MR. SHACK: Pat, let's just pick it a different way. Why didn't you pick a baseline that was the plant's average for '95, '97 and it would never change?

MR. BARANOWSKY: Because it's a sparse data.

MR. KRESS: Because it's sparse data that you don't have.

MR. BARANOWSKY: If you only take that many years, some plants are -- even though statistically are going to have a high number and some are going to be low because they were going into outages or not in outages --

MR. KRESS: Exactly.

MR. BARANOWSKY: So we needed to take more data.

MR. KRESS: And then they did the best they could with that --

MR. BARANOWSKY: Right.

MR. KRESS: -- by using the planned for plant specific.

MR. BARANOWSKY: Exactly.

MR. KRESS: And they knew that wasn't all of it, and they got the rest of it --

MR. APOSTOLAKIS: But let me change the

statement. Instead of using the '95, '96, '97 data, use the number that the utility used in calculating the CDF. Because that number included all these considerations.

MR. KRESS: That might be another choice.

MR. APOSTOLAKIS: And that could serve as the baseline.

MR. SHACK: You say UA_p 2000 and then that would be fixed forever.

MR. APOSTOLAKIS: Whatever.

MR. BARANOWSKY: Well, as it turns out, this a mute discussion because the numbers are about the same whether you use the '95 to '97 or the '99 to 2001, as Hossein is going to tell you. Okay.

We only did the '95 to '97 to be consistent with the philosophy that was espoused in 99-007.

MR. APOSTOLAKIS: You know, this is a discussion that at least on the Committee we've had several times in the last two or three years. It comes back to the fundamental objective of this ROP. In quality control in manufacturing, forget about reactors for a moment, the whole idea of quality control is to measure deviations that could be unacceptable from the expected performance of this machine. I don't care that there other 10,000 machines in the world. My machine. Okay?

Now, we come to reactors. If we bring this philosophy over to ROP, then we would be saying I want to know whether San Onofre has deviated from San Onofre's expected performance as reflected in the PRA.

The 007 said no, we're not going to do that. We're going to look at San Onofre and say is San Onofre deviating from the industry average. Different approach.

MR. BARANOWSKY: Well, George, I think --

MR. APOSTOLAKIS: Different approach. And that's what you're trying to --

MR. BARANOWSKY: George, wait a minute. No, not exactly. I'm not sure I think I agree with you.

If I'm making parts for airplanes in four different factories on machines and I have a specification for what's acceptable, I apply a QA that includes deviations from the specification to those four different machines. I don't have a different deviation spec for each machine. So I'm not sure I agree with your --

MR. APOSTOLAKIS: No, but your machines in manufacturing are identical. Here you have different device.

MR. BARANOWSKY: They're never identifiable, just like all these --

MR. APOSTOLAKIS: No, no. Here you have different designs here. I mean, the curves in 007 show that.

MR. BARANOWSKY: I think the principle I espouse is correct.

MR. APOSTOLAKIS: The fundamental question is do I want to know how much South Texas deviated from South Texas' performance or do I want to know how much Texas deviated in the industry average?

MR. HAMZEHEE: And I think Steve made a good point.

MR. SHACK: No, you want to know how much South Texas deviated from acceptable performance.

MR. HAMZEHEE: That's exactly the point.

MR. SHACK: The question is how do you determine acceptance performance.

MR. HAMZEHEE: That's exactly the point.

MR. APOSTOLAKIS: Well, it's stating the same question a different way.

MR. SHACK: No, it's a different question.

MR. APOSTOLAKIS: Okay. If acceptable is

with respect to -- is acceptable performance with respect to industry average. Because acceptable is also the fact that I have licensed it. That was acceptable independently of industry average. I licensed South Texas. So if I licensed it and I do the PRA, the PRA tells me that this is what the NRC licensed. And then acceptable for me --

MR. KRESS: George, let's look at UA_p for a moment; that's the unavailability that's in the PRA. Now supposedly they try to keep that updated in a basin sense.

MR. APOSTOLAKIS: Sure.

MR. KRESS: Because they want to use plant specific data and say well I didn't know what to use when I first started my PRA for this, but I'm going to adjust it as I go along.

UA_{BLT}, it's almost the same thing, which is what you're asking for it to be. It's almost the same thing because they're using the plant specific planned maintenance and are saying "Well, I still don't have enough plant specific data to add to that to make it the total, which I would put in for my UA_p anyway. So they're trying to get those two to approach the same thing, like you're talking about, but they have to use industry wide data because they don't have enough plant specific data to do it.

I think it's probably a pretty good way to do it.

MR. SHACK: I mean, the plant is free to make UA_p get better and better every day. I mean that's their choice.

The NRC says there's some level of unavailability below which we will not let you go. And those are different numbers. Well, they are approximating it here but the performance that they had in '95 to '97.

MR. HAMZEHEE: That's correct, yes. That's correct.

MR. APOSTOLAKIS: What is the level of unavailability? I don't understand that. I see the difference.

MR. ROSEN: It's not exactly what you said, Bill. The level of unavailability below which you may not go is defined by your tech specs. And it is a level well above --

MR. SHACK: No. This is a level by which we think your performance is unacceptable. It's not legally unacceptable, but it's a level below we will start coming and looking --

MR. ROSEN: It will change your color of

one of your --

MR. SHACK: That's right. This is a level that if you go beyond it we will change the color of one of your indicators. You will get management attention. If you don't think that gets a lot of attention, you're wrong. It does.

MR. APOSTOLAKIS: Let's talk talk about UA_p minus UA_{BLT} divided by UA_p. What is that?

MR. HAMZEHEE: That tells you that based on your actual performance or actual unavailability during a 12 quarters time frame what fraction of that unavailability was changed or increased with respect to baseline. In other words, UA_t minus UA_{BLT} divided by UA_p gives you the fraction of change in your unavailability.

MR. APOSTOLAKIS: But why do I divide by UA_p? That's not in the numerator.

MR. HAMZEHEE: No, no, no. If you look at the equation and I am moving USRP to the last term, make it easier.

MR. APOSTOLAKIS: Right. Right.

MR. HAMZEHEE: And if you look at that, you see that you get a fraction.

MR. APOSTOLAKIS: But usually to get a fraction of deviation from something, you subtract the actual performance from the something and then the something is in the denominator, too.

MR. HAMZEHEE: That's correct.

MR. APOSTOLAKIS: Instead you're dividing by something else.

MR. SHACK: But he's got to get the UA_p out of there because he's built that into the delta CDF and he's going to compute from CDF times Fussell-Vesely.

MR. BARANOWSKY: Right. In order to make this agree with the PRA model we have to use that value. This is an approximation. We could have written 18 pages of fault trees here. Okay. And probably would have gotten away with it. But instead we took something simple and said assume this stuff in the brackets is 18 pages of fault trees. All right? And we changed only one perimeter, the UA, and we've compared it to baseline and we did the delta calculation. That's it.

MR. SHACK: Now, if I was writing this equation, I would write parenthesis CDF star FV divided by UA_p. And that's really the CDF DUA and then I would have delta U multiplying --

MR. HAMZEHEE: And we have some backup information in our Appendix F that does have all those derivation and how we got to this point. We just didn't want to bore you with those things. But if you like, we can give you the information after the meeting.

MR. ROSEN: You don't know our problems.

MR. BARANOWSKY: Well, could I suggest that we're also looking at just to see if there are some other better approximations. And it's not, you know, closed book necessarily. But I think this is the way we want to go. And we can come back to this at another meeting and let's get some --

MR. KRESS: George might have been happy if you would have had UA_{BLT} in the denominator. Would that be just as bad or good --

MR. HAMZEHEE: Yes, we tried that.

MR. KRESS: You tried that?

MR. HAMZEHEE: And I tell you why we got erroneous results. The problem we're having is your Fussell-Vesely is based on your plant specific PRA. And if the USRP is not, then you divide them by each other, you get different contributions.

MR. KRESS: But the plant specific UA_p should have been something like a UA_{BLT}

MR. SHACK: It shouldn't be very different.

MR. KRESS: It shouldn't have been very different.

MR. HAMZEHEE: That's correct, yes.

MR. SHACK: This seems like the correct first order --

MR. KRESS: Yes.

MR. HAMZEHEE: That's correct.

MR. KRESS: It's a very good first order approximation.

MR. APOSTOLAKIS: CDF times FV by itself is the change -- the maximum change in CDF I can get if I assume the component is always good.

MR. HAMZEHEE: That's correct.

MR. APOSTOLAKIS: Without dividing by anything?

MR. HAMZEHEE: That's correct.

MR. ROSEN: It's like the inverse of --

MR. APOSTOLAKIS: So now I want to somehow take a fraction of that and consider it acceptable in my plant?

MR. HAMZEHEE: Yes.

MR. APOSTOLAKIS: So I will multiple by some fraction.

MR. HAMZEHEE: By fraction of change in your unavailability.

MR. APOSTOLAKIS: Right. But you see that's the problem, that it's not a fraction of change if I subtract UA_{BLT} and divide by UA_p.

MR. KRESS: It's an approximation, though.

MR. APOSTOLAKIS: To what?

MR. KRESS: It's an approximation to that fraction you --

MR. APOSTOLAKIS: Well, why don't I divide by UA_{BLT} then?

MR. HAMZEHEE: If you are mathematically want to have an exact equation, you're right, it should be USRT minus -- $_{BLT}$ divided by UL_{BLT} or USRT minus USRP divided by USRP. That mathematically the exactly term. But when we did the validation and compared these with the actual full scope PRAs, this equation would give us the best approximation.

MR. APOSTOLAKIS: Sol you have the actual -- the exacting somewhere?

MR. HAMZEHEE: Yes. Well, we use the full scope from all those and then we run them this equation to see if you get acceptable results. You know, you want to make sure what you get here is somehow close to what you may get if you use your full scope PRA.

MR. KRESS: Now you want to get what you

would have gotten if the full scope PRA had been corrected to have the right value of UA, which would have been in my mind a UA_{BLT}.

MR. HAMZEHEE: That's correct.

MR. KRESS: But I maintain that UA_p is close enough.

MR. HAMZEHEE: That's correct.

MR. KRESS: It just makes a good approximation.

You know, I'm not surprised. Because the full scope's formula has a UA_p in it which probably isn't an updated UA_{BLT} at all. So I'm not surprised that this gives you better approximation to what you get by the PRA. It may not be a better approximation to the delta CDF.

MR. HAMZEHEE: But we also had the utility folks at our pilot plants -- there are how many, Tom? Ten some plants that are working with us.

A few of them went back and validated this through using their own updated PRA models. And they also came out with --

MR. KRESS: So they had the updated UA_p?

MR. HAMZEHEE: That's right. They used theirs and they ran it through their models to see what kind of approximation we get. And they all came out with positive indications.

So this is a joint effort with the industry. WE're not doing this in isolation.

MR. KRESS: Yes, I think this is a pretty good approximation myself.

MR. APOSTOLAKIS: To what?

CHAIRMAN BONACA: We need to move on.

MR. APOSTOLAKIS: It's not clear to me what we're approximating.

MR. KRESS: You're approximating the delta CDF due to the departure of the unavailability from a baseline level.

MR. HAMZEHEE: That's correct.

MR. KRESS: In fact, the delta CDF you get may be negative.

MR. HAMZEHEE: That's correct.

MR. KRESS: Even though you've decreased performance.

MR. WALLIS: That's why the word "change" is misleading. You say index due to changes in train. You can have an equation three with a positive or negative value without changing anything.

MR. KRESS: That's right.

MR. WALLIS: So the word change is a bit misleading here. It's really really the deviation of train unavailability from some rather arbitrary chosen baseline.

MR. KRESS: It's a difference in your CDF from some baseline CDF.

MR. WALLIS: Right. It's very different from the idea of a change.

MR. APOSTOLAKIS: Yes, it's not a change.

MR. WALLIS: Not a change in anything.

MR. FORD: Reality it's a second difference, isn't it? It's a change of a change. It's a change in delta CDF. It's defining what you get by multiplying CDF times Fussell-Vesely, doesn't that give you delta CDF?

MR. APOSTOLAKIS: Right. Delta CDF.

MR. FORD: And then you're multiplying by this on another change ratio --

MR. APOSTOLAKIS: Because they want to normalize it to something else. That's really what they're doing in their second difference. Their second fraction. And my problem is that the denominator seems to be different from what you have in the numerator and you say it's an approximation. And I don't know what it approximates.

MR. BARANOWSKY: Dale Rasmuson has a comment.

MR. RASMUSON: The first part there, if you take CDF_p times Fussell-Vesely divided by UA_p is-- if you work it out, is just really the Bernbaum importance measure. That's what it comes down to.

MR. HAMZEHEE: That's another way of presenting it.

MR. WALLIS: That doesn't help me at all.

MR. HAMZEHEE: I know. That's why it's presented like this.

MR. WALLIS: Doesn't the DCFD -- isn't that what it is?

MR. APOSTOLAKIS: Well, why do we let the man finish.

MR. RASMUSON: You know, the Bernbaum importance measure is just the partial derivative of the basic event in question with respect to the core damage frequency.

MR. WALLIS: Using the UA?

MR. RASMUSON: Right.

MR. WALLIS: It would be simpler if we started with that.

MR. RASMUSON: Right. I mean, that's what it's equivalent to.

MR. WALLIS: I think what we're all arguing about is what you multiple it by to get anything that means anything.

MR. SHACK: -- CDF DU, then the delta they've chosen is the right one. It's the actual version what you find acceptable.

MR. APOSTOLAKIS: Why do you say DU? All I see is UA_p which is the value of unavailability. It's not the DU.

MR. SHACK: He's arguing that that does in fact give you DCDF DU.

MR. APOSTOLAKIS: No. I don't see why. I mean it's just the value of unavailability.

MR. SHACK: The delta.

MR. APOSTOLAKIS: UA_p in the denominator is not a delta. It's the unavailability itself.

MR. WALLIS: You're looking at the significance as far as CDF is concerned of the plant deviating from some baseline.

MR. APOSTOLAKIS: I think we said earlier is the more appropriate.

CHAIRMAN BONACA: We have been stuck on this equation for 40 minutes flat. And I think we need to make some progress.

MR. APOSTOLAKIS: Now let's to equation two.

CHAIRMAN BONACA: Right.

MR. APOSTOLAKIS: Let's go to equation two.

CHAIRMAN BONACA: The next 40 minutes, yes.

MR. APOSTOLAKIS: If I have one of the four system, the four trains --

MR. HAMZEHEE: Yes.

MR. APOSTOLAKIS: Then my UAI will be worse than if I -- in a plant where I have two trains. I don't understand why.

MR. HAMZEHEE: No. But remember if you have four train system, then you have four Fussell-Vesely values.

MR. APOSTOLAKIS: Lower.

MR. HAMZEHEE: Exactly. You got it.

MR. APOSTOLAKIS: But I still don't understand why UAI is a sum.

MR. ROSEN: Say the rest of that sentence. You have a four train system, you have four Fussell-Vesely values and?

MR. HAMZEHEE: You're going to have four different values for Fussell-Vesely. And when you use equation three to add four terms, using equation three then the equation three because of the Fussell-Vesely is going to be much smaller quantity because of the importance of one train for the four train system is going to give much lower Fussell-Vesely value. So it does very nicely put together the PRA model into a four train system by having those terms multiplied and added together.

MR. APOSTOLAKIS: Well, let's look at equation two now.

Why is the system unavailability index due to changes in train unavailability, the sum of the unavailability and this is for the trains? Because the system unavailability is not the simple product or the simple sum of train unavailability. There is coupling there because of the testing schemes. So I don't understand why it's the sum.

And the word "change" just throws me off everywhere I see it. It is what Dr. Wallis said, that these are changes not in performance, they're changes with respect -- differences actually from some baseline performance?

MR. HAMZEHEE: Yes, I think --

MR. APOSTOLAKIS: So these are differences from the baseline?

MR. HAMZEHEE: That's correct.

MR. APOSTOLAKIS: Not changes due to random --

MR. HAMZEHEE: Well, that's what it said, changes in train unavailability relative to the baseline value. That's the more accurate -- well, you're right. I'm just adding that. It means relative to the baseline value. That's what it means.

Now, we didn't write everything here because the intention was not for this to be a textbook.

MR. APOSTOLAKIS: No. The problem of saying is that you're dealing with collecting data.

MR. HAMZEHEE: Yes, sir.

MR. APOSTOLAKIS: And changes there mean that the data collect now should tell me that I deviate from what was happening before. But that's not what you mean. You mean from some baseline.

MR. HAMZEHEE: Relative to a baseline value. That's what these --

MR. APOSTOLAKIS: Anyway, why is equation two true?

MR. HAMZEHEE: Because the way -- you're right. Now, you look at the system from a reliability perspective, what you said is very true. But the way we look at the PRA models and we wanted to evaluate the contribution of a system unavailability on total CDF, in reality what we do is we go to that system components and trains and change their perimeters from a nominal value to some changed value at the same time.

Once we make those changes, then we go back and requantify the CDF to get a revised CDF.

So the way we're doing it here is in a sense doing the same thing. You're saying if the unavailability of train changes by X percent or by X hours and B by Y hours, you go back in reality when you do the full scope evaluation of those changes by changing the system train A increasing or decreasing it by some value. At the same time you go use the train B increase or decrease unavailability. And then you requality your core damage frequency.

MR. APOSTOLAKIS: So what's this? This sub.

MR. HAMZEHEE: Yes.

MR. APOSTOLAKIS: It doesn't say --

MR. HAMZEHEE: But the way we have formulated the equations, you sum it but using equation three gives you exactly what you do in reality when you try to measure the impact of a change in a system performance on CDF.

CHAIRMAN BONACA: Let me just say this. Okay. This is not the proper approach to go about this equations. I mean, clearly maybe the best thing to do is to give you a chance to go back and write -- all this discussion in writing, maybe 3, 4, 5 pages, so that we can review it and then we much better can understand. Because I think we're getting back to the same definitions.

I wrote down deviation availability from the baseline about half an hour ago and now the same point is being made again. I mean, so otherwise we're going in circles.

MR. KRESS: It wasn't exactly the same point. But owing to the comment to George that the summation -- George. George is not listening.

MR. APOSTOLAKIS: I have to listen. I think he's complaining. I'm sorry.

MR. KRESS: The reason the summation is all right is because this is an index, it's not a real thing. It's an index.

MR. APOSTOLAKIS: I don't understand that. I mean, the system consists of two trains. They probably listed performance of the trains is not independent. They're not independent because they have coupled them by the way I do tests.

MR. KRESS: I don't care. I just want an index that tells me there's something different than what I used to have.

MR. APOSTOLAKIS: But it has to have some basis --

MR. BARANOWSKY: It has a basis, but I think that we're not going to solve it here, as Dr. Bonaca said.

MR. APOSTOLAKIS: Absolutely.

MR. BARANOWSKY: I suggest that we do produce a document that you can look at.

MR. APOSTOLAKIS: Yes, good.

MR. BARANOWSKY: Which I think we have to do anyhow.

MR. APOSTOLAKIS: Are we here in this next week as well?

CHAIRMAN BONACA: No.

MR. HAMZEHEE: It may be the short version of this presentation to full Committee next week.

CHAIRMAN BONACA: I don't want to see any equations next week.

MR. HAMZEHEE: No, no. Just text, you're right.

MR. BARANOWSKY: Because we're coming back to this Committee --

CHAIRMAN BONACA: In fact, I heard before the plan is to have a couple of more updates before we have a product that we would comment on. So that --

MR. APOSTOLAKIS: A two or three pager explaining the basis of these equation. And when you say approximation, explaining what you're approximating would go a long way towards --

CHAIRMAN BONACA: Well, most of all, I mean they've made an effort to explore different possibilities. They did that. And I think if you can describe that and explain to us why you made the choice you made.

MR. ROSEN: In your white paper how a system with three trains in a system with two trains gets -- how the system with three trains gets credit for the --

MR. HAMZEHEE: Yes. All right.

MR. ROSEN: You know, with some arrows so the stupid ones like me can understand to see how you're dividing it out.

MR. APOSTOLAKIS: Another thing I would appreciate is if I do consecutive testing of the trains or I do staggered test, would that make any difference anywhere here. Don't answer now.

MR. HAMZEHEE: All right. All right. We will provide some backup documentation and background, and then we'll give it to you.

MR. BARANOWSKY: We now we have something to do for the next time we get together.

MR. WALLIS: But I disagree with Pat's suggestion that the next presentation have no equation. I mean, these are such simple equations that we ought to understand.

MR. BARANOWSKY: At the full Committee? That's next week.

MR. WALLIS: Yes, based on what you're doing.

MR. BARANOWSKY: Well, we're not going to have a white paper put together by next week.

MR. WALLIS: But there's nothing complicated.

MR. BARANOWSKY: I agree with you. It's not a problem, it's just that --

CHAIRMAN BONACA: Wait a minute. They can state what the meaning of the equation is. Okay. But, you know, we shouldn't be there taking it apart and questioning every single step. There is no time for doing that. I mean simply we have to have a better understanding before we get to Committee.

MR. APOSTOLAKIS: If we have your letter next week, then it's okay.

MR. HAMZEHEE: And I think the idea was to provide some concept and give you background information, you read them and come back to us if you have more questions. There are some background information, yes.

MR. ROSEN: But they're the same equations?

MR. HAMZEHEE: We are not going to go over any detail, but let me just spend a few minutes and tell you what the next page equations are if you don't ask me any questions.

The next one is very similar to unavailability index, but this is not for unreliability. The only difference is the other one was done at the train level, this is done at the component level for active components within a system.

MR. APOSTOLAKIS: Now why on earth is the same here, this is Bayesian-updated component unreliability for previous 12 quarters and the previous one you don't say Bayesian-update?

MR. HAMZEHEE: It's a very good question. But, George, you realize that in any PRAs for unavailability we always use exact numbers for unreliability, we use Bayesian-update.

MR. APOSTOLAKIS: Why don't we use Bayesian for unavailability?

MR. HAMZEHEE: Because unavailability you have more data and more information, the uncertainty is lower than if you use the unreliability that is very scare and you don't have as much events.

MR. APOSTOLAKIS: So you are taking the approach now that use Bayesian when I have lot of uncertainties. That doesn't make sense. I mean, you can use it all the time.

MR. HAMZEHEE: Is that done in PRAs?

MR. APOSTOLAKIS: Not some PRAs, not all PRAs.

MR. HAMZEHEE: The majority of the PRAs they don't do Bayesian on unavailability.

MR. APOSTOLAKIS: This is not a democracy. We are not voting here. Okay. Most PRAs don't do uncertainty analysis. That doesn't mean they're right. Okay?

MR. HAMZEHEE: All right.

Now, that's the concept. Do you want me to spend anymore time or are you happy with just what I said?

MR. APOSTOLAKIS: I don't want to spend anymore time, but that doesn't mean we're happy. Don't draw conclusions.

MR. KRESS: I'd like to hear about

equation five.

MR. APOSTOLAKIS: Oh boy.

MR. HAMZEHEE: Okay. Equation five now for unreliability you see that you have that URBC which is the actual unreliability that is going to measure for any period, in this case 12 quarters.

Now, to calculate that if you remember John's definition the unreliability, the way we define it to make sure that the combination of unavailability and unreliability is complete, we define it as a failure of the component to function on demand or given that it is started successfully on demand, it continues operating for the mission time. So this is what that equation is.

And the PD give you the probability of the components failing to function on demand. And the second term gives you the probability that it's going to fail during the mission time. And the T_m is the mission time, which usually is about 24 hours, in some cases different.

MR. KRESS: Well, really the question was why wasn't that by the -- and you answered it it's the mission time.

MR. HAMZEHEE: That's correct. Not a fault exposure time. That's correct.

MR. APOSTOLAKIS: Now, the failure on demand probability. Isn't that one of the views of before?

MR. HAMZEHEE: No. None of these things were used in the previous page. Those were all unavailabilities only, which were the direct calculation of unavailable hours divided by the number of hours that the reactor was critical.

MR. APOSTOLAKIS: So it's only unavailability due to some reason that --

MR. HAMZEHEE: Planned and unplanned maintenance.

MR. APOSTOLAKIS: Okay. So it then includes that plus something else?

MR. HAMZEHEE: That's correct.

MR. APOSTOLAKIS: And that something else is what?

MR. HAMZEHEE: No. PD does not include unavailability. It only includes on demand time.

MR. APOSTOLAKIS: On demand. On demand.

MR. HAMZEHEE: Remember we said that up front the big equation was that the mitigating system performance index has two terms. Unreliability index plus unavailability index. The unavailability index had all those planned and unplanned maintenance activities that would make the equipment unavailable.

The second term is what you see here, the unreliability index.

MR. APOSTOLAKIS: So if there is a -- I mean PD would be something -- you could put the zero for many cases?

MR. HAMZEHEE: No, it won't. Because you use Bayesian-update. It can never be zero.

MR. APOSTOLAKIS: Physically. Look at it physically.

MR. HAMZEHEE: Physically, yes, it could be zero actually for many quarters, yes. Yes. And that's why we use Bayesian, because you don't want to use zero when it comes to probability.

MR. APOSTOLAKIS: No, no, no, no. That's okay.

MR. BARANOWSKY: Well, if it's more than that, I think the issue about using a Bayesian-update has to do with sparse statistics of where you only have a few numbers of demands and then you have a failure.

If you take a piece of equipment that normally, say, doesn't fail but once every 600 demands and you only have then demands per year. Okay? Now every once in a while there'll be a failure, but if you look at only a three year period with 30 demands, it's going to look like your performance was pretty bad. But, let's face it; you have to have a way of judging whether or not that's an outlier or not. And so this allows us to do that, which is exactly the way the PRAs are done.

MR. APOSTOLAKIS: PD represents failure modes.

MR. HAMZEHEE: Component failure on demand probability based on --

MR. APOSTOLAKIS: Failure modes that are there because you are trying to start the thing?

MR. HAMZEHEE: That's correct, right. Or open a valve or close a valve.

MR. APOSTOLAKIS: Well, start. Do something.

MR. HAMZEHEE: Possibly start or it's failure to run.

MR. APOSTOLAKIS: It's available in the previous equation.

MR. HAMZEHEE: That's correct.

MR. APOSTOLAKIS: But it doesn't start because there's some extra stresses or some --

MR. HAMZEHEE: Yes. As Pat said, very consistent with PRAs. That's the best way of approximating equipment on reliability or unavailability. We're not presenting anything new here.

MR. ROSEN: And this is the solution for the T over 2 problem?

MR. HAMZEHEE: That's exactly right. That's why don't you need T over 2 and it gives you a better approximation of equipment unreliability.

MR. WALLIS: Now, I have to say this. I'm very happy that you're giving us equations, but I have great difficulty getting the dimensionality right. N and A seem to be numbers. And T is hours?

MR. HAMZEHEE: Yes.

MR. WALLIS: And P cannot be numbers and hours and be compatible --

MR. HAMZEHEE: Yes. Let me just give you a quick explanation. The whole thing has to be dimensioned. The PD you agree that's dimension, right?

MR. WALLIS: Well, everything is dimension except this mission time, which is in hours.

MR. HAMZEHEE: Yes. But lambda is barely a rate per hour.

MR. WALLIS: Well, then T is in units of hours.

MR. HAMZEHEE: Correct. Mission time is in hours.

Are you looking at (5b) or are you looking at (5)?

MR. APOSTOLAKIS: 3 and B are not the same units.

MR. BRANCH:

MR. HAMZEHEE: Yes. Now let's go back. A and B are the perimeters of the industry priors.

MR. APOSTOLAKIS: They're numbers.

MR. HAMZEHEE: B is hours also. These are not the same As and Bs from (5a) to (5b).

MR. APOSTOLAKIS: Then B is not compatible with A.

MR. BARANOWSKY: B is in hours.

MR. HAMZEHEE: Let me explain it.

MR. APOSTOLAKIS: Please do.

MR. HAMZEHEE: For the simplification of it, (5a) and (5b) are two different equations. As and Bs in (5a) are different from As and Bs in (5b).

MR. APOSTOLAKIS: Then these?

MR. HAMZEHEE: Correct. Just for simplicity I used the same nomenclatures.

MR. APOSTOLAKIS: Okay. With two different calculations.

MR. HAMZEHEE: Exactly.

MR. WALLIS: You're going to make it clear when you go do it next time?

MR. HAMZEHEE: Yes.

CHAIRMAN BONACA: I think it would be important again for these equations to understand what the purpose was in the index. But you tried, because clearly this is an approximation, as you're saying, but you try. You try different things and why you chose -- you rejected most of them and you chose the product that you had. And I think we'll have it in writing, I think it will be easier to evaluate for discussion at that time. We need to look at it again.

MR. KRESS: I personally think you're on the right track here.

MR. HAMZEHEE: Thank you.

MR. KRESS: And don't have these problems that the other guys have.

The one thing that I see that I worry about is I don't want to know the technical basis of the one times 2 to the minus 6, the thresholds. You know, I understand you've taken a one times 2 to the minus 4 and dropped off two orders of magnitude. This is sort of arbitrary thing to me. And I would like a little more explanation of that at some point.

MR. BARANOWSKY: Okay. But in a nutshell, that came from what we did in 99-007.

MR. KRESS: Yes, I know. I didn't like it then either.

MR. BARANOWSKY: And it's supposed to be consistent with reg guide 1.174.

MR. KRESS: Yes, and I didn't like that either.

MR. BARANOWSKY: Well then you won't like our explanation.

MR. SHACK: If you read the Brunwick letter, you'll see why?

MR. RANSOM: Just one quick question.

MR. BARANOWSKY: Yes, sir.

MR. RANSOM: On the URBLC that you use here, is that also an industry average?

MR. HAMZEHEE: That is the same concept. It's baseline value based on industry average for some period of time. Same logic, same concept.

MR. ROSEN: I was wondering if you were hungry when you did this, because you've orders of magnitude $_{BLT}$s. I'll have one order of that.

MR. BARANOWSKY: I'm going to suggest that we probably don't need to go over the rest of the viewgraphs. Because we've covered the issued i them, you know, the thresholds, baselines and all that other kind of thing. So instead of plowing through it, we've got the record. It's replete with stuff for us to look at and take into consideration.

CHAIRMAN BONACA: Would you just go through the final page.

MR. HAMZEHEE: Do you want to go over conclusions?

CHAIRMAN BONACA: Yes, just the conclusions.

MR. HAMZEHEE: All right.

MR. APOSTOLAKIS: Well, do you want to say anything about technical areas currently under evaluation? Well, say something that we haven't said before.

MR. HAMZEHEE: You want to go on the one page before the last page?

MR. APOSTOLAKIS: What?

MR. HAMZEHEE: He said they wanted --

MR. APOSTOLAKIS: Well, there is technical areas under evaluation, I'd like to hear about the thresholds. Second to last page.

MR. HAMZEHEE: Again, these are the areas that we're currently working with the industry to further refine and improve. And one thing they try to determine the acceptable of level of false-positive/false-negative indication. And the following is the example. And what the first one means is the probability of calling in performance indicator Y when it's actually the baseline performance.

And the second one is calling something green when it's either white or yellow and calling something green when it's yellow or red. And I don't even want to go over more discussion. We talked about this more earlier.

And then the next one is issues, again, as you all raised questions and concerns or mainly questions. We want to again go back during the pilot and revisit the baseline values for these index--indices. So we're still trying to come up -- you know, make sure that these values are the best values to use.

And the third bullet talks about the fact that as part of this pilot program we also want to have some independent calculations of these perimeters and indices using the SPAR models versus the licensee's PRAs.

And last but not least is to evaluate any potential differences that we may get using these indices versus using the SDP process.

These are the current areas that we're working on.

And the last page are just summary of the conclusion. I think based on what we've done and all the work that we've done in the last year or so and using a lot of insights from RBPI, we believe that this MSPI approach is based on risk insights and it does account for plant-specific design and operating characteristics through the use of plant-specific data and risk models.

And again, those are the things that we think it does.

MR. APOSTOLAKIS: Wait a minute. If you go back to your -- oh, remember the studies that you guys do, the reliability studies?

MR. HAMZEHEE: Yes.

MR. APOSTOLAKIS: They do not define under reliability as your equation five. You include the human intervention. Here you don't, huh?

MR. BARANOWSKY: We put recovery in there. That's correct.

MR. APOSTOLAKIS: You will put recovery in there?

MR. BARANOWSKY: No, no. We do put recovery --

MR. APOSTOLAKIS: In those --

MR. BARANOWSKY: But there are rules in the data collection for when to include recovery and not include recovery. I mean, there's a definitions document, there's going to be documents this thick.

MR. APOSTOLAKIS: I remember. But are you going to do the same thing here?-

MR. BARANOWSKY: It's going to have a procedure for crediting recovery that's consistent with some guidelines that we're putting in.

MR. APOSTOLAKIS: So it will not be just lambda T_m. It would be plus other things.

MR. BARANOWSKY: The data will be adjusted so that those with recovery are treated differently.

MR. APOSTOLAKIS: Okay.

MR. HAMZEHEE: And that's actually how we get some of the As and Bs.

MR. APOSTOLAKIS: Okay.

MR. HAMZEHEE: We apply some recovery so we adjusted failure rate.

MR. APOSTOLAKIS: Oh, through the failure rate?

MR. HAMZEHEE: Yes. Because some are recoverable, some were not using the NUREG reports that we have generated. So we're consist in that area.

Now, let's quickly go over the first bullet and look those sub-bullets.

Use of Fussell-Vesely importance measures does account for plant-specific features. That's the beauty about it.

Treatment of demand failures in unreliability indicators, that's no more fault exposure time.

Use of Bayesian update for unreliability indicators because i the short period of time you have less data points, so Bayesian gives a better approximation of equipment unreliability and it uses risk-significant functions rather than design-basis functions, MSPI.

And then, again, having PI for support systems mainly for the cooling water, such as service water and CCW.

And then I think --

MR. APOSTOLAKIS: The English is correct here.

MR. HAMZEHEE: I'm sorry?

MR. APOSTOLAKIS: The English is correct here.

MR. HAMZEHEE: Oh, good, I'm glad.

Well, the second bullet MSPI approach allows -- now, that's why some of you were saying well one may be negative, one may be positive. But another good aspect of this approach is that you can balance between component reliability and component unavailability. So that the plant that is doing a lot of PMs is going to have higher unavailability, but hopefully he has low on reliability. So they're going to balance each other in a very logical fashion and it's also consistent with the maintenance rule.

MR. APOSTOLAKIS: Again --

MR. HAMZEHEE: Uh-oh.

MR. APOSTOLAKIS: If I do PM on one train, don't I make sure the other train is good?

MR. HAMZEHEE: Definitely, by tech specs.

MR. APOSTOLAKIS: Right.

MR. HAMZEHEE: So?

MR. APOSTOLAKIS: So somehow you're penalizing those people. You say, you know, your unavailability is very high because you're doing a lot of PM. I mean --

MR. HAMZEHEE: But at the train level or the component level, not the system level.

MR. APOSTOLAKIS: AT the train level, yes. And you're penalizing them for that?

MR. HAMZEHEE: No. And you have a high unavailability, but remember you sum them up. The other terms which is unreliability is going to go down. So you balance between unreliability and unavailability.

MR. ROSEN: As long as you do good maintenance.

MR. HAMZEHEE: Exactly. Now, if you do a lot of maintenance but you're doing the wrong thing, then both are going to go up. Then that's a good indication, too.

MR. APOSTOLAKIS: But isn't there some situations where if one thing is down, one train is down, then people actually take extra measures and make sure the other train is up.

MR. HAMZEHEE: That's correct, yes.

MR. ROSEN: What we do is start the other train --

MR. APOSTOLAKIS: There's absolutely no--

MR. ROSEN: Start the other train first. No, you don't take it out of service to check that, you start it. You put it in test.

MR. APOSTOLAKIS: Yes, and there is no credit for that.

MR. ROSEN: You start it and run it and

make sure it's okay, shut it back down. And now you take the other train and you're going to do maintenance out.

MR. APOSTOLAKIS: And so why am I going to be penalized for that maintenance?

MR. HAMZEHEE: We are not penalizing. Maybe either I did not state it clearly or something. The way these are consistent with PRA models, when you look at the PRA model you never allow for simultaneous either maintenance or test on more than one train at the same time. And you know better that even if you do at the end, you go back and zero out those -- that have two trains out due to maintenance or testing.

The same thing is done here. We don't penalize them. We use the same PRA model, the same approach, but given that one train is unavailable, that's what we're counting. The other train, the models don't allow to be unavailable. So there is no mismatch or no penalizing --

MR. APOSTOLAKIS: But your approach I argue doesn't include the fact that the other train is available.

MR. HAMZEHEE: Oh, it does.

MR. APOSTOLAKIS: No, it doesn't. In FV only. In FV.

MR. HAMZEHEE: Yes, that's because it's not allowed to be unavailable.

MR. APOSTOLAKIS: It doesn't matter it's not allowed. In FV it --

MR. HAMZEHEE: It does. In FV it does account for it.

MR. APOSTOLAKIS: All right.

Now, in the bullet here, the before last, the limitations. What is the biggest limitation of what you're doing?

MR. HAMZEHEE: Oh,I'm sorry. Which one are you?

MR. APOSTOLAKIS: The --

MR. HAMZEHEE: Well, remember the limitations, for instance, is one is we do not include concurrent failure of multiple components.

MR. APOSTOLAKIS: Okay. So that's the biggest one?

MR. HAMZEHEE: Sure.

MR. APOSTOLAKIS: Good.

MR. HAMZEHEE: One is we don't look at common cause failures. Now, they don't happen often but --

MR. APOSTOLAKIS: No, you answered the question I wanted. You know, there was an expected performance and you met it.

MR. HAMZEHEE: And the last one --

MR. APOSTOLAKIS: That's to be a joke, per se.

MR. HAMZEHEE: I don't know what is joke and what's not anymore. Sorry.

MR. ROSEN: Now we've achieved --

MR. APOSTOLAKIS: See, I don't base your expected performance on the NRC staff average. Would you like me to?

MR. HAMZEHEE: Well, no comment.

And the last one is that it we believe based on all the work we've done that it provides appropriate risk categorization of performance degradations that are covered by --

MR. APOSTOLAKIS: Okay. When you write the white paper, when you say approximation, would you please tell me what the exact thing is. Don't assume I know, okay?

MR. ROSEN: You have been subjected to the average level of abuse that we normally subject NRC staffers to. But --

MR. APOSTOLAKIS: No. This group is --

MR. ROSEN: Maybe you need more. Maybe one star. The average level times a star.

But I would like to say that --

MR. HAMZEHEE: Yes, sir.

MR. ROSEN: -- this is very good work.

MR. HAMZEHEE: Thank you.

MR. ROSEN: And it's very much in the right direction and solves many of the problems that I have had of the discriminatory treatment of plants that exists in the current mitigating system.

MR. APOSTOLAKIS: What's beyond means though for --

MR. HAMZEHEE: And thank you.

MR. APOSTOLAKIS: -- why for 2 or 3 years now people have been telling me that plant specific is not the way to go and now all of a sudden it is the way to go?

MR. HAMZEHEE: We are learning.

MR. BARANOWSKY: George, I don't know whose been telling you that, but remember we're trying to factor in some of the latest things that we did in the risk-based PI program and from what we learned from doing all those studies. And we think we've got enough basis to go forward with this kind of thing on a plant specific basis.

MR. RANSOM: And one thing I don't understand is why this is tied to the industry trend, you know, rather than being an absolute measure of whether the plant is improved or not.

I mean, the industry is presumably a value that will float and could either get worse or better. And the measure now is relative to that rather than to where the plant is actually operating.

MR. HAMZEHEE: Well, again, maybe I did not explain it clearly. But once we defined the baseline, we're not planning to change that. The baseline we're planning to keep it constant. Because as Pat said, we at some point in time basically between '95 to '97 we agreed that the industry performance was acceptable. So if everybody agreed and we used the industry average for that period, then that's going to be fixed. You don't change it anymore.

MR. RANSOM: Oh, okay.

MR. HAMZEHEE: That's the acceptable level of performance.

MR. RANSOM: That's not changing with time.

MR. HAMZEHEE: That's right. No, no, no. And I did not explain that. I apologize.

MR. APOSTOLAKIS: I don't know what it means that the industry performance was acceptable when there is some plants that have CDFs higher than

10-4. Why is that acceptable? It's just that legally we can't do anything about it. That's unacceptable.

MR. BARANOWSKY: They did not pose undue risk and the Commission said that's okay.

MR. APOSTOLAKIS: Right. So now it's undue risk and I can go from 10^{-3} all the way to 10^{-7}. And we're saying this is nice and acceptable.

MR. LEITCH: Have you considered the treatment of --

MR. APOSTOLAKIS: We have a goal of 10^{-4} and yet being above the goal by an order of magnitude is fine.

MR. ROSEN: Because it's an average goal for the whole fleet.

MR. HAMZEHEE: That's right. We're not taking one plant --

MR. APOSTOLAKIS: On the average, everybody's an average person.

MR. LEITCH: In the treatment of shared systems, for example, a diesel that's shared between two units.

MR. HAMZEHEE: Yes. And we are -- actually that's a good point. We have talked about this several times during our public meeting with the industry. There are some criteria that we define in

9902, the NEI document that said if you follow and omit certain criteria, those shared equipment like a diesel for 2 units per plant can be credited into the PR if they're credited in the PRAs, we do allow their operation and that is built into the Fussell-Vesely. So that's a very good point. Those plants are going to have ore flexibility with the diesel generator reliability.

MR. LEITCH: All right. In a PWR, for example, where you're looking at HIPSI RCIC, RHR in an HIPSI mode perhaps and diesels and cooling water systems. Are we talking about 12 indicators? In other words, there would be six for each one of those things for unavailability and six for unreliability? In other words, are we developing a whole family of indicators here or all this data somehow assimilated into one indicator?

MR. HAMZEHEE: Well, no, the one unreliability and unavailability are going to be combining to one. So you're going to have one PI for the system. That includes unreliability contribution and unavailability contribution of the system, for the given system.

Now talking about the cooling system, as you mentioned there are variations of them. And if you remember, we mentioned that was one of the difficulties that we encountered during the RBPI Phase-1 study. And now as part of this effort with the industry we are planning to combine all the cooling water such as service waters, CCW or their equivalent into one or two PIs. So you're not going to have more than maybe two PIs.

MR. LEITCH: So for example to go back to HIPSI just to make sure I understand, there would be one HIPSI PI?

MR. HAMZEHEE: In this PI, correct.

MR. LEITCH: That would reflect both unavailability and unreliability?

MR. HAMZEHEE: Correct. So in other words, we estimated if we have six systems on the average that we monitoring, we're estimating that we have anywhere from 4 to 6 PIs.

Am I right?

MR. SATORIUS: Yes, that's correct.

MR. LEITCH: But then in order to -- I mean, it's quite a different problem whether it's unavailability or unreliability. They're different actions the utility would take to solve those problems.

MR. HAMZEHEE: Sure.

MR. LEITCH: They're different areas the regulator may want to look at. So you have to go back another level. In other words, if that indicator is going off, you need to look back one level further down the chain, so to speak.

MR. HAMZEHEE: Exactly.

MR. LEITCH: To say is this unreliability problem or an unavailability.

MR. SATORIUS: Absolutely. And that would be part of the inspection program. Because if this PI would cause a system to change colors from green to white.

MR. LEITCH: Right.

MR. SATORIUS: Then the action matrix would indicate that there would be a supplemental inspection that would take place. And that supplemental inspection would be charged to do just what you've indicated.

MR. ROSEN: But there's no question, Graham, that the utilities will monitor this not at the indicator level. They're monitor at the unreliability and the unavailability.

MR. LEITCH: Yes, they already are.

MR. ROSEN: Yes.

MR. LEITCH: And what I'm saying is if you just looked at the indicator that you're producing, it wouldn't be intuitively obvious what the problem was. I mean, you would know it was our problem, but --

MR. HAMZEHEE: But the beauty about it is that if you look at the equations, you can easily go back and find out where they come from.

MR. LEITCH: Right.

MR. HAMZEHEE: So you can look at the contributions and do your root cause analysis all the way down to the component level. Because that's how these things are built up.

MR. LEITCH: Yes.

MR. HAMZEHEE: So that would allow you to go back and look at the root cause of the problems.

MR. LEITCH: Okay. Another question I had was do you now have or do you plan to assess as part of the pilot what is the level of effort on the part of the utility to collect all this data?

MR. SATORIUS: You know, Mr. Houghton whose available with NEI might be in a position to speak for industry on that.

The question, Tom, was are we mindful of and is the pilot going to investigate the level of effort that licensees are going to have to expend in order to capture this data. And the answer to that is, yes, we've gotten very good feedback. WE have a working group that's been formed for approximately a year and it consists of members of industry as well as NEI. And we are reminded monthly that the level of effort that is going to be involved with collecting this data.

CHAIRMAN BONACA: And there was an issue that was raised, in fact, by the industry that, you know, if you increase the number of performance indicators are you going to take back something from the inspection program.

MR. APOSTOLAKIS: They need some sort of guidance. If you increase the number of performance indicators, what else are you decreasing?

MR. SATORIUS: Well, and I think it's our view, it's the staff's view that this creation of adding reliability and unavailability -- because at one point in time we were looking are reliability and an unavailability PI so that industry was, quite frankly, balking because they were looking at going from 4 PIs to a dozen, as many as a dozen. And there was reluctance. And I think it was quite an innovative fix to come up with this addition to where you come up with really not increasing the actual PI burden significantly on industry.

MR. APOSTOLAKIS: Okay. This is not part of the oversight process yet, right? This is still research?

MR. SATORIUS: Oh, yes, this is a pilot. And during the pilot program, George, which we would intend to be about six months in length or longer, depending upon the other PIs and the other program would continue in parallel such that the pilot plants would be burdened to not only continue to report the information required by the current PI, but also to go outside of that and gather this additional information.

MR. APOSTOLAKIS: Okay. Now, one of your objectives -- changing the subject a little bit -- was to do -- let's see, to minimize to the extent practicable the differences and increase the consistency between this approach, the maintenance rule, the PRA and the SDP.

Now, the maintenance rule, as far as I know, doesn't use any industry averages, does it?

MR. HAMZEHEE: Mark, correct me if I'm wrong. And, John, you guys know better.

I think here what we meant was the data collection, some of the definitions --

MR. APOSTOLAKIS: But the maintenance rule doesn't use industry averages. And I wonder why this agency does one thing with industry averages and another thing with plant specific numbers.

MR. HAMZEHEE: Here it's talking about the industry average. It's talking about the areas that are common to both.

MR. APOSTOLAKIS: Isn't it plant specific?

MR. HAMZEHEE: No, I understand. I am saying what this bullet covers is those areas that are common to the maintenance rule, to SDP and to ROP.

MR. APOSTOLAKIS: But let's go beyond the bullet.

MR. SATORIUS: Let me give it a try. Right now licensees are required or because of the maintenance rule are required to collect data and monitor the performance of systems.

MR. APOSTOLAKIS: Right.

MR. SATORIUS: And one of the pushes by industry was to the extent that's practicable that we make the data that they go out ad collect for the maintenance rule be similar or the same as the data that they would collect for this PI, that the data that they would collect for WANO, for the data they would collect for INPO -- so it lessens the burden.

MR. APOSTOLAKIS: It goes beyond the

bullet. Why in the maintenance rule we are happy with the number, the baseline number -- used in its PRA and in this context we are -- in the maintenance rule we asked the utilities tell us what you want to put for this train or this system. The utilities looked at their plant specific PRA. They massaged it a little bit according to more recent information and they said X. We didn't ask them to go to the industry average and do something and give us X star.

So all of a sudden we're saying we have a major rule that everybody's hailing as being great because it's risk informed, but is plant specific and now we're doing this which in addition to being plant specific evokes something that's called industry average performance. And the philosophy here it seems to be inconsistent and I'm wondering why.

Now, maybe it's not your job to do that.

MR. HAMZEHEE: You're right, it's not.

MR. SHACK: But he argues that that's only a surrogate for the data that he needs.

MR. APOSTOLAKIS: No. He says

MR. SHACK: I mean we've had more arguments here this afternoon. But I mean one of the arguments was they tried to make -- that industry average they talk about is part plant specific and industry average.

MR. APOSTOLAKIS: But why --

MR. SHACK: They made it as plant specific as they could, they just didn't have enough data to do the whole --

MR. APOSTOLAKIS: And why did they have enough in the maintenance rule? I don't understand that.

MR. BARANOWSKY: George, we're --

MR. APOSTOLAKIS: We're not talking about regulation here. It's the maintenance rule. Oh, those Americans are doing this -- and all of a sudden there is another major rule that says no, we're going to do it different this time. The rest of the world doesn't do that.

MR. BARANOWSKY: Yes, I know. There are differences in the way the maintenance rule does some calculations of things. They're rigorously controlled then the reactor oversight process in terms of any standards, so the comparability between plants and the identification of when plants on a consistent basis exceed an unacceptable or a point in which we should engage them more, let's say, would be inconsistent. And so what we're trying to do here is identify ways to get that consistency.

We've made a number of impacts on I think the maintenance rule, including especially the way unavailability information is collected and how unavailability is defined which was a significant challenge for us, okay.

MR. ROSEN: A significant area for the industry.

MR. BARANOWSKY: Yes. And I guess I'm a little concerned that we're not hearing that we've made a lot of progress here, and we don't have perfection but we do have a lot of progress.

Okay. So let's identify the few things that we've got to still work on, we'll be glad to work on them.

MR. APOSTOLAKIS: No. You're misunderstanding my comment. I'm not saying you didn't progress. What I'm saying is that as an agency we seem to be happy using one philosophical approach in one major piece of regulation, the maintenance rule, which is consistent with my example earlier of the machines, the quality control.

We told them for your plant tell me what this unavailability should be, but then make sure you meet it. And the industry says fine, we'll do that. So that was plant specific. There was no question of industry average. South Texas didn't give a damn of what the other plants were doing. They said this is us.

Now we are coming with this other major piece of regulation and we're saying well, you know, it's nice to know what you guys are doing, but we really want you to compare with some industry average.

And I'm having a problem with this different philosophical approach to two major pieces of regulation.

MR. ROSEN: It's an accommodation. I think they've said that they even had sparse data, so they just did what they could.

MR. SATORIUS: And, George, I don't think -- I can't speak authoritatively on the maintenance rule, and I think we're a little bit light on that, so we might want to have to get back to you on that just because --

MR. APOSTOLAKIS: And maybe we should be asking different people, you know.

MR. SATORIUS: That's just it. And I'm thinking maybe we ask some maintenance rule people to be with us when we discuss this with the full Committee in case there's a short discussion on that.

CHAIRMAN BONACA: If I understand it, you have two more presentations to go through today?

MR. SATORIUS: Yes.

CHAIRMAN BONACA: That's on the industry trends program. And we have an hour left. So, I mean, we intend to cover this ground?

MR. APOSTOLAKIS: I thought we were just discussing now.

CHAIRMAN BONACA: Well, you go into discussion and the discussion is over.

MR. SHACK: Trending time.

CHAIRMAN BONACA: How long?

MR. SATORIUS: WE need to change two people and can start in 30 seconds.

CHAIRMAN BONACA: Okay. Do you want to take a break before we do that? Let's take a ten minute break. But then that means that you have ten less minutes.

MR. SATORIUS: We can talk quickly. This is an update on the trends.

(Whereupon, at 4:01 p.m. off the record until 4:12 p.m.)

CHAIRMAN BONACA: With that, let's --

MR. KRESS: It's the reasonable men are left.

CHAIRMAN BONACA: We have two

presentations to go through.

I would like to ask members when you ask questions to make sure we don't talk simultaneously because our transcriber has pointed out that it makes it very challenging for her to distinguish who said what.

With that, this is about industry trends program.

MR. BOYCE: Thank you. Yes. Good afternoon. I'm Tom Boyce of the Inspection Program Branch of NRR. And I'm going to present the industry trends portion of this briefing.

Before I get started, after looking at the dynamics that occurred and the level of questioning over the last three hours I had two thoughts. The first is I'm glad my colleagues went first and the second is, given we only have 50 minutes left and it was an average level of abuse, we won't lower the average too much if you under perform in this last hour.

I would like to set a framework, a mindset for you. We're no longer at the plant specific threshold level. What we're trying to do is take all the indicators that we have at the plant level, aggregate them into an industry average. And that was alluded to earlier, but it's not an industry average like we talked about in terms of this equation. It's an overall level of performance that may or may not be directly related to the baseline values you saw here. And I'll get into that in a moment, but I wanted to just -- it's easy to lose sync between a plant specific indicator and a plant specific threshold versus an industry indicator and an industry threshold.

So with that also I'll be followed by Dale Rasmuson of Research, and he'll talk more about threshold development right after I talk about an overview of the industry trends program.

This is what I'll be talking about. I will skip going over each bullet. Just let you know it follows the normal path of introduction and conclusion at the end.

As background, improving industry trends contributed to the decision to revise the reactor oversight process. This is about 1998/1999 time frame and simultaneous the NRC's strategic plan was revised. And in that revision was included a performance goal measure of no statistically significant adverse industry trends in safety performance. The NRC is required to report to Congress on the state of achieving that measure every year, and we do it as part of the NRC's Performance and Accountability Report.

Responsibility for this particular performance goal measure shifted from Research to NRR in late calendar year 2000. Subsequently NRR developed a formal ITP in early 2001. And we initially used existing indicators from the former Office of AEOD, their PI program, and we also are using the Accident Sequence Precursors, which I think you've been briefed on several times.

We've provided two reports to the Commission. I think you've also gotten copies of those. They're SECY papers; one in June of 2001, one in April of this year.

Bottom line, we have identified no adverse industry trends to date.

And if I haven't said so, ITP is industry trends program. Sorry if I omitted that.

MR. LEITCH: Have you identified any positive industry trends?

MR. BOYCE: Each of the indicators that we have monitored has shown improving trends. But we have not -- as a negative agency, we haven't gone out of our way to say these are all positive trends.

We've just said that we've had no adverse trends.

MR. APOSTOLAKIS: As a negative agency?

MR. LEITCH: But aren't the positive trends statistically significant. But what I'm saying is are they statistically significant, the positive trends?

MR. BOYCE: Yes, they are actually. The improvements are statistically significant, and if you've got the SECY papers, each of the AU DPIs, and I believe there are 7 of them, have all shown improving trends and they've all been statistically significant. In addition, the ASP program, and we use the total counts of ASP events, well that's almost statistically significant through FY 2001. I think the P value is like .08 and a statistically significant P value, I think, is .05.

MR. LEITCH: So I guess I'm just trying to develop a feel then. If the industry performance had declined as much as it has improved in the past. Are you saying it's something -- there is an adverse trend then?

MR. APOSTOLAKIS: Right.

MR. BOYCE: Yes, I would. Let me -- a picture is worth a thousand words, and actually when we get to Dale's presentation he'll be talking about--

he has some graphs and will be able to illustrate this point I think more clearly with automatic SCRAMs while critical.

MR. LEITCH: Yes. Okay.

CHAIRMAN BONACA: But you use certain number of years of performance, I mean to develop a trend?

MR. BOYCE: That's correct. Jumping to a little bit about what Dale's going to get into, we had to respond to the performance goal measure very quickly, and that's why we used the existing performance indicators. What we decided to do was go back to as long as we had what we felt was good data and had confidence in the data. That year turned out to be 1998 for the AEOD indicators. I believe the ASP program is going back to 1993.

As far as those two main purposes of the industry trends program, the first is to provide a means to confirm that the nuclear industry is maintaining the safety performance of operating reactors. And the second is by clearly communicating industry performance, we believe we will enhance stakeholder confidence in the efficacy of the NRC's processes.

The industry trends program actually

complements existing NRC processes. AS I've described earlier, the reactor oversight process takes a look at safety of plants on a plant specific basis. What we're doing is aggregating the data and trying to look for the big picture. Are we missing anything by focusing on each of the 103 operating units out there.

While we're looking at the big picture if we do discover an adverse trend in any of our indicators, we would respond and take a response in accordance with our existing processes for addressing generic issues. Those process are the generic communications process and the generic safety issues process.

This slide shows how we communicate with stakeholders, and it's in a variety of ways. We've been briefing our ongoing development efforts to an NRC industry working group that looks at the reactor oversight process, and those have been periodic, perhaps quarterly type of briefs.

We published the industry indicators on the NRC's website.

There's an annual review of the industry trends program and results at the agency action review meeting, and we provide annual reports to the Commission in those two SECY papers so far that I alluded to on an earlier slide.

We also provide an annual report to Congress and the graphs of the industry indicators were included in the most recent report to Congress. And these industry indicators are also presented at various conferences with industry. The most example is the Regulatory Information Conference this past March.

This slide depicts some of the concepts that we used when we developed the ITP. We tried to adopt a hierarchal approach. I had alluded to earlier that we used a qualified set of indicators in reporting to Congress. And the reason we use that term is, actually we ran into a situation where we had just a multiplicity of potential indicators for use in the program. And so the hard part was identifying what was the correct level of reporting and what indicators acted as, if I could use the term, macroscopic type of indicators that would give us good insights across the spectrum and were not so detailed that we might be missing something.

If we do find a problem in those macroscopic indicators, we would use all the other multiple indicators that we think are subordinate to investigate why we got an up-tic in the more macroscopic indicator. And I'll try and show you this on the next slide a little bit more what I'm talking about.

WE did use these existing programs. And what we're trying to do is flush out these -- I say these existing indicators. We're trying to flush out these existing indicators and make them give us insights in all the cornerstones of safety. Right now we have seven cornerstones of safety. Much of the previous discussion this afternoon focused on the initiating events and mitigating system's cornerstones. We are also trying to develop industry level indicators for the other cornerstones such as occupational radiation exposure, public radiation exposure, physical protection and that sort of thing.

WE're trying to flush that out by deriving these indicators from the information that was submitted for the plant specific reactor oversight process, performance indicators. And we've also tasked research to update some of the studies that, again, were alluded to earlier this afternoon such as initiating events and reliability studies.

This slide is intended just to illustrate the concept of hierarchy of potential indicators. What we're trying to get to is representative industry risk here. But where we are is in terms of our thinking is right here. And three hours of discussion this afternoon focused on right here in plant level risk. And the challenge is to aggregate 103 units into something that's representative of industry risk without causing a distortion of the indicator.

If there is a problem up here, we can go down and break the indicators into their constituent parts right here. An example might be for initiating events we have reactor SCRAMs. Well, if you have up-tic in reactor SCAMs, you got to take a look at the cause. Do you have an up-tic due to automatic SCRAMs, do you have an up-tic due to manual SCRAMs. Is the cause due to loss of off site power, or is it due to instrument air issues, is it due to steam generator tube ruptures. You get into that. And so the question becomes do you want to track all these subordinate initiating events or can you stay with that one roll up indicator of SCRAMs. So, that's what this is intended to illustrate.

And if you got any questions on this, I borrowed it from Pat. So I'm going to make Pat answer the question.

MR. WALLIS: Well, I guess someone's going to ask eventually how the things that we worried about recently fit into this pattern? The Sumner and Davis-Besse Is that human error or where does that fit into the --

MR. BARANOWSKY: Those would normally show up -- there's actually one more thing that's not shown here, and that's the accident sequence precursor program, which is another slightly different way of trying to capture performance information. And we would sum it through those. Because those things aren't in the PRA models, they're hard to account for. So we have --

MR. LEITCH: But those are the things which obviously we worried about most in the recent times.

MR. BARANOWSKY: Right. That's why the ASP program exists and why we have things there.

MR. APOSTOLAKIS: The ASP is not an indicator.

MR. BARANOWSKY: What's that?

MR. APOSTOLAKIS: I mean this -- I thought you were using indicators to do this trending.

MR. BARANOWSKY: No. ASP --

MR. APOSTOLAKIS: ASP doesn't use indicators.

MR. BARANOWSKY: It's an industry

indicator and it's been reported to the Commission for several years.

MR. BOYCE: Yes, the total counts of ASP events. The total counts of ASP events can be trended from year-to-year, and that's the index that we're using.

MR. APOSTOLAKIS: Well, yes, they could.

MR. BARANOWSKY: And not only that, I mean it's the total counts where we can look at trends. And I don't know, Dale, if you have something on that in here. But we're looking at what's the right way to present ASP information to show what safety implications are, whether they're getting better or worse. And we're going to see some interesting things going on with ASP when we add some of these new events in.

MR. WALLIS: It's not just counts, it's the severity.

MR. BARANOWSKY: Yes, the severity's important.

MR. APOSTOLAKIS: But if I wanted to understand whether human performance at U.S. nuclear plants is improving or deteriorating, or doing anything I really have no way of learning that, do I?

MR. BARANOWSKY: Right.

MR. BOYCE: Yes, not through the industry trends program.

MR. BARANOWSKY: That's correct.

MR. BOYCE: And the same question applies to the reactor oversight process, because that's one of the cross cutting issues.

MR. APOSTOLAKIS: Sure, they will be asked the same question, don't worry.

MR. BARANOWSKY: Right.

MR. BOYCE: And the answer I believe is that we expect that human performance errors would manifest themselves in performance issues, such as reactor SCRAMs or in the case of maintenance, lower reliabilities and higher unavailabilities.

MR. APOSTOLAKIS: Yes. And at least I hope that this expectation will be revised. Because, you know, in the case of Davis-Besse, yes, it would have been revealed in a medium size LOCA. That doesn't help me at all.

MR. BARANOWSKY: Well, it was revealed through the identification of the degradation at the plant.

MR. APOSTOLAKIS: Sure.

MR. BARANOWSKY: And, you know, clearly there's some relationship to human performance there.

So, any of these things that occur, common cause failure or whatever, you can go and see whether there's a human element involved. And if you get a few hits on these things, that tells you, Ops, that's an area to focus on. And I think that's one of the things that's been going on in the oversight process.

MR. SATORIUS: Yes, that's right.

MR. KRESS: An ASP then is one that would have a conditional CDF of 10^{-3}.

MR. BARANOWSKY: Six.

MR. APOSTOLAKIS: Six.

MR. BARANOWSKY: Or greater. Or greater.

MR. KRESS: There is no CDF of 10^{-6}.

MR. APOSTOLAKIS: Is somebody doing the Davis-Besse thing, the ASP, or you've not yet --

MR. BARANOWSKY: No, it's in the preliminary stages, but we're working with NRR because it's so complicated I think we're just going to work together on it for now.

MR. ROSEN: Isn't it true in principle that that second level down on your diagram, plant risk; plant 1 plus 2 all the way up to N, if everybody had a good PRA done to the same standards and that was updated, couldn't you just sum all those and divide by the total number of plants?

MR. APOSTOLAKIS: Or just look at the 103 units.

MR. BOYCE: Probably.

MR. BARANOWSKY: We could do that if we were able to trust -- the reason we disaggregate it, we don't think we have enough trust in these individual models to just take that one number. So we're looking at some of the individual subelements and it's a judgment call as to how many elements you look at.

But, you're right. In the future one could in theory have highly qualified PRAs and you could track just performance at the risk level. And when there was a problem, then you'd disaggregate the thing down to get at the root cause in terms of areas of the plant or issues.

MR. WALLIS: The cracked pipes aren't in PRAs, are they?

MR. BARANOWSKY: Well, those are some of the reasons why we have other things.

MR. WALLIS: Yes.

CHAIRMAN BONACA: But you would pick up that one, for example, significant events. You're plugged into significant events as a function of here. So that would pick up, for example, there is Besse under that, wouldn't you? Or would you have to go necessarily only to the precursor --

MR. BOYCE: I would think those would be counted under both. There is slightly different criteria that NRR uses for the significant events program and the ASP program. I would expect they'd be counted in both areas.

CHAIRMAN BONACA: Yes, some of the indicators like equipment forced outages, forced outage rate; these are pretty insightful. Average exposure to plant.

MR. BARANOWSKY: Well, I think we're going to look at making some changes. The old AEOD indicators are in there because they're well developed and understood. We're working on a number of things that maybe have a better nexus to safety and risk. And in the future when they're proven, I think Tom may mention something about that, that might replace them.

MR. BOYCE: That's right. What Pat's said is correct. We are working to be more risk informed in as many cornerstones as we can. Those are primarily the reactor safety cornerstones, initiating events, mitigating systems and barrier integrity.

MR. APOSTOLAKIS: One of the things that really concerns me is that as you said earlier, we have a number of ways of looking at performance. We have your program. We have the ROPs, we have the ASP, we have -- you know -- and that's fine. I agree that we should have a multi-pronged approach.

The thing that really bothers me is that all of these programs are hardware oriented. And the industry operating experience is telling us that's not where the problems are. Now, again, that's a question that's bigger than you, than your issues here.

MR. SIEBER: AEOD had some indicators that had human performance factors in them where they did the percentage comparison to causes.

MR. BOYCE: Yes.

MR. SIEBER: But those are not being done anymore, right?

MR. BOYCE: Right. That's correct.

MR. BARANOWSKY: I think the approach we're taking now is if it impacts a functions availability, then we go down and dig down into causes. It's just too expensive to have all the causes tally and ready to go for any possible number of things. It's a lot more practical to look at safety functions. If the functions are okay, you don't have to dig down. If they're not okay, then you dig down and find out what's going on.

CHAIRMAN BONACA: Yes, the only thing is that, I mean again the performance of active components that the utility has focused on for 20 years may not be the best hook on human reliability.

MR. BOYCE: That's right.

CHAIRMAN BONACA: And, you know, for example certainly, I mean issues that -- decisions during outages may cause latent effects because you have a comforter between, you know, the economics and safety issues. I mean, and you have those kind of competition, and time. I mean, we've seen it in the root cause evaluation of Davis-Besse.

Those things, I mean right now they're not being --

MR. BARANOWSKY: But they're going to manifest themselves in terms of availability of equipment or reliability of equipment.

And one that I have a concern about is operator performance in an accident situation where we really have nothing more than the training and the simulators.

MR. APOSTOLAKIS: That's true, Pat. But if you look at Davis-Besse, I mean you can't really say, "Okay, I would catch it if the vessel were breached." I mean, that's too late. Something like that you can't afford to say I will wait until I see the impact on the hardware.

MR. BARANOWSKY: Well, I think when we see something like Davis-Besse we go through lessons learned, and we ask ourselves what is it about our inspection program or indicators that suggests we should make some changes.

MR. APOSTOLAKIS: But I think you will never make the right changes as long as you are forbidden from getting into cultural issues and organizational issues.

MR. BARANOWSKY: Well, I think you can inspect that stuff. For instance, if we weren't looking at how licensees were inspecting their heads and other passive components and we spending a whole lot of time worrying about the reliability of diesel generators where we have good data --

MR. APOSTOLAKIS: Right.

MR. BARANOWSKY: -- maybe what we should be doing is inspecting those softer areas where the human element is important and I can't get a good indicator or quantification that changes in time line.

MR. APOSTOLAKIS: Yes, I agree.

MR. ROSEN: Let me tell you the last things I'm worried about, are diesel generator performance and operator performance during transients. What I'm worried about mostly is human performance other than operator performance.

MR. APOSTOLAKIS: Me, too.

MR. ROSEN: Meaning the maintenance people, engineering people, managers, supervisors and executive.

CHAIRMAN BONACA: And, you know, it's interesting, you know, if you look at the root cause for Davis-Besse where you have -- you read the guys did go and cleaned up and then they stopped cleaning when the schedule said that's it, that's the time you got, so they didn't complete the activities because time was up. And, you know, now from the root causes it's hard to understand if there was a real contention there. If somebody said oh we should be doing more, an somebody said no you're not going to do more. Or if you simply everybody was in lock-step doing that. There are many opportunities there.

But this is really typical in outages. And you know one concern I've always had is right now there has been the race of the industry to have shorter and shorter outages. Okay. And I think that those kind of pressure to have shorter outages are going to put some pressure on some critical activity and decisions there. Because that's what you got.

MR. BOYCE: I can only add one more thing that will not be a disagreement with what you said, but we did attempt to take a look at whether there was commonality in some of the events that we were seeing. And so in the first SECY paper that we did we took a look at issues that were what were called greater than green and we tried to look at some of the factors like what was going on at the time. Was it at power, was it shutdown, what systems were involved and what the apparent cause was. And as you know, we do follow up inspections every time you cross that green white threshold. So we had some data that we could go look at.

And we concluded, and all the results are in there, that was not sufficient commonality to be able to draw any conclusions or have any reasonable indicators that would tell you anything in advance.

Anyway, I'm not going just make that statement, but I'm not going to disagree with your premise.

CHAIRMAN BONACA: And I'm not saying it is an easy thing to do I'm only saying that somehow we have to get there.

MR. APOSTOLAKIS: I think there is one

area where we are reluctant to get into because it's not thermal hydraulic structure or mechanics, or reactor physics, and that's the soft area organization, cultural. We keep getting those messages from the plants that that's where the problems are and we're not getting into that for some reason.

Now you might say, "Well, gee, tell me what to do." I don't know what we should do. That's why there's an Office of Research. But, you know, we need to spend money doing more work on performance indicators that deal with hardware, because that's where we know what to do.

But this is a really different subject. I mean we should --

MR. ROSEN: Yes, we are going to move on.

MR. BOYCE: All right. This lays out in detail the process for industry trends. And essentially what we're trying to do is use statistical techniques to identify the adverse trends using indicators that have been qualified for use. And what this does is is you just fit a trend line to it to whatever the indicator is and in general, based on what we've had so far, if the trend line is pointing down or is flat, you do not have an adverse trend. If the trend line is going up, you have an adverse trend in general.

We've also got a statistical technique where we look for one year deviations from the norm, and it's called prediction limits. And I don't want to get bogged down into it. But recognizing that we started in 1988, it would take a significant trend to give us an adverse trend, and that's why we used the prediction limit method is to look for that short term trend. We're not calling that an adverse industry trend, we're calling it we exceeded the prediction limit and we will investigate it. It's a bit of a nuance, but I wanted to point it out.

If we identify an adverse trend, the next step is to evaluate the underlying issues and their safety significance. And then based on that safety significance, take the appropriate agency response in accordance with our existing processes.

And finally, there's an annual review by the senior managers of the agency at the agency action review meeting.

Just to give you snapshot of the results of the program today, as I said there's no statistically significant adverse trends identified in fiscal year 2001.

In looking at the indicators that we're deriving from the ROP data given that the ROP started in April of 2000, we did not have sufficient data to do long term trending. However, an inspection of the data that's been submitted so far, and there's 18 of those indicators, didn't reveal any significant issues.

In the most recent SECY paper you'll see examples of initiating event indicators that the Office of Research has developed. Those are essentially an update of the initiating events indicators in NUREG 5750. We took a look at those, and again those statistically significant adverse trends were identified.

MR. APOSTOLAKIS: I think the issue of statistical significance, it is meaningful it seems to me to talk about statistically significant trends when you talk about indicators that are a fairly low level if I take, you know, what you showed earlier about risk. This is core damage and I'm way down there. Again, statistically significant trends make sense.

I wouldn't apply this criteria to core damage. I'm not going to say, "Look, I only had one core damage event last year out of 103 plants, that's not statistically significant, right?" The higher I go the notion of statistically significant becomes less valued, it seems to me.

MR. BARANOWSKY: Yes, but the NRC has some performance standards that say that's unacceptable.

MR. APOSTOLAKIS: For low level indicators.

MR. BARANOWSKY: No, for like core damage frequency. We don't say if we get a statistically significant one. No, we say none is the accepted performance level.

MR. APOSTOLAKIS: But you're right.

My question is let's say next year nothing else changes and the only piece of information in 2002 is Davis-Besse. Are we going to still conclude that the NRC says that there is flat -- or the indicators show that there are flat or improving trendliness, trend lines, and this and that? In other words, is that an outline there that doesn't effect any of our conclusions?

MR. BOYCE: Well, the ASP program does in fact, there's actually two outputs in the ASP program.

MR. APOSTOLAKIS: But that --

MR. BOYCE: Actually, there's a second performance goal measure that uses the ASP program. And it's in the strategic plan. And it says no more than one event that exceeds 10^{-3} delta CDF. So there's a -- okay. So that's an example of a threshold base criteria.

We're looking at a trending base criteria. The ASP program would pick that up because it --

MR. APOSTOLAKIS: But not this program?

MR. BOYCE: Well, that's correct.

MR. APOSTOLAKIS: Because this relies on AEOD?

MR. BOYCE: Because the index that we're using for ASP counts total number of ASP events. So this program would not pick up that significant event.

MR. APOSTOLAKIS: So I wonder whether we could still claim next year that the industry's performance is improving? If I have one ASP event, as 10^{-2}.

MR. BARANOWSKY: Well, you have to be careful about talking about the industry versus a single licensee that's had a problem. I mean, that's part of the assessment that I believe you would do, Tom. If some one or two events occur, you want to know is this an industry problem or a one plant? You know, just because one kid's chewing gum, we don't make the whole class stay after school.

MR. APOSTOLAKIS: That's true. But, I

mean, you know the caution should be both ways. One is to generalize and say, gee, this is an industry problem. But also I think you should be cautioned not to say this is an isolated event too quickly.

So let's do it both ways.

MR. BARANOWSKY: Well, I mean, that part of their assessment will be whether or not we have weaknesses in the way we either inspect our licensees, implement program. And if it's generic, we'd have to say we have a generic issue that was identified.

MR. WALLIS: Well, the generic issue would probably be symptoms which because for various reasons which you can go to at Davis were ignored.

MR. BARANOWSKY: Yes.

MR. WALLIS: And other places where symptoms are being ignored, maybe because they're not in the PRA or something.

MR. APOSTOLAKIS: They are not in whatever we're doing.

MR. SIEBER: Well, one of the interesting things with performance indicators is as soon as you establish them, people manage them.

MR. BOYCE: Yes. Right.

MR. SIEBER: And other things were thrown off that your performance indicators --

MR. ROSEN: George, I think we'll get to this discussion on Saturday I think when we talk about our response to Davis-Besse. In particular, I want to be sure I address the culture issue and how we use Davis-Besse as an example of where we don't want to go.

MR. APOSTOLAKIS: Exactly.

MR. ROSEN: And why the regulatory system needs to do something to respond to those culture issues which I think is at the root of the Davis-Besse. And then we define that as corrective action, system failures and a lot of other kinds of failures.

CHAIRMAN BONACA: Well, it's interesting. I mean, there -- criteria that were used there. Like, for example, the pressure was -- on the flanges. The pressure was simply through the start. So therefore, how many flanges can you fix in these many hours, and the answer was --

MR. ROSEN: Rather than the opposite approach, which is to shut the plant down until you fix all the flanges, clean the head up completely, make sure you have no degradation and restore the initial design basis.

CHAIRMAN BONACA: For the prospective of a regulator, however, the question then comes should it be an option left to the corrective action program or should it be a requirement that if you have leakage from the head or from somewhere in the primary system you're going to fix it before you start.

If you have that, you're helping the technician whose doing the work up there who doesn't have to stop and question whether or not he should go beyond the point.

So the issue is broader. There are things that really help facilitate the process if you take the decision away from the hands of some intermediate management or management.

MR. ROSEN: I don't want to be here three years from now with another plant, XYZ plant, that's had a serious incident, maybe even an accident, whose root cause was the same kind of safety culture deficiencies that happened at Davis-Besse.

MR. APOSTOLAKIS: Yes, of course.

MR. ROSEN: And that we didn't do something different. That we just saw Davis-Besse, knew what the root cause was and safety culture and said "Okay, we'll just keep doing the same regulatory stuff we have now."

CHAIRMAN BONACA: Exactly. Exactly.

MR. ROSEN: Because what that is is an

embodiment of the commonest definition of insanity, right? Doing the same thing over and over and expecting different results.

MR. APOSTOLAKIS: I'm with you. I'm with you.

MR. BOYCE: Let me press on.

CHAIRMAN BONACA: Yes, let's press on.

MR. BOYCE: One of the problems that we identified early on was with the indicators that we've looked at so far, given that we started in 1988, the indicators all have like an expediential type of curve. And it appears, just visually, that they might be approaching an -- and if you get to that point, it would be very easy, particularly if we shortened the period of time that we were looking at, to get just almost like a random up-tic in the indicator. And by our process we would then start reporting events to Congress that may or may not have safety significance.

So what we are attempting to do is establish thresholds for reporting and thresholds for monitoring and actions so that -- an example would be SCRAMs. In 1988 we were on the order of about 3 SCRAMs per plant per year. The most recent or Fiscal Year 2001 we were at .85 SCRAMs per plant per year. So if we go up to 1 SCRAM per plant per year, is that much less safe or are we maintaining safety at one SCRAM per year. And that's the philosophical issue you face.

And so we are trying to have a rational basis to establish thresholds where we would monitor what's going on below the threshold so that we wouldn't ignore an emerging problem, but at the same time we would only be reporting issues of safety significance to the appropriate stakeholders.

All right. So that's the problem. The Commission helped us out with an SRM directing us to develop risk informed thresholds as soon as practicable. We've asked Research to help us out with that for the appropriate cornerstones and indicators. We're going to take on the other cornerstones, NRR is, for like occupational radiation exposure, physical security, etcetera.

We'll engage the appropriate stakeholders including this body as we develop them.

The near term indicators that are concern we think are the ROP indicators because we think they will have in excess of 4 years worth of data which we have somewhat arbitrarily said are our threshold for starting to use these indicators.

The nuance here is to start the ROP in

April of 2000. We asked licensees to submit historical data, but that data was best estimate type of data, so we're taking a hard look at that data and seeing if we can use it. And so that looks like the near term issue.

If we get these thresholds, we would then move we think towards a different performance measure, one that was more oriented towards crossing thresholds such as the ASP program rather than the totally based on trends in the indicators.

And with that, I'll turn it over to Dale Rasmuson whose got some ideas on developing thresholds.

MR. RASMUSON: I will try to move fast here, just pick out some selected slides. I did colored ones because I know George likes colored slides.

We wanted to share with you our thoughts. We've just started on this process --

MR. APOSTOLAKIS: You guys are taking abuse, but you are giving it out, too, you know.

MR. RASMUSON: Oh. Okay.

MR. APOSTOLAKIS: Give and take.

MR. RASMUSON: We wanted to explain some of the technical approaches we've identified for generating information for thresholds and to receive any ideas or suggestions that you may have as a body.

One of the points I want to make is the second bullet here, is that industry thresholds differ from plant-specific thresholds. And to illustrate that, for instance, we'll stay with the unplanned SCRAMs. In the ROP process, the green/white threshold is 3 SCRAMs. When I look at the performance on an industry basis, we're down at about .6 SCRAMs per plant for average for automatic SCRAMs. And when I get a trend in this type of fashion here, if I were going to use three, I'm clear up here. To set a -- I would probably think that I would be down here for the industry in some sense.

And so those are the types of things that we're working and focusing on.

MR. APOSTOLAKIS: Now, have you read the ACRS letter on the reactor oversight process of last October?

MR. RASMUSON: I have not.

MR. APOSTOLAKIS: You should, because we have attacked this threshold.

MR. RASMUSON: Right.

MR. APOSTOLAKIS: We don't like it at all.

MR. RASMUSON: Yes.

MR. APOSTOLAKIS: There's no sympathy here, you know. Three means nothing.

MR. RASMUSON: Right. Right. And all I'm trying to do is use that for an example here. Three may be meaningful for a plant, but for the industry average when we're taking industry behavior, we tend to -- you get average behavior and so forth. And so the threshold probably ought to --

MR. APOSTOLAKIS: And what we said in that letter is that even for a plant --

MR. RASMUSON: Right.

MR. WALLIS: Well, just the average is 95 percent. And that's more significant than the average, and that's always way below one or it's around one.

MR. RASMUSON: I don't know. I haven't looked at --

MR. WALLIS: I mean, I thought you had it on your picture there.

MR. RASMUSON: Well, that was a prediction -- right. And I don't know whether I would use that value or not. We're looking at two types of thresholds, one an action threshold and an early warning threshold.

The action threshold would be sort of the one that would be used for reporting to stakeholders. The early warning one would be used as a tool for helping us in the industry here to monitor performance and to take some action as we start to see some upturn in the process.

MR. APOSTOLAKIS: Now, why can't the reactor revised oversight process do that? Early warning? Marshaling my resources and then have something else that says "Boy, am I in trouble."

MR. SATORIUS: I would argue that that's exactly what the ROP does, George.

MR. APOSTOLAKIS: It doesn't do that. We'll see that. The action matrix doesn't say things like that. It may be doing it --

MR. SATORIUS: With the green/white thresholds and the white/yellow thresholds, and the inspection findings manifest themselves into colors that force -- or produces more inspections and further review by the staff, I would say it does exactly that. A measured approach.

MR. APOSTOLAKIS: If you move the thresholds--

MR. SATORIUS: It's a graded approach.

MR. SIEBER: You can have an increasing industry trend and not change colors on anything at any specific plant. But something's going on and I think that's part of regulation to figure out why is this uptake occurring.

MR. SATORIUS: Tom, you want to answer that?

MR. BOYCE: Yes, that's the point of the ITP is to catch those sorts of things.

MR. SIEBER: And outcomes that would be -- or something like that that it says we've looked at this and analyzed it and here's steps that the industry ought to take.

MR. BOYCE: Right. And we would follow up with inspections if appropriate.

MR. SIEBER: Right. So there's a difference to me, anyway, between the ROP and an industry wide effort.

MR. APOSTOLAKIS: We'll come back to that.

MR. BOYCE: I have every confidence you will at some point.

MR. RASMUSON: Okay. Threshold characteristics. Here thresholds should have a rational basis, they should be practical, they should be conceptually simple, they should be consistent with the existing regulatory framework and they should reflect risk, safety and regulatory perspectives.

Those are sort of the criteria that we're working towards.

Our protocol that we're proposing to use for this is to develop risk and statistical information related to the trends for input to an expert panel, provide associated safety and regulatory information to the expert panel, and then the expert panel would set the thresholds based on the inputs.

Inputs for the expert panel would be some of the things, we could start with the values set for the ROP indicators. We'll look at values from the risk based performance indicator report, those if they're applicable. Other risk insights. We'll look at the current industry performance, the trends, estimate some of the characteristics from that using various statistical methods such as prediction intervals, Bayesian predictive distributions and different things like that can help us to give some insights.

Using these we will select some values and that. We'll evaluate the risk implications of some of these things is applicable using some selected SPAR models to just give some idea of what the risk is on these. And then suggest the values to the panel.

Technical approaches we're looking at are prediction limits, Bayesian predictive distributions, percentiles from industry distributions, insights from PRAs, rate-of-change of the trend, expert panel input, modification of current ROP thresholds.

There, for instance, some people have suggested that we take a percentage of, say, the green/white threshold and use that for an industry trend threshold.

Integrated risk measure concept being developed in the enhanced PIs that was talked about today. That's an idea that we may use for some of these, but we'll see how that develops and comes along, and that. That may be applicable for rolling up some of the indicators like initiating events or something. Or a combination of all of those.

Technical questions that we are considering are how many years should be included in a trend. For instance, if we look at this one here, certainly this trend right here is certainly driven by the early years. If we take something in a shorter interval, that model changes and the prediction interval changes there.

MR. WALLIS: With all of these things fit a very simple expediential --

MR. RASMUSON: This particular model here is strictly a linear one. This is an expedient model here.

MR. WALLIS: Yes.

MR. APOSTOLAKIS: So if they look at the last 6, 7 years, they really have a horizontal line, don't they?

MR. RASMUSON: They have a horizontal line. And so that's one of the questions that we're interested in looking at there.

What level is appropriate for reporting to Congress.

What level is reported for the agency action to an adverse trend or the start of one.

How should some of the PIs be grouped. We have initiating events, should we group all of those into one over -- say super indicator or something and use that for reporting to Congress and then maybe trend some of the other things that maybe don't occur as frequently, such as steam generator tube ruptures. Certainly we can have information from looking at some of these lower level initiating events or characteristics that can help us an agency.

How does the safety goal influence setting thresholds or should it?

And should the concepts in Reg. Guide

1.174 be used in setting thresholds, if they're applicable.

Those are some of the questions that we're kicking around right now and moving forward on. And so those are the types of things that we're doing.

MR. BARANOWSKY: So it's early and we've just really started this, but there's a lot of questions that we've raised and we're going to be soliciting information. And I think the expert panel approach is something that we wanted to mention here.

MR. WALLIS: One thing that will keep you alive is if you have a requirement that every year you introduce one new PI and discharge one old one. Because existence of PIs themselves conditions the sort of behavior in management of a plant to some extent, which means that something else may be forgotten. So if you force every year to bring in a new PI, you have to think about what's important that you haven't been trending.

MR. KRESS: You've got to have four years for a good trend, so by then it's --

MR. WALLIS: Yes.

MR. SHACK: I missed, what was the time frame for this? I mean, when do you plan to have at least a preliminary version of this in place?

MR. BOYCE: Well, of course, the AEOD indicators and the ASP program are ongoing. Personally I'd like to do it sooner rather than later because I think it's just a question of when we get an up-tic that we'll be explaining to Congress and having to fully understand the safety significance, which isn't easy when you're just dealing with numbers being submitted.

And so I'm asking research to go as rapidly as possible. I think it's going to take maybe to the end of FY 03 before we're able to do it.

MR. SHACK: It's that kind of time frame you're talking about?

MR. BOYCE: Yes.

CHAIRMAN BONACA: This was actually on the line of -- you know, when you come up next week it would be interesting to have a time line for -- you know, you mentioned before, Pat, that you were planning to have a couple of more updates to us as you get progress going.

MR. BARANOWSKY: Yes. Yes, we were going to put together some tentative dates on what would happen with that. But our plan is to come back here at least a few times before to change this up.

MR. APOSTOLAKIS: Actually, I was about to recommend that once you have, you know, a couple of ideas as to how to proceed on each of the questions, it would be a good idea to have a Subcommittee meeting. I mean, if you are interested in getting our feedback. Because if you get it after you invest a year and a half into it, it's kind of late.

MR. BARANOWSKY: Okay. I think we want to look at some concepts, try some things out showing you what it looks like. And then show you what it looks like and solve, and you tell us what other problems we missed.

MR. APOSTOLAKIS: So you're going to show us the approximations?

MR. BARANOWSKY: Yes.

MR. SATORIUS: We could probably have some of those dates, Pat, I think put together for the Committee briefing next week, don't you think?

MR. BARANOWSKY: I think so.

MR. SATORIUS: Okay.

MR. RANSOM: IS there anything to be learned from other maturing industries, you know, in terms of what could be expected? I mean, because there are obviously reflecting learning curves that go with time and I think there is quite a bit of information available, isn't there? My idea would be you never can set zero as the goal, so there's got to be some realistic expectation on where these things can go.

MR. BARANOWSKY: But there's two things that happen. It's true that people manage the indicators. I mean, that's a well known thing.

And the second thing is lessons that were learned long ago that caused people to fix things tend to be forgotten after a period of time when they don't appear to be important anymore. Sol those kind of things have to show up.

But managing the indicators is an issue for sure.

MR. APOSTOLAKIS: Does the airline industry have anything like this?

MR. SATORIUS: Or the railroad industry? I mean, that's probably --

MR. BOYCE: I don't think we've taken a really hard look at that. You know, some of this, again we're only a year and a half into this program. Some of it is you got to be able to be consistent with like WANO indicators, which worldwide plants -- everybody contributes to that system. And so if we come up with new ideas, it's got -- we're trying to work within the worldwide framework. And INPO has got its ideas. And so we're trying to work so far within that sort of existing framework. But I think there might be some value in doing a compare and contrast.

MR. WALLIS: I'm not being factious about bringing in new indicators. It seems to me that after a while there may be so few unplanned SCRAMs it doesn't mean anything, it makes no sense anymore. And something else is going to be much more significant and you ought to look at it.

MR. RASMUSON: For example, I mean this is sort of the yearly distribution of unplanned SCRAMs. And starting over here you can see how it's quite flat and here that it's tightened up.

Another way of looking at that is to look -- just plot it by year. This is the total number of plants. This one right here is plants with two or more SCRAM. This one is with one SCRAM only, and this is with no SCRAMs. And you can see how the industry has improved in that.

I mean, just looking at some of these things you sort of see as you get in and cut the data a little bit different, you sort of see that, hey, you know, the industry has learned some things. And maybe we ought to replace this one. I don't know.

MR. SATORIUS: From a historical

perspective, we choose SCRAMs and unplanned power changes because our history had taught us from monitoring these plants in the past that typically plants that are changing power often or are SCRAMing often have other problems, whether it be maintenance, whether it be operational. But they were good indicators of plants that were having problems.

MR. ROSEN: Did Davis Besse change power often?

MR. SATORIUS: I don't know.

MR. APOSTOLAKIS: See, that's why Graham's point becomes irrelevant now. Because now we have to look for a new indicator.

MR. BOYCE: Yes. I would just add -- I mean, I think that's an intriguing thought. I would just add that at least as we're bringing on 18 ROP indicators on line at the industry level. And so those are still relatively new. So, you know, at least for a couple of years I think we're bringing in new stuff.

MR. APOSTOLAKIS: I think there is no question that for the indicators on which we have focused in the past the trends are the right ones. So what we're saying now with the new incident is, you know, do we have a complete set. Is there something that we're leaving out.

MR. WALLIS: And are there some other possible indicators for which the trends are bad?

MR. APOSTOLAKIS: Yes. Exactly. Exactly.

MR. BOYCE: And then the other point I was going to add, remember this is a voluntary program for the ROP PIs to submit data. And we don't have unlimited access to unlimited data.

MR. APOSTOLAKIS: Yes.

MR. BOYCE: And so anything we do, you know, we're relying on existing sources because it's hard to justify just for the sake of data asking licensees to collect and submit it. And so we're reviewing LERs as one of our sources of data. We're trying to leverage the ROP PIs, and we're trying to also go to the EPICs IMPO realm.

But all I'm doing is telling you some of the problems that we're facing. I think your idea is intriguing in trying to change them.

MR. WALLIS: I think the licensees themselves should be sources of PIs. It doesn't have to be something you know about. I mean, if they observe themselves that something else is a better indication of the state of their plant, they ought to be willing to upgrade it to a PI eventually.

CHAIRMAN BONACA: And they trend a lot of things and you can really see what's going on.

MR. ROSEN: Open corrective maintenance items that don't require an outage to correct. That's just a measure of what they're not getting to, even though they could. I mean, there's a whole lot of different things that licensees watch that are not in this program.

MR. SATORIUS: I'll add, too, that we provided a paper to the Commission I think in the January time frame where we had gave some historical perspectives and also acknowledged that we've worked with some of our international colleagues and looked at some of the performance indicators that some of our international colleagues are tracking. And they look at things, Steve, similar to what you had noted yourself that are outside of the scope of what we're looking at. And we're mindful of those and are aware of those, and work with NEI and industry on developing different looks and different PIs.

MR. KRESS: I think your threshold idea is good because you don't want to be reporting things that aren't statistically significant trends.

I think the words "statistically significant" ought to be a strong input into your thinking on thresholds, which implies to me you need a distribution of the trends and use standard statistical measures of what's a significant change in a distribution.

I'm very skeptical of trying to tie it to risk at all for these things. I think you're going to have the same problem we had with the plant specific ones.

I think safety goals would be useless to you here. I can't see any way you can factor them into your thinking at all.

So, I would think in terms of statistical significance based on actual data and get a threshold that is from your thinking there that says this thing is beyond what we expect for the random variations and it wouldn't necessarily risk significant at all, but it's an indicator of statistical change in the industry's distribution.

MR. BARANOWSKY: One of the other things that we were thinking about doing, you know with the SCRAMs right now we have like, say three is the ROP number. But not all SCRAMs are equally important. And the three is based on them having about the same importance. So look at this list of initiating events.

You have a wide variation in the safety

significance of these things. The indicator might somehow take into account and you may end up coming with a different type of indicator that drops it down a notch to catch the most risk significant ones, and that's the kind of thinking we're trying to do.

MR. APOSTOLAKIS: Right.

MR. BARANOWSKY: Which changes the indicator, as you were saying, from a simple a beans to something else, although it's in essence trying to count the same thing.

MR. APOSTOLAKIS: I think our letter on the ROP, though, is relevant. So maybe you should consult it. In October, was it?

CHAIRMAN BONACA: So how much time do we have allowed for doing this ACRS meeting?

MR. CRONENBERG: An hour and a half I believe.

CHAIRMAN BONACA: One hour and a half. So clearly you would want to take -- well, handle this equation. I don't know what the agreement was. I mean, if you bring them up, there have to be a way to deal with them. We don't --

INTERVIEWER: Yes, sir, we understand our challenge.

MR. KRESS: You know, everybody's here but two members. And I don't think you'll get the same question on those. We've already -- so I think you'll be all right with it.

MR. BARANOWSKY: I mean, this was an information briefing, both of them, by the way. Because we have quite a bit of work to do as we go on the road. So --

CHAIRMAN BONACA: So we will expect a letter.

Any other questions of this program? That was an interesting update, and I appreciate it personally.

If not, the meeting is adjourned.

(Whereupon, at 5:10 p.m. the meeting was adjourned.)

CERTIFICATE

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

Name of Proceeding: Advisory Committee on Reactor Safeguards Subcommittees on Reliability and Probabalistic Risk Assessment and Plant Operations

Docket Number: N/A

Location: Rockville, Maryland

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

/s/ Debra Wilensky

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

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
SUBCOMMITTEES ON RELIABILITY & PROBABILISTIC RISK ASSESSMENT and PLANT OPERATIONS: *DEVELOPMENT OF RELIABILITY/AVAILABILITY PERFORMANCE INDICATORS & THE INDUSTRY TRENDS PROGRAM*
MAY 30, 2002
ROCKVILLE, MARYLAND

- PROPOSED AGENDA -

	TOPIC	PRESENTER	TIME	
I.	ACRS Introduction	Bonaca/Sieber ACRS	5 min	1:00 - 1:05 pm
II.	NRC Staff Presentation		2:25 hr	1:05 - 3:30 pm.
	Introduction - overview & meeting objectives	P. Baranowsky, RES	10 min	1:05 - 1:15 pm
	ROP Pilot for MSPI - description & objectives - scope & schedule - measures of success	M. Satorius, NRR J. Thompson, NRR	30 min	1:15 - 1:45 pm
	MSPI Technical discussion - algorithms for MSPIs - Fussel-Vesely approach - data and data treatment - studies and opens issues	H. Hamzehee, RES	45 min	1:45 - 2:30 pm
	....**BREAK**.............................		15 min	2:30 - 2:45 pm
	Industry Trends Program (ITP) - description, process, results	T. Boyce, NRR	15 min	2:45 - 3:00 pm
	Industry Trends Program (ITP) - policy & philosophy - scope of data and indicators - technical approaches - statistical methods - related methods	D. Rasmuson, RES	30 min	3:00 - 3:30 pm
III.	Committee Discussion		30 min	3:30 - 5:00 pm

Development of Thresholds for Industry Trends

Dale M. Rasmuson
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission

May 30, 2002

Purpose of Presentation

- To share with the ACRS our thoughts about threshold characteristics
- To explain the technical approaches we have identified to establish thresholds
- To receive any ideas or suggestions that we should consider in the threshold development

May 30, 2002 Industry Trend Thresholds 2

Industry Trends

- The particular trends are the following:
  - Initiating Events
  - Common-Cause Failures
  - Accident Sequence Precursors
  - System Performance
  - Reactor Oversight Process PIs
  - Fire Events
  - Component Performance

Industry Trend Thresholds

- RES is developing industry trend thresholds for use in a risk-informed regulatory framework.

- Industry thresholds differ from plant-specific thresholds.

Plant-Specific Thresholds versus Industry Thresholds

- Combining plant-specific thresholds may not be meaningful for industry thresholds
  - Unplanned scram green/white threshold = 3 unplanned scrams per reactor
  - This implies an industry threshold of 300 unplanned scrams per year based on 100 reactors
- Industry thresholds must consider the industry performance as well as other factors
  - Industry unplanned scram average is about 0.6 scrams per reactor per year.

May 30, 2002 Industry Trend Thresholds 5

Kinds of Thresholds

- Action Threshold
  - Used to measure industry performance, similar to thresholds used in ROP process
- Early-Warning Threshold
  - Used to alert NRC to a change in industry trends that may indicate a change in industry safety performance

May 30, 2002 Industry Trend Thresholds 6

Threshold Characteristics

- Thresholds should have a rational basis that is well documented.
- Thresholds should be practical, that is, possible to determine and compare from data or other means with modest effort.
- Thresholds should be conceptually simple.
- Thresholds should be consistent with the existing regulatory framework.
- Thresholds should reflect risk (including associated uncertainties), safety, and regulatory perspectives.

May 30, 2002 Industry Trend Thresholds 7

Protocol for Setting Thresholds

- Develop risk and statistical information related to trends for input to an expert panel
- Provide associated safety and regulatory information for expert panel
- Expert panel sets thresholds based upon input and expert judgment

May 30, 2002 Industry Trend Thresholds 8

Inputs for Expert Panel

- Start with values for the ROP indicators, values from risk-based performance indicator report, and/or risk insights from PRAs
- Assess current industry performance (e.g., trend, average)
- Estimate trend statistical characteristics (e.g., prediction intervals, Bayesian predictive distribution)
- Using these inputs pick a feasible value for the threshold
- Evaluate the threshold's risk implications using selected SPAR models, if appropriate
- Suggest threshold values based on principles from the threshold characteristics

May 30, 2002 Industry Trend Thresholds 9

Technical Approaches to Estimating Trend Thresholds

- Prediction Limits
- Bayesian Predictive Distribution
- Percentiles from Industry Distributions
- Insights from PRAs
- Rate-of-Change of Trend
- Expert Panel Input
- Modification of Current ROP PI Thresholds
- Combine Plant-specific Thresholds
- Integrated risk measure concept being developed for the enhanced PIs
- Combination of the above

May 30, 2002 Industry Trend Thresholds 10

Technical Questions

- How many years should be included in the estimation of a trend?
- What level is appropriate for reporting to Congress?
- What level is appropriate for agency action to an adverse trend?
- Should some of the PIs be grouped?
- How does the safety goal influence setting thresholds?
- Should concepts in Reg. Guide 1.174 be used in setting thresholds?

REVISED OVERSIGHT PROCESS PERFORMANCE INDICATOR PILOT PROGRAM

MITIGATING SYSTEM PERFORMANCE INDEX

PRESENTATION TO ACRS SUBCOMMITTEE ON PRA

John Thompson (415-1011)
Office of Nuclear Reactor Regulation
Hossein G. Hamzehee (415-6228)
Office of Nuclear Regulatory Research

May 30, 2002

REVISED OVERSIGHT PROCESS PERFORMANCE INDICATOR PILOT MITIGATING SYSTEM PERFORMANCE INDEX

BACKGROUND

- SECY 99-007 ADDRESSED THE NEED TO FURTHER REFINE USE OF PIs BY DEVELOPING RBPIs
- DURING THE FIRST TWO YEARS OF INITIAL ROP IMPLEMENTATION, STAFF AND INDUSTRY IDENTIFIED PROBLEMS WITH CURRENT SSU PI AND MADE SEVERAL CHANGES
- SSU PI PROBLEMS DISCUSSED AT REGULAR SSU PI WORKING GROUP MEETING IN SPRING, 2001
- DECISION MADE TO FORM A SPECIAL SSU WORKING GROUP TO ADDRESS A POTENTIAL PI REPLACEMENT FOR THE SSU PI
- ACRS BRIEFED IN 2001 ON STAFF EFFORTS TO DEVELOP RBPIs
- MSPI PILOT IS AN EVOLUTIONARY STEP TOWARDS ENHANCED PI DEVELOPMENT

PROBLEMS WITH CURRENT SSU PI

- RISK INSIGHTS ARE NOT ACCOUNTED FOR WITH USE OF DESIGN-BASIS FUNCTIONS
- SSU PI THRESHOLDS NOT PLANT-SPECIFIC OR RISK MANAGED
- DEMANDS AND DEMAND FAILURES NOT PROPERLY ACCOUNTED FOR
- USE OF FAULT EXPOSURE HOURS CAN OVER ESTIMATE THE SIGNIFICANCE AND RESULT IN A PI THAT CAN NO LONGER MEASURE FURTHER DEGRADATION OF PERFORMANCE
- CASCADING OF SUPPORT SYSTEM UNAVAILABILITY TO THE MONITORED SYSTEM UNAVAILABILITY OVERSTATES THE ACTUAL UNAVAILABILITY OF THE MONITORED SYSTEM

OBJECTIVES OF THE MSPI PILOT PROGRAM

- TO CREATE A BETTER AND MORE ACCURATE INDICATOR OF PERFORMANCE THAT ADDS MORE VALUE AND SOLVES THE KNOWN PROBLEMS WITHOUT ADDING UNDUE BURDEN
- TO CALCULATE THE REVISED UNAVAILABILITY AND UNRELIABILITY PI VALUES AND TO COMPARE THE RESULTS TO THE EXISTING SSU PI DATA TO ASCERTAIN WHETHER THE PROPOSED CHANGES ADDRESS THE EXISTING CONCERNS AND SUIT THE NEEDS OF THE ROP
- TO MINIMIZE TO THE EXTENT PRACTICABLE THE DIFFERENCES AND INCREASE THE CONSISTENCY BETWEEN THE MSPI, MAINTENANCE RULE, PRA, AND SDP
- TO EXERCISE THE MSPI DATA REPORTING MECHANICS AND CALCULATIONAL METHODOLOGY
- TO IDENTIFY ANY UNINTENDED CONSEQUENCES AND ASSESS THE IMPACT

QUESTIONS TO BE RESOLVED DURING THE PILOT

- Is the MSPI an equivalent or better indicator of risk than using the SDP such that the staff need only to rely on the MSPI for the risk significance characterization?
- Is the MSPI methodology more consistent with the maintenance rule and other risk assessment policies?
- Can the NRC inspect and verify the pilot MSPI without major problems?
- Can pilot licensees implement the MSPI with no major problems by the end of the pilot period?
- Do pilot participants believe the guidance is clear and easy to implement?
- What is the change in staff/licensee PI data collection/reporting resource burden?
- If it is an increase in burden, do the benefits (solves the known problems) justify the increase resource expenditure?
- Are there any unintended consequences, and if so, are they acceptable ?

OVERVIEW OF THE MSPI

- MSPI IS COMPRISED OF THE 4 EXISTING SSU PI SYSTEMS PLUS THEIR SUPPORT COOLING SYSTEMS AS MONITORED SYSTEMS
- THE MSPI IS A 12 QUARTER ROLLING AVERAGE OF THE UNAVAILABILITY AND THE UNRELIABILITY OF A MONITORED SYSTEM, CALCULATED IN RELATIVE TERMS OF ΔCDF.
- MSPI INCORPORATES PLANT-SPECIFIC MODELS AND USES DATA TO CALCULATE CDF index.
- MSPI THRESHOLDS WERE DEVELOPED USING STANDARD RISK INSIGHTS AND ARE DEFINED AT 1E-6 (GREEN/WHITE); 1E-5 (WHITE/YELLOW), AND 1E-4 (YELLOW/RED) CDF_{INDEX}
- DISCOVERED CONDITIONS THAT PREVENT FULFILLMENT OF THE SAFETY FUNCTION WILL BE ACCOUNTED FOR IN THE UNRELIABILITY PIs

PLANTS PARTICIPATING IN THE PILOT MSPI

Region I	Region II	Region III	Region IV
Limerick 1/2	Surry 1/2	Braidwood 1/2	Cooper
Millstone 2/3		Prairie Island 1/2	Palo Verde 1/2/3
Hope Creek			San Onofre 2/3
Salem1/2			South Texas 1/2

LIST OF MSPI MONITORED SYSTEMS

BWRs	PWRs
HPCI/HPCS (high pressure core injection/spray)	HPSI (high pressure safety injection)
RCIC (reactor core isolation cooling)	AFW (auxillary feedwater or equivalent)
RHR (residual heat removal)	RHR (residual heat removal)
EDGs (Emergency AC Power)	EDGs (emergency AC power)
Support System Cooling (ESW + RBCCW + TBCCW)	Support System Cooling (ESW + CCW)(or equivalent)

MSPI UNAVAILABILITY

- MSPI UNAVAILABILITY IS THE SUM OF THE PLANNED AND UNPLANNED (CORRECTIVE) UNAVAILABILITY, REPORTED BY TRAIN

- MSPI TRAIN UNAVAILABILITY IS THE RATIO OF HOURS THAT THE TRAIN WAS UNAVAILABLE TO PERFORM ITS RISK-SIGNIFICANT FUNCTION(S) (DUE TO PLANNED/CORRECTIVE MAINTENANCE OR TESTING DURING THE PREVIOUS 12 QUARTERS WITH THE REACTOR CRITICAL) TO THE NUMBER OF CRITICAL HOURS THAT THE TRAIN WAS REQUIRED TO BE AVAILABLE

MSPI UNRELIABILITY

- MSPI UNRELIABILITY IS A MEASURE OF THE DEMAND FAILURE PROBABILITY OF THE MONITORED SYSTEM AND FAILURE PROBABILITY DURING A MISSION TIME.

- MSPI COMPONENT UNRELIABILITY IS THE FAILURE ON DEMAND PROBABILITY THAT THE SYSTEM WOULD NOT PERFORM ITS RISK-SIGNIFICANT FUNCTION(S) WHEN CALLED UPON DURING THE PREVIOUS 12 QUARTERS

IMPLEMENTATION SCHEDULE

JULY 23-25, 2002	PUBLIC WORKSHOP TO PREPARE FOR LAUNCH OF THE MSPI PILOT
AUGUST 1, 2002	START OF MSPI PILOT
NOVEMBER, 2002	BRIEF ACRS SUBCOMMITTEE ON PILOT PROGRESS
FEBRUARY, 2003	MSPI PILOT DATA COLLECTION ENDS. START OF THE ANALYSIS PERIOD TO ANALYZE COLLECTED DATA
MARCH, 2003	BRIEF ACRS SUBCOMMITTEE ON PILOT PROGRESS
JULY, 2003	END OF PILOT. RIS TO COMMUNICATE PILOT RESULTS

MSPI Technical Discussion

- The purpose of this presentation is to describe the technical aspects of the Mitigating System Performance Index (MSPI).

- This presentation will include:

  - Summary of insights from Phase-1 RBPI study
  - Technical aspects of MSPI approach
  - Conclusions

MSPI Technical Discussion

Insights From Phase-1 RBPI Study:

- There were enough risk-significant differences among different plants that necessitated the development of plant-specific thresholds for unavailability and unreliability PIs.
  - MSPI accounts for plant-specific differences
- Unavailability and unreliability indicators were found to provide objective and risk-informed indications of plant performance. They also provide broader risk coverage.
  - They were tested by evaluating plant-specific data for 44 plants over three-year period (1997-1999).

MSPI Technical Discussion

Insights From Phase-1 RBPI Study (cont'd):

- Performance indicators for CCW and SSW (or their equivalent) support systems were found to be difficult to develop due to the wide variation of plant-specific design features.
  - Based on the technical analyses performed by NRC/industry, an approach has been developed for the pilot.
- Use of Bayesian update for estimating component unreliability was found to minimize the likelihood of false-positive/false-negative indications.

Technical Aspects of MSPI Approach

Concepts:

- Mitigating System Performance Index monitors risk impact (i.e., change in CDF) of changes in performance of selected mitigating systems.

- MSPI includes Level-I, internal events for at-power mode, which is consistent with the scope of the current ROP PIs.

- MSPI consist of two elements, system unavailability and system unreliability. MSPI is the sum of changes in a simplified CDF evaluation resulting from changes in system unavailability and system unreliability relative to baseline values.

  - Baseline values are based on SECY-99-007 concepts.

Technical Aspects of MSPI Approach

Concepts (cont'd):

- The risk impact of changes in mitigating system performance on plant-specific CDF is estimated using plant-specific performance data and Fussel-Vesely importance measure.

- Those aspects of mitigating system performance that are not covered by MSPI will be evaluated through inspection/SDP. Examples are:

  - CCFs
  - Concurrent failures of multiple components
  - Passive components outside the scope of MSPI
  - Demand failures not capable of being discovered during normal surveillance tests.

MSPI Technical Discussion

Scope of MSPI:

- For unreliability calculations, only active components within a system are included in the performance indicator.
  - Active components are those components within a system that are required to change state upon demand in order for the system to perform its risk-significant functions; e.g., normally closed valve that must open on demand to allow flow through the system.
  - All pumps and diesels in the monitored systems are considered as active components.
  - Active failures of check valves are excluded from performance indicators and will be included in the inspection program.
  - Redundant valves within a train are not included in the performance indicators. PRA success criteria are used to identify those valves.

Scope of MSPI (cont'd):

- Component boundaries are generally consistent with those used in PRAs.
  - For example, the motor-driven pump boundary includes pump body, motor/actuator, lubrication system cooling components of pump seals, breaker, and its associated local control circuit.
- SDP will be used for performance areas outside the scope of MSPI:
  - CCFs
  - Concurrent failures of multiple components
  - Passive components
  - Demand failures not capable of being discovered during normal surveillance tests.

MSPI Technical Discussion

Equations:

MSPI for each monitored system is calculated as follows:

$$\mathbf{MSPI = UAI + URI} \qquad (1)$$

UAI: system unavailability index due to changes in train unavailability
URI: system unreliability index due to changes in component unreliability

System Unavailability Index (UAI):

$$\mathbf{UAI = \Sigma UAI_t} \qquad (2)$$

Where: the summation is over the number of trains in the system.
UAI_t is unavailability index for train t

$$\mathbf{UAI_t = CDF_P\,(FV_{UAP}/\,UA_P)(UA_t - UA_{BLt})} \qquad (3)$$

CDF_P :	plant-specific, internal events, at-power Core Damage Frequency
FV_{UAP} :	train-specific Fussel-Vesely value for unavailability based on plant-specific PRA
UA_P :	value of unavailability for train t from plant-specific PRA
UA_t:	actual unavailability of train t during previous12 quarters
UA_{BLt}:	baseline unavailability value for train t

MSPI Technical Discussion

Equations (cont'd):

System Unreliability Index (URI):

$$URI = CDF_P \Sigma [(FV_{URC}/UR_{PC})(UR_{BC} - UR_{BLC})] \qquad (4)$$

Where the summation is over the number of active components in the system

CDF_P:	plant-specific internal events, at power, Core Damage Frequency
FV_{URC}:	component Fussel-Vesely value for unreliability based on plant-specific PRA
UR_{PC}:	value of component unreliability from plant-specific PRA
UR_{BC}:	Bayesian-updated component unreliability for previous12 quarters
UR_{BLC}:	baseline unreliability value for each active component in the monitored system

UR_{BC} (Component unreliability) is calculated as follows:

$$UR_{BC} = P_D + \lambda T_m \qquad (5)$$

P_D:	component failure on demand probability based on data for previous 12 quarters
λ:	component failure rate (per hr) for failure to run based on data for previous 12 quarters
T_m:	mission time for the component based on plant-specific PRA assumptions

$$P_D = (N_d+a)/(D+a+ b) \qquad (5a) \qquad\qquad \lambda = (N_r+a)/(T_r+b) \qquad (5b)$$

MSPI Technical Discussion

Equations (cont'd):

N_d:	total number of failures on demand during the previous 12 quarters
D:	total number of demands during the previous 12 quarters
N_r:	total number of failures to run during the previous 12 quarters
T_r:	total number of run hours during the previous 12 quarters
a, b:	parameters of industry priors derived from industry experience

MSPI Technical Discussion

Key Data Elements:

- Baseline unavailability data:
  - Planned unavailability values are based on actual plant-specific values from 1999 through 2001.
  - Unplanned unavailability values are based on ROP PI data from 1999 through 2001.
  - Initial study indicated that these values are consistent with 1995-1997 data, and they will be validated during the pilot.

- Baseline unreliability values are based on component/system reliability studies
  - NUREG/CR-5500
  - Generally cover performance data from 1987 through 1995
  - These values will be updated when reliability studies through 1997 become available.

MSPI Technical Discussion

Key Data Elements (cont'd):

- Constrained, non-informative priors based on the mean of the industry performance were used for component unreliability calculations.
  - These priors minimize likelihood of false-positive/false-negative indications.

MSPI Technical Discussion

Technical Areas Currently Under Evaluation:

- Acceptable level of false-positive/false-negative indication.
  - P(W/baseline)
  - P(G/W-Y)
  - P(G/Y-R)
- Issues related to data that were used to set baseline unavailability and unreliability values.
- Independent calculations using SPAR models versus licensees PRA models.
- Evaluations of potential differences between MSPI and SDP results.

MSPI Technical Discussion

Conclusions:

- The MSPI approach is based on risk insights. It accounts for plant-specific design/operating characteristics through the use of available risk models and data.
  - Use of F-V importance measures to account for plant-specific features.
  - Treatment of demand failures in unreliability indicators.
  - Use of Bayesian update for unreliability indicators.
  - Use of risk-significant functions rather than design-basis functions.
  - Use of a new indicator for cooling water support systems.

- The MSPI approach allows for balancing between component unreliability and unavailability consistent with the Maintenance Rule.

- The MSPI provides more objective indication of plant performance, and will provide broader risk coverage.

- The limitations of MSPI have clearly been identified, and will be covered through inspections/SDP.

- The MSPI provides appropriate risk-categorization of performance degradations that are covered by PIs.

ACRS BRIEFING ON

INDUSTRY TRENDS PROGRAM (ITP)

May 30, 2002

Introduction

- Background
- Purposes and Role of ITP
- Communications
- Concepts and Approach
- Process for Industry Trends
- FY 2001 Results
- Threshold Development

Background

- Improving industry trends contributed to decision to revise ROP

- Strategic Plan performance goal measure of "No statistically significant adverse industry trends in safety performance" - annual report to Congress as part of NRC's Performance and Accountability Report

- Responsibility assigned to NRR from RES in late 2000

- NRR developed formal ITP in 2001
  - Initially used indicators from former AEOD PI and Accident Sequence Precursor (ASP) programs
  - Reports in SECY-01-0111 (6/2001) and SECY-02-0058 (4/2002)

- No adverse industry trends identified to date

Purposes and Role of ITP

- Purposes:

  (1) Provide a means to confirm that the nuclear industry is maintaining the safety performance of operating reactors

  (2) By clearly communicating industry performance, enhance stakeholder confidence in the efficacy of the NRC's processes

- Complements existing NRC processes:

  (1) Plant-specific oversight by ROP

  (2) Processes for addressing generic issues (i.e., generic communications process in NRR and generic safety issues process in RES)

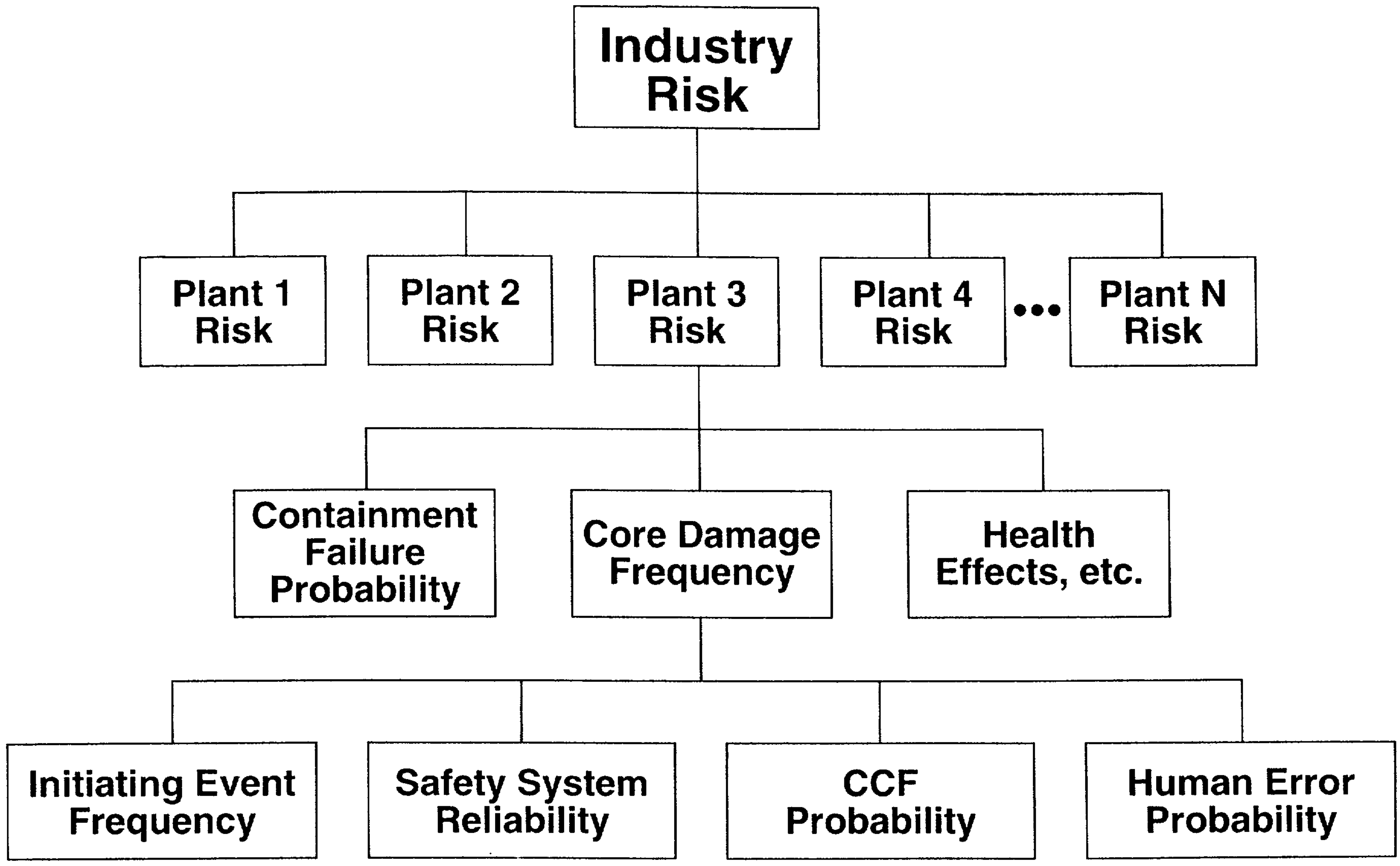
Communications

- Ongoing development efforts briefed to NRC/industry working group on ROP
- Industry indicators published on NRC web site
- Annual review at AARM and report to Commission
- Annual report to Congress in NRC Performance and Accountability Report
- Conferences with Industry

Concepts and Approach

- Hierarchal approach to use of industry indicators
  - Qualified set of indicators used for reporting to Congress
  - Indicators may be "decomposed" into multiple indicators to investigate any trends
- Used existing programs for initial set of indicators
  - ex-AEOD indicators
  - ASP program
- Developing additional industry indicators for each cornerstone of safety
  - PIs derived from plant-level PIs in ROP
  - PIs from operating experience data (initiating events and reliability PIs)

A DECOMPOSITION OF REACTOR RISK



Process for Industry Trends

- Identify any statistically significant adverse trends in industry indicators
  - Statistically significant fit of a trendline to each indicator
  - Improving or flat trendlines = no adverse trend => done
  - Degrading trendlines = adverse => report to Congress & initiate evaluation
  - In addition, to investigate short-term variations before they become trends, single data point above prediction limit => initiate evaluation

- Evaluate underlying issues and assess safety significance
  - Decompose indicators and look for outliers
  - If appropriate, review of LERs and inspection reports

- Agency response IAW existing NRC processes for generic issues
  - Early engagement with industry and assessment of issues
  - Responses could include industry initiatives and requests for information
  - NRC may conduct generic safety inspections

- Review at AARM

FY 2001 Results

- No statistically significant adverse industry trends in safety performance identified in FY 2001
  - Ex-AEOD indicators show flat or improving trendlines
  - ASP program shows overall improving trends and no significant precursors (SECY-02-0041)
- Insufficient data (<4 years) on ROP indicators for long term trending in FY 2001 (however, no issues identified by inspection of short term data)
- Industry indicators for initiating events developed; no statistically significant adverse trends identified

Threshold Development

- SRM in August 2001 directed staff to develop risk-informed thresholds for industry indicators “as soon as practicable”
  - NRR tasked RES to develop risk-informed thresholds for initiating events, mitigating systems, and ASP
  - NRR to develop thresholds for other cornerstones of safety
  - Stakeholders, including ACRS, will be engaged as thresholds are developed over next 1-2 years
- ROP indicators may have long term data (>4 years) in FY 2002; NRR evaluating efficacy of early “best estimate” data and may qualify for use in FY 2003
- Threshold development may allow changes to performance goal measure so that agency response based on thresholds vice trends