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NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

SUBCOMMITTEES ON RELIABILITY AND

PROBABALISTIC RISK ASSESSMENT AND

PLANT OPERATIONS

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DEVELOPMENT OF RELIABILITY/AVAILABILITY

PERFORMANCE INDICATORS & THE INDUSTRY TRENDS PROGRAM

THURSDAY, MAY 30, 2002

The Subcommittees met at the Nuclear Regulatory Commission, Two White Flint North, Rockville Pike, Rockville, MD, at 1:00 a.m., Mario V. Bonaca, Chairman, presiding.

COMMITTEE MEMBERS:

MARIO V. BONACA, Chairman

GEORGE APOSTOLAKIS,

THOMAS S. KRESS

GRAHAM M. LEITCH

VICTOR H. RANSOM

WILLIAM J. SHACK

STEPHEN L. ROSEN

JOHN D. SIEBER

GRAHAM B. WALLIS

ACRS STAFF PRESENT:

AUGUST W. CRONENBERG, Senior Staff Engineer

MAGGALEAM W. WESTON, Staff Engineer.

ALSO PRESENT:

TOM BOYCE

RON FRAHM

DON HICKMAN

MARK SATORIUS

JOHN THOMPSON

PETTERI TIIPPANA

PATRICK BARANOWSKY

BENNETT BRACY

HOSSEIN HAMZEHEE

DALE RAMUSON

LINDE CARPENTER

D. COE

TOM HOUGHTON

A-G-E-N-D-A

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

1:00 p.m.

CHAIRMAN BONACA: This meeting will now come to order. This is a Joint Meeting of the ACRS Subcommittees on Reliability and PRA and Plant Operations.

I'm Mario Bonaca, Chairman of this Joint Meeting.

The purpose of this meeting is to discuss staff progress related to risk in forming the reactor oversight program and the agency's pilot program to assess the adequacy and trends associated with safety system and availability using the performance indicator PI approach.

Dr. August Cronenberg is the cognizant ACRS staff engineer for this meeting, while Mrs. Maggalean Weston is the designated federal official.

Rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the *Federal Register* of May 8, 2002.

A transcript of this meeting is being kept and the open portions of this transcript will be made available as stated in the *Federal Register* notice.

It is requested that the speakers first

identify themself and speak with sufficient clarity and volume so that they can be readily heard.

We have received no written comments or requests for time to make oral statements from members of the public.

We will now proceed with the meeting, and I call upon Mr. Baranowsky of RES to begin.

MR. SATORIUS: My name is Mark Satorius. I just have a couple of words. I'm a Chief of the Performance Assessment Section in the Inspection Program Branch of NRR.

We're very pleased to be here to address the Subcommittee today and talk about the performance indicator pilot program that we intend on beginning later this summer.

And with me is Mr. John Thompson, who is a member of my staff, who will give an outline on some of the background and go forward with some of the details of the pilot program as well as Hossein Hamzehee who is here from the Office of Research, and he'll go into more depth on some of the details of how the pilots program is actually going to work.

And I think, Pat, you did have something that you wanted to mention?

MR. BARANOWSKY: Yes. I just wanted to

mention that we have briefed this Subcommittee and the full Committee several times in the past about the programs that we have underway in the Operating Experience Risk Assessment Branch that involved the collection of data and the analysis of data that relates to risk analysis. And what we're going to be doing today is discussing two projects that the Office of Research has been heavily involved in supporting NRR and a lot of the technical basis for the work that we're presenting here is founded on work that we have done, as I said, over the last several years.

So I just wanted to give that as a piece of background. It includes not only the databases, but the system and component reliability studies of some aspects of the action sequence precursor program and in particular some use of the SPAR models. And I think you'll see that a few places.

So having said that, I'd like to just turn it over, I guess, to John Thompson to get started on what the first issue is about.

MR. THOMPSON: Thank you, Pat.

Good afternoon, members of the Subcommittee. Can you hear me?

I'm going to be talking today about an overview of a pilot program to develop a replacement performance indicator for the mitigation systems, safety system unavailability.

We've been in the revised oversight process for about 2 years now and we've observed some problems with the current SSU indicator and has led us to develop a working group to address some of these issues. We are here today to brief you on status of where we are in a pilot program to replace this indicator, and hopefully your knowledge level will come up and understand where we're trying to go and what we're trying to do for the near future with this pilot program.

To se the background for this program, SECY 99-007 addressed the need to further refine the use of the performance indicators by developing risk based performance indicators and taking steps in that direction.

During the first 2 years of the ROP staff and industry, like I said, identified problems with the current indicator and make several interim changes as well as trying to address the need for the longer term. We formed a working group and have met regularly since the spring of 2001 to discuss these issues with industry and with members of NEI and with the staff.

MR. APOSTOLAKIS: SSU is safety system unavailability?

MR. THOMPSON: Correct.

We made a formal decision --

MR. APOSTOLAKIS: Which was really safety train, not system. The way it was defined it was a train.

MR. THOMPSON: But the indicator gives us system indication.

MR. APOSTOLAKIS: I thought it was a train?

MR. BARANOWSKY: I think you're right, George. It was a train level indication that was meant to be a surrogate for the system's performance. It was never put together into a --

MR. APOSTOLAKIS: A system.

MR. BARANOWSKY: A system type thing. But the threshold for performance were based on understanding of the implementations of that train in a risk model, if you will. That's all we originally did.

MR. APOSTOLAKIS: But you didn't know in a particular case whether the system was a one out of two or one out of three

MR. BARANOWSKY: Yes. We've had a lot of

problems, and those are some of the things we're going to try and correct with the methodology we're proposing here.

MR. APOSTOLAKIS: And also the unavailability was only the maintenance, really. I mean, how long was it out? It didn't include human error or error -- probability of failure to start, right? It was just that --

MR. BARANOWSKY: I think it included some of those things, but the way it included it was somewhat problematic, and we're going to try and go over that also.

MR. APOSTOLAKIS: Okay. All right.

MR. THOMPSON: Going hand-in-hand with this effort was the development of the risk based performance indicators, and you were briefed on that in 2001. And that'll be part of Hossein's presentation following mine.

And this pilot is recognized as an evolutionary step toward enhanced PI development.

MR. APOSTOLAKIS: So what your heading calls mitigating system is what your main body says safety system? It's the same thing?

MR. THOMPSON: Yes.

MR. APOSTOLAKIS: Okay. If they were

considering it, it would MSU?

MR. THOMPSON: Yes, it's the cornerstone title that we borrowed from, and to give it a different title than the current indicator.

MR. APOSTOLAKIS: All right. So it's the same thing?

MR. THOMPSON: Yes.

MR. APOSTOLAKIS: Good.

CHAIRMAN BONACA: Now, I'm sorry. The heading said "Mitigating System"?

MR. THOMPSON: Yes.

MR. APOSTOLAKIS: But inside you see the second bullet says "with current SUU"?

MR. THOMPSON: Yes.

MR. APOSTOLAKIS: That's safety system unavailability, but it's mitigating system.

CHAIRMAN BONACA: Okay. So it is the same thing?

MR. THOMPSON: Yes, we gave it a different title to denote that it's a different indicator with different systems and stuff.

MR. APOSTOLAKIS: So your new indicator will be mitigating system?

MR. THOMPSON: Yes, that's the title of it.

MR. BARANOWSKY: And it's going to be a system level indicator, whereas the other one was more of a train level indicator --

MR. APOSTOLAKIS: Good. Good.

MR. BARANOWSKY: -- with some implications for a system.

MR. APOSTOLAKIS: Very good.

CHAIRMAN BONACA: But, you know, one could contend that a trip function is a separate system. I mean, yet you're counting that as an initiator. Isn't it confusing, I mean, to --

MR. APOSTOLAKIS: I wonder whether -- I'm sorry, I don't want to interrupt.

CHAIRMAN BONACA: No, I just was trying to understanding.

MR. APOSTOLAKIS: Is a high safety injection system a mitigating system?

MR. THOMPSON: Yes.

MR. APOSTOLAKIS: I thought it was a safety system.

MR. SATORIUS: But it's in the mitigating cornerstone of the ROP.

MR. THOMPSON: Yes.

MR. APOSTOLAKIS: Right.

MR. SATORIUS: It's considered because it mitigates the effect of an accident, so it's in the mitigating portion of the cornerstone of the ROP.

MR. APOSTOLAKIS: Well, in other contexts prevention and mitigation; prevention is everything before core melt and mitigation and everything after core melt. Now your point of reference is the initiating event.

MR. BARANOWSKY: Agreed. From a risk analyst point of view that's the same way I talk, too. But the way the direct oversight process has been set up, mitigating systems are the preventive ones. And we're not going to try and go back and change 99007.

CHAIRMAN BONACA: That was because -- I mean before PRA. But before we believed that there could be a core damage, I mean --

MR. APOSTOLAKIS: Remember, 007 has a license to kill.

CHAIRMAN BONACA: Exactly.

MR. APOSTOLAKIS: So we can't go back--

CHAIRMAN BONACA: With the old terminology of the FSAR. Okay.

MR. ROSEN: But we don't need a license here.

MR. BARANOWSKY: By the way, the names are subject to change if they aren't pleasing in some way.

MR. APOSTOLAKIS: Well, it's just in different context we use different names. I mean, you know, the standard thing about prevention and mitigation refers to core melt. You guys refer to the initiating event and you're mitigating the initiating event. It's a good usage of English.

CHAIRMAN BONACA: I'm only saying that before PRA became of age, that was the definition they were using for the FSAR.

MR. WALLIS: Mitigating the accident, George.

CHAIRMAN BONACA: Mitigating was mitigating an initiator --

MR. APOSTOLAKIS: Not the initial event.

MR. WALLIS: Now you've got accident.

MR. APOSTOLAKIS: Well, but --

MR. WALLIS: ECCS mitigates the accident.

MR. THOMPSON: That's right.

MR. APOSTOLAKIS: But what is the accident, that's the question.

MR. WALLIS: Accident's already underway.

MR. APOSTOLAKIS: But it has not reached core melt.

MR. WALLIS: That's right.

MR. SHACK: The mitigating systems work,

it may not.

MR. THOMPSON: We just wanted to have a slide to go over some of the known problems that we've been trying to deal with with the current indicator. The first is that the risk insights are not accounted for in the current indicator because it uses design-basis function instead of PRA or unit functions.

At that thresholds developed or the SSU were not plant-specific nor were they risk informed thresholds. The new --

MR. APOSTOLAKIS: They were not? They were. They were not the right thresholds, but they were --

MR. HAMZEHEE: Were not plant specific.

MR. APOSTOLAKIS: Right. And now you guys are saying they should have been plant specific?

MR. HAMZEHEE: That's right. As we go along with this presentation, we say --

MR. THOMPSON: We are moving in that direction.

MR. WALLIS: We're trying to agree with an ACRS point. They should be more plant specific.

MR. APOSTOLAKIS: Several centuries ago.

MR. WALLIS: Exactly. Well, we've finally caught up.

MR. APOSTOLAKIS: See, that answers my earlier question. We do have an impact after a few years.

MR. ROSEN: It takes a while.

MR. APOSTOLAKIS: They're mitigating it.

MR. ROSEN: Now, it's going to be plant specific. Does that mean that a plant that has three trains of safety systems versus a plant that has two trains will get some more credit?

MR. HAMZEHEE: That's correct, yes. And when we get to the technical aspects of it, you see that, yes.

MR. ROSEN: I think I'm done here. I think I'm done here.

MR. KRESS: Mission accomplished.

MR. APOSTOLAKIS: I have complained from day one.

MR. THOMPSON: Actually, I don't want to leave you with the impression that the thresholds are plant specific. They are standard thresholds but the margin to the thresholds are plant specific.

MR. BARANOWSKY: The risk thresholds are standard. Just like REG Guide 1.174 has what you might call thresholds of regulatory acceptance, the thresholds of risk that are associated with the performance of these systems are the same. But the performance within any given system can change depending on the --

MR. APOSTOLAKIS: How much margin you have?

MR. BARANOWSKY: Right.

MR. THOMPSON: The level of redundancy or the risk associated with that system.

MR. APOSTOLAKIS: You'll explain though, probably.

MR. BARANOWSKY: And he's going to explain it all if we get there.

MR. APOSTOLAKIS: So now I see this thing that it was inside NRC, risk manage, does it replace risk informed?

MR. THOMPSON: Yes.

MR. APOSTOLAKIS: And the Commission has agreed to that?

MR. THOMPSON: I don't know that.

MR. BARANOWSKY: This is also news to me. I'm hoping to get some definition other than from inside NRC.

MR. APOSTOLAKIS: There was something inside NRC. You guys are changing it already.

MR. HAMZEHEE: Well, we're proactive.

MR. APOSTOLAKIS: I'm not sure risk manage is a good idea.

CHAIRMAN BONACA: And before we change everything, you know --

MR. APOSTOLAKIS: At least we can discuss it a little bit.

MR. THOMPSON: Certainly.

MR. APOSTOLAKIS: We've been talking about risk informed initiative now for what? Five or six years? The least you can do is ask the Commission whether they agree with the change. Okay. I know that one person wants that, according to inside NRC, but I think it's a good idea, as Pat said, not to get our marching orders from inside NRC.

MR. BARANOWSKY: Well, anyhow, I do think it's important to note that we do have five points that we're trying to correct in at least skipping some of the terminology problems here. One of them I think was that second one, was a pretty important one.

So why don't you go on, John?

MR. THOMPSON: Yes. The demand and demand failures are not properly accounted for by the current indicator either. It's kind of a mix, a hodgepodge that doesn't match well. And the new indicator, the new pilot more properly accounts for those instances.

And the other big issue with the current indicator was that use of fault exposure hours can over estimate the significance and then result in a PI that can no longer measure further degradation of performance because the indicator's already yellow or red and smaller increments of degradation is not measured.

MR. APOSTOLAKIS: So you're going to tell us later why these are valued points?

MR. THOMPSON: Yes.

MR. APOSTOLAKIS: Because it's not clear to me what you mean by this?

MR. THOMPSON: That's correct.

MR. APOSTOLAKIS: And the first bullet is unclear, too.

MR. THOMPSON: Yes, all of that will be cleared up later.

And then the last issue is that cascading of support system unavailability to the monitored system overstates the actual unavailability of the monitored system which end up measuring is not only the availability of the monitored system, but the availability of the support system that maintains that system. And it kind of defeats what you're trying to measure. The new pilot corrects that by monitoring separately the support system.

MR. APOSTOLAKIS: So you're becoming more PRA oriented?

MR. THOMPSON: This is definitely a step in that direction.

MR. APOSTOLAKIS: Yes.

Another question. I mean, PRA's have been distinguishing between support systems an front line system now for 25 years. I don't understand why we have to stop -- anyway, go ahead.

This should be -- the whole thing should be PRA based.

MR. BARANOWSKY: Well, remember, this is-- we're trying to bring what we learned from the risk based performance indicator work into this project; just the things that we tested out and believe work. And so you're seeing a lot of risk concepts here today.

MR. APOSTOLAKIS: Okay.

MR. BARANOWSKY: Yes.

MR. ROSEN: The objectives of this program simply stated was that we wanted to create a better indicator and a more accurate one of performance that adds value and solves the known problems that I just over without also adding undue burden both to the inspectors that got to oversee this PI as well as industry which has to implement it.

We want to calculate in this pilot the revised unavailability -- unreliability values.

MR. APOSTOLAKIS: Now you're mentioning unreliability for the first time. That's not part of your five bullets? Are you adding it as a PI

MR. BARANOWSKY: Yes.

MR. APOSTOLAKIS: So the previous five was corrections to something that existed?

MR. THOMPSON: Yes.

MR. APOSTOLAKIS: But this will be added as a sixth?

MR. ROSEN: You note that we mentioned unreliability in one of our letters, George.

MR. APOSTOLAKIS: Oh, yes.

CHAIRMAN BONACA: That was already part of the Phase-1, right? Phase-1 development?

MR. THOMPSON: Yes, that's one of the objectives of this new PI is to calculate both and to compare the results from that to the existing PI data and to ascertain whether or not the differences observed in the changes address our concerns and suits the needs of the revised oversight --

MR. ROSEN: That implies you're going to

do that retrospectively? You're going to go back?

MR. THOMPSON: We're going to do both.

MR. ROSEN: And calculate all this stuff?

MR. THOMPSON: We're doing both.

MR. ROSEN: And compare it to what you got -- what you have from -- the existing SSU PI data? How you could to do that when they haven't captured -- many places haven't captured that data respective, you know?

MR. THOMPSON: Well, we're going back to look at the pre-ROP data and run that data through the mechanics of this new PI and then look at it, see how the SDP looked at it.

We're also going to look at the last two years of data through tabletops exercises. And then we'll look at it as the actual data comes in through in the pilot.

MR. ROSEN: And then in answer to my question, how you going to get the manuscript --

MR. HAMZEHEE: Well, Steve, I think there are two parts of your question. One is as part of the RBPI we looked at some previous data to see if this concept worked. And we looked at 44 plants, and I'll talk about them in more detail and demonstrated that these are reasonable and they do provide adequate performance indication.

The other thing that John is talking about is insights learned and the improvements we want to make the existing PI. So these are mainly for the future PI. But to make sure that they do work, we are going to do a visual validation of going and looking at some, whatever data we can get for the on demand failures and a number of demand basically based on EPICS, that is the only available database in the industry. And in order to see how these things work and what kind of results we get.

But the main objective is not to be retroactive and try to regenerate the past 5 or 10 years of performance.

MR. ROSEN: You think EPICS has captured enough demand data to do that?

MR. HAMZEHEE: For a validation purpose, yes. And we have a section in phase I RBPI report NUREG 1753 that shows that. But for the future in order for these PIs to be fully implemented, then one of the conditions is for the industry to report accurate reasonable data to support this performance indicator.

MR. ROSEN: Yes, I would just put some measure of grain of salt on the past EPICS data.

MR. HAMZEHEE: That's correct.

MR. ROSEN: Once the staff puts this in place, then you as a regulatory requirement, then you can have more confidence.

MR. HAMZEHEE: That's correct. And as part of this pilot program industry is going to work with the NRC staff to provide the actual data for some time period so that we can go through all these "what if" questions and try to validate the results.

So you're right. In the past we did not have enough information on the on demand failures.

CHAIRMAN BONACA: Yes, and that's good just as a baseline for us. Two years ago commenced our work that was being done and two recommendations were made. One was that we work with the industry to improve the ethics to the point where there will be consistent reporting, otherwise --

MR. ROSEN: That's correct.

MR. HAMZEHEE: And the other one was to provide some -- to work towards a common definition of unavailability and reliability with the industry so that we're comparing apples and oranges there.

MR. ROSEN: Yes.

MR. HAMZEHEE: And it would be worthwhile for us to understand if any progress has been made on those two issues.

MR. BARANOWSKY: Now, for sure we have had some progress on the EPICS thing, except I want to point out that not all plants are embracing the EPIC system, so they're not necessarily providing complete data. But a lot are and we've worked pretty closely with INPO in their working groups. And that involves the technical folks from the plants that are providing this information.

So even though it maybe has on a few places some errors on the order of 10 to 20 percent on counting demands, that's probably good enough to get an idea. Because even if the demands are off 10 or 20 percent, we're in the ball park. Now, a few plants might be off by 50 percent, but most of them are based on what we can understand providing the bulk of the data that's been requested. And we think we've come together on the unavailability unreliability definitions through this project, I believe, and Hossein will cover that in a few minutes.

CHAIRMAN BONACA: Good.

MR. WALLIS: Are you going to tell us what the first bullet means? Are you going to tell us that? I mean, I have no idea what a better indicator performance is, and I don't know how you can tell when it's good and when it's better. And more accurate means nothing to me. I mean, if number of SCRAMs is-- if I measure SCRAMs to 2 significant figures, is it better than 4 significant or 1 significant figures, or something. Accurate isn't a good word.

MR. HAMZEHEE: Yes, we are going to talk about this. This is for him to set the ground for us to know what is our --

MR. WALLIS: And having value, I have no idea what your value is so I don't know how to add it.

MR. BARANOWSKY: Okay. I think he's saying that this will provide a method that fixes some of the problems that we've have in the past where there were approximation that resulted in many so called frequently asked questions where because of the lack of rigor in the development of the PI from a methodological point of view, we went into more and more permutations on how to deal with those slight deficiencies. And what we're trying to do is get away from that, have something that has more rigor up front so we don't have to come up with special cases on how to deal this to make it sort of fit like what we would expect if we had a more rigorous formulation for the indicator.

MR. THOMPSON: And not only that, a lot of these cases ended with a conclusion that the indicator was not a good way to do this. And we would --

MR. WALLIS: I think you need to start with a definition of what an indicator should do. What it's purpose is, how you measure one being better than another in terms of what it does. Then we can tell whether the new one is better than the old one.

MR. THOMPSON: Well, I think this new indicator is going to do something different than what the old one was trying to do. It's trying to accurately capture the unavailability and unreliability which was not necessarily the purpose of the original indicator.

MR. BARANOWSKY: Yes, I guess what we haven't done is sat here and other than identifying those five points on the prior viewgraph, gone through the methodology things in the current indicator that are problematic. And I guess we're more focusing on what's in the one that we're proposing. But if I step back a bit, just the fact that we didn't have demands and failures in the prior indicator, it was missing something. Just the fact that there was a single model with a single threshold for every plant, we knew that was a problem.

So we've identified a number of things

that we know are flawed in the current indicator and what he's trying to say is we're going to make progress in removing those things. And if those are flaws and we fix them, then we know this is a better indicator.

MR. WALLIS: Yes, I think you're proceeding by solving problems which have been recognized.

MR. BARANOWSKY: Right.

MR. THOMPSON: Exactly.

MR. BARANOWSKY: That's our approach.

MR. THOMPSON: That's right.

Another objective of the pilot is to minimize the differences and increase the consistency where we can between this pilot, the maintenance rule, PRA and the SDP. And as I go this, you'll see where we're trying to address those things.

We also want to exercise the methodology, the actual reporting, the mechanics as licensees would really do it if we went to full implementation with this PI such that the data will come in, we'll actually see the data as it would be for full implementation.

And then we want to identify after the pilot any unintended consequences that might result and assess their impact, if any.

Now, we do have a list of questions, predetermined questions that we want answered during the course of the pilot. These probably aren't all inclusive. They were just some of the ones that the working group has come up with.

And the first one is one we just went over in the last slide, is this a better indicator of risk than using the SDP which we're forced to do through the frequently asked question resolution such that the staff may need only rely on the PI indication for the risk significance and not do the SDP. That is a big issue with industry right now. That is something they want, and they think and the working group believes that if the indicator works as we designed it, we may be able to achieve that.

MR. APOSTOLAKIS: To achieve what?

MR. THOMPSON: To be able to use the outcome or the color characterization from the PI as the appropriate risk characterization.

MR. APOSTOLAKIS: This touches on something I think that's much bigger, which is -- I mean, it's not clear to me that the PI should actually deal with risk. One of the major comments we made in our last letter, I think, was that the PI by itself as a measure of risk is not very minimal. That's why the red threshold was so bad. Because you had to go through 23 SCAMS to see a significant change in risk.

And as many of my colleagues here have been saying, we are looking at the PIs to marshal our resources. Now when you get an early indication that something's going wrong, and we're going to send more NRC inspectors or we're going to look more carefully and so on. But this is not really related to risk.

So it seems to me that this kind of approach has to be resolved because you may be going down the same path as the previous PIs. See, the prblem there was that in order to see a change of 10^{-3} or ^{4} -- not 3; 4 or 5 in the CDF because of one PI, you have to change the PI so much that it was unrealistic. And we know that accidents don't happen that way. In accidents you have usually a combination of events. Right? It's not one thing that you have too many SCRAMs. The accident is really that you have one SCRAM and you have other things that are failing.

So I'm not sure that trying to pursue the PIs as better indicators of risk is a good idea.

MR. BARANOWSKY: Let me clarify a couple of things on that. In other words, there's another point maybe.

MR. HAMZEHEE: No, go ahead.

MR. BARANOWSKY: It is a conditional measure of the risk, which is basically what I think you were pointing out, George. Holding other things constant.

In terms of whether some of the indicators require many failures, if you will, or incidents to occur before the indicator trips a threshold, I think that's a measure of the risk significance of the functions that we're trying to monitor performance on. And maybe we're not monitoring the right performance or maybe we need to monitor things differently.

The MSPI indicator is meant to provide an accumulation of unavailability/unreliability and what the implications are with regard to performance as it relates to how risk is changing if that performance declines.

The SDP looks at individual instances such as something failed or something was out of service, and that unavailable contributes to an amount of risk, such as a risk meter might look at it. I don't know of any risk meter, for instance, that has a change in the failure rate or demand failure probability as a function of time every time one has a failure you update. I don't think they do that. That's what this indicator does.

So it accumulates information on a performance of whatever system or function we're looking at instead of looking at individual points.

MR. APOSTOLAKIS: I understand that. But I think the notion that everything in the -- should be tied to risk is questionable.

For a long time I was advocating -- not advocating as it should be, but I was working on the assumption that it was. And some of my colleagues here said no, that's not the purpose of this. Whether I have three SCRAMs in a year or not tells me something else. It doesn't really tell me much about risk, but it tells me that I should be going there and looking and that something is not proper, you know. That's very different from tying it to risk.

MR. SHACK: Yes. I mean, are the PIs measuring the safety status of the plant or are they measuring the performance? And I think, you know, you could argue that looking at one of these PIs, yes, I can tolerate a very large variation before that in itself is a measure of an unsafe condition. However, as an indicator of the performance of the licensee, you might have -- you know, the risk informed indicator I think is a reasonable thing. I think the thing that we're getting at is how do you set the threshold. And setting the thresholds on a delta CDF we argued led to problems because you were isolating something. And you're really not trying to measure the plant safety status, you're trying to measure performance.

MR. APOSTOLAKIS: Right. And performance is in the sense that this fellow deviates too much from the industry.

MR. SHACK: And as an indicator of everything else that he's doing. I mean, we're looking at one thing.

MR. APOSTOLAKIS: Right.

MR. SHACK: And it's indicator of how he's performing overall because we're not measuring everything that's related to the plant.

MR. BARANOWSKY: Yes. Well basically what we've done, of course, in this whole oversight process is aggregated some things. The cornerstones themself are disaggregation. I mean, we could have just put down plant safety status and put containment barriers, mitigating systems and initiating events all into one thing; plant safety status. But then you've got a problem with figuring out well when the safety status is bad, how do you know what to go look at.

So there was a judgment call that was made. And we're not trying to revisit that issue today, even though I think I understand what the nature of the concern is because in fact in the risk based performance indicator report we did talk about an integrated indicator. That would be essentially at the plant level --

MR. APOSTOLAKIS: Oh, all right. Yes.

MR. BARANOWSKY: But I don't think we're ready to go there yet.

MR. APOSTOLAKIS: I like that.

MR. BARANOWSKY: We're not ready to go there yet.

MR. APOSTOLAKIS: I know.

MR. BARANOWSKY: We have to take some steps, and this is the first step. If this step works and it looks like it makes sense to address the issues of plat status versus monitoring performance, then I think there's probably something we can work on.

MR. APOSTOLAKIS: The ideal situation would be to have PC model where I can input the findings and get the delta CDF. Isn't that what --

MR. HAMZEHEE: We already have that.

MR. THOMPSON: Yes, we call that PRA.

MR. BARANOWSKY: Yes, we call that a PRA, right?

MR. BARANOWSKY: Right. And we're having enough trouble changing things like 5046, Appendix J and everything else so if we attack that --

MR. APOSTOLAKIS: It runs already, though--

MR. BARANOWSKY: -- none of you will be a member of this committee by the time we end up coming with a new indicator.

MR. APOSTOLAKIS: Because the findings are not always PRA.

MR. HAMZEHEE: And all the plants have that already and they do it for internal purposes. And I think Steve had it as his --

MR. APOSTOLAKIS: No, but a lot of the findings in the inspections require additional processing.

MR. BARANOWSKY: You're going to see a lot of use of PRA in this that you haven't seen before as far as I can tell. And I think we're just going --

MR. APOSTOLAKIS: Let me take one point, and I did try last time we were writing the letter but it was pretty much -- I think the way the action matrix is put together causes a lot of misunderstandings and leads you the wrong path.

Because it tries to -- it has two different purposes, really.

One purpose is to look at performance and the other is to look at risk. And I think the attitude so far has been risk. Let's try to make everything risk related. And, you know, sometimes that leads to an unrealistic result. But that's something to think about with other guys, not you.

MR. BARANOWSKY: There has to be a nexus between performance and risk or else we can't --

MR. APOSTOLAKIS: At some point.

MR. BARANOWSKY: -- set the performance targets in any rational way.

MR. SIEBER: Well, I sort of disagree with that to some extent. If you look at thresholds, the ones that seem to be outrageous are the ones associated with initiating events. And perhaps that's because initiating events are designed, there's a design in the plant to cope with them. And so on that basis initiating events like reactor SCRAMs for example are better off being performance based than risk based. But perhaps mitigating systems might have some value in being risk based.

And so I would treed carefully in this area. But the way I see it, I see applications for both performance basing and risk basing in the PI.

MR. APOSTOLAKIS: Sure. Sure. But right now I think most people look at the action matrix and they really think in terms of risk.

MR. SIEBER: Risk.

MR. APOSTOLAKIS: Except some members of this committee.

MR. SIEBER: That's right.

MR. KRESS: And I think it's very difficult to take an individual performance indicator and convert that into risk. I know if it's a mitigating system, you can plug in the change in unreliability -- in the PRA. But that's not what we're after here, I don't think.

That as an indicator of what things -- other things may go wrong, and you don't know what those other things are and you don't know how to input those into the PRA at the same time.

So I think we make a mistake in actually saying selecting a delta CDF due to this unavailability to represent our threshold. Because I don't think we have a way to establish that threshold that way. I don't think you have any basis for choosing. You could probably arbitrarily choose it, but I don't know how you would do it.

MR. APOSTOLAKIS: The problem I think comes back to what I said earlier. Accidents don't occur because of a single thing.

MR. SIEBER: That's true.

MR. KRESS: Yes, that's exactly right.

MR. APOSTOLAKIS: It will not be the unavailability of something. It will not be an initiating event, it will be a combination of some hardware or some human error, or some of this and some of that, and all of a sudden you have a problem.

MR. BARANOWSKY: Could I just point out --

MR. APOSTOLAKIS: That is difficult to capture, though. It's very difficult.

MR. BARANOWSKY: We're talking about not one performance indicator for one system or component. We're talking about performance indicators that cover several systems and components. So the issue of --

MR. KRESS: But that's my whole problem is you don't have a way to conglomerate those together at the same time.

MR. BARANOWSKY: Well, actually, we do have a way and that's through the PRA.

MR. APOSTOLAKIS: So great. Let's wait until we see how you do it.

MR. BARANOWSKY: If we can get --

MR. KRESS: You don't have a way to set the threshold.

MR. BARANOWSKY: Yes we do.

MR. APOSTOLAKIS: That's the way to do it.

MR. KRESS: Well, okay. I'll wait.

MR. APOSTOLAKIS: But I think the first bullet, though, I mean really at this time it seems to argue for the SDP, because the SDP is --

MR. BARANOWSKY: The SDP is looking at single incidents.

MR. APOSTOLAKIS: Well, it's not done correctly?

MR. BARANOWSKY: What?

MR. APOSTOLAKIS: We also recommended that if they find three things, they should do one SDP for the three things, not separately.

MR. HAMZEHEE: Or should they be looking at them at the same time.

MR. BARANOWSKY: Oh, no. If they find three things and you want to know the risk significance, then you've clearly you've got to have an integrated model.

MR. APOSTOLAKIS: Exactly.

MR. BARANOWSKY: But if you want to know about performance, how has performance changed, do you go every single time there is a failure or an unavailability if you do -- equivalent, do an ASP analysis to the SDP.

MR. APOSTOLAKIS: I agree with you. And I think the action matrix --

MR. BARANOWSKY: I mean, if that's true, then what's the role of reliability and unavailability in the PRA itself?

MR. APOSTOLAKIS: Yes. I think you're a little ahead of the ROP. You are ahead of the ROP. Because I really think the action matrix should make that very explicit that performance and safety, you know, they overlap a lot, sure. But there may also be different objectives.

MR. BARANOWSKY: There is a bunch of simplifications in the reactor oversight process framework. Okay. We knew they were there when we put them, and what we're trying to do is slowly but surely improve on those.

We can't just overhaul everything at once. So we're going to take them on --

MR. APOSTOLAKIS: Well, let's see what you have solved already. I mean, we've never been there.

MR. BARANOWSKY: Based on one of the thorniest issues.

MR. APOSTOLAKIS: The way we're going, we'll never get there.

MR. HAMZEHEE: We're on page 3, I think.

MR. KRESS: What did you say?

MR. HAMZEHEE: We're still on page 3 and we have 20 some pages.

MR. APOSTOLAKIS: Can you use, I mean with the permission of the Chairman, your judge on this, keep the motherhood statements.

CHAIRMAN BONACA: Yes.

MR. THOMPSON: Let's go to the next viewgraph.

MR. BARANOWSKY: And I'll turn it over to you.

MR. THOMPSON: All right. This is an overview of the workings of the pilot.

The MSPI comprises the four existing systems currently monitored by the SSU PI, plus we're adding in the support cooling system as monitored systems for the pilot. That really means the central service water or its equivalent and the component cooling water or its equivalent for the boilers.

It's a 12 quarter rolling average like the current PI, but we're going to monitor and calculate the unavailability and unreliability in relative terms of a new unit that we're calling delta CDF index. I know it doesn't say index here, but we've come up with an equivalency to a conditional CDF.

MR. BARANOWSKY: And that's because of the issue of Dr. Kress and Dr. Apostolakis raised about it being an incomplete measure of the risk.

MR. THOMPSON: Yes. The PI incorporates plant specific models and uses data to calculate the index. And Hossein will go over that in detail with his slides.

The thresholds were developed using the standard risk insights and are defined as 1E-6 for the green/white, 1E-5 for white/yellow and 1E-4 for yellow/red with the units of CDF Index.

MR. APOSTOLAKIS: So they are risk related?

MR. THOMPSON: Yes, and not plant specific thresholds.

One of the big differences, too, is that discovered conditions that prevent fulfillment of the safety function of the monitored system will be specifically accounted for in the unreliability portion of the PI.All right.

MR. LEITCH: I think I missed a subtlety here. You said it, but CDF index as compared to delta

CDF? I'm not sure I understand the difference.

MR. THOMPSON: As Pat said, it's because it's a conditional look at what we're trying to monitor and not a broader look like what the SDP would do.

MR. ROSEN: Another way to say that I think, Graham, is that if you really wanted to calculate delta CDF, you have to use the plant model, the PRA model and calculate the whole CDF. Here they're just looking at a couple of systems. It doesn't take into account the interrelationships between all of the plant's components and the different initiating events.

MR. BARANOWSKY: And we're only looking at level one, so we don't have other factors.

MR. ROSEN: And you're not looking at shutdown risk.

MR. THOMPSON: Or operator recovery, or anything like that.

MR. ROSEN: So it's an index, it's just not the whole deal. Ultimately the right way to do this is to use the plant PRAs.

MR. SATORIUS: Right.

MR. ROSEN: But they're just taking -- you know, before they could just crawl, now they're standing up and trying to walk. And then ultimately something else will happen.

I would like to ask a question about the last bullet on that slide. "Discovered conditions that prevent the fulfillment of the safety function" now are counted in the unavailability. They're considered in the unavailability index. That is, you go back to the last time you knew it worked and usually take half of that time.

MR. SATORIUS: Right. The fault exposure.

MR. ROSEN: The fault exposure time and the unavailability. And now what does this mean? That it's being accounted for in the unreliability PI; I don't get it.

MR. THOMPSON: Let me take a first stab.

The problem with what we're doing now is while true that the PI as we have now was designed to do that, it's the so called T over 2 issue and the PI is not measuring that no longer. We're using the SDP. We're taking those instances because the PI can over estimate the significance of that issue and having it monitored using the SDP.

So the PIs really not accounting for those things no longer, especially with the interim fix that we use with the 99-02 Rev. 2.

MR. APOSTOLAKIS: Now, the unreliability will be over a period of time, right? Unavailabilities at the given time? So this will include the operator intervention to stop the system if it doesn't stop?

MR. ROSEN: I think we're getting --

MR. THOMPSON: I think you'd better try that answer.

MR. BARANOWSKY: No, it's really simple. If the condition was such that had you tried to initiate a start of the piece of equipment, it wouldn't have functioned. It would have failed on demand. So we call it a failure on demand. And since we're looking at performance over a long period of time, we just take that as one failure, one demand and we put it in with the others that have occurred. And we compute an unreliability for failure on demand. Whereas before we were looking at it as a single incident by itself without looking at any other prior history and just saying how significant is that condition.

MR. APOSTOLAKIS: So unreliability is not used in the sense of a PRA. Unreliability is the failure to start on demand?

MR. BARANOWSKY: That's what this would

be. Let's say turbine driven pump, somebody walked by the turbine driven pump and found that some valves were in the wrong position --

MR. APOSTOLAKIS: But you guys are producing these other reports that are very good that are looking at the operating experience and you're calculating unreliability as the probability of the system not working over a period of time.

MR. BARANOWSKY: Well, we do it both ways. We look at the probability that it will not operate when called upon, at start up in order words, and the probability that it will not continue to operate to fulfill its safety mission.

MR. APOSTOLAKIS: Right.

MR. BARANOWSKY: That's all included in this indicator now.

MR. APOSTOLAKIS: But the probability of not starting any continuing to operate --

MR. BARANOWSKY: Yes.

MR. APOSTOLAKIS: -- is the unreliability.

MR. BARANOWSKY: That's right. And that's exactly the way we're defining it.

MR. APOSTOLAKIS: Not just the probability of failure to start?

MR. BARANOWSKY: If we get there, I think you're going to see it.

MR. APOSTOLAKIS: All right.

MR. ROSEN: You may not get there, but you'll have fun on the way.

MR. HAMZEHEE: And I think, George, the way we're doing it now is we are very consistent with the PRA approach. So it's nothing --

MR. APOSTOLAKIS: Then your earlier answer was not exactly right. But that's fine.

MR. ROSEN: Okay. So you're solving the PI with two problems you think by doing it this way?

MR. APOSTOLAKIS: Correct. Fixing a terminology problem.

MR. ROSEN: So you discover a component -- it's easy. I mean, you have to do a monthly test or something, you go do the test and it doesn't work, doesn't start. Okay. That's a failure on demand. And that's the only way you count that. You don't say, mmm, we tested this last week and it worked, it passed the test, so it can't have been out more than a week. Now what did we do during this week? Oh, it must have been when we repacked this valves yesterday afternoon.

MR. APOSTOLAKIS: Right.

MR. ROSEN: Now it turns out it doesn't work because this valve doesn't stroke. We repacked the valve. Oh, yes, we asked the guy who repacked whether he knew how to do it. It turns out he was unqualified.

We've got a lot of problems here, but we think the time that that valve was made inoperatable, when that step was taken, was really when that -- it would have worked up until that time. So if you have that, you can say fault exposure hours. In that case, it's just a day.

All right. And then you add that into unavailability. Now you're saying we're not going to do that. We're just going to say, okay, it didn't work, bang. We've got one failure on demand. Forget all the unavailability, we're going to consider that it's available throughout that whole time up until this test. Is that right?

MR. BARANOWSKY: That's right.

MR. HAMZEHEE: That's correct.

MR. ROSEN: Don't you lose something, is my point? Don't you lose some real unavailability by doing that? Now before you might have been over estimating -- you might have been overestimating unavailability if you're using the T over 2 algorithm. Might have been. You might also have been under-estimating. That's why we use T over 2 because we didn't when in some cases you would over estimate it, some cases you under estimate; on the average you'd hit it right on the nose.

MR. BARANOWSKY: No.

MR. ROSEN: Now this new way, you're almost certainly going to estimate unavailability.

MR. BARANOWSKY: No, I disagree with you on that.

MR. ROSEN: Almost there's no question that you're going to under estimate unavailability. Because the only case in which you are not going to under estimate unavailability is the case where it just failed. It would have worked a microsecond, an epsilon in time before we did this test it would have worked, but now it won't.

MR. BARANOWSKY: There's going to be some cases where you over and under estimate it and the assumption is that it's basically a constant failure rate process. You'll under estimate by about a factor of 2.

If you assume that the inspection occurs at the end of the test interval. The inspection occurs randomly within the interval, then the T over 2 approximation is correct.

What this solves, though, is the issue of taking a potential single failure for something that only has a limited number of demands in, say, a year in which if you take only, say, one failure in one year and a limited number of demands in one year; then you know that for any given one year period of time you're going to have things like perfectly reliable, perfectly reliable, highly unreliable, then back to perfectly reliable again.

The approach that Hossein is going to talk about is how we are going to bring in Bayesian statistics to account for this high increase or zero situation which is basically a sparse statistics issue.

MR. SIEBER: Do you take into account post maintenance testing since maintenance generates a lot of the future failures to start?

MR. HAMZEHEE: Yes. As part of the unavailability.

MR. SIEBER: Right.

MR. HAMZEHEE: That's correct, yes. They are all unaccounted for.

MR. APOSTOLAKIS: Well, we should wait and see until --

MR. ROSEN: I'm still not convinced that you're not going to lose unavailability. You're measuring unavailability and unreliability separately now, right?

MR. APOSTOLAKIS: That's correct.

MR. ROSEN: That's a wonderful, wonderful thing to do. It's very good you moved in that direction. But now that you've changed the algorithm for how you account for the unreliability, you're going to lose real unavailability hours. You're not going to account for times that the machines were really unavailable by doing it this way.

MR. THOMPSON: But there's another issue. You don't want to double count. You don't want to take a demand failure and take the unavailability. That's like double counting.

MR. ROSEN: No, it isn't.

MR. APOSTOLAKIS: Let's raise the issue when we see the actual --

MR. BARANOWSKY: I mean there's a definite -- there's an equivalence with a constant failure rate assumption between a failure on demand in the T over 2 situation. It's a very simple mathematical formula and we're trying to account for it here.

MR. APOSTOLAKIS: And it depends very much on what value for lambda you use.

MR. BARANOWSKY: It has to be a small

value of lambda and it has to be a constant failure rate process.

MR. THOMPSON: Next slide.

MR. APOSTOLAKIS: Yes, let's move on.

MR. THOMPSON: As of today this is the list of plants that have volunteered to participate in the pilot. We've tried to --

MR. APOSTOLAKIS: Next time you should have the plants that are not participating and show them this time.

MR. THOMPSON: We tried to get a good random representation, but it was voluntary so these are the ones that we ended up with.

MR. APOSTOLAKIS: So what does 1/2 mean? Both units one and two?

MR. THOMPSON: Yes. Units one and two.

The next slide shows the monitored systems in the pilot. The first four are identical to the systems currently measured by the SSUPI. The last line of each of the Bs and Ps are the support system that is the additional system that the PI is going to monitor.

MR. APOSTOLAKIS: What are the support systems?

MR. THOMPSON: Like under B column the

support system cooling, which is essential service water plus the building closed cooling water and the turbine building.

MR. APOSTOLAKIS: I don't see any of those here. Is there?

MR. THOMPSON: The last line.

MR. APOSTOLAKIS: Oh, down at the bottom.

MR. HAMZEHEE: The very last line.

MR. THOMPSON: Any questions? Okay. Next slide.

MR. APOSTOLAKIS: Actually, support system cooling is wrong English, isn't it? You're not cooling the support systems, are you?

MR. HAMZEHEE: That's true, we're not.

MR. THOMPSON: True. It's the support --

MR. APOSTOLAKIS: Well, like all the component cooling water system, right?

MR. THOMPSON: The support cooling --

MR. ROSEN: But you have a very high standard. You want the staff to speak English.

MR. BARANOWSKY: We just factor in here English is our second language, you know.

MR. ROSEN: I didn't think we have any such expectation.

MR. THOMPSON: The next slide is to give

you the definitions of unavailability and unreliability as we're defining them for the pilot.

The MSPI unavailability is the sum of the planned and unplanned maintenance reported by train, corrective unavailability. It's not all unavailability. I wanted to make that point.

MR. BARANOWSKY: We're going to show equations for all this.

MR. APOSTOLAKIS: Wait a minute. This is the MSPI train unavailability, correct?

MR. THOMPSON: That's correct.

MR. APOSTOLAKIS: Yes, with the word "train" in front of unavailability?

MR. THOMPSON: Well, it says reported by train

MR. APOSTOLAKIS: Well, it says MSPI -- MSPI train unavailability.

MR. HAMZEHEE: George, but I think if you wait until we go through the algorithm, you realize these are system --

MR. APOSTOLAKIS: I understand that.

He took away the microphone.

MR. THOMPSON: The next bullet is the train unavailability is the ratio of hours that the train was unavailable to perform its risk-significant function or functions as defined in the PRA, the plant specific PRA, due to planned or corrective maintenance or testing during the previous 12 quarters with reactor critical, by the way, which is the current definition of the SSUPI to the ratio to the number of critical hours that the train was required to be available.

MR. ROSEN: Now wait a minute. Now you told RHR was one of the MSPI indicators you're going to look at.

MR. THOMPSON: Yes, it is.

MR. ROSEN: Well, how often is RHR needed when the plant is critical?

MR. HAMZEHEE: The RHR for at power functions, there are so many functions as you know for RHR. What we're talking about here are those functions that are required during at power mode.

MR. THOMPSON: Okay. Right.

MR. BARANOWSKY: And some plants use RHR in power.

MR. HAMZEHEE: Well, for a mitigating purpose, yes, under --

MR. ROSEN: No, it's not all plants, but some do.

MR. HAMZEHEE: That's correct, yes

MR. APOSTOLAKIS: So there should have been a third bullet there saying that the train unavailability will be put together somehow to get the MSPI unavailability. Okay. Okay.

MR. THOMPSON: Yes. For unreliability the MSPI unreliability is a measure of the demand failure probability.

MR. APOSTOLAKIS: So it's both. Good.

MR. THOMPSON: Yes. Of the monitored system and the failure probability during a mission time.

MR. APOSTOLAKIS: Yes. Okay.

MR. THOMPSON: And that the component unreliability is the failure on demand probability that the system would not perform its risk-significant function when called upon during the previous 12 quarters.

Now all of this Hossein will go over in a little more detail with his presentation.

Now our schedule, which has turned out to be an ambitious one, at the end of next month we have prepared a workshop for the pilot participants, both for the licensees and for the inspectors that will partake in the pilot, a three day workshop.

MR. APOSTOLAKIS: Right.

MR. THOMPSON: We will go over the details and bring everybody up to speed.

August 1 is the start of the pilot and we plan to come back to the ACRS and brief you on the pilot progress in two or three months.

MR. APOSTOLAKIS: See, that's confusing to me. Every bullet is a noun, public workshops, start of MSPI pilot. So brief there I thought it referred to a brief subcommittee. You mean to brief or briefing the ACRS. It's not that you're declaring the Subcommittee --

MR. ROSEN: We have to deal with this all the time. You only have to deal with it during this meeting.

MR. APOSTOLAKIS: So briefing the ACRS Subcommittee.

MR. THOMPSON: It would require two lines and two slides otherwise.

MR. APOSTOLAKIS: Okay.

MR. THOMPSON: In February the pilot ends and we start the analysis period.

MR. APOSTOLAKIS: So what do you expect to learn from the pilot?

MR. THOMPSON: That we solved the problems.

MR. APOSTOLAKIS: Certainly those guys are not going to tell you anything about the theoretical basis of this. They will probably tell you that that it was difficult to get the data you thought you were going to get. I mean, have you thought about it?

MR. THOMPSON: Yes.

MR. APOSTOLAKIS: What is the value of the pilot?

MR. HAMZEHEE: Yes, there are pilot objectives. I think if you go over the objectives of your pilot program --

MR. APOSTOLAKIS: There will be a slide on that? Fine.

MR. BARANOWSKY: We gave those to you earlier.

MR. APOSTOLAKIS: Oh, you did?

MR. THOMPSON: It was I think the third slide.

MR. HAMZEHEE: There's a slide on the objective of the pilot program.

MR. APOSTOLAKIS: The third slide.

MR. BARANOWSKY: I mean, a major thing is this is a new and somewhat more complex way of doing the calculation using a plant specific PRA, if you will. And so we've got a lot of technicalities that we have to go over.

MR. APOSTOLAKIS: Yes, these are not really objectives I had in mind. I mean --

MR. BARANOWSKY: Well, we want to determine how difficult this is to do in order to get consistent results.

MR. APOSTOLAKIS: Right.

MR. BARANOWSKY: Because while the industry is doing their thing --

MR. APOSTOLAKIS: It's the doing of it?

MR. BARANOWSKY: -- the staff is going to be doing their thing as a check.

MR. APOSTOLAKIS: But let's not over estimate the value of the pilots. They will tell you how difficult it is.

MR. BARANOWSKY: Yes.

MR. APOSTOLAKIS: Or of it's impossible, or whether it's impossible to do what you want to do. But they will never tell you or question the theoretical basis of what you're doing.

MR. BARANOWSKY: No. During the pilot we're also going to do what we are calling "table top studies," issues that are raised in this meeting or by other stakeholders that are related to methodology. And what would happen if you treated it this way or that way. We're going to run a bunch of case studies on them. But we want to get the industry into trying to collect the date and exercise the basic method, even though it might change a little bit. There's some technicalities and what Hossein's going to show you that we're going to have some questions on and we may want to try other ways.

But we know that collecting the data and getting everyone to compute in a consistent way the same thing is a little bit of a problem.

MR. APOSTOLAKIS: Right. So what in July of 2003?

MR. THOMPSON: We'll collect the results and roll them up into a RIS and communicate that to the members of the public.

MR. ROSEN: What's a RIS?

MR. APOSTOLAKIS: What's a RIS?

MR. THOMPSON: Regulatory information summary. It's kind of like an information notice.

MR. SATORIUS: That's the vehicle that we report to the public and our other stakeholders. And it's also the pilot, whether we consider it a success, whether it met the pre-agreed upon success criteria and attributes.

MR. THOMPSON: Right.

CHAIRMAN BONACA: Now let me understand now. You wrote, you know, a NUREG in which you had Phase-1 development of the RBPIs and you're really testing some of these RBPIs that you have in that Phase-1 development, right?

MR. HAMZEHEE: Which were customized for the ROP, yes.

CHAIRMAN BONACA: That's right.

MR. HAMZEHEE: That's correct.

CHAIRMAN BONACA: No decision has been made on the part of NRR yet whether to use them in the ROP or not?

MR. SATORIUS: That's correct. That's the purpose of the pilot.

CHAIRMAN BONACA: Okay. The pilot really is to either --

MR. SATORIUS: We'll test what we believe will be a working system. And, as George had mentioned, it will exercise the mechanics of reporting the data for licensees to be able to go out and collect the data.

CHAIRMAN BONACA: You're doing that?

MR. SATORIUS: And for us to check that the algorithms are actually working and, as Pat had mentioned, to do a table top exercises to validate or to verify that it's doing what --

CHAIRMAN BONACA: With some sensitivity to the changes you made. I mean, some of them may not be significant.

MR. SATORIUS: That's correct, some of them may not be.

CHAIRMAN BONACA: They may not be, you know, worth the time that -- the collection on the part of the licensees. Okay. I understand.

MR. SATORIUS: I think, Hossein, you're ready to start on the technical discussion.

MR. APOSTOLAKIS: Do we want to take a break?

CHAIRMAN BONACA: No. We have scheduled a break at 2:30. Let's go on.

MR. HAMZEHEE: Okay. I am Hossein Hamzehee in research NRC. And I think the purpose of this presentation is mainly to provide the technical aspects of this new approach of mitigating system performance index. And as part of this presentation I will first talk about the major insights from our Phase-1 RBPI study and then I will go in a little more detail into the technical aspects of the approach. And then at the end we'll summarize the conclusion.

And just to make sure that I can finish

this, I'm going to try to be very focused so that I can get to the meat of this presentation. And then I'll be more than happy to answer any easy questions.

MR. APOSTOLAKIS: What about the difficult ones?

MR. HAMZEHEE: Now first, let's talk about the insights from the Phase-1 risked-based performance indicator study.

As you may have all seen in the report, this study really demonstrated that there are enough planned risk-significant differences among different plants in the industry that would make it necessary to develop some kind of plan specific thresholds for unavailability and unreliability performance indicators. And the main reason, as we all know, is because many of these plants even though they may be Westinghouse, BNW, PWRs, they all have significant design features and operating characteristics. And during this Phase-1 study that was demonstrated.

And the way MSPI will work is this algorithm will account for those plant specific features.

And then we also found that this unavailability and unreliability indicators that were treated separately in the RBPI study were found to provide objective and risk informed indication of plant performance. Again, they were all mainly risk informed. And they also provide broader risk coverage, mainly because they had more systems and they had unreliability in addition to unavailability.

And as I mentioned earlier, the approach that was described in the Phase-1 report was tested by evaluating plant specific data for 44 nuclear plants over a three year time period, which was basically from '97 to '99 and reused our available SPAR model. And I'm assuming we all know what SPAR models are. And we use EPICS for unreliability information and ROPPI for unavailability information.

MR. WALLIS: I don't understand this. How would you know if they were not objective? They have to be risk informed because that's what they're based upon, aren't they?

MR. HAMZEHEE: That's correct.

MR. WALLIS: Well, how would you know that they were not risk informed? You're reaching a conclusion that you discovered that they were risk informed.

MR. HAMZEHEE: No. Because if you read the report, at the beginning we set some criteria that would be based on risk.

MR. WALLIS: Oh, so you have a criteria to determine whether they were risk informed or not?

MR. HAMZEHEE: Exactly. We defined up front before we started the study.

MR. WALLIS: Okay.

MR. HAMZEHEE: We said all right how can we develop objective risk informed indicators. So we went ahead and defined the criteria.

MR. WALLIS: Okay.

MR. HAMZEHEE: And then we developed the approach and we would go back and look at those criteria to make sure that --

MR. WALLIS: So you found that they did what they were intended to do?

MR. HAMZEHEE: That's exactly correct.

MR. WALLIS: Okay. Good.

MR. HAMZEHEE: Yes, sir.

MR. WALLIS: Thank you.

MR. HAMZEHEE: We also realized as part of this that support systems are very important. And we looked at the significance of those support systems. And CCW and service water system or their equivalent were found to be some of the most risk significant support systems. But we also realized that they were difficult to develop PIs for mainly because of the variation of designs among the industry. And they were so plant specific that it would not be easy to develop PI generically. So with that in mind, when we started this pilot program as part of preparation, we worked with the industry and we have come up with some approach that would be used to developed performance indicators for those two support systems or their equivalent.

And the last bullet talks about the fact that in order to have a good estimation of component unreliability we used Bayesian update approach. And it was found to minimize the likelihood of false-positive and false-negative indications. And as you may all know, because of the monitoring period it is very difficult based on statistics, scarcity of data, the nature of these PIs to develop a PI in a time frame that could give you 100 percent accuracy. So you always have to deal with some false-positive and false-negative probabilities.

MR. APOSTOLAKIS: I don't understand that. What's a false-negative?

MR. HAMZEHEE: False-negative, I have one slide on this one. But false-negative means if you shows a performance indicator that would indicate the performance is green when in reality it's non-green.

It's either yellow or red, or what; that's called false-negative. And false-positive means if your performance indicator indicates red, yellow or white where in reality it's at the baseline or green performance.

MR. WALLIS: How do you know what the reality is? You're measuring something other than the performance indicator which is more real?

MR. HAMZEHEE: Well, there are two parts. One is based on -- for instance, you look at the statistics of the information because you're always dealing with numbers and then probabilities. And you estimate. And then you go back and see based on this estimation. And then availability among these estimations. What is the likelihood that you are within your 90 percentile, 95 percentile of actual performance and what's the probability that if your performance is green, you're going to demonstrate non-green performance.

So it's basically looking at data and statistics.

MR. WALLIS: I thought green was defined by the output from the performance indicator and there was no other measure of it to compare it with.

MR. HAMZEHEE: That's correct

MR. WALLIS: Absolute measure --

MR. BARANOWSKY: Remember, the performance indicators, the current ones and even these are going to basically have a mean value. And the mean value allows for some probability, of course, that you're over or under predicting what the performance is.

And so he took the statistical characteristics associated with the probability distributions as to whether or not they were --

MR. WALLIS: I thought that whatever came out of the process was the measure of meanness.

MR. BARANOWSKY: No.

MR. WALLIS: And there's no other measure of that.

MR. BARANOWSKY: No. It's like you said, if you're coming up X number of things and Y is your threshold, you just ask if you're going over that threshold.

Here what we're saying is instead of counting X number of things, we're computing perimeters and we're having an uncertainty on those perimeters and that uncertainty expressed in terms of a distribution was used to derive the probability that we had a false-positive or a false-negative outcome.

MR. WALLIS: That's correct, yes.

MR. BARANOWSKY: And then we varied a number of things associated with the distribution in some assumptions, the time period that we looked at to come up with the smallest possible range of both false-positive and false-negative in which we balance them out.

If you just use the mean, you know like about half the time you're going to be over or under estimating whether or not you passed that threshold.

MR. APOSTOLAKIS: Another way of putting it, if I see a failure, is that a random failure or is it really a real thing that shows a trend?

MR. HAMZEHEE: That's exactly right, yes.

MR. APOSTOLAKIS: I mean, I may be wrong. They don't have another indication.

MR. WALLIS: I still don't understand.

MR. HAMZEHEE: And we have a section in the appendix in RBPI if you would like later on, look at it and let us know. We'll be --

MR. WALLIS: I guess what you're saying is if you used a more sophisticated measure which included uncertainty, then you might reach a different conclusion. But if you've already chosen to use the mean as your measure, then that's it.

MR. BARANOWSKY: That's correct. Suppose

we want to have 95 percent confidence, that would be different than the mean, obviously, different point in the distribution.

MR. APOSTOLAKIS: If I flip a coin ten times and I get ten heads, one logical conclusion would be that it's not a fair point. But I may be wrong. It may still be fair and I just witnessed a rare event. All ten trials resulted in heads. That's what they're addressing.

MR. WALLIS: I don't know. It seems to me if you have three strikes, you're out, and that's it. And you define the rules --

MR. APOSTOLAKIS: If I see ten heads in ten tries, I can either conclude it was not a fair coin, it was biased toward heads, or it was fair but I witnessed something that's extremely rare. Because it's allowed in a fair coin to have ten heads in ten trials. But the probability is so low so that essentially that's the problem they're addressing.

MR. HAMZEHEE: That's correct.

MR. APOSTOLAKIS: It's not that they have a different piece of information because the real coin will do this. Because that's all they have.

MR. BARANOWSKY: This is a big issue with the industry. They don't want to have the chance of false-positives.

MR. APOSTOLAKIS: This is standard in quality control. I mean, what I see; is that a random weird occurrence or is it something that shows a trend? For example, coming from an earlier discussion, is Bayesian an aleatory thing that is unusual or rare or does it show a trend of some sort.

CHAIRMAN BONACA: Well, after we have three or four of those, we will make a decision.

MR. APOSTOLAKIS: Okay. Hossein?

MR. HAMZEHEE: And again, another challenging part that would add to this is the monitoring period. Of course, if you have 20 years of monitoring period, then these indications become more and more accurate. But when you narrow down the monitoring period, then you need to understand what are the probability of these false indications.

MR. ROSEN: Move faster.

MR. HAMZEHEE: You want to go faster? I can. All right.

Now let's just put --

MR. ROSEN: It's not your fault you're going slowly, it's George Apostolakis' fault.

MR. HAMZEHEE: Thank you, Steve.

Now quickly let's go over some concepts

before we get into the equations so you're all familiar with what we're talking about.

Again, the mitigating system performance index monitors the risk impact of changes in performance of selected mitigating systems. And this impact is based on change in core damage frequency.

And then as was already mentioned earlier, the MSPI includes Level-1, internal events for at-power mode. And this is consistent with the current ROP performance indicators.

And again, as was mentioned earlier, the MSPI for a given system consists of two elements, unreliability and unavailability. And the MSPI is the sum of the changes in a simplified CDF evaluation that shortly I'll show you how from changes in the system unavailability and system unreliability relative to a baseline values. And again soon I'll tell you what those baseline values are.

MR. ROSEN: Now it's my fault.

MR. HAMZEHEE: That's okay, please.

MR. ROSEN: Why do you sum them, a simple sum? Is that mathematically correct?

MR. HAMZEHEE: Yes. Because in a right format, yes. Because in reality a piece of equipment could not -- could be unable to perform its function either due to unavailability. It's unavailable because they're doing some maintenance activities on it or because they tried to start it and it failed to start. So either one of those is going to add to the probability that that piece of equipment is unable to perform its function. So you have to --

MR. APOSTOLAKIS: Well, in theory you should subtract the probability --

MR. HAMZEHEE: That's correct.

MR. BARANOWSKY: And also we've done some checking. It's linear approximations that we're making in order to make this a fairly simple equation to work with. And we're testing it with full blown models to see how much potential error is being introduced.

MR. WALLIS: Well, you might get numbers bigger than one.

MR. BARANOWSKY: I doubt it.

MR. HAMZEHEE: You're going to be very, very surprised if you get anything even close to one.

MR. APOSTOLAKIS: The only place where you have to do this is in seismic analysis where the probabilities of failure are fairly high. So you have to --

MR. HAMZEHEE: Conditional probability

given you have a seismic.

MR. APOSTOLAKIS: You have to subtract the probable. But here it's -- go ahead.

MR. HAMZEHEE: Well, you're my teacher.

MR. APOSTOLAKIS: Go ahead.

MR. HAMZEHEE: All right. The next one, the other concepts, again, the risk impact of --

MR. APOSTOLAKIS: Where's the equation. I'm looking --

MR. HAMZEHEE: The risk impact of these changes on plant performance are estimated using plant-specific performance data and a Fussell-Vesely importance measure. And I assume you know what Fussell-Vesely importance measure is. If not, we'll go over it.

And again, I think this is very important to realize that those aspects of the MSPI that are not -- that those aspects of safety performance that are not covered by MSPI will be evaluated through our normal inspection and significant examination process. Because this MSPIs don't cover all performance areas.

And some example are, for instance, common cause failures, concurrent failures of more than one component in a system, passive components that are --

MR. APOSTOLAKIS: Passive components?

MR. HAMZEHEE: Passive components --

MR. ROSEN: We had a discussion this morning that BRA doesn't cover passive components.

MR. HAMZEHEE: Next time, yes. And then the other -- and these are the typical things that are not included in the MSPI and it will be covered by a SDP and inspection.

MR. WALLIS: There's also passive management.

MR. APOSTOLAKIS: Yes, I think cultural issues are not covered. And Fussell I think is double L.

MR. HAMZEHEE: That's correct, yes.

Now the next one is the scope of MSPI. Let me quickly go over the scope.

For unreliability calculations calculations only active components within a system are included in the performance indicators. And we all know what active components are. A good example is a normally closed valve that has to open on demand to allow flow through a system. We call that an active component.

And all pumps and diesels in the monitored systems are considered as active components even if they're normally running because of their significance.

Active failures of check valves are not included in the MSPIs and they'll be covered under inspections and SDP.

MR. APOSTOLAKIS: Why is that? Why aren't they included?

MR. HAMZEHEE: Check valves?

MR. APOSTOLAKIS: Yes.

MR. HAMZEHEE: Well, because --

MR. APOSTOLAKIS: If the valve is close, is suppose to open?

MR. HAMZEHEE: Yes.

MR. APOSTOLAKIS: Then why not?

MR. HAMZEHEE: There are a few reasons. That was one of the issues that in the last year we reviewed and analyzed and discussed with the industry and the conclusion was not to include them; (1) is because the risk-significant failure of the check valves are not failure to open, but rather a failure to prevent reverse leakage from high pressure to low pressure systems.

MR. APOSTOLAKIS: Oh. So essentially what you're saying it's a passive system?

MR. HAMZEHEE: Exactly. And it doesn't happen often. But if it does, then the consequence could be severe and we evaluate it through SDP inspection. So that's important because --

MR. APOSTOLAKIS: Active failures. No, this is --

MR. HAMZEHEE: If it has to open on demand, this is active failure mode. Because in a --

MR. APOSTOLAKIS: No, no, no, no. If it has to open and it doesn't open, that's an active failure and that should be included.

MR. HAMZEHEE: That's correct. And what I am saying --

MR. APOSTOLAKIS: But if it fails to remain closed --

MR. HAMZEHEE: That's correct.

MR. APOSTOLAKIS: -- then it's passive.

MR. HAMZEHEE: That's correct. Exactly.

MR. APOSTOLAKIS: You shouldn't be using the word active?

MR. HAMZEHEE: No. What this bullet is saying is that the active failure mode of a check valve, which is failure to open on demand, is not included in the MSPI intentionally.

MR. APOSTOLAKIS: But it should be included.

MR. HAMZEHEE: I understand. You know, I

understand. But as I said, the decision was not to include that because the failure probability of a check valve to open on demand is very low. So we said since it does not happen often and it's not risk-significant, we included it in the inspection and SDP so it's not forgotten. It's treated in a different place.

MR. BARANOWSKY: Let me also point out that the likelihood of seeing one of these valves fail to open is small and that's why we said we would only rarely have to look at it. So we would use a different tool instead of collecting data, data, data that we're never going to get any pay off from.

Now we're going to study this a little bit further during the pilot, okay. But the idea is to keep the number of components that we have to collect data to a manageable set. And you're going to see that we're going to have to collect really a lot of information, and so that's what the decision was here.

These are the things that show up rarely. And if they show up rarely, let's treat them with some tool that's good for treating rare events.

MR. APOSTOLAKIS: But the baseline inspection program will inspect these check valves how often?

MR. SATORIUS: Typically these would be as a result of a failure to open and there would be an event. So there would be event follow up and then --

MR. APOSTOLAKIS: Oh. So it's not something that will be done routinely?

MR. SATORIUS: Not necessarily. There are -- back there to help me here, but there are specific inspections that we do where we can select surveillances that are either performed or maintenance activities. So that there is an opportunity within the inspection program to routinely take a look at these components. But typically we see a failure here and we react to that using an event follow up type of an inspection.

MR. APOSTOLAKIS: Because if it's done routinely, I mean essentially what you're saying is the probability of failure is so low that we'll inspect it every time. Now come on. The inspection is not risk informed. But if what Mark said is what's happening, then it's okay.

MR. SIEBER: Generally when a check valve fails to open, and in 40 years I've never seen that, that what it would do would be reduce the performance of the system. But where you do see check valve failures is in failures to close. They may come off the pins or get caught in there.

MR. HAMZEHEE: That's correct. That's exactly --

MR. SIEBER: And generally -- and that is tested in surveillance tests.

MR. HAMZEHEE: That's correct.

MR. SIEBER: It's the Appendix V tests and so forth.

MR. HAMZEHEE: It's also covered under the maintenance rule.

MR. SIEBER: That's right. And it's not a mitigating system function either.

MR. APOSTOLAKIS: This is philosophical. If something is so rare that it can't be in the PI, then it would be logically inconsistent to say I will move it to the inspection program and inspect it every time.

MR. SATORIUS: We're not saying that, George.

MR. HAMZEHEE: We're not saying that. We're saying it's fairly impassive --

MR. APOSTOLAKIS: Somehow the inspection has to be risk informed, too.

MR. SIEBER: If it fails to open, you're going to get a system failure.

MR. HAMZEHEE: That's correct.

MR. SATORIUS: Exactly, and then you would have an event and you would do event follow up and use the inspection program.

MR. SIEBER: And that would be unreliability instance, too, that would count against a system.

MR. HAMZEHEE: That's correct, yes.

MR. APOSTOLAKIS: So what does the last bullet mean?

MR. HAMZEHEE: And the last bullet is -- let me just give you an example. For instance, let's say you have a high pressure safety injection system in a PWR which has two trains, train A and train B. Sometimes in train A it had more than one flow path from discharge of a pump. So you may have two fully redundant parallel flow path from discharge of train A.

We're saying that those two valves, even if they're active components because of the failure of both valves at the same time has a very low probability. We're not going to include it in the MSPI, but rather we do exactly what we said like the check valve.

MR. APOSTOLAKIS: Which brings up another issue. What does it mean to include it? I mean, you're looking at the whole train, aren't you?

MR. HAMZEHEE: No, and we show you what we -- we were going to tell you soon what is the scope of a system.

MR. APOSTOLAKIS: Oh.

MR. HAMZEHEE: Because usually what we are going to do is we are going to look at a full system and within that system we are going to highlight the active components. And based on the preliminary studies that we have done, a typical system train has a pump and between one to three valves. That's the scope of a given train.

MR. APOSTOLAKIS: Okay.

MR. HAMZEHEE: And then it's talking about component boundaries that are consistent with PRAs and then the SDP will be used for the performance areas that are also MSPI. We already talked about those areas.

Now, should I get into equations, Mario, or you want to take a break?

CHAIRMAN BONACA: Is it a good time, because you have still quite a bit of --

MR. HAMZEHEE: That's correct.

CHAIRMAN BONACA: -- material to go

through, right?

So let's take a break now. And let's get-
-

MR. SIEBER: This requires more thinking.

CHAIRMAN BONACA: So that in the meantime, George can review all this upcoming algorithms. Let's get back here at 20 minutes of 3:00.

(Whereupon, at 2:23 p.m. off the record until 2:39 p.m.)

MR. HAMZEHEE: Should I go ahead?

CHAIRMAN BONACA: Yes, please.

MR. HAMZEHEE: All right. So the next one is talking about equations. And the equation number one mainly says that the mitigating system performance index for a system is the summation of unavailability index and unreliability index.

MR. APOSTOLAKIS: I don't understand why it says changes in train unavailability. You're not calculating changes, you're calculating the actual unavailability, aren't you?

MR. HAMZEHEE: Yes, but it says system unavailability index due to changes in train unavailability.

MR. APOSTOLAKIS: Yes.

MR. HAMZEHEE: In other words, you're

going to have a baseline unavailability and then based on that baseline you measure the changes.

MR. APOSTOLAKIS: Why? How.

MR. HAMZEHEE: Will you let me go through the equations, George, at the end of it if you don't understand it, then I'll try to explain it.

MR. APOSTOLAKIS: All right.

MR. KRESS: Equation three is a fractional change in unavailability.

MR. HAMZEHEE: If you guys don't mind, let me just quick run through the equations quickly and then I'll be more than happy to stop.

So it's UAI, which is the system unavailability index due to changes in train unavailability and URI system unreliability index due to changes in component unreliability. And you see one is train, one is component and we'll explain why.

Now, let's see how we find UAI. UAI is the summation of the UAI_T, which UAI_T is unavailability index for train T and the summation is over the number of trains in the system. So for the two train system, it's one T, 1 plus T2.

I'm sorry, Steve.

MR. ROSEN: I said it's victory.

MR. HAMZEHEE: And then UAI sub t is equal to DCF_p and equation. Fussell-Vesely, sub UA_p divided by USRP; the whole thing multiplied by that USR_p minus UR_{BLT}. And let me explain.

MR. KRESS: That's essentially a plant specific change in CDF?

MR. HAMZEHEE: Exactly. You got it. That's exactly what it is.

And let me quickly go over the terms and then I explain a little more.

CDF_p is plant specific internal events at power core damage frequencies that is going to be obtained from licensees.

Fussell-Vesely --

MR. APOSTOLAKIS: The mean value, right?

MR. HAMZEHEE: Yes. Right now we're merely talking about mean values.

And FVUSRP is the train specific Fussell-Vesely value for unavailability based on plant specific PRA. So if you have four different planned PRAs with four different design characteristics, most likely you're going to have four different Fussell-Vesely. And each represents a different plant.

And then USRP is the value of unavailability for train 2 T from plant specific PRAs. In other words, you're going to go to that system and ask licensee what they have used for that train in their PRA models for that system. And that's what we use. And then later one we talk about how NRC is going to validate or confirm, make sure those are the right numbers.

MR. KRESS: Then the question I might have there is that may be what they used in their PRA, but what was their normal value? Do they have a standard value that might be different from what was used?

MR. HAMZEHEE: Yes. I'm going to talk about them. Yes. You're right. There's going to be some variations, some differences. We'll talk about it.

MR. ROSEN: When you say you're going to go ask them what they used, do you mean in their last model update?

MR. HAMZEHEE: In their most recent updated PRA, yes.

MR. ROSEN: Because it changes over time.

MR. HAMZEHEE: That's correct.

MR. KRESS: But you used plant specific data?

MR. HAMZEHEE: That's correct.

MR. ROSEN: Because we're basing an update here.

MR. HAMZEHEE: That's exactly right. But then we also have to define some frequency at which you can do those. Otherwise, you don't want to change these everyday, but you're right.

MR. ROSEN: No. But a update frequency, it's a function of -- it's in our license.

MR. HAMZEHEE: That's right.

MR. ROSEN: Because at South Texas it's part of the exemption.

MR. HAMZEHEE: That's right.

MR. ROSEN: So now what you're saying is we will be using that number during a cycle? Okay. Well, that'll work.

MR. HAMZEHEE: And right now I think I'm going to focus on how technically we're going to calculate these. But then later on as part of pilot with NRR we have to define how often and why, and how we're going to --

MR. ROSEN: That's right. South Texas is in the pilot, so you'll get some feedback on how that works in a plant with an exemption.

MR. HAMZEHEE: Exactly.

MR. SATORIUS: But we understand that there are reasons for licensee to change their PRA as they may modify the plant, as they make changes to the plant. It's a reasonable thing for them to do. And we're mindful of that.

MR. ROSEN: Change the model as well as change the data.

MR. HAMZEHEE: Exactly.

MR. KRESS: Now your summation, is that the summation over the four trains --

MR. HAMZEHEE: If you have a South Texas three train system, then that's train A plus B, plus C. For Comanche two train system, it's only two of them.

MR. KRESS: Okay. But you don't sum it over systems?

MR. HAMZEHEE: No. This is a system. This is MSPI, which is mitigating system performance index for a given system.

MR. KRESS: A specific system?

MR. HAMZEHEE: In other words, we're going to have one for HPI, one for 00 feed water, one for RHR.

MR. KRESS: And the way you'd summate those would be in your --

MR. HAMZEHEE: Within the system.

MR. KRESS: -- multiple performance indicators in your matrix?

MR. HAMZEHEE: That's correct, yes.

MR. KRESS: You'd have a sort of a summation?

MR. ROSEN: But RHR is only for RHR systems that are used for an at power function?

MR. HAMZEHEE: Correct.

MR. ROSEN: So plants that use their RHR only for shut down, only in shut down modes --

MR. HAMZEHEE: Those functions are not.

MR. ROSEN: -- they will not have an MSPI for shut down or for RHR?

MR. SATORIUS: It should be the same way it is right now, Steve. Because we're making no change to RHR and how it's viewed between the way that unavailability is measured today and the way unavailability will be measured under the pilot.

MR. ROSEN: I thought you said RHR was in the pilot?

MR. SATORIUS: It's in this pilot. It's also in the PIs that we're gathering unavailability data for today.

MR. ROSEN: All right. Then why are we measuring RHR?

MR. HAMZEHEE: Tom, would you like to ask something?

MR. ROSEN: Is there some RHR function at power?

MR. BARANOWSKY: No. Are we talking about low pressure safety injection?

MR. HAMZEHEE: I think Tom Houghton is here from NEI.

MR. HOUGHTON: Let me try to help. The two functions of RHR that we're thinking about are the accident mitigation function, okay, which we would include for RHR while at power because it's needed immediately upon initiation of the accident.

MR. ROSEN: That's the low pressure coolant injection mode of RHR.

MR. HOUGHTON: Right. That's exactly right.

And the shut down cooling mode we would not include as a function of RHR.

MR. ROSEN: Now I'm trying to remember in the South Texas design the low pressure coolant injection. South Texas has a separate and completely independent low pressure coolant injection system.

MR. SATORIUS: Steve, I would bet you, and I don't know for sure, I can find out that South Texas is providing that low pressure safety injection system of unavailability today. Because that function, that system provides that high volume, low pressure --

MR. ROSEN: And labeled paren RHR which it's not?

MR. SATORIUS: Right.

MR. ROSEN: Because the RHR system at South Texas is a very different plant, remember, but it's inside containment -- totally motor's inside containment, it's used only for shutdown. So, you know, what we have is separate LPCI.

MR. SATORIUS: Yes, you do.

MR. ROSEN: Which functions in the mode that other plants or two loop plants typically use their RHR for. So I think your point, Mark, is that South Texas is reporting performance of LPCI in lieu of RHR?

MR. HOUGHTON: Yes.

MR. ROSEN: Because functionally they're equivalent.

MR. HAMZEHEE: I'm confident that that's what they're reporting. I can double check that, and will.

MR. ROSEN: I think that's the right answer.

MR. APOSTOLAKIS: Can we go back to the equations so I can understand it.

MR. WALLIS: Could we go back to the equations and explain to someone stupid like me what's going on here.

MR. HAMZEHEE: Yes.

MR. WALLIS: What you seem to be doing is trying to get a measure of of the effect on CDF of system unavailability and unreliability.

MR. HAMZEHEE: That's exactly right, yes.

MR. WALLIS: And you never said that. And so the units of this MSPIR are delta CDF?

MR. HAMZEHEE: Correct.

MR. WALLIS: And the rest of it I can sort of believe what you're doing. Why don't you just calculate all the CDF directly?

MR. HAMZEHEE: Well, that's what it is.

MR. WALLIS: This is a very round about way of doing it.

MR. BARANOWSKY: No, no, no. That's not answering your question. Your question is answered by this: The full blown, you know, fault tree models all linked together and everything are going to be fairly large. This is just a couple of simple --

MR. WALLIS: Well, doesn't Fussell-Vesely do that for you?

MR. BARANOWSKY: Well, the Fussell-Vesely incorporates all that modeling in a simple perimeter so we can just work with some simple --

MR. KRESS: It's almost a precalculation--

MR. BARANOWSKY: Right. So do the calculation and then only when you change your model do you go back and mess with this.

MR. WALLIS: Yes.

MR. HAMZEHEE: Now let me then go over the rest of them. I think at the end it may be more clear.

The USRP then is the actual unavailability of train T during the previous 12 quarters. And that is what we're going to measure as part of this MSPI for that system.

MR. APOSTOLAKIS: So let's see now, if I multiple CDF_p time the parenthesis, what do I get?

MR. HAMZEHEE: Well, if you get CDF times Fussell-Vesely, then Fussell-Vesely tells you that that multiplication gives you the change in CDF do to that system. And then you multiply that by the --

MR. APOSTOLAKIS: No, no. Fussell-Vesely is the ratio of the minimal that contain that train, right?

MR. HAMZEHEE: Yes, it is --

MR. APOSTOLAKIS: Divided by the CDF.

MR. HAMZEHEE: Exactly.

MR. APOSTOLAKIS: So you multiply it by the CDF and you --

MR. HAMZEHEE: So you get the ultimate CDF.

MR. BARANOWSKY: No, that's like saying what fraction of the CDF was due to this.

MR. APOSTOLAKIS: Right. Due to this --

MR. BARANOWSKY: Right.

MR. APOSTOLAKIS: So now I have a fraction of the CDF that's due to this train. Not the faction, I don't have the fraction -- I have the --

MR. BARANOWSKY: A portion of the CDF.

MR. APOSTOLAKIS: It's not even a portion.

MR. HAMZEHEE: No, no, no. You are taking CDF, you multiply it by Fussell-Vesely. Fussell-Vesely is the change in CDF. You're saying that what's the CDF if a piece of equipment or that system is perfect minus the CDF for the base case.

Oh, I'm sorry, base case minus if that system is perfect. So you get a delta CDF that you divided by the base case CDF. That's the fraction -- the condition of Fussell-Vesely. So when you divide it by CDF, up front you multiplied it by CDF. So the result of those first two terms are the change in CDF.

That if --

MR. APOSTOLAKIS: If the system is always good.

MR. HAMZEHEE: It's perfect, yes.

Now, this is means -- the maximum contribution that a system can have on CDF.

MR. APOSTOLAKIS: Right.

MR. HAMZEHEE: Right. Okay. Now hold that portion.

MR. APOSTOLAKIS: Divide by UAB.

MR. HAMZEHEE: Yes.

MR. APOSTOLAKIS: And what do I get now?

MR. HAMZEHEE: Now, hold that portion now. The second term is the USRT minus $USRB_{BLT}$ divided USRP.

MR. APOSTOLAKIS: But before I go, are the UAs that be divided --

MR. HAMZEHEE: Exactly, it doesn't matter. Yes.

MR. SHACK: Well, he'd be better off to write it that way.

MR. APOSTOLAKIS: Yes, you'd better write it that way.

MR. KRESS: He just have to --

MR. SHACK: You see what I'm saying?

MR. HAMZEHEE: Yes. But it was just

easier when I was using WordPerfect.

MR. KRESS: Yes, that's right. WordPerfect don't let you do it.

MR. APOSTOLAKIS: So logically then the UAB should be dividing the last parenthesis?

MR. HAMZEHEE: That's correct. So have you a fraction dimension that's times change in CDF which is going to give you change in CDF --

MR. APOSTOLAKIS: Now what was the last parenthesis dividing UAB, what does that --

MR. HAMZEHEE: Okay. Now let's go over that. The first term USRT is the actual unavailability of train T during the previous 12 quarters. That is the actual measure of unavailability as John defined what those things are for planned and unplanned unavailability minus the USR_{BLT} which is the baseline unavailability value for train T. And in a couple of pages I explain what the baseline unavailability is.

Quickly just to make sure you understand, the baseline is something that is based on the industry average over some period of time.

MR. APOSTOLAKIS: Is that the one that was used in calculating in CDF?

MR. HAMZEHEE: No. Not the baseline.

MR. KRESS: No. That's just sort of an industry -- that's the old industry average that you want to see did not depart too far from.

MR. HAMZEHEE: That's exactly right.

MR. APOSTOLAKIS: And why do I bring the industry average --

MR. HAMZEHEE: Because now if you look at the USRP, that's the unavailability of the train based on plant specific PRA. So that term with Fussell-Vesely plant specific PRA are going to be in terms of the same perimeters.

MR. APOSTOLAKIS: Wait a minute. The CDF that you have there, CDF_p.

MR. HAMZEHEE: Yes.

MR. APOSTOLAKIS: Is the plant specific internally events PSA?

MR. HAMZEHEE: Correct.

MR. APOSTOLAKIS: And then you bring the industry average there for some reason in the last parenthesis.

MR. KRESS: It's like your quality control concept.

MR. WALLIS: Yes, I don't understand that.

MR. HAMZEHEE: Well, yes. Because what we're trying to do here is that we have the plant specific CDF, plant specific Fussell-Vesely, plant specific USRP which is going to be under dominator. And then you look at the delta.

Now the delta is the actual performance minus something that is a baseline performance. You have to have some baseline --

MR. SHACK: Why did you choose UA_p instead of --

MR. APOSTOLAKIS: That's right.

MR. HAMZEHEE: We tried that and I'll give you the answer. We've done a lot of work. We didn't just use this equation.

The reason for that is when we use UA_p for the minus, then the results when you compare it to the actual using the full scope PRA don't compare. You get a much closer approximation when you use this equation.

MR. APOSTOLAKIS: Well, what do you mean that they don't compare? I don't understand that.

MR. HAMZEHEE: In other words, if you use--

MR. BARANOWSKY: No. I know what he's saying. He's saying remember this is an approximation. And first of all what's not clear I think to this Committee is why we're using a baseline to start off with.

The baseline is the same situation that was used when the original performance indicators were instituted. We have to identify what is an acceptable level of performance to measure departures from.

MR. HAMZEHEE: Right.

MR. BARANOWSKY: So the baseline is measured against what the performance was in the '95 to '97 time frame consistent with what was known at the current PIs as documented in 99-007 SECY. So we didn't want to deviate from that philosophy. So we have a baseline of if you're at this baseline, you're okay.

Now the reason for using the Ap in the denominator is since this is a linear approximation, we wanted to agree as best as possible over the realistic range with the full model. We ran the full model and we found out that when we used the value that was in the PRA for the unavailability in this equation, it gave us a better agreement for that linear approximation over the range of values that were realistic to be expected in terms of deviations from the baseline.

MR. WALLIS: I thought the whole idea was to be plant specific.

MR. BARANOWSKY: It is plant specific.

MR. WALLIS: Now you're bringing in a baseline which is an average of all the other plants and it's not plant specific.

MR. KRESS: That's the acceptance criteria.

MR. BARANOWSKY: The acceptance criteria is that -- I mean, it would be very hard for us to pick a baseline -- I mean, that's the right to do it is to pick a baseline for every single plant that matches up with where they were in '95 to '97. But going back and getting that information seemed to be outside of what we were able to do. And this is practical and I think people are satisfied.

MR. KRESS: Yes, George, this is not your concept of plant specific acceptance criteria at all.

MR. APOSTOLAKIS: No, wait, wait, wait. Well, I could see something like this: I have an industry wide average which is a baseline and then I have this plant. For this plant I have a plant specific CDF, right? I can work backwards now and say this plant deviates from the industry average by this much; it's higher, say, by this much. And then I will use that as part of my acceptance criteria for the actual deviation. But I would not use the deviation in equation three, the actual performance.

In other words, derive the acceptance criterion first and then you look at the actual performance and somehow you adjust it to the plant specific situation.

Let's take the situation where this particular plant is extremely redundant, okay? So the UA_t calculated using the baseline and the nominal that they use at the plant gives me --

MR. SHACK: The UA_t is real.

MR. APOSTOLAKIS: Yes.

MR. SHACK: The UA_t is real.

MR. APOSTOLAKIS: UA_t is real, but I would not be using UAt in equation three.

MR. SHACK: I sure will.

MR. APOSTOLAKIS: No, no, no, no. One way of developing the acceptance criteria, if you want to compare with the baseline, is to say because this plant is so redundant, I will allow the actual performance to deviate more from the nominal performance. Because I'm already low. But that's not what they're doing unless it's built into it, and I don't see.

MR. SHACK: I think it is. It's saying that they're measuring their performance versus the industry performance and this guy's extremely redundant. He can let his unavailabilities go up and he doesn't get penalized as much.

MR. BARANOWSKY: That's correct.

MR. SHACK: So that if he's worse than average, he's going to have to --

MR. APOSTOLAKIS: Well, if that idea is built into this, and it's not clear to me right now --

MR. KRESS: It seems possible to me that UA_t minus UA_{BLT} could be a negative number.

MR. BARANOWSKY: That's right. Yes, it can. That in essence says the risk associated with unavailability for the time period of interest is declined. That's possible. Performance improved, if you will.

MR. KRESS: No, I maintain that --

MR. APOSTOLAKIS: No, the performance is not improved.

MR. KRESS: I maintain the UA_t could be a decrease in performance and still have a negative number there.

MR. BARANOWSKY: A decrease in performance.

MR. KRESS: For that plant.

MR. SHACK: If he's good enough and he

could even decrease his performance if he's good enough.

MR. APOSTOLAKIS: There are two points of reference, Pat. One is the industry average and one is the nominal unavailability of the train of this plant.

MR. BARANOWSKY: That's the p value.

MR. APOSTOLAKIS: Yes, let's not go there now.

MR. BARANOWSKY: Right.

MR. APOSTOLAKIS: You can be measuring deterioration with respect to the industry average.

MR. BARANOWSKY: That's right.

MR. APOSTOLAKIS: Or with respect to the nominal of the plant.

MR. BARANOWSKY: Oh, that's true. That's true.

MR. APOSTOLAKIS: Now, what is three doing? Compared to what?

MR. BARANOWSKY: Okay. Here's the other reason for doing it this way.

MR. APOSTOLAKIS: I may be deteriorating with respect to --

MR. BARANOWSKY: The other reason for doing it is the current value, UA_p is changing in time. Not quite rapidly as UA_t.

Now, the idea was instead of saying well let's just look at how things deviate from some current performance, which means every time you make an improvement you then have a little racket look at this thing instead of saying what's the baseline upon which I want to measure your performance change from so that there's some acceptance criteria that doesn't change forever. That's what it is.

MR. ROSEN: So this is to avoid the racket?

MR. BARANOWSKY: This is to avoid ratcheting.

MR. ROSEN: Self-ratcheting?

MR. BARANOWSKY: That's right. You would be self-ratcheting every time you updated your model.

MR. ROSEN: Let's take a plant that is updating his model routinely and its performance is gradually improving. And then over time at one point it no longer improves. It's been improving for five years and now they have a bad quarter or a bad half a year.

MR. BARANOWSKY: Right.

MR. ROSEN: Now their performance indicator is going to go --

MR. HAMZEHEE: That's exactly right. They'll be penalized --

MR. ROSEN: Even though they've been improving for six years and they're below the industry average?

MR. APOSTOLAKIS: Let's understand first of all what three does. Not what it should be doing, what it does.

You remember the way the threshold for the industry was set, it was the 95th percentile of the plant-to-plant variability curve. They put 103 units unavailability and said 95 percentile. Right? That was the threshold.

MR. BARANOWSKY: Yes.

MR. APOSTOLAKIS: Okay. It does not say automatically that the thing in parenthesis is negative for 95 percent of the plants.

MR. KRESS: That's what I would have thought.

MR. HAMZEHEE: No. Not really.

MR. APOSTOLAKIS: Why not?

MR. BARANOWSKY: Because the UA -- the baseline UA has nothing to do with a 95 percentile point.

MR. APOSTOLAKIS: No. But that's what --

MR. BARANOWSKY: This is a different number.

MR. HAMZEHEE: This is a different number.

MR. APOSTOLAKIS: This is not the threshold that was set at the time?

MR. BARANOWSKY: These numbers are derived from different information because the whole formulation is different.

MR. APOSTOLAKIS: But I thought you said that you wanted to maintain that 007 approach?

MR. BARANOWSKY: No. What we wanted to maintain was the fact that we're baselining it to the '95 to '97 time period. But this unavailability definition is different than the one that was used in the 007 unavailability definition. Therefore, the number's different.

MR. SHACK: You said it was an industry average, right?

MR. BARANOWSKY: This is an industry average. What we were looking for before was the deviation from the 95 percentile measurement. This is what's the deviation from an acceptable baseline performance that gives me a delta CDF index of some value.

MR. WALLIS: What's the baseline

unavailability value for a train T which is unique to a given plant?

MR. BARANOWSKY: What we said was we didn't have that --

MR. WALLIS: Never happen?

MR. BARANOWSKY: Well, that's not such an easy thing for us to go and get.

MR. HAMZEHEE: Did you say what's the value for UA_t?

MR. WALLIS: How do you get an average, the industry average for a particular train which is unique to a given plant. That's a certain plant that has different design.

MR. HAMZEHEE: Remember, though, I think we talk about in a couple of pages. But that specific curve is the summation of unplanned and planned unavailabilities. Okay. And then the planned version of it is plant specific baseline.

In other words, because plant A and plant B have different maintenance practices; some do more PMs, some do less PMs. So the plant portion of it is plant specific and the unplant portion we are going to use a three year average based on industry information.

MR. APOSTOLAKIS: Plant specific or

industry?

MR. HAMZEHEE: No. There are two terms for that UA baseline. One is a plant unavailability which is based on preventive maintenance, surveillance testing. Those are going to be plant specific values.

This other portion of the unavailable are due to unplant maintenance activities such as corrective maintenance. Those corrective maintenance consistent with PRAs are going to be average of the industry. And we picked '95 to '97 based on what Pat explained.

MR. APOSTOLAKIS: But why? I mean, I don't understand that. Why is some part plant specific --

MR. HAMZEHEE: Well, because the answer is because for the plant maintenance activities they are very plant specific. Every plant has a different PM program, different --

MR. APOSTOLAKIS: But the unplanned presumably are correlated with the planned ones.

MR. HAMZEHEE: That's not true. Now --

MR. APOSTOLAKIS: That's not true?

MR. HAMZEHEE: Well, there's some relationship --

MR. APOSTOLAKIS: It's not true for

preventive maintenance. I expect not to have many unplanned --

MR. HAMZEHEE: Right, there's some relationship. But the unplanned portion is based on some failure; either random failures or some dependent failures based on your maintenance activities.

MR. APOSTOLAKIS: Right. So you're going to penalize this guy who has an excellent PM program because some other guy doesn't do that and has a lot of unplanned SCRAMs. I mean, that's very arbitrary, isn't it?

MR. HAMZEHEE: I don't think so.

MR. KRESS: You have sparse data on the unplanned.

MR. BARANOWSKY: I don't understand what's going on here, to be honest with you. All I can tell you is this is a measure of the change in CDF that's associated with departures from a baseline value of unavailability that's determined to be acceptable. Okay. That's all this is, nothing more.

MR. APOSTOLAKIS: Okay.

MR. BARANOWSKY: And if we had not used this formula that you see here, you would have seen the full blown PRA model with all the Bayesian expressions and you would have still seen delta UA--