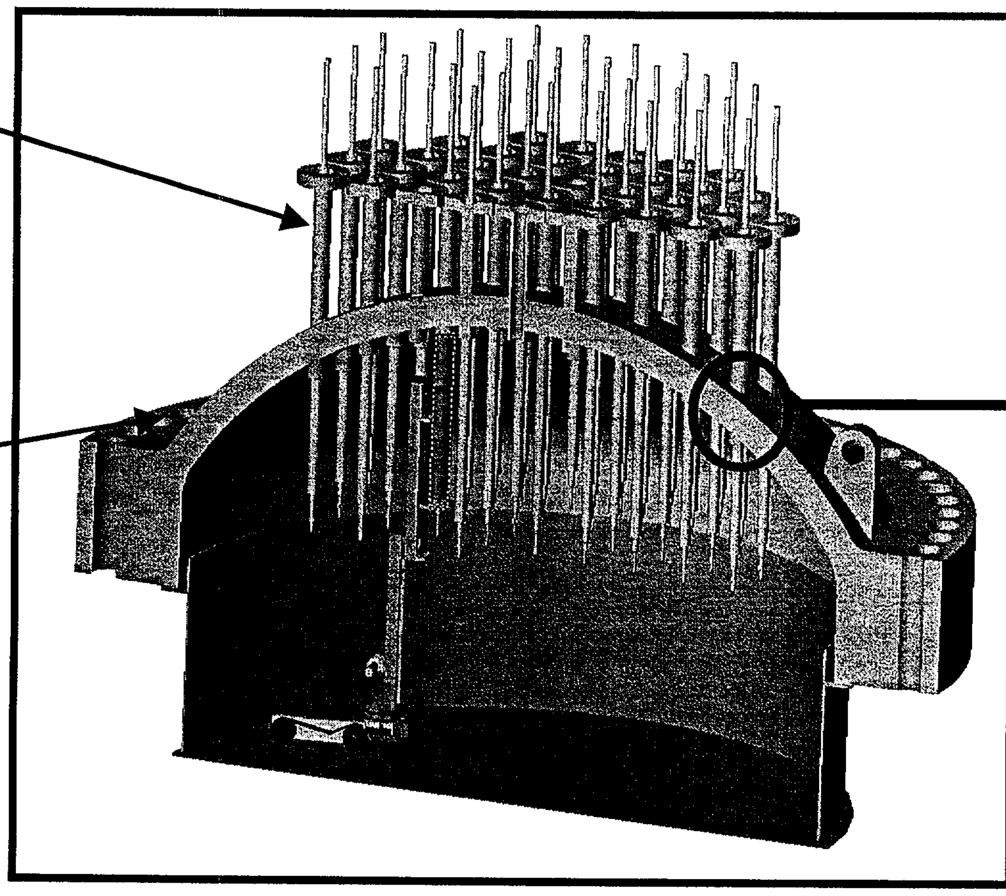


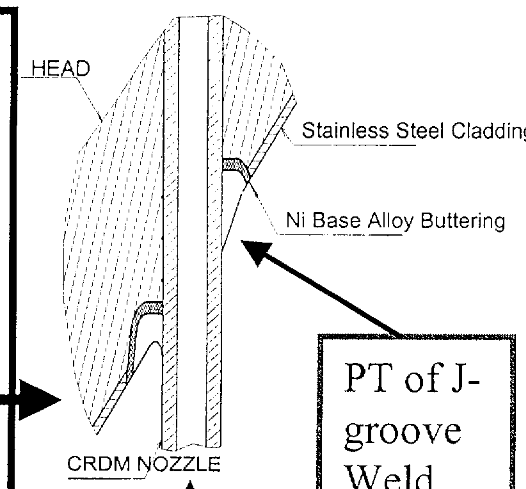
- Minor differences in RPVCH O-ring design
  - O-ring grooves are slightly different requiring the use of smaller diameter O-rings (0.455 in. vs 0.500 in.)
  - New O-rings will be installed

Examinations of Replacement RPVCH

RT and PT of CRD Nozzle to Flange Weld

RT, UT, and MT of Flange to Dome Weld



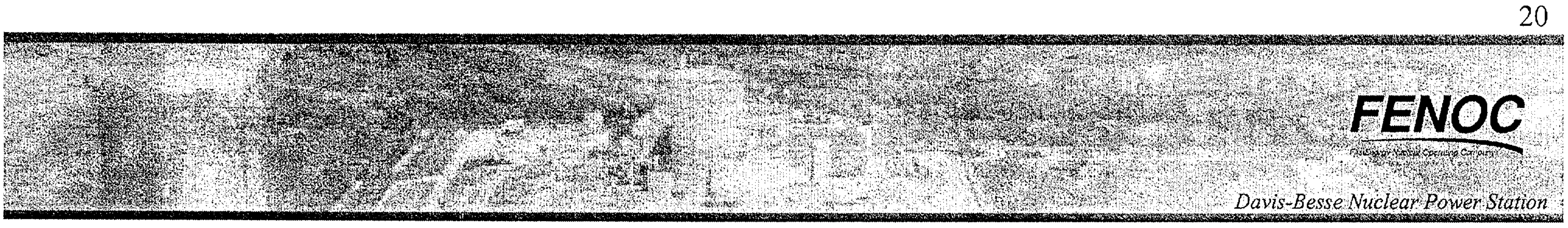


PT of J-groove Weld

UT and ET of CRD Nozzle

Examinations of Replacement RPVCH

- Examinations to supplement ASME Code Data Package:
  - Visual examinations
  - Radiography (RT) of flange-to-dome weld
    - Lifting attachments prevented full coverage
  - RT of nozzle-to-flange welds
  - PT examination of the CRDM nozzle J-groove welds



Examinations of Replacement RPVCH

- Preservice Inspections
  - Magnetic Particle (MT) examination of flange-to-dome weld
  - Ultrasonic (UT) examination of flange-to-dome weld
  - Liquid Penetrant (PT) examination of peripheral CRDM nozzle-to-flange welds

Examinations of Replacement RPVCH

- Additional Non-Destructive Examinations
  - Chemical smears
  - Baseline UT of CRD nozzles
  - Eddy Current Testing (ET) of CRD nozzles

Installation of the Replacement RPVCH at Davis-Besse

- Davis-Besse Containment Building will require temporary access opening
- Original RPVCH will be moved outside Containment Building for storage and/or disposal
- Davis-Besse Service Structure will be used
- Inspection ports will be installed on replacement support skirt

Installation of the Replacement RPVCH at Davis-Besse (continued)

- Original Davis-Besse control rod location and core configuration will be used
  - Existing CRD Mechanisms will be used
  - CRD Mechanisms nozzle flange split nut ring modification will be performed
  - Upgraded gasket design will be incorporated

Root Cause Investigation

Steve Loehlein
Root Cause Investigation Team Leader

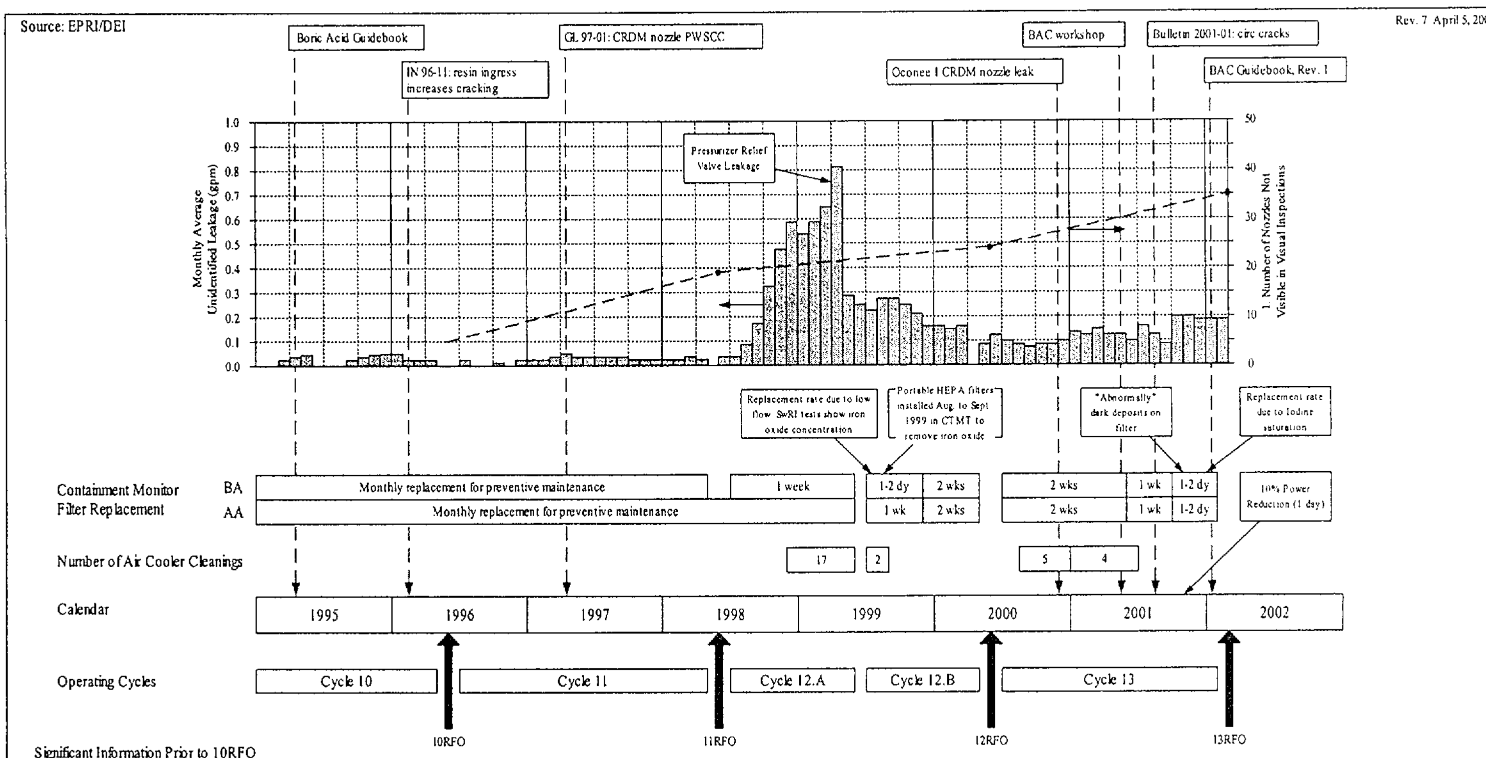
Key Questions

- Was there a new mechanism that caused this degradation?
- Was there adequate guidance/knowledge available to have prevented the degradation to the RPV closure head?

Key Conclusions

- The degradation to the RPV closure head was caused by Primary Water Stress Corrosion Cracking (PWSCC) of the Control Rod Drive (CRD) nozzle which led to leaks that were undetected allowing boric acid corrosion to occur
- The existing guidance/knowledge was adequate for preventing unacceptable RPV closure head degradation from CRD nozzle leaks

Timeline of Key Events



Significant Information Prior to 10RFO

1) Nozzle 66 gasket replaced at 7RFO and 8 RFO		1) Nozzle 31 gasket leaks but not changed 2) BA is powder and white	1) Replaced gaskets on flanges 3, 5, 6, 11, 31 2) "Red" deposits under nozzle 3 flange 3) Bottom of nozzle 3 flange not inspected due to hard BA	1) No leakage from flange gaskets 2) "Red" deposits under nozzle 3 flange 3) Difficult to get camera in place due to hard, brown, boric acid	CRDM Flange Conditions
1) Head flange clean in 1994	1) BA flowing towards mouseholes in S-E quadrant	First indication of red colored boric acid deposits from mouseholes in quadrant of S-E quadrant	Significant flow of red colored boric acid deposits from mouseholes, piling to 6" deep behind studs in S-E quadrant	1) Significant flow of boric acid deposits from mouseholes in S-E quadrant 2) BA deposits extend around entire flange 1" deep max	RPV Flange Conditions
1) BA deposits dripping through insulation at 8RFO 2) Head "cleaned" at 8RFO 3) Head not inspected during 9RFO	1) Visual inspection 65/69 nozzles 2) Minor BA deposits around outer nozzles of RV Head 3) BA deposits at center of head	1) Visual inspect 50/69 nozzles 2) Loose BA piling up behind outer nozzles 3) BA brittle, breaks easily	1) Visual inspect 45/69 nozzles 2) BA definitely red and hard to break up (needed crowbar) "lava-like"	1) Visual inspect 34?/69 nozzles N-1: leak [Nozzles 5 & 47 cracked] N-2: leak, circ & minor wastage N-3: leak & major wastage	RPV Head Conditions

Figure 26. Timeline of Key Events Related to Reactor Vessel Head Boric Acid Corrosion

Concluding Remarks

NRC Staff Activities on Vessel Head Penetration Nozzle Cracking and Vessel Head Degradation

Bill Bateman, Branch Chief
Materials & Chemical Engineering Branch
301-415-2795

ACRS Full Committee Presentation
June 6, 2002

NRC Staff Activites

- Assess Current Status of PWRs
  - Bulletins 2001-01 and 2002-01
  - Information Notice 2002-13
- Effective "Future" Management
  - Proposed New Generic Communication - Interim Inspection Guidance
  - Long-term Inspection Requirements - Technical Basis
- Davis-Besse Specific
  - Manual Chapter 0350 Panel
  - Lessons Learned Task Force

United States Nuclear Regulatory Commission

Technical Assessment of GSI-168 Environmental Qualification of Low-Voltage I&C Cables

Presentation to Advisory Committee on Reactor Safeguards

Office of Nuclear Regulatory Research
N. Chokshi and S. Aggarwal, Division of Engineering Technology
June 6, 2002

Purpose:

- To presents to the ACRS the technical assessment of GSI- 168 and request a letter from the Committee.

Process

- Technical Assessment is complete.
- RES plans to incorporate the ACRS comments.
- Forward the Technical assessment to Director, NRR by June 30, 2002 (copy to EDO).

Overview of the Technical Assessment:

Technical Assessment Based On:

1. EQ Literature Review
2. LOCA Tests
3. Condition Monitoring Tests
4. Interaction with the Nuclear Industry
5. Risk Insights

Test Results (Items 1- 3) were presented to the ACRS on October 6, 2000.

– The qualification criterion is "zero" failures based on testing of a single prototype.

STEPS IN LOCA TESTS

- Preaging: Thermal & Radiation- to simulate end of life conditions.
- LOCA Exposure: To simulate postulated DBE.
- Post LOCA Simulation Test: To demonstrate an adequate margin of safety by requiring mechanical durability.

Research Results:

- Failures of certain I&C cables in NRC tests.
- Failures of single conductor bonded Okonite cables.
- No single condition monitoring technique is effective to detect degradation- combination of techniques could be used.
- Visual Inspections proven to be useful.

United States Nuclear Regulatory Commission

RISK

- Results indicate that benefits from reducing the cable failure probabilities to zero are modest.

- The state- of- the art of incorporating cable failures into PRA is still evolving.

- KEY ASSUMPTION: Operating environments are lower than or equal to those assumed during qualification.

- Uncertainties arise from sparse data, uncertainty of applicability of experiments, and human error probabilities.

- Complete coupling between redundant trains was assumed.

Interaction with Nuclear Industry

- I&C cables have not experienced any significant aging. In limited cases of hot pots, several options are exercised (early replacements, modification of environments, or some kind of condition monitoring).

- Aging evaluation are ongoing throughout the plant life.

60 Years Aging Assessment

- In NRC tests 8 out of 12 cables failed the Post LOCA Simulation Test.
- Some of these cables may not have sufficient margins beyond the 40 years of qualified life.
- If the operating conditions are less severe than the qualification parameters, the margins could be used to extend the life.
- Knowledge of the environment for cables continues to be essential.

Summary of RES Findings:

- Qualification test programs include numerous conservative practices.
- Failures in NRC tests indicate that some cables did not meet qualification criteria and the margins are reduced.
- Knowledge of the operating environment for cables is essential.

Summary of RES Findings (Cont'd):

- Industry good practices, as described by NEI, seems to be adequate.
  - Plant specific practices are not known.
- Walkdowns to look for any visible signs of anomalies attributable to cable degradation have proven to be effective and useful.

United States Nuclear Regulatory Commission

RES RECOMMENDATION

- Dissemination of research results and other information consistent with the generic communication process, to include:
  - Results of Tests conducted on cables for service life of 40 & 60 years.
  - Summary of Okonite test results and subsequent NRC actions.
  - Summary of research findings on condition monitoring techniques.
  - Summary of the industry good practices for condition monitoring.
  - Importance of knowledge of operating environments for cables.

Revised Oversight Process
Performance Indicator Pilot Program
Mitigating System Performance Index

Patrick Baranowsky (415-7493)
Office of Nuclear Regulatory Research

June 6, 2002

Purpose/Outline

- The purpose of this presentation is provide an overview of the reliability/availability performance indicator pilot program for the revised reactor oversight process (ROP).
- Presentation outline
  - Background
  - Problems with current ROP PIs and how they are addressed by pilot program PIs
  - Insights from the phase 1 risk-based performance indicator (RBPI) study
  - Overview of technical approach and its limitations
  - Summary of issues raised by ACRS subcommittee on PRA
  - Conclusions/implementation schedule

Background

- SECY 99-007 stated the need to further refine reactor oversight process (ROP) performance indicators (PIs)
- During first two years of initial ROP implementation, staff and industry identified problems with current ROP PIs and made several changes
- It was decided to form a working group to address these problems and develop new/revised PIs
- Reliability and availability performance monitoring of selected mitigating systems is one aspect of the ROP refinement

Problems with Current ROP PIs

- Current ROP PIs include design-basis functions along with risk-significant functions
- ROP PI thresholds are generic
- Demand failures are not properly accounted for
  - Demand failures are treated in unavailability using fault exposure hours
  - Use of fault exposure hours can overestimate the risk significance of equipment performance degradation
- There are no PIs for support systems
  - Unavailabilities of support systems are cascaded onto the unavailabilities of monitored systems
  - Cascading support system unavailabililty results in overestimating the unavailability attributed to the performance of the monitored system

How are These Problems Addressed by PIs in the Pilot Program?

- Pilot Program PIs are based on risk-significant functions
- Pilot Program PIs account for plant-specific design/operating characteristics through use of available risk models and data
- Demand failures are accounted for in unreliability portion of PIs
- New PIs are developed for risk-significant support systems
  - Component cooling water and service water systems (or their equivalent cooling water systems)
- Pilot Program PIs address the recommendations made by ACRS on ROP PIs
  - PI thresholds should be plant-specific
  - Technical basis for choice of sampling intervals should be explained
  - Action levels should be related explicitly to risk metrics such as CDF and LERF, where possible

Insights from Phase 1 RBPI Study

- There were enough risk-significant differences among different plants that necessitated the development of plant-specific thresholds for unavailability and unreliability PIs
  - MSPI accounts for plant-specific differences
- Unavailability and unreliability indicators were found to provide objective and risk-informed indications of plant performance. They also provide broader risk coverage
  - They were tested by evaluating plant-specific data for 44 plants over three-year period (1997-1999)
- Performance indicators for CCW and SSW (or their equivalent support systems) were found to be difficult to develop due to the wide variation of plant-specific design features
  - Based on the technical analyses performed by NRC/industry, an approach has been developed for the Pilot
- Use of Bayesian update for estimating component unreliability was found to minimize the likelihood of false-positive/false-negative indications

Overview of Technical Approach

- Mitigating System Performance Index (MSPI) monitors risk impact (i.e., change in CDF) of changes in performance of selected mitigating systems, which accounts for plant-specific design and performance data
- MSPI includes Level I, internal events for at-power mode, which is consistent with the scope of the current ROP PIs
- MSPI consists of two elements, system unavailability and system reliability. MSPI is the sum of changes in a simplified CDF evaluation resulting from changes in system unavailability and system unreliability relative to baseline values
  - Baseline values are based on SECY-99-007 concepts

Overview of Technical Approach (cont.)

- The risk impact of changes in mitigating system performance on plant-specific CDF is estimated using plant-specific performance data and Fussell-Vesely importance measure
- MSPI for each monitored system is calculated as follows:

$$MSPI = UAI + URI$$

  - UAI is the system unavailability index due to changes in train unavailability
  - URI is the system unreliability index due to changes in component unreliability

List of Monitored Systems

- BWR Systems
  - HPCI/HPCS (high pressure core injection/spray)
  - RCIC (reactor core isolation cooling)
  - RHR (residual heat removal)
  - EDGs (emergency AC power)
  - Cooling water support systems (ESW+ RBCCW+TBCCW)
- PWR Systems
  - HPSI (high pressure safety injection)
  - AFW (auxiliary feedwater or equivalent)
  - RHR (residual heat removal)
  - EDGs (emergency AC power)
  - Cooling water support system (ESW + CCW or equivalent)

Limitations of Pilot Program PIs

- Inspection/SDP will be used for performance areas outside the scope of MSPI
  - CCFs
  - Concurrent failures of multiple components
  - Passive components
  - Demand failures not capable of being discovered during normal surveillance tests
- During the pilot, various approaches will be evaluated as well as other technical issues as summarized below:
  - Acceptable level of false-positive/false-negative indication
    - P(W/baseline)
    - P(G/W-Y)
    - P(G/Y-R)
  - Issues related to data that were used to set baseline unavailability and unreliability values
  - Independent calculations using SPAR models versus licensees PRA models
  - Evaluations of potential differences between MSPI and SDP results
  - Others

Summary of Questions Raised by ACRS Subcommittee on PRA

- Summary of questions raised by ACRS subcommittee on PRA during the presentation on May 30, 2002 are:
  - What are the reasons/justifications for selection of baseline values used for calculating changes in unavailability and unreliability elements of the PIs?
  - Should the pilot program PIs be based on SECY-99-007 thresholds (i.e., 1.0×10^{-6}, 1.0×10^{-5}, 1.0×10^{-4})?
  - Background information on the technical approach/equations should be provided
- We will provide a white paper explaining the technical aspects of the pilot program PIs to ACRS members in time for the next ACRS subcommittee meeting
- We will hold at least two more ACRS subcommittee briefings during the course of the pilot program to discuss these and other technical issues

Conclusions

- The MSPI approach is based on risk insights. It accounts for plant-specific design/operating characteristics through the use of available risk models and data
  - Use of F-V importance measure to account for plant-specific features
  - Treatment of demand failures in unreliability indicators
  - Use of Bayesian update for unreliability indicators
  - Use of risk-significant functions rather that design-basis functions
  - Use of a new indicator for cooling water support systems
- The MSPI approach allows for balancing between component unreliability and unavailability consistent with the Maintenance Rule
- The MSPI provides more objective indication of plant performance and will provide broader risk coverage
- The limitations of the MSPI have been clearly identified and will be covered through inspection/SDP
- The MSPI provides appropriate risk-categorization of performance degradations that are covered by PIs

Implementation Schedule

July 23-25, 2002	Public workshop to prepare for start of the MSPI pilot
August 1, 2002	Start of MSPI pilot
November 2002	Briefing to ACRS subcommittee on pilot progress
February 2003	End of MSPI pilot data collection and start of the analysis period to analyze collected data
March 2003	Briefing to ACRS subcommittee on pilot progress
July 2003	End of pilot program

Plants Participating in the Pilot MSPI

Region I	Limerick 1/2 Millstone 2/3 Hope Creek Salem 1/2
Region II	Surry 1/2
Region III	Braidwood 1/2 Prairie Island 1/2
Region IV	Palo Verde 1/2/3 San Onofre 2/3 South Texas 1/2

Industry Trends Program

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June 6, 2002

Industry Trends

- Background
- Communications
- Process
- FY 2001 Results
- Future Development

Background

- NRC performance goal measure
- Purposes
- Relationship to NRC processes

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Communications

- Industry indicators are published on the external NRC web site
- Annual report to Commission
- Annual report to Congress in NRC Performance and Accountability Report
- Conferences with Industry

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Process

- Identify any statistically significant adverse industry trends
- Evaluate underlying issues and assess safety significance
- Agency response in accordance with existing NRC processes for generic communications
- Review at annual agency review meeting

FY2001 Results

- No statistically significant adverse industry trends in safety performance
- Insufficient data on ROP indicators (<4 years)

Future Development

- SRM of 8/2001 – Develop risk-informed thresholds "as soon as practicable"
- Enhanced performance goal measure
- Potential additional indicators

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Industry Trend Thresholds

- RES is developing industry trend thresholds for use in a risk-informed regulatory framework.
- Industry thresholds differ from plant-specific thresholds.

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Kinds of Thresholds

- Action Threshold
  - Used to measure industry performance, similar to thresholds used in ROP process
  - Report to Congress
- Early-Warning Threshold
  - Used to alert NRC to a change in industry trends that may indicate a change in industry safety performance

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Threshold Characteristics

- Rational basis that is well documented
- Practical and simple
- Consistent with the existing regulatory framework
- Reflect risk (including associated uncertainties), safety, and regulatory perspectives

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Protocol for Setting Thresholds

- Develop risk and statistical information related to trends for input to an expert panel
- Provide associated safety and regulatory information for expert panel
- Expert panel sets thresholds based upon input and expert judgment

Technical Approaches to Estimating Trend Thresholds

- Prediction Limits
- Bayesian Predictive Distribution
- Percentiles from Industry Distributions
- Insights from PRAs
- Rate-of-Change of Trend
- Expert Panel Input
- Modification of Current ROP PI Thresholds
- Combine Plant-specific Thresholds
- Integrated risk measure concept being developed for the enhanced PIs
- Combination of the above

Technical Questions

- How many years should be included in the estimation of a trend?
- What level is appropriate for reporting to Congress?
- What level is appropriate for agency action to an adverse trend?
- Should some of the PIs be grouped?
- How does the safety goal influence setting thresholds?
- Should concepts in Reg. Guide 1.174 be used in setting thresholds?

Schedule

- Initial thresholds for initiating events and mitigating systems – July 02
- Thresholds for other cornerstones – Sep. 02
- Change to performance goal measure – Fall 02
- Annual Commission paper – Mar. 03
- Final thresholds – FY03

United States Nuclear Regulatory Commission

Presentation to the ACRS Full Committee

Potential Policy Issues for Advanced Reactors

Ashok Thadani, Director
Office of Nuclear Regulatory Research
Farouk Eltawila, Director
Division of Systems Analysis and Regulatory Effectiveness
Office of Nuclear Regulatory Research

Outline

- Purpose of the Briefing
- Background
- Enhanced Margin of Safety
- Relationship to International Standards
- Five Potential Policy Issues
  - Event Selection
  - Fuel Performance
  - Source Term
  - Containment Performance
  - Emergency Evacuation
- Future Plan

Purpose of the Briefing

- Summarize Technical Issues With Generic Policy Implications For Advanced Reactors Resulting From Technical Portion of Preapplication Reviews
- Summarize Staff Previous Resolution of These Issues
  - SECY-93-092, July 30, 1993, SRM
- Solicit ACRS Feedback On Scope and Nature of Issues:
  - Is the List the of Key Issues Complete?
  - Are They Stated Clearly and Correctly?
  - What Are the Important Considerations in Their Resolution?
- Develop Risk-Informed Performance-Based Criteria for Advanced Reactors
  - Risk-Informed Regulation Implementation Plan Update, June 2002
- ACRS Letter

Background

- Preapplication Reviews For AP-1000 Complete
- PBMR Preapplication Activities in Closeout
- GT-MHR Preapplication Activities Planned
- Other Preapplication Activities Possible (E.G., GE-ESBWR, Framatome SWR1000, NG-CANDU)
- Many Issues Developed in the Course of the Review Have Generic Policy Implications:
  - Legal/Financial (SECY-01-207)
  - Technical (Memorandum to the Commission in Preparation)
- NEI White Paper On Risk-Informed Regulatory Framework For All Reactor Types
- Continued Work On Generic Policy Issues Can Facilitate Future Regulatory Work On Advanced Reactors

Enhanced Margins of Safety

- Advanced Reactor Policy Statement Expectations:
  - Enhanced Margins of Safety
  - Use of Simplified, Inherent, Passive or Other Innovative Means to Accomplish Safety Functions
- The Severe Accident Policy Statement Expectations:
  - Expectation for Advanced Reactors--Should Safer than Current reactors, as a minimum Provide the Same Degree of Protection As Current Plants
  - Completion of PRA and Consideration of Severe Accidents Vulnerabilities
  - Containment Equivalent to a Large, Dry Containment Capable of Mitigating a Core Melt
- Key Fundamental Policy Issues For Commission Consideration (RIRIP)
  - Current Metrics (CDF and LERF) Insufficient
  - Should Additional Cornerstones Be Included?
  - Should Environmental Risk Metrics Be Considered?
  - Should a Higher Level of Safety Be Required For New Plant Designs?
  - How Should Defense-In-Depth Be Applied to New Plant Designs?
  - Should Criteria Apply to Single Unit or Entire Site?

Relationship to International Safety Requirements

- Future Plant R&D Design and Marketing Are Becoming International Efforts
  - Designers
  - Suppliers
- Issue For Commission Consideration:
  - What Should Be the Relationship of NRC Safety Requirements to International Safety Requirements?
- Could Be Useful in Bringing in Expertise in Areas Where NRC Lacks Infrastructure

Event Selection and Safety Classification

- To What Extent Should a Probabilistic Approach Be Used to Establish the Licensing Basis For New Plant Designs, Considering:
  - Less Experience, Data, Methods
  - PRA Quality, Completeness and Documentation
- What Should Be the Criteria For Event Selection and Safety Classification, Considering
  - Role of Engineering Judgment
  - Risk Metrics, Criteria
  - Treatment of Uncertainties
  - Desired Confidence Level
- *In SECY-93-092, the Staff Recommended an Approach That Is Deterministically Based Supplemented With Probabilistic Information. In the July 30, 1993 SRM, the Commission Approved the Staff Recommendation.*

Fuel Performance and Qualification

- Fuel Performance and Qualification
  - Designed to Achieve Burnup of 80,000 MWd/t
  - Withstand High Temperature (1600^0 C) Without Release of Fission Products
- Should Fuel Qualification Testing Be Completed Prior to Granting A COL?
- Should Applicants Be Required to Test Fuel to Beyond Design Basis Event Conditions?
- What Independent Fuel Testing Should NRC Perform?
- Under What Conditions Can Fuel Manufactured Outside the U.S. Be Accepted For Use in a U.S. Plant?
- What Conditions Should NRC Employ to Ensure Fuel Quality Over the Life of the Plant?

Source Term

- Licensing Source Term –TID-14844, NUREG-1465 Are Used to Determine LWR Containment Effectiveness and Site Suitability
- Questions
  - Under What Conditions, If Any, Should the Commission Accept the Use of Scenario Specific Source Terms For Licensing Decisions Regarding Containment and Site Suitability?
  - What Codes and Model Validation Should Be Used?
  - How to Account For Uncertainties?
- *The Commission July 30, 1993, SRM Approved the Staff Recommendation in SECY-93-092, Which Recommended That Scenario Specific (Mechanistic) Source Terms Be Allowed Provided There Was a Sufficient Understanding of Fuel Performance, Fission Product Behavior and Accident Selection to Bound Uncertainties.*

Containment Performance

- Criteria For Containment/ Confinement Performance
  - Limit Fission Product Release
  - Barrier to Release
- Question
  - Under What Conditions, If Any, Should the Commission Accept the Use of Non-pressure Retaining Containment Building?
  - The Role of Containment Vs. Confinement In Protecting the Plant From External Threats, Sabotage, and Maintaining Public Confidence?
- *In SECY-93-092, the Staff Had Proposed an Approach for Containment That Focused on Functional Performance, Rather Than Prescriptive Design Criteria. The Commission July 30, 1993, SRM Approved the Staff Proposal, With the Addition of an Air Ingress Event to the MHTGR Proposed Accidents to Be Considered.*

Emergency Evacuation

- Under What Conditions, If Any, Would the Commission Approve Reducing the EPZ, Including a Reduction to the Site Exclusion Area Boundary?
  - Criteria For Evacuation Planning
    - Timing For Release
  - Source Term and Probability
  - Margin (Defense - In - Depth)
  - Evacuation Planning Zone
  - Infrastructure Requirements
  - Exercises
- *The Commission July 30, 1993 SRM Stated That It Was Premature to Reach a Conclusion on Emergency Planning for Advanced Reactors, but Requested the Staff Remain Open to Suggestions to Simplify EP Requirements for Reactors With Greater Safety Margins.*

Future Plan

- Develop Draft Staff Positions on Each Issue
- Solicit Stakeholder Feedback:
  - Public Workshop
  - ACRS Meetings
- Final Paper Requesting Commission Guidance - Fall 2002