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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

June 15, 2005

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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JOINT MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

SUBCOMMITTEES ON RELIABILITY & PROBABILISTIC

RISK ASSESSMENT & PLANT OPERATIONS

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WEDNESDAY, JUNE 15, 2005

ROCKVILLE, MARYLAND

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The Subcommittees met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., George E. Apostolakis, Chairman, presiding.

COMMITTEE MEMBERS:

GEORGE E. APOSTOLAKIS, Chairman

MARIO V. BONACA, Member

THOMAS S. KRESS, Member

WILLIAM J. SHACK, Member

ACRS STAFF PRESENT:

JOHN FLACK

JOHN G. LAMB

MICHAEL R. SNODDERLY

NRC STAFF PRESENT:

TOM BOYCE, NRR

JIN CHUNG, NRR

MARK REINHART, NRR

T.R. (BOB) TJADER, NRR

ALSO PRESENT:

BIFF BRADLEY, NEI

GARY CHUNG, SONGS

JOHN GAERTNER, EPRI

RICK GRANTOM, STP

WAYNE HARRISON, STP

GENE HUGHES, Exelon

JAY PHELPS, STP

MICHAEL PHILLIPS, Scientech LLC

JOHN STEINMETZ, Exelon

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

8:32 a.m.

CHAIRMAN APOSTOLAKIS: Ready? The meeting will now come to order. This is a joint meeting of the ACRS Subcommittees on Reliability and Probabilistic Risk Assessment and Plant Operations. I'm George Apostolakis, Chairman of the Subcommittee on Reliability and PRA. Members in attendance are Dr. Mario Bonaca, Dr. Tom Kress and Dr. William Shack.

The purpose of this meeting is to discuss the status of the Risk Management Technical Specifications Initiative 4b, which proposes to rely on PRA and risk monitors to calculate technical specification completion times for returning structure systems and components to operable studies. The subcommittees will gather information, analyze relevant issues and facts and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee.

Mr. Michael Snodderly is the designated federal official for this meeting and Mr. John Lamb of the ACRS Staff is in attendance to provide technical support.

The rules for participation in today's meeting have been announced as part of a notice of this meeting previously published in the Federal Register, 7 PFR 31547, on June 1, 2005. A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice. It is requested that the speakers first identify themselves, use one of the many microphones and speak with sufficient clarity and volume, so that they can be readily heard.

We have received no written comments or requests for time to make oral statements for members of the public today regarding this meeting. We will now proceed with the meeting and I call upon Mr. Tom Boyce of the Office of Nuclear Reactor Regulation to begin.

MR. TJADER: Thank you, Dr. Apostolakis. Tom Boyce, our tech spec section chief, is in the back here. I'll be giving the tech spec portion of the brief.

CHAIRMAN APOSTOLAKIS: Oh, okay.

MR. TJADER: Thank you for the introduction and having us today and good morning, ACRS Committee Members. I'm Bob Tjader of the Tech Spec Section. I coordinate the Risk Management Tech Spec reviews. To my left is Mark Reinhart of the NRR PRA Branch who will be giving a portion of the review, of the presentation.

About a year ago, we presented the status of Initiative 4b, an overview of Initiative 4b risk-informed completion times to you, and at that meeting, you requested additional information on PRA and configuration risk management monitors. This presentation is addressing that request.

We, on the staff, have no necessary requirements for a letter or any type of request from you, unless you so desire. The industry --

CHAIRMAN APOSTOLAKIS: You say you have no use for it?

MR. TJADER: No, we have no request.

CHAIRMAN APOSTOLAKIS: Oh, request.

MR. TJADER: No request. We always would have a use for it, I'm sure, if you deemed it essential to produce on. All licensees, to some extent, today utilize configuration risk monitors qualitatively or in a blended approach in their Maintenance Rule (a)(4) Risk Assessments. So they all do that to some extent. The licensees today will present what they currently -- how they currently utilize monitors and some will present how they anticipate utilizing the monitors in the Initiative 4b risk- informed completion time efforts.

Well, I will give an overview of Initiative 4b just as a reminder or a refresher of what exactly risk-informed completion times are. Mark Reinhart will give an overview of what we expect from PRA in the utilization of monitors for Initiative 4b. And then we will turn it over to Biff Bradley and the industry and they will present the monitors and how they utilize them and how they anticipate utilizing them.

The presenters from industry, there is a lot to go over, so we're going to try to get to the industry as quick as we possibly can, so they can present their monitors. Time permitting, they are willing to provide a demonstration of their monitors. They are basically going to describe their use and attributes and that sort of thing. And time permitting, at the end, and they are willing to stay later if necessary, if you want to see a demonstration of those, they will provide them.

An overview of the risk-informed completion times, tech specs have limited -- the specs have limiting conditions for operations. If you don't meet that, then you are in a condition of in which you don't meet it. And then if you are in that condition, then you have a required action or a set of required actions that have to be met within a certain completion time. These completion times have been determined in the past through engineering judgment and are established. They are inflexible.

What Initiative 4b will do is will allow a real-time calculation of plant configuration risk to determine what an appropriate completion time is if they don't -- if they anticipate they will not meet the front-stop of their -- or the existing completion time. They can extend that completion time up to a maximum of a backstop of 30 days. This project, the implementation of it is currently under development. It will include a decision-making process, implementation guidance, PRA requirements and risk metrics.

All these will be contained in a Risk Management Guidance Document, which we will incorporate into the specs in the Admin Control Section of the tech specs. Currently, there are four pilot plants. Two have made submittals, South Texas and Fort Calhoun, and there are two that we anticipate having -- giving us submittals at the end of the year after they upgrade their PRAs and that is Hope Creek and Prairie Island.

A quick example of how it would work.

I've showed this to you in the past, but this is just a refresher. There is the front-stop, as I mentioned. There is the configuration risk management calculated completion time, the backstop and then the risk assessment tools, which we will be briefing you on today, will provide results we hope in a timely manner, and the decision-making needs to be reliable.

Basically, this is an example of a system in which the current specs would have just B.1. The system is inoperable, take summary part actions, i.e., restore them to operable status in a period of time, 72 hours. If it is anticipated that, under 4b, you will not be able to restore the system within 72 hours, then you must conduct the B.2 set of required actions. B.2 is within the initial completion time, determine the appropriate risk-informed completion time, that you can extend the completion time to.

And B.2.2 states, basically, if there is a risk significant configuration change, the completion time needs to be recalculated within a timely manner, i.e., it's proposed 24 hours, it may be less, it may be 12 or something like that, that's under discussion. And then B.2.3 is the backstop, 30 days.

DR. BONACA: Before you move on just for

clarification.

MR. TJADER: Sure.

DR. BONACA: When you talk about a change in configuration, this can be initiated by the plant. I mean, it doesn't have to be something that happens there?

MR. TJADER: Right.

DR. BONACA: They may decide, for example, to take out the HPSI.

MR. TJADER: It could either be an emergent condition or a planned action.

DR. BONACA: Yes.

MR. TJADER: Yes.

DR. BONACA: Second action also could be wrong.

MR. TJADER: Right. If they think that is appropriate to change the plant configuration to accommodate other activities or something, then they will -- and it's risk significant and it affects the PRA, then they would recalculate the completion time and yes, it would either be emergent or planned.

DR. BONACA: Okay. Thank you.

MR. TJADER: Okay. I'm going to turn it over to Mark, so he can give a brief explanation of what is expected from the PRA in support of Initiative

4b.

MR. REINHART: Okay. The three pieces that really we need to support a flexible allowed outage time approach that would be a PRA configuration risk monitor, can you hear me, and a program, a process that is established approved. What we are going to focus on today, primarily, is that second piece, the configuration risk monitor. But we want to at least address the other two to put the context in place.

And the first piece, the PRA, the question comes up what are the capabilities, what is the quality you need? We had a series of workshops between the staff, industry, interested stakeholders, Trade Press, anybody who wanted to come and we -- our goal was to understand each other. What do you think we need and why? And out of that discussion, we really had a four day concentrated discussion. See, what's on the table right now is what's described up here.

What we are looking for in the capability is a PRA that's a level 1 and level 2. It would include internal events as well as external events, fire, flooding, seismic, severe weather. And the goal, the minimum for those, both those pieces, is that the PRA captures the impact, modeling it preferably, to quantify the risk-informed completion time.

DR. KRESS: And if you have a configuration risk monitor, what role does the PRA play? Isn't that what you use to capture the actual risk status?

MR. REINHART: That's what we're going to try to show in the main presentation here.

DR. KRESS: Okay.

MR. REINHART: How the PRA feeds the configuration risk monitor, if there's a difference at all.

DR. KRESS: Okay. I'll wait.

CHAIRMAN APOSTOLAKIS: So actually, what you need is really a PRA which can be calculated very quickly. And that's what the monitor does.

MR. REINHART: Yes, yes. And some will be precalculated, some will be calculated near real-time.

CHAIRMAN APOSTOLAKIS: Yes.

DR. KRESS: Is there such a thing as peer review for the risk monitors like you have for PRA?

MR. REINHART: That's proposed, yes, sir. And I think the industry is going to propose exactly what they anticipate to come in by saying here is how we're going to review it when you get your chance to review and staff. Overviewing that, looking at the level 1 and level 2, we're looking at modes 1 and 2, some of us would like all modes, some of us are trying to be practical and we're saying we need at least modes 1 and 2 with the assurance that all the modes are bounded.

Now, staff is still looking at shutdown. We're talking about it. But what we're saying is industry, if you can come in and show us with your mode 1 and 2 model, but somehow you are bounding all the modes that are applicable to the risk-informed completion time effort, we're going to consider that.

DR. SHACK: We're focusing on completion times here. Now, surveillance test intervals are also part of this, right?

MR. REINHART: That's 5b.

DR. SHACK: Yes.

MR. REINHART: This is 4b.

DR. SHACK: 4b, okay.

MR. REINHART: It's a different approach. But what we're talking about is going to, you know, someday be supportive of that.

DR. SHACK: Okay. Today we're just focusing on the 4b part?

MR. REINHART: Yes, sir. We're wanting to make sure all configuration changes are captured in this process.

DR. BONACA: Just to pursue the configuration changes, irrespective of where they are coming from, so there will be proper consideration of components out for surveillance test intervals?

MR. REINHART: Absolutely.

DR. BONACA: Okay.

MR. REINHART: What we are looking at in 5b is the frequency with which we perform the surveillance.

DR. BONACA: Yes.

MR. REINHART: But any time equipment comes out, whether it is surveillance test, maintenance, whatever reason, we turn it off to give it a rest, being somewhat lighthearted there. Whatever the change, the Configuration Risk Management Program needs to capture that, the licensee has to be aware of and manage that risk, whether it is a completion time or whatever else they are doing to manage that risk.

We're looking for all set significant sequences to be modeled. And when we get to standards that exist, we're expecting the safety category or the

Capability Category 2 or else a reason, a basis for why something else would apply. We expect that to be maintained current, obviously. The plant as it is today, if we're going to use the PRA to operate the plant today, we want it to perform.

The big thing to point out here is this is significant change. It's a significant change for the staff. It's a significant change for the licensees. We need to be ready. They need to be ready. There's going to be some inspection, learning curves here. We're going to have to have inspection procedures and process. The inspector in the control room is going to be in a little bit of a different environment. He has to be aware of that. And then the licensees more robust use of the PRA will be different from them.

Again, I mentioned the three points we need. We need the PRA, a sufficient quality capability. We need the process, the program. At another time, the industry is proposing what's called a Risk Management Guideline, which would have the basis for the program the industry would use. And again, we have the configuration risk management tool that will be the focus of what we talk about later on.

DR. KRESS: Now, when you talk about reliability of the configuration risk management tool, what I hear, when I think of reliability, one of the things I think of is uncertainty in the calculation of the risk that it puts out. Does uncertainty play any role in this process at all?

MR. REINHART: It does and we have asked and industry is prepared to address that today, I believe. They are smiling at me, so I think they are ready to do that.

CHAIRMAN APOSTOLAKIS: Did you say that the PRA has to be a Category 2 when compared to the ASME standard?

MR. REINHART: Yes, sir.

CHAIRMAN APOSTOLAKIS: Why are we talking again about the quality? I mean, does that define the quality?

MR. REINHART: It really does.

CHAIRMAN APOSTOLAKIS: Could you remind us what Category 2 is?

MR. TJADER: That's component level and Category 1 is systems. Category 2 takes it down to the component level.

CHAIRMAN APOSTOLAKIS: But you still do common cause failures, etcetera?

MR. TJADER: Absolutely. Right.

CHAIRMAN APOSTOLAKIS: And then what's

Category 3?

MR. TJADER: Category 3, I think, is a higher level of determination.

CHAIRMAN APOSTOLAKIS: Maybe Biff can --

MR. BRADLEY: Okay. Basically, our Capability Category 2 reflects the pretty much best practices of all the existing PRAs. We have a pretty major effort underway in the industry now to come up to Capability Level 2. No existing PRA in the U.S. meets the pretty high standard even at level 2. Basically, we find as an adequate for, you know, regulatory application. Capability Category 3 is more of a, you know, state of the art kind of model that really doesn't exist. It's more just a finding, a goal, I think, for what the ultimate PRA would be. But most -- practically all the regulatory applications we're pursuing 5069, 5046, this, all rely on Capability Category 2.

CHAIRMAN APOSTOLAKIS: And the peer review process is really focused on Category 2?

MR. BRADLEY: Correct. The Reg Guide 1.200 the entire focus on it is on Capability Category 2.

DR. SHACK: But again, that's all internal events.

MR. BRADLEY: That's right. That's the only standard that has been endorsed by NRC so far.

DR. SHACK: So the quality judgment on the rest of it is a more --

MR. BRADLEY: You know, for now we're in what we call phase 1/2 of the Commission Paper where if there is no standard, then the staff will need to use some other method to assure themselves of that.

MR. REINHART: I think we have kind of covered this slide really. But the point, what we're called is a "proof of concept" where we have to go beyond what Reg Guide 1.200 does and the standards that are in existence today, we're going to have to use a proof of concept type approach, which is going to be an additional burden on the staff to review. But we're going to have to do that and we will do that.

DR. KRESS: On one of your earlier slides of PRA capabilities you mentioned it could have external events, fire, floods, seismic, severe weather. Given the time frame for these configuration outages and completion times, do you really think it's necessary to have those external events as part of the PRA? Couldn't it be rationalized away because of the short time frame?

MR. REINHART: The word "rationalized" is interesting. I think we see significant risk from external events.

DR. KRESS: Yes, if you take the long-term view. But, you know, if you're talking about 20 day outages, the risk is probably acceptable, you know. You don't go into outages, unless you're going into outages when a hurricane is coming by.

MR. TJADER: Yes, I think that's what we mean by bounding type situations. If a plant can prove, i.e., that seismic doesn't apply to them, then the PRA wouldn't necessarily have to address it.

DR. KRESS: Well, I'm talking about the likelihood of having one of these events during this time.

CHAIRMAN APOSTOLAKIS: I thought the bounding analysis applied to other modes.

MR. TJADER: The bounding analysis can also apply to fire.

MR. REINHART: Maybe I can address it item by item. We said okay, floods, internal floods, most plants have done an internal flood any way, so that's there. The seismic, if a plant is in a significant seismic area, they have already done a seismic PRA and that is taken care of. A plant that is not in a high seismic area, we're willing to discuss to what extent that needs to apply.

DR. KRESS: But aren't you dealing with delta CDFs?

MR. REINHART: Yes.

DR. KRESS: And if you are, you know it's the delta. I understand where you have those things on the baseline.

MR. REINHART: Right.

DR. KRESS: But if you are looking at delta, I'm a little --

MR. REINHART: I think we're focusing on fire.

DR. KRESS: Well, fire maybe. That would be the one exception, I think, might have to be in there.

MR. REINHART: And I think we need to -- and like I say, flood is already there. Seismic, we think, it's either there or it's not if it's probably a basis and fire is really where we need to put most of our concentration.

DR. BONACA: Plus, I think, once this is implemented in many plants, you will have this happening many units are the simultaneously and you will have a significant impact on components out-of-service. And I don't know if the aggregate -- I mean, anyway I can see the point and that provides already the evaluation for -- where there is fire.

MR. REINHART: The final thing we did as a focus group, if you will, is we tried to identify the characteristics that we felt needed to be explained in going from the PRA to the configuration risk monitor. And this is a list of general areas that, I believe, we all agree should be addressed, and that's what we're going to turn it over to the industry to address now, is their configuration risk monitors, how they work and try to assure us all that they address the aspects they need to address. Thanks.

MR. TJADER: Biff Bradley will lead off the industry presentation.

MR. BRADLEY: I'm going to put John's up, even though he is next. All right. Good morning. I'm Biff Bradley from NEI. I'm primarily here just to introduce our industry participants today. I appreciate the introduction by Bob and Mark. I think they did a good job explaining the overall concept of Initiative 4b.

The industry has a tremendous amount of experience with configuration, risk management and safety monitors. It's going back to the original Maintenance Rule that was promulgated in 1995 and it was revised in 2000 to actually make a regulatory requirement to assess and manage risk. But, in effect, all plants have been doing it since the original rule in '95. So we have about 10 years industry-wide experience and I think you will see when we present these tools, these are pretty sophisticated tools. There has been a tremendous amount of effort put into these tools.

We're going to have three plants, three companies discuss their particular tools. These are three different types of tools. First, we're going to have EPRI, John Gaertner, discuss the attributes and the general technical attributes that all these tools need to have if we're going to use them for Tech Spec 4b. Remember, we're already using these for Maintenance Rule (a)(4), but the challenge, I think, is to codify the appropriate attributes and the regulation or the tech specs that establish that you can use these for the more significant completion time extensions.

So John is going to talk about those attributes, the technical attributes. And then we're going to have three presentations. STP, who is one of our 4b pilots, will talk about their tool, which is called RAsCal. And then SONGS, San Onofre, uses the safety monitor. They will provide a presentation on that. And finally, Exelon uses PARAGON. These are three different types of tools, but they all, we believe, meet these attributes. We will show you the user interfaces and show you how these tools work.

So we'll have a lot of information to present to you. And I would just like to go ahead, at this point, and turn it over to John.

MR. GAERTNER: Thank you, Biff. I'm John Gaertner. I'm the senior technical lead for risk technology at the Electric Power Research Institute and I was asked on behalf of the industry to lead this presentation by describing what we think are important attributes of these Configuration Risk Models for this application.

It's important that you realize that these attributes are implemented in different ways depending on the unique application, the unique implementation of the tools by the utilities. So I would appreciate any questions if I don't speak clearly and I would be glad to clarify attributes. But if you have deep detailed questions, you might find it in your best interest to wait until you have seen the case studies and then you might see the answer to your question in various ways, and if you don't, then you can ask us as a group at the end. That might be the most efficient way to do this.

CHAIRMAN APOSTOLAKIS: We're not known for efficiency springs eternal. But thank you anyway. Hope springs eternal.

MR. GAERTNER: Right.

CHAIRMAN APOSTOLAKIS: Good luck.

MR. GAERTNER: My objective is to identify the necessary attributes of the Configuration Risk Monitor Models that would be -- that might not be addressed explicitly by the PRA standards and the evaluation of the PRAs by the peer reviews. Most aspects of the CRM Models are identical to the PRAs from which they are derived, and we see over the years a real convergence, so that at most plants there really is only one PRA and it functions both to give the average risk for those applications and the real-time or near real-time risk for the configurations.

But some attributes are unique and may not be adequately reviewed in the process we use for the PRAs, go from quality. So we have envisioned, as in purple, a process to assure that the CRM Model has adequate quality and capability. And that is that the

PRA would be peer review, which they all are, and that the PRA would meet the necessary requirements of the standards, both as required by the consensus standards and perhaps as required by NRC Regulations, such as whatever comes from Reg Guide 1.200, and then, an additional verification of these attributes.

The current status of CRM Models in the industry is, as Biff and Mark pointed out, that all U.S. plants use quantitative CRM Models for Maintenance Rule requirements at power. Core damage frequency and LERF are the figures of merit, but LERF is sometimes not part of the quantitative CRM Model today for Maintenance (a)(4) applications. There is enough flexibility in the Maintenance Rule requirement that LERF might be handled in a more qualitative fashion.

Internal events are always in the quantitative CRM Models today. Flooding is usually there, because flooding is part of the IPE process. Fire is sometimes part of it and seismic sometimes part of it and perhaps other plant-specific external initiators. All of these initiators need to be addressed by the Maintenance Rule. And all will need to be addressed by Initiative 4b. But all may not be formally part of the quantitative configuration risk monitor. But what I will be speaking of today is those aspects which are quantified in the CRM Model.

At the plants today, these CRM Models are an integral part of regulatory compliance through the Maintenance Rule. They are an integral part of the work management process. They are used daily in association with work planning and scheduling and they are an integral part of operations at the nuclear power plants.

DR. KRESS: Does every nuclear power plant have one?

MR. GAERTNER: I believe that every U.S. nuclear plant has an operating configuration risk management risk monitor.

DR. KRESS: Are a lot of these identical?

MR. GAERTNER: There are several common varieties, because there are several tools that are prominently used, so there are groups of plants that do things similar because of velocity and the tool that supports that. There are a number of methods. And we have tried to give you today a spectrum by the three we give you, you'll see a spectrum of tools and a spectrum of approaches.

DR. BONACA: Those that don't have quantitative treatment of fire, how do they deal with fire issues?

MR. GAERTNER: Well, it is in a variety of ways. I think I'll let you ask the individual case studies, rather than give you those spectrum, if that's okay. The Configuration Risk Models are subject to regulatory oversight process, so that if the models were -- there were problems in the use of these models, they are subject to ROP oversight and regulatory actions. So there is that regulatory incentive also in addition to the importance they have for plant performance.

CHAIRMAN APOSTOLAKIS: I don't understand that. How can a model be part of the ROP?

MR. GAERTNER: The application of the CRM Model required by the Maintenance Rule (a)(4) requires that each configuration be reviewed and appropriate -- the risk be determined and appropriate actions be taken to control the risk during that configuration. If something were to occur at the plant or if an inspection were to find that the configuration was not appropriately evaluated or the actions were not taken, they -- it would be subject to a risk determination under the ROP process and could undergo a significance determination. So it's quite formally involved.

CHAIRMAN APOSTOLAKIS: But they would not go back and review the model itself? I mean, they would just say it was evaluated correctly.

MR. GAERTNER: Yes, that's right. The plant would be required to have a corrective action and if that meant the model --

CHAIRMAN APOSTOLAKIS: Yes. Just --

MR. REINHART: It might be worthy to point out --

CHAIRMAN APOSTOLAKIS: You want to come on up? Can we hear you?

MR. REINHART: Can you hear? It might be worthy to point out that the vision is that the Configuration Risk Program would be captured in Section 5 of the tech specs, be part of the license, and therefore under the Reactor Oversight Program.

DR. SHACK: Well, at the moment, we're just talking about (a)(4)? That's right?

MR. GAERTNER: That's right.

MR. REINHART: Okay. I gotcha.

MR. GAERTNER: And the purpose of this slide is to give you the status today.

CHAIRMAN APOSTOLAKIS: Yes.

MR. BRADLEY: I just want to --

MR. GAERTNER: Yes, go ahead.

MR. BRADLEY: Just a second just to

clarify on the regulatory oversight of (a)(4). NRC just issued Appendix K to the, I forget the number for the Inspection Manual, 0609, and it's designed to provide inspection and enforcement for (a)(4). It actually allows the staff to go in and verify the calculations that the licensees perform.

And if there's a delta or if the risk hasn't been appropriately assessed or managed, the staff can issue a, you know, GREEN or WHITE or whatever finding based on the delta between what was assessed in management, what risk was actually incurred. There is enough significant, you know, programmatic issues identified that staff can actually go into the inner-workings of the model. I don't think that has happened frequently, but, you know, there is that provision in the inspection process to allow that. But that Appendix K just recently was issued.

MR. GAERTNER: Okay. These are the 10 attributes that we have determined through a long series of meetings with PRA professionals within the industry and, as Mark pointed out, meeting with the NRC PRA Staff. We have determined that these 10 attributes constitute that delta that should be -- might need to be looked at further beyond the PRA.

I'm not going to read these to you, because I'm going to go over each one individually and carefully.

The first attribute has to do with initiator dependencies. Independent initiating events in the Configuration Risk Monitor Models should address external conditions and the impacts of out-of-service components. In PRAs, we often represent initiators by frequencies. So there isn't a model, perhaps, for plant trip or there isn't a model for loss of off-site power and there could be merely a frequency.

These frequencies need to be the appropriate ones for -- when transferred to use for configuration risk, they need to be reviewed to make sure that they are the appropriate ones for the configuration risk. Also, some initiators are affected by out-of-service components. So if there's a loss of off-site power initiating -- I'm sorry, a loss of service water initiating them, obviously affected if service water pump or some element of the service water system is out of service.

CHAIRMAN APOSTOLAKIS: That usually is not presented by just a frequency. I think usually a frequency is as a result of a fault tree or something.

MR. GAERTNER: That's correct. That's the point we're making is that these need to be reviewed to make sure that when there is an out-of-service dependency, this would need to be represented in the model by a fault tree.

CHAIRMAN APOSTOLAKIS: But for off-site power, you wouldn't do any of this, would you? That's clearly representative of fault tree.

MR. GAERTNER: That's correct. For off-site power, it would still be represented by a frequency, but there -- that frequency, for one, should be reviewed to make sure that it is appropriate. For example, the plant may want to use to account for seasonal differences, when you are doing configuration, because you know the actual configuration you're in, so if you know you're in a higher risk regime, you may want to account for that.

So the idea is to verify that what you are using is appropriate.

CHAIRMAN APOSTOLAKIS: This is an interesting point you are raising and I want to ask about it. As you said earlier, I believe you said, that we are now coming close to using PRA in real-time. And as we know, PRAs really were produced originally and reproduced after that to look at the average risk from the plant over a period of years, for example. So a lot of things, there is doubt. We don't keep track of the detail time history of the plant, because we will go crazy and it's not essential for me to keep every component.

Now, when you enter this, I assume that what you are doing is that you are saying okay, we're entering this 4b at time zero. At time zero, our initial condition will be the actual plant configuration and the actual component state.

MR. GAERTNER: Right.

CHAIRMAN APOSTOLAKIS: And we know those. I mean, the configuration probability. The components we know also. And the monitor helps us do that.

MR. GAERTNER: Yes.

CHAIRMAN APOSTOLAKIS: Is that correct?

MR. GAERTNER: Absolutely. You'll see as we go through them.

CHAIRMAN APOSTOLAKIS: So the monitor is adding to this, what I said earlier about if you had a good PRA that you recalculate weekly is not quite right, because the PRA itself doesn't monitor. Even the monitor, you have to enter the state of the component, don't you? It's not automatic.

MR. GAERTNER: Semi-automatic.

CHAIRMAN APOSTOLAKIS: Semi-automatic.

But it's a true statement that we are starting this process with the plant as is at that time.

MR. GAERTNER: That's correct. To the best of our ability to represent it.

CHAIRMAN APOSTOLAKIS: So in that spirit then, what you just said makes sense. If you know that you are in the middle of August and you are in Florida, you know you have certain conditions, certain atmospheric conditions, temperatures and so on.

MR. GAERTNER: That's right.

CHAIRMAN APOSTOLAKIS: And you may have a different frequency of failure of power at that time.

MR. GAERTNER: That's correct.

CHAIRMAN APOSTOLAKIS: I know this is free program.

MR. GAERTNER: Oh, yes, that's very important. There are no -- you will see the flavor of this.

CHAIRMAN APOSTOLAKIS: You'll make decisions.

MR. GAERTNER: That's right. There are no off-the-cuff decisions here about changing a frequent -- well, that's a pretty serious looking cloud out there, I better up the frequency. That's not the way it's to be done.

CHAIRMAN APOSTOLAKIS: That's a Category 3 cloud.

DR. BONACA: You know, I would like to ask a question. At some point, it doesn't matter now, but, you know, you made the statement before that all plants, you believe, have CRMs to manage Maintenance Rule. But my understanding is some of these CRMs are as good as the PRA.

MR. GAERTNER: Some of the CRMs are essentially the same.

DR. BONACA: The same.

MR. GAERTNER: Because as the changes are made as required for CRM applications, those changes will back and start --

DR. BONACA: Now, some of them are whether or not, some are far from a complete PRA. So I think it would be valuable for the subcommittee, at some point, to hear a little bit from the people from the industry, at some point, some view of, you know, how far means that is not the full PRA. I mean, I really have an appreciation right now. But, you know, when I look at some of the statements you made for attribute 1, I mean, I will have the spectrum that those will be almost in any CRM already consideration in it. And clearly, by studying the attributes, you know, it may not be true actually. There are models that do not account for that.

MR. GAERTNER: I think we can tolerate models that is wrong in a conservative sense. But some models could be wrong in a conservative sense, simpler than they need to be, but they could still function, they can still serve for certainly a 4 application, then perhaps some other applications. Although, they may be less sophisticated than others.

DR. BONACA: Are these attributes that you are saying what they have to do to get the CRMs to the point where they can support Initiative 4b or is it the expectation you have right now for the CRM?

MR. GAERTNER: No, I think these are verifications that would have to be done to do Initiative 4b.

DR. BONACA: Okay.

MR. BRADLEY: That's an important distinction.

DR. BONACA: Okay.

MR. BRADLEY: We have existing regulatory guidance for (a)(4) already. This is going beyond that for those plants that want to use 4b.

DR. BONACA: Okay. Because of the impact on tech specs and the -- all right. So -- all right.

That helps already. Thank you.

MR. GAERTNER: Okay. So the first attribute has to do with initiator, initiators making sure they are represented properly. The second attribute has to do with truncation levels. Our current state of the art, we still have limited -- we still have trips. When we solve the computer to limit the computer time and the amount of calculation that is done, so we have truncation levels where we stop calculating. These are very low levels now and they are not like --

CHAIRMAN APOSTOLAKIS: Meaning constant verification, 10^{-8} or 10^{-9}.

MR. GAERTNER: That's correct. Or to the minus 12.

CHAIRMAN APOSTOLAKIS: You know, is there any move to reach the methods that won't require verification?

MR. GAERTNER: There is a --

CHAIRMAN APOSTOLAKIS: The BDDs?

MR. GAERTNER: We at EPRI are working on BDDs.

CHAIRMAN APOSTOLAKIS: Ah, you are?

MR. GAERTNER: Yes.

CHAIRMAN APOSTOLAKIS: Well, very good.

MR. GAERTNER: And the industry has considered that, but so far, no one is doing a BDD solution at the plants.

CHAIRMAN APOSTOLAKIS: That's encouraging that you guys are working.

MR. GAERTNER: Yes, we really are and it's promising.

CHAIRMAN APOSTOLAKIS: Because I would like to see what we would do with SAPHIRE, if you start producing cores like that.

MR. GAERTNER: The idea is that there may be different -- a different truncation level might be desirable for the CRM Model in order to make it run faster, because we may need -- we may want better time solutions. So it's important that we make sure that the truncation levels we're using are adequate and that if we do -- and that we don't remove important model elements that aren't important in the average PRA, but might become important when you bring equipment out-of-service.

DR. KRESS: How do you make the decision of whether your truncation level is appropriate? Do you have to vary the truncation level?

MR. GAERTNER: Yes. That's typically what's done.

DR. KRESS: To get the results?

MR. GAERTNER: You do validations to test it. But there is a certain amount of engineering judgment to make sure that you have -- you now have a robust model, because you can't test every imaginable configuration.

DR. KRESS: That's right.

MR. GAERTNER: The way in which this is done depends on the way in which the CRM Model is done, whether it's a totally dynamic solution on-line or whether it is presolved. And you will hear today from the case studies varies ways of doing this.

DR. BONACA: Why wouldn't this attribute be required for evaluation to support the Maintenance Rule?

MR. BRADLEY: I can answer that. The Maintenance Rule was written with the provision that tech specs are already there. I mean, we have lived for many years just with tech specs. And then in 1995, we had -- or in 2000 we had (a)(4) layered on top of that, so we basically have double regulations for configuration control. There was a recognition of the cause we were still bound to the tech specs that would be ending to have a tremendous amount of rigor in description of the capability of this. Now that we are trying to get some flexibility in the tech specs and to balance that, we have to put more rigor and more, you know, technical requirements on this part. But that's generally the answer to that.

DR. BONACA: Yes, well, I understand it, but, you know, when I read it, the statement says that current CRMs may not be able to represent incremental risk configurations when multiple equipment out-of-service. And I thought that that's not -- the maintenance allotted to that.

MR. BRADLEY: Well, you're going to have to do that through some, you know, method. You're going to have to demonstrate that you are capable of doing that maybe through a combination of qualitative defense-in-depth methods and other things. I mean, you're right. I mean, you have to be able to address both equipment out-of-service.

DR. BONACA: Well, I thought it was the heart of the change that was made to that. So okay.

CHAIRMAN APOSTOLAKIS: The bullet before last about the delta risk less sensitive to truncation. Is that consistent with the rest of the bullets? I mean, I thought you were worried here about the truncation level because you are calculating incremental risk. And then you say no, it's less sensitive than --

MR. GAERTNER: Yes, I had a separate slide on this, but it probably is a little confusing, so we took it out. It turns out that if you look at -- if you were to do an experiment with your PRA with equipment out-of-service, you would find that the delta risk value settles into a cost and value sooner than the total risk number. And so --

CHAIRMAN APOSTOLAKIS: Oh, this has to do with the time you reach the asymptotic values?

MR. GAERTNER: That's correct. So this was intended to give us some -- this gives us some assurance that we have a sort of built-in protection.

CHAIRMAN APOSTOLAKIS: What I don't understand is what is the message from this slide? What do they do as examples? You may change the -- in the configurations I understand. You do it until you are satisfied that you have robust solutions. But the dynamic solution, now, what do you do?

MR. GAERTNER: The message from all of these attributes, I'm not indicating that any of these are problems. I'm only indicating that the change might shake something loose in your PRA. It has to be verified.

DR. SHACK: Well, I mean, the answer is

you want to relax the truncation level to get faster solution.

MR. GAERTNER: Yes, you might to relax your truncation level.

DR. SHACK: He doesn't want to wait. He wants to make sure it doesn't screw the solution up.

MR. GAERTNER: Right. You might want to relax your truncation to get a faster solution. You also might bring --

CHAIRMAN APOSTOLAKIS: You may not.

MR. GAERTNER: -- a more level thing.

CHAIRMAN APOSTOLAKIS: But what would prompt me to start thinking that way? That's what I don't understand. I am in a situation and presumably who is running these things? Who is doing it? Is it the operators?

MR. GAERTNER: Yes.

CHAIRMAN APOSTOLAKIS: Is it the experts, the PRA experts?

MR. GAERTNER: The plant staff.

CHAIRMAN APOSTOLAKIS: It's real-time now, right?

MR. GAERTNER: The reason for these verification is so that plant staff can operate these models.

CHAIRMAN APOSTOLAKIS: Plant staff needs?

MR. GAERTNER: Plant staff needs a planning person or an operator or work release person.

CHAIRMAN APOSTOLAKIS: So that person then will be knowledgeable enough to say ah, in this particular situation my truncation levels are not good enough?

MR. GAERTNER: He will be knowledgeable.

CHAIRMAN APOSTOLAKIS: Now, that sounds to me like --

MR. GAERTNER: No, no, no. First of all, he will be --

MR. BRADLEY: No one has to do that. We're not putting those kinds of burdens on the operators or the workers.

CHAIRMAN APOSTOLAKIS: Well, that's what I don't understand. How is this slide affecting me?

MR. BRADLEY: We're writing a guidance documents, efforts writing the Risk Management Guidance Document. Our challenge is to capture enough guidance on how you do this. You know, it's a detail level that we're still working on.

CHAIRMAN APOSTOLAKIS: Oh, okay. That's fine.

MR. BRADLEY: Okay.

MR. BOYCE: Part of the review and approval process prior to us issuing a license amendment authorizes the plant to --

CHAIRMAN APOSTOLAKIS: Would you, please, identify yourself?

MR. BOYCE: I'm sorry, I'm Tom Boyce, Section Chief at NRR. And this is part of the review and approval process for a license amendment for a plant that wants to adopt Initiative 4b. Okay. So when we say that you can use it, then it would be the operator would then use the tool as it has been reviewed and approved.

CHAIRMAN APOSTOLAKIS: Is there a study or kind of analysis behind these that created attribute 2? Somebody did some analysis and said hey, in these situations you have to worry about it? Because it's kind of an unusual attribute.

DR. SHACK: You know, it just comes down to if you want to make it faster, one of the obvious ways is to increase the truncation level, you know, relax that. So clearly, they want to make these things faster. They want real-time, but when you do that --

CHAIRMAN APOSTOLAKIS: Someone must have done that.

DR. SHACK: -- you show --

CHAIRMAN APOSTOLAKIS: If I go from counting the minus to count minus 10, I'm gaining so many seconds.

MR. BRADLEY: I don't know if there is a formal analysis. We have so much experience implementing this now with so many plants that this is just, you know, the community of CRM professionals is aware of this through use of the tools for so long.

MR. GAERTNER: We're trying to give confidence to the regulator and to management that these tools are reliable. And so we're trying to make a checklist that the PRA group, before they release this tool for use in the plant, they validate that these attributes are met. And that give the confidence to the regulator and to the management and hopefully avoids an RAI and other analysis. So that's the intent. The intent isn't to poke up problems because they exist.

MR. REINHART: Well, if I could add to that. What the regulator is looking for is that if there is a difference between the PRA and the configuration risk monitor and if there is a difference in truncation, there may not be, and if they come to us and say there is no difference, then we'll take it. But if there is a difference in truncation that they need to run it faster to get near real-time, then we want confidence that the results are not significantly different or at least conservative as opposed to non-conservative.

But therein lies the problem. So we want to make sure that there is no significant difference in relying on the plant calculating risk-informed completion times. And my understanding is once they make the case, they are not going to be changing truncation levels on the fly. It's not the operator, the SGA or the plant staff. They will have agreed to a certain truncation level and that's part of the program that we accept.

CHAIRMAN APOSTOLAKIS: Well, when there is some sort of analysis and decision, I would like to see that.

MR. GAERTNER: Exelon did one of those sensitivity studies. We had it in here and we didn't realize this would be so much of interest, we removed it because of time. We ended up probably spending more time if we had left it. Okay. I'm going to try and go more quickly, because I think you will really will want to hear these case studies. And you will be ask the people about these in the case studies.

The third attribute is that the model translation from the PRA to the CRM, that's the appropriate and the fault tree should be traceable to the PRA. This is self-evident, but this is to make sure that we don't have divergent models. And we don't. But the purpose is to validate that. This is the detail down there simply says that some of the methods, such as the one you will hear from STP, they don't have this problem, because they essentially use the PRA to develop these configurations. But if the plant falls more dynamically, this could be more of a concern.

It applies to both model attributes. Some of the things that you might need to do is remove -- some PRAs use, intentionally, asymmetries. They will assume a single -- a certain train is out to represent the possibility that either train is out and these are little tricks that give the right answer for an average PRA, but would have to be changed to represent the actual configuration. We might have to incorporate initiating event models. We might have to allow for multiple configurations, such as seasonal differences and that sort of thing.

There also could be data differences. We need to make sure that the data which was for average purposes in the PRA has been adjusted to be now appropriate for the actual configuration. This is just a picture to show that if you think your two worlds, the PRA world and the CRM world, that there is a -- in the data world there is a significant overlap. In the fault tree world there is almost complete agreement, but there may be differences in the actual logic model that solve as to representation of that attribute.

The next attribute is to make sure that human action events, which are dependent on equipment, take appropriate account for out-of-service equipment. I got yelled at by the industry people on this one, because they think there aren't many of these situations out there. That's great. But we still need -- we still think it needs to be validated.

The biggest issue here might be for a recovery. If you are relying on a piece of equipment for recovery that's inherent in the HRA calculation, but it's not an explicit basic event, and if that piece of equipment is not available, then that human event likelihood would change. And so those things need to be checked to make sure that they are correct. But these would be quite rare.

CHAIRMAN APOSTOLAKIS: Which HRA model do most of the industry CRMs use?

MR. GAERTNER: Again, I'm going to ask you to ask them. There is a variety. A number of people are using the EPRI HRA Calculator, which has several choices, and there is a variety.

CHAIRMAN APOSTOLAKIS: Okay.

MR. GAERTNER: Attribute 5, this is very important. You might not think of this right away, but activities have to be correctly mapped to the basic events in the PRA. Work planners plan work activities. They don't plan basic events. So we need to have a clear translation from the work activity to the basic events in the PRA. This is a little cartoon that might show. The maintenance activity could involve multiple components and then it actually affects different basic events.

It may isolate, it may close a valve so we're interested in only certain failure modes of those components. We may be interested in human errors. We may be interested in changing house events, that is maintenance might put you in a different configuration, so you would set a house event. So that configuration came through, instead of a different one. So what plants typically do is they will have a mapping. So when a work planner plans an activity, he has a set of PRA parameters to change. That's very important for quality control.

Attribute 6, represent, we have to make sure that we're representing the as-built, as-operated plant. Most of the attributes we have talked about so far are the responsibility of the PRA staff to make sure that the model that is used at the plant is robust and won't be misused by the plant staff. That it has all the checks and balances. This attribute really puts some responsibility on the plant staff to make sure that they are entering what they think they are entering, so there has to be a knowledge of the plant's staff, enough knowledge on how to enter that information and that the configuration they are representing is actually the one that is modeled in the plant.

Attribute 7, treatment of common cause. All PRA models have robust common cause failure treatment in them. But when you take a piece of equipment out-of-service, you could alter that common cause model. Also, if a piece of equipment were to fail, one might ask is the common cause treatment in the PRA still appropriate. It's important to realize to answer that question that upon failure of a tech spec component, at all plants today, operators are required to make an operability call or they are required to make a determination on whether the failure that occurred, that emergent event could be a common cause event.

And so they make that call. That makes it much easier for the CRM Model application. Because once that call is made, then that component has failed, but the remaining components are known to not be failed by that common cause, so we can continue to treat the remaining equipment. Although, the remaining equipment might fail in common cause ways, it's not a result of that first piece of equipment.

CHAIRMAN APOSTOLAKIS: One thing that always puzzle me is this. Suppose I have two trains and one has the probability of failure for demand of 10^{-3} and then due to common cause failures, the second one would have a conditional failure probability, which is data, which is about 10 percent. So the total is 10^{-4} for PRA purposes.

MR. GAERTNER: Right.

CHAIRMAN APOSTOLAKIS: Now, I go to a situation like this and I find one train down. Do I assume that the probability of the other train is .1 or is it down to 10^{-3} again? That would make a big difference.

MR. GAERTNER: That's correct.

CHAIRMAN APOSTOLAKIS: Now, you are saying that somebody has to decide whether the common cause thing is still applicable.

MR. GAERTNER: We're saying once the operator has made the determination that the failure that occurred was not a common cause, then the --

CHAIRMAN APOSTOLAKIS: You see, that's the problem. As you know, I mean, your own organization sponsored the major study some years back on common cause failures and they had all sorts of diagrams to show that they could elect something else. We had conditional probabilities of this and that.

I can't imagine that anyone would do something like this in real-time and the common cause failures, I mean, by their very nature, they are a class of failures. They are modeled as a class. So it's very hard to say oh, this pump now failed due to this cause, but this cause doesn't apply to the other one. Well, we don't know what it does.

So the conditional probability of the second train seems to be could be different by a couple of orders of magnitude depending on whether you want to use the original data or go back down to 10^{-3}. And I just don't know how one would make such a determination. What is the appropriate demand?

MR. GAERTNER: Well, the current --

CHAIRMAN APOSTOLAKIS: Unless you do it on a precalculated basis.

MR. BRADLEY: Well, I think what we're proposing right now in the current extracts, you're required to make an operability call, which includes an extent of condition evaluation and if that evaluation, which is done is an engineering evaluation --

CHAIRMAN APOSTOLAKIS: So when the three presentations are made there, Gary, are you going to address that at all?

MR. GAERTNER: I can.

MR. GARY CHUNG: Well, they can, but I can tell you --

CHAIRMAN APOSTOLAKIS: You can if asked.

MR. GARY CHUNG: Yes, well, we can. Well, right now we make it pretty similar to what South Texas does. The operator makes the call right there whether it's a common cause or not.

CHAIRMAN APOSTOLAKIS: I just don't know how he does that, so maybe we can talk about it.

MR. GARY CHUNG: Yes.

CHAIRMAN APOSTOLAKIS: I don't know what

begins to make a call that it's a common cause when the common cause is not defined.

DR. BONACA: It's a good guess.

MR. BRADLEY: It's called extent of condition. I mean, it's something we have to do right now.

CHAIRMAN APOSTOLAKIS: Well, we'll see, we'll see.

MR. BRADLEY: Yes.

CHAIRMAN APOSTOLAKIS: Let's let John continue.

MR. GRANTOM: John, I'll address all this when we get into that.

MR. GAERTNER: Okay.

MR. GRANTOM: We'll talk about common cause later.

MR. GAERTNER: Yes, that's the purpose of this, is to stimulate questions for the remainder of the morning and not for me to answer them all, mainly because I'll get beat up by the crowd if I answer them. Not to their satisfaction.

CHAIRMAN APOSTOLAKIS: You're the stimulator in chief.

MR. GAERTNER: Then, of course, we realize we have to have a consideration of uncertainty, any new uncertainties introduced into the CRM Model.

CHAIRMAN APOSTOLAKIS: Well, we just discussed one.

MR. GAERTNER: Well, that's one, that are not evaluated in the PRA uncertainty evaluation must be identified and evaluated prior to use. This is somewhat of a global statement. It doesn't say how to do it and we could spend the rest of the morning talking about how we might do this.

But it's simply a commitment the industry is making to make sure that when we transfer from a PRA situation to a configuration risk monitor situation that we appropriately account for uncertainty. So it is a general statement not an explicit methodology.

DR. KRESS: I don't know what to do with that uncertainty.

MR. GAERTNER: Well, it's challenging and we are as industry dealing with it. We're trying to develop a guideline for how to consider both parametric and modeling uncertainties in industry and I know NRC is also grappling with that.

DR. KRESS: Well, let's presume you have got a limit on delta CDF. Are you going to put a confidence level on that?

MR. GAERTNER: Absolutely. It's very important to realize that in order for this to be used in an operational sense, we need clear and actionable results, and so we use the best estimate result of the configuration risk monitor. The considerations of uncertainty that we're talking about are prior to release of the CRM Model for its use and prior to the operator pushing that button to define the configuration. But once the decision is made that the model is appropriate to this application, he uses the best estimate value. I think that's important. Otherwise, we will --

DR. KRESS: So there is some uncertainty level that you find acceptable. Is that the idea?

MR. GAERTNER: That's correct, and that we have done enough sensitivity studies and so forth, that we think we have figured it out, the important, the critical uncertainties and address them.

DR. KRESS: That's an interesting concept to me, an acceptable uncertainty.

CHAIRMAN APOSTOLAKIS: Now, best estimate is not a mean value, is it?

MR. GAERTNER: Best estimate is a mean value.

CHAIRMAN APOSTOLAKIS: It is real mean

value.

MR. GAERTNER: Well, it's a mean value. If it's a real mean value, I don't know.

CHAIRMAN APOSTOLAKIS: No, I mean, I have seen cases where people say, you know, my mean value is 10^{-3} and it's a mean value because they declare it to be mean. And there are other cases where people have distributions and they find the mean value.

MR. GAERTNER: No. This isn't a Monte Carlo simulation result to achieve a mean value.

DR. SHACK: This is an intended mean value.

MR. GAERTNER: This is close to a mean value using algebraic manipulation and Boolean equations, as you know.

DR. KRESS: If you use means for all the inputs, you don't get a mean --

CHAIRMAN APOSTOLAKIS: You come up with something pretty close.

MR. GAERTNER: Yes, it's close and that's another thing that has to be checked. By this standard, you have to say that the mean value that you're using would have to validate that it is --

CHAIRMAN APOSTOLAKIS: Only if you have a state of knowledge about this. It's very broad distributions as inputs.

MR. GAERTNER: Those things are all done off-line before the models are released. We are not intending to do any of that in real-time.

The final two attributes just have to do with -- they are quite simple in nature. The first has to do with the software quality. These CRM tools are sophisticated pieces of software. Some are commercially offered and they are being used by a large number of utilities and there are users groups who work with the vendors to make sure that the quality is checked and maintained and notices are sent of errors and so forth.

But it is in the end the responsibility of each utility to make sure their application of that software is correct. And some of the software, such as STP's, is an individual utility's software, so they have the full responsibility for software quality and that would have to be shown.

And finally, the last attribute has to do with maintaining the model quality through testing and configuration control. The big issue there is, of course, these can't be entirely fluid models. They are carefully checked, put in the control room, in the work planning room, and the plant undergoes small changes in reliability, perhaps design changes, procedural changes, and these would have to be evaluated on an ongoing basis to make sure that model is appropriate for use or an update would be necessary. So that's an important consideration in configuration, more so than the base PRA.

So I know I did this quickly, but that was intentional. I wanted to give you these 10 attributes so that you have some confidence that we as an industry have thought about what it takes to have this quality and with the peer review and the standards and the validation of these attributes, we feel we are assured of a high technical quality and adequate capability for these configuration monitors.

Now, you will see three real examples of how these are put in place and you may want to ask individuals about some of these attributes as you go along.

CHAIRMAN APOSTOLAKIS: Okay. Any questions for John? Thank you, John.

MR. GAERTNER: Thank you.

CHAIRMAN APOSTOLAKIS: So the next one is STP.

(Whereupon, at 9:43 a.m. a recess until 9:46 a.m. due to a PowerPoint crash.)

CHAIRMAN APOSTOLAKIS: Rick, we're speculating that you just had an epiphany that the whole darn thing is a mistake and you walked out.

MR. GRANTOM: Well, good morning. It's a pleasure to get to talk with the ACR Members again and for me this is the culmination of a vision we have had probably a decade or so ago of how we could use PRA in one of its quintessential applications in determining Configuration Risk Management. So we're going to go get into the meat of this thing here and talk a little bit about this.

Most of you know me. I'm Rick Grantom. I am the Manager of Risk Management in the South Texas Project. I have to my left here Jay Phelps who is the Operations Manager at STP Unit 2, current licensed SRO, Senior Reactor Operator. And I have Wayne Harrison also here from STP Licensing.

A couple of things I'm going to talk about. We're going to take in an overview of STP's PRA and our on-line risk assessment tool, which is called the Risk Assessment Calculator. We're going to talk about the attributes of that program, how we apply it currently at STP and then the application to the 4b Initiative here.

Real quickly to go over just the

attributes of STP's PRA, the tool we're bringing to the table here that is going to be the engine behind this 4b Initiative here. We have a full scope level 1 and level 2 PRA. We're a RISKMAN shop, so they tend to characterize it as a large event tree linking, but we have kind of gotten gigantic fault trees and very gigantic event trees now, and configuration risk management is another very big reason of why those event trees are now much bigger than they were before.

DR. KRESS: Does your full scope include shutdown risk?

MR. GRANTOM: No.

DR. KRESS: Okay.

MR. GRANTOM: No, it does not. This is a full at power level 1, at power modes 1, mode 2. When you think of going into power dissention, the PRA obviously takes us down to shutdown conditions descending in that regard.

External events are included, including fire, external flood, high wind, seismic are all included. We have a detailed spacial interactions database that was used as part of the fire and flood analysis. Human reliability analysis is factored in and we have detailed common cause evaluation, because we are so unique because of our three train design.

The PRA is updated in accordance with our procedures under the PRA Configuration Control Program and the PRA and the Configuration Risk Management tool in particular comply with Appendix B Software QA requirements at the station.

DR. SHACK: We had a question last time. How long does it actually take you to do a calculator, to requantify the PRA once you make a change and you go through and recompute the numbers?

MR. GRANTOM: It depends on the truncation levels, but for purposes of configuration risk management, within about an hour.

DR. SHACK: About an hour.

MR. GRANTOM: About an hour to do one configuration. This is a great contrast from the days --

CHAIRMAN APOSTOLAKIS: But, Rick, we heard that others can do this in a matter of minutes.

MR. GRANTOM: Well, that's --

CHAIRMAN APOSTOLAKIS: Why is it taking so long?

MR. GRANTOM: Well, it's our approach. In the approach that we use at STP during the early days of this configuration risk management, I viewed it as something I didn't want to have to answer to you or to anyone else as to what's in the model and what's not in the model under the Configuration Risk Management Program.

So we elected to go ahead and build the configuration risk management toggles, which is directly into the full PRA, so we could quantify configurations at the same -- so the PRA and the configuration risk management tool are, in fact, one and the same.

CHAIRMAN APOSTOLAKIS: You don't have a monitor?

MR. GRANTOM: We do have a monitor, yes, but we're going to get into that. The monitor is basically a graphical user interface that goes and accesses PRA results.

MR. HARRISON: This is Wayne Harrison. I just want to clarify the question. I understand the question is how long does it take you to run a re-quantification of the full PRA versus if you're using -- run a case on RAsCal.

MR. GRANTOM: Well, keep in mind if I go run a new case in RAsCal, I'm going to walk over to the PRA and we're going to go punch the button on a specific configuration, we're going to quantify that whole PRA in an hour and come up with a result and go add it to the database. Now, if I change that to 10^{-14th} truncation, it's going to take a lot longer.

MR. HARRISON: But if you do something that has already -- if you have run RAsCal and something is already in the database, that's a much shorter period of time.

MR. GRANTOM: If it's already in the database, it's as long as it takes the computer to go find the data value out there and bring it up on a screen. It's instantaneous.

MR. HARRISON: Yes.

MR. GRANTOM: There is no delay.

MR. BRADLEY: How many configurations do you have pre-quantified?

MR. GRANTOM: Well, we're trying to get into that, over 20,000.

MR. BRADLEY: Right.

CHAIRMAN APOSTOLAKIS: 20,000?

MR. GRANTOM: Yes, well over 20,000. Oh, George, we have come tremendous ways from the days when we have to go, you know, quantify from impact vector days of when we had to go and quantify all the entries for every impact vector that we had. We're leaps and bounds beyond all that. It's incredible technology now. It's still probably not as good as it probably could be, because you mentioned what John Gaertner said before, that we are going to be bridging it eventually where the truncation is a non-issue, but we're not quite there yet.

So just real quick, we have undergone the peer review and the Reg Guide pilot under Initiative 4b here for PRA quality. So here is what we -- the STP PRA is quantified, full quantification of the total PRA with external events, everything, for every configuration in the RAsCal database.

Now, what do we mean by configuration? We have a certain vernacular at STP. We call it a maintenance state, but it basically means it's a given set of equipment that's out-of-service at a selected piece of time. So we have about 22,000 of these. About 500 have actually occurred in the station and the rest of them are because planning and scheduling use this tool. So every week they come up and say well, you know, we're going to take this and that, but we might want to take that out or this out.

So initially, in the early days, we would get a lot of these unquantified maintenance studies, you know, the software, whenever they put in something and the computer can't find a match for that. And basically what happens in RAsCal is the PRA, we have got these binary identifiers, it basically says if you click on the mouse with this, this and this, and Jay will show you this in a little bit, that identifies a binary identifier and it goes directly over here and finds that and returns that value and then it displays it to the operators.

DR. KRESS: Now, a normal PRA when you have it, given plant configurations, the calculation of risk as if that plant configuration goes on forever.

MR. GRANTOM: Right.

DR. KRESS: Now, but you anticipate these configuration as some parts of equipment will be out a shorter time than others and it's going to change, so there is a time element. How do you deal with that when you're calculating delta CDF?

MR. GRANTOM: Yes. Well, what happens basically when a work planner goes in there and he -- and so what does a work planner know? He doesn't need to know anything about the PRA. He doesn't need to know anything about common cause, split fractions, basic events. He needs to know I'm going to take this component out-of-service, at this time, and I'm going to plan to return it to service at that time, and he works his whole weekly schedule doing that.

Now, what this RAsCal Program is going to go do, it's going to take vertical slices at a time and say what's in and out-of-service? What has he toggled on and off in all these slices and then evaluates that schedule, and it determines here are all the maintenance configurations that are going to occur during that week. And then the program goes out and says out of the 20 or some odd, whatever it is, it goes and returns the CDF values for that.

DR. KRESS: So in each slice it's evaluating the delta CDF as if that slice would go along for a year.

MR. GRANTOM: It builds a profile.

DR. KRESS: Okay.

MR. GRANTOM: It builds an incremental or normalized or instantaneous, whatever you want to call it, and it also builds a cumulative.

MR. HARRISON: We'll show some screen shots.

MR. GRANTOM: Yes, and we'll show you some screen shots of how that works.

CHAIRMAN APOSTOLAKIS: What does RAsCal stand for?

MR. GRANTOM: Rick is a Super Cool Awesome Leader.

DR. KRESS: You were expecting that question, weren't you?

CHAIRMAN APOSTOLAKIS: I suspected that.

MR. GRANTOM: Risk Assessment Calculator. Anyway, we developed this in-house and it has been used for nine years and it's used in our control room. Operators use this and our work control planners and schedulers use this tool and we maintain the configurations.

As I mentioned before, we calculated 20,000 maintenance states. RAsCal itself, you know, and this is something that's important to note here, it doesn't really calculate the CDF. Once again, as I said before, it's taking results that have been precalculated from the PRA.

However, there are some adjustments that we can make with RAsCal. We also have a balance of plant trip model. And so if we take equipment out-of-service on the balance of plant that would affect the average trip rate, that delta is transferred over to RAsCal, so you can actually see an impact of balance of plant equipment removed from service in addition to the NSSS Island Power Block, so it will do that little piece of that, but it's just a proportion of the delta to amend that turbine trip frequency. We think it's a very good user interface and we developed that with work control and operators and that's how we came up with these kinds of screen shots.

And so if we look at the RAsCal attributes, you will see in my rendition here of the attributes, a lot of it is going to just default right back to the PRA, because it's the PRA. They are one and the same. And so with initiator dependencies all of that is the same.

Now, in our Configuration Risk Management Program, we had to go build what we called a Maintenance Pre-Tree during the initial days of this in which we would build -- it's a characteristic or a feature of event trees that you could have a multi-branching event tree where you could have a branch and there's multiple branches within there.

We can identify certain things that are on and off and we built macros within RISKMAN to go and toggle equipment on and off. So if we turned off a high-head safety injection pump, it turned off not only the pump, but we also identify all the other things that need to be turned off like any associated operator recovery actions have to be failed for that. And with these macros and pre-trees, we call them, it's propagated throughout the model.

So you get an answer and we truncate this at 10^{-11th} is what we truncate all of these results at, and so the initiator dependencies are all accounted for and we had to go and remove all of the asymmetries. You know, it's just as likely that, you know, in the average model train A was running, train B was off, train C was in standby. Well, in configuration space you have all those, so we had to remove all those, so that you can specifically toggle all those.

Also, we had to build what we call a Zero Maintenance Model, because we measure the delta CDF from the zero maintenance, the optimal everything is available condition. The human action treatment in RAsCal, RAsCal doesn't do a human action treatment, because it's going right directly back to the PRA.

DR. SHACK: The answer you gave last time was we measured the zero maintenance from the configuration that we're at.

MR. GRANTOM: Yes. As it changes, yes, because when you do the profile and the cumulative, you're accruing the risk. You will start out the work week with everything's available and then when you have something out-of-service, you're accruing risk.

When something else comes, it starts from where you were at and continues to accrue out until you return everything back to service. And then in the profile you will see it just flat lines out and then the next week we start over again. Now, if emergent items happen, then it continues to accrue risk, so we account for that, I mean, we'll do that.

There were several other things we had to do in the average model, too. We used to adjust some of the initiating event frequencies based on the capacity factor, how long you were at or how well in this model here they are all adjusted to remove that contribution or that reduction.

DR. SHACK: Can you do a hurricane frequency in August?

MR. GRANTOM: Yes, we have talked about that. We have talked about using a different loss of off-site power initiating event distribution for hurricane seasons. We have not incorporated that yet, but we have talked about doing that. And it kind of goes down to this. If we have data to support something, we can consider doing it.

I have been not a proponent of saying just because there's dark clouds out there that we're going to start flipping numbers in there. We're not going to do that kind of thing. But if there's data to support something, and this might be an area that we might and could do, we could probably do that.

CHAIRMAN APOSTOLAKIS: So which HRA Model are you using now?

MR. GRANTOM: We used the HRA calculator.

CHAIRMAN APOSTOLAKIS: EPRI?

MR. GRANTOM: Yes, the EPRI HRA Calculator, and we just recently made that transition over the last year or so to do that.

CHAIRMAN APOSTOLAKIS: Now, the NRC has never reviewed this, has it?

MR. GRANTOM: George, I don't know the answer to that question.

MR. GAERTNER: Not formally, but they participate in the meetings and they are aware of the decisions that are made. Gareth is one person who attends.

MR. GRANTOM: Okay. So the activities are mapped to basic events. This is kind of an interesting thing I like to bring up, because when our negotiations started with work control, we had to ask the questions well, how do you take equipment out of service? And we go back to the Equipment Clearance Program that we have at South Texas and this is how they tag out certain pieces of equipment or certain trains of equipment.

So we had to make certain that when they tag out auxiliary feed water train A that it comes from this point to this point, and we had to translate that directly into the model, so that when we had our toggle switches with our macros that it appropriately bounded all those basic events. So those are specifically tailored to match the way we do work at South Texas. And another utility could be slightly different but, you know, that effort has been done there.

The as-built, as-operated, RAsCal is updated. We're in the process right now of rolling out another 20,000 maintenance states. Drew right now told me yesterday he has probably looked at around 15,000 right now and it takes us about two weeks with about three or four computers, and we have learned to batch these jobs together to go and repopulate RAsCal's database and that's part of the PRA update process, is to update all of that.

On the issue of common cause, we have to talk about two different things here. One thing is how is common cause treated in the model, because the operators have nothing to do with the model or common cause or anything like that. But what the operators do perform is extent of condition and operability determinations.

Now, if we have a component that breaks, operations will declare that inoperable and then they will perform an extent of condition. Could this same condition be existing on the other two trains? And they will make that call either with the information they know or if they need assistance, they will call engineering and they will assemble a team together, but they will make an operability determination on those other two trains at STP or another train if it was a two train plan. And based on that, they will declare those other trains either operable or inoperable.

Now, conservative decision-making comes into play. The Generic Letter 91-18 criteria and all those things come into play. But it's very important to distinguish the difference between what the operators do and what the PRA does in common cause modeling, which is a separate thing that they don't see.

So if operations makes the call that the other two trains are affected, they will declare them inoperable and they will go into RAsCal and say all two trains or all three trains are inoperable and failed, and RAsCal will go and find the appropriate CDF number and it would be reflected.

And we're very much wanting to keep this part of technical specifications the same for operators. Operability decisions are still operability decisions. They are the responsibility of the individuals who hold a license. That is not the PRA person's call. If they tell me it's operable, I believe them. If they tell me it's inoperable, I believe them.

CHAIRMAN APOSTOLAKIS: So let me understand. There will never be a situation where when the probability, the conditional probability of the second train failing given the first one was found out will be beta, because if there is any doubt that there is a connection between the failure of this train, which is down, with the possible failure of the other train, they will declare it inoperable using conservative decision-making?

MR. GRANTOM: Yes.

CHAIRMAN APOSTOLAKIS: Yes. Otherwise, the probability goes back to the original level of 10^{-3}.

MR. GRANTOM: You're correct. But in the PRA, for example, okay, that's done in the software itself, because you're correct. If you go and you look at the 1 minus the beta and you look at the beta and you go and do the math, you're left with the failure rate of the component ultimately. And the software does that. Whenever they toggle that component out-of-service, the software automatically does the math.

CHAIRMAN APOSTOLAKIS: Yes. I mean, the software would say it's unavailable period.

MR. GRANTOM: Right, period.

CHAIRMAN APOSTOLAKIS: But what I'm saying is that in real life, there is some uncertainty as to whether the cause they put this down operates on the other train, too, and that's why you have this conditional probability of something, .1, .05. You are avoiding an assessment of this probability by deciding in a conservative way whether the second train will do its job or not. And if he does then you say okay, then it's operable. There is a standard failure rate.

MR. GRANTOM: That's right. It's operable.

CHAIRMAN APOSTOLAKIS: Okay. That answers my question.

MR. GRANTOM: Yes. And I think that is

clearly --

CHAIRMAN APOSTOLAKIS: So the key here is the conservative attitude when you declare it operable or not.

MR. GRANTOM: Absolutely.

CHAIRMAN APOSTOLAKIS: Because if you're not, if you make a mistake there then --

MR. GRANTOM: And it clearly is conservative decision-making and, you know, operations and, you know, Jay will tell you that this absolutely says that there isn't any indeterminate time. When they declare that it's operable, it is operable. They have done the evaluations to determine there is not -- that the extent of conditions not common cause and you still have the failure rates of the other one or that they will fail conservatively and say they are inoperable. And if they are inoperable then we fail them or we assume they are failed in the analysis and we take the appropriate action at that point.

CHAIRMAN APOSTOLAKIS: Well, that's certainly one way of having it.

MR. GRANTOM: Yes.

CHAIRMAN APOSTOLAKIS: They key is, of course, the conservatism.

MR. GRANTOM: Yes. And I think that

clearly for now, this is the best way to do this, because it keeps operators within the current framework of operability determinations that they have been doing, that they hold a license for.

As I mentioned before, under the uncertainty thing, uncertainty issues, a lot of debates on that. The uncertainty certainly is in the base CDF Model and when you talk about the aleatory and the epistemic, the aleatory is kind of taken care of, because we're looking at delta. So you know, it's already within the model itself.

So our current application, we use this for our (a)(4) program right now and we have extensive use on this and what I really need to do now is roll me off of this and let me get to Jay here who will talk to you a little bit about how the software program really works, you know, from an operator's perspective.

MR. PHELPS: Okay. Thanks, Rick. It's a pleasure to come up and talk to you a little bit. What we have talked so far about has been enlightening to me. This is all things that take place behind this screen that my staff uses. What I want to tell you is a little bit about how operations utilizes this program, some of the values that it has.

CHAIRMAN APOSTOLAKIS: Excuse me, but that raises an interesting question especially for Rick. How much of the technology that is behind this screen, as Jay just said, are the operators familiar with? Do you ever talk to them about what goes into the PRA?

MR. PHELPS: Yes, oh, yes. Rick or Wayne come over frequently to our Licensed Operator Re-qualification Program. They have frequent discussions as we talk through how these -- what the development activities were that go into that.

As far as utilization of that, this is the part that we really touch on. We have a clear understanding of the need to recognize the current plant configuration, any changes in that plant configuration, to understand what the changes are to the calculated values on our delta CDF as we move through that. So they are very involved with this.

MR. GRANTOM: Yes. But one thing that this has caused, enforces, is that we get a lot more calls coming not our direction to them, their direction back to us. And whenever we roll out a new model, we have part of the -- an update or indoctrineization, here is the changes in the PRA model that occurred and here is the impact that you will see in here, because they will call us about it.

Hey, you know, this looks different than it did before. And so that is the kind of problem.

So we participated in the requal classes and we also have periodically, about once every other cycle there, we'll have a new kind of introduction to PRA and talk about the changes that we have made over time. So we're involved in training to do that. And I might add that training has asked us things like what are the important operator actions? And so we have had that feedback actually with the Training Department, so we coordinate with them to schedule all of these kinds of things like that.

MR. PHELPS: Just to tell you a little bit of what you're looking at here, this is basically a screen that comes over to us. The work window planners and stuff, they get together and they will get all this blue data over here, input, all the systems that are affected and those are the planned times to take the equipment out, the planned times to get that back and the following screen will show you a little bit about what the graphical representation that we can pull up on this would look like to show the operator the cumulative risk that is going to occur over that planned work week.

Additionally, for unplanned or emergent

conditions, the operator has the ability to go over here to a little drop down menu, pull up any number of systems in its associated train, input that data down here with the actual times and it also impacts that.

They will go through and over here we actually do the actual what time did the operator really go make that component out-of-service and what time did we actually bring that back, and that will give us our comparison between our planned risk profile for the week versus the actual risk profile that we saw for the week.

It doesn't take very long. As you see, it's pretty simple. Click and point. Usually it's done by our unit supervisor, the Senior Reactor Operator that's in the control room. He will sit back and make log entries for all of this. As he has time, he will go in and update that against the plant is really kind of how it works.

DR. SHACK: And again, who makes the decision when you're doing an activity as to what system was affected?

MR. PHELPS: The unit supervisor will make the decision on which one is affected on there. It's already pre-planned, but we will go through and validate that to ensure that the work week planner, the schedulers who put the plan together, has properly captured the right systems that are impacted by whatever maintenance or testing activity is planned for that day.

Now, we talked a little bit. Behind that screen there is another tab you can click on that will really pull this up. This is an example really out of our daily meeting package, if you will, following the completion of a work week. It will show us in tabular format down here the actual components or maintenance states that were done on this one, actually see the risk assessment, core damage frequency.

The other one Rick had mentioned to you was on our balance of plant or our baseline trip risk model, that some of those components if they increase the trip risk of the plant, being a key initiator, any of those will also roll over into a calculation and raise that level of core damage frequency as a result of that.

So they will go through. We have the planned times, the durations that we were talking about, the actual times so we can evaluate how we did against what our plan was. The graphical representations up here are the maintenance states. Obviously, we took the first component out-of-service over here. You saw the planned increase in risk, where it went, took it a little bit more out and continued on.

The blue dashed lines show you the actual risk that we incurred. So for this particular week we were slightly above that. You can look down through here and determine what happened and we really had one of our components, a steam generator power-operated relief valve, out-of-service a little bit longer than planned and the calculated value reflects how we managed to accomplish that. Are there any questions on this slide?

MR. HARRISON: Let me point out that this is something we look at each week in management.

MR. PHELPS: Right. That's correct. We also calculate that value of the operators in the operational status reports. Each day we'll have the actual for the day as of 0600 in the morning versus what the plan for the week was, so we can tell on a daily basis just to keep the station aware of where we are from an accumulation of the core damage frequency risk.

DR. SHACK: Now, on your first step you exceeded your planned time. Does somebody have to make a decision whether that's acceptable?

MR. PHELPS: We have got thresholds for each of these. For the smaller deviations that you see up here, when were in the, I think, the minus 8th range, we probably won't do a whole lot with that in all honesty as far as going out to understand what's there.

CHAIRMAN APOSTOLAKIS: I thought you kept track of delta CDP, the incremental probability. That's what the document --

MR. PHELPS: The operations.

MR. GRANTOM: That's what that is. That's what it is.

CHAIRMAN APOSTOLAKIS: It says delta CDF.

MR. GRANTOM: Yes. Well, it's really a crop-up probability.

CHAIRMAN APOSTOLAKIS: In other words, you have an average delta CDF and you multiply it by the time.

MR. GRANTOM: Yes. You're looking at delta CDF here, you know, is what it is and, basically, they are just looking at the delta from the zero maintenance state to the incremental part of that or what the --

CHAIRMAN APOSTOLAKIS: The document I thought referred to the conditional probability not the CDF, and I did some calculations with the produced numbers and, indeed, it's the conditional probability.

MR. GRANTOM: Yes, it is the probability.

CHAIRMAN APOSTOLAKIS: It's delta CDF times T.

MR. GRANTOM: Right.

CHAIRMAN APOSTOLAKIS: T being the time you're allowed for configuration.

MR. GRANTOM: Yes. If you go calculate the area --

CHAIRMAN APOSTOLAKIS: That's why it goes up linearly.

MR. GRANTOM: Yes. If you go calculate the area, the duration that you're in that state --

CHAIRMAN APOSTOLAKIS: Yes, yes.

MR. GRANTOM: -- you get the probability.

CHAIRMAN APOSTOLAKIS: So this is not an accurate figure then.

MR. GRANTOM: Well, it's showing a risk profile of the change in delta CDP, but what it doesn't show there is if you calculate that area that you were in one of these maintenance states under each of these durations here, it doesn't return that value of what the probability is.

CHAIRMAN APOSTOLAKIS: I mean, if the

decision is based on CDP, you might as well show the CDP.

MR. GRANTOM: Yes, we can show either one of them, but these are true up to a threshold, 1 E^{-6} threshold.

MR. BRADLEY: The way STP does this, they do it on a work week basis, so they are always planning for a week and they have targets.

CHAIRMAN APOSTOLAKIS: Don't they have a backstop?

MR. BRADLEY: Yes, they have all that.

CHAIRMAN APOSTOLAKIS: Yes. So it's important.

MR. BRADLEY: Yes. They have the time element captured that way and that's what's --

CHAIRMAN APOSTOLAKIS: I don't know. I mean, the whole point is that, you know, you are calculating the backstop by using the delta CDP and the 10^{-6}.

MR. GRANTOM: 6 threshold and that's the time.

CHAIRMAN APOSTOLAKIS: Yes.

MR. GRANTOM: Yes.

CHAIRMAN APOSTOLAKIS: Yes.

MR. GRANTOM: Yes, we'll assume that.

CHAIRMAN APOSTOLAKIS: Do you have any example of this here?

MR. GRANTOM: Not with me, but we do that same calculation.

CHAIRMAN APOSTOLAKIS: Separate.

MR. GRANTOM: Yes. All our calculations, they are in the new RAsCal. You're looking at the RAsCal for Maintenance Rule.

CHAIRMAN APOSTOLAKIS: Yes. I think that's what I wrote down.

MR. BRADLEY: Most plants use CDF ratios now to do this, because you are always constrained by tech specs. Right now, there is always a finite time that you have to meet, so plants will manage this by CDF because they are constrained.

CHAIRMAN APOSTOLAKIS: Sure.

MR. GRANTOM: But, George, if you'll just wait a second. When you see the new version of this, you'll see that it is a probability.

CHAIRMAN APOSTOLAKIS: I'm going to see it?

MR. GRANTOM: Yes, you're going to see that in just a minute here.

MR. JIN CHUNG: This is Jin Chung. Let me paraphrase what you said. You can present the data in a true way. One is like you said, integrate the CDF as a function of the time. That will create the exponential curve. It's not the straight line. Also, there is another way of presenting the same data. At a given time you can annualize the CDP in terms of the average. So I think --

CHAIRMAN APOSTOLAKIS: These are mental acrobatics. Why do you do it like that? I mean, it's not natural.

MR. JIN CHUNG: That's how we use it in our Reg Guide 1.200.

CHAIRMAN APOSTOLAKIS: Anyhow, I thought I was going to see what I read in the report that says there is --

MR. GRANTOM: Okay. George, there is a real easy answer to this.

CHAIRMAN APOSTOLAKIS: Huh?

MR. GRANTOM: I mean, it really is the probability. But, see, what you're looking at is a screen shot from the package of the plant and we identified to them that they needed to change the F to P.

CHAIRMAN APOSTOLAKIS: I would like to see the calculation.

MR. GRANTOM: Well, you will see that in

just a second.

CHAIRMAN APOSTOLAKIS: Okay. Well, that's good. Now, the figure on the right.

MR. PHELPS: Yes, sir.

CHAIRMAN APOSTOLAKIS: Trip probability percent increase, I guess that's for internal use?

MR. GRANTOM: Yes.

MR. PHELPS: Yes.

CHAIRMAN APOSTOLAKIS: It has nothing to do with configuration.

MR. GRANTOM: That's not part of 4b.

MR. PHELPS: That's not part of 4b.

CHAIRMAN APOSTOLAKIS: 4b doesn't have anything to do with it.

MR. PHELPS: That's correct. That's just managing our own trip risk that we have there and, as we mentioned before, something that can't fall over into the core damage probability calculation, basically.

CHAIRMAN APOSTOLAKIS: Okay. Good. Let's look at the --

MR. PHELPS: Okay. We'll talk a little bit. Now, how are we going to move from utilization of this tool for (a)(4) reasons to -- as we move forward into implementation of a risk-informed technical specification?

We use the same tool, the RAsCal Program that we have got, as Rick says, capable of determining the configuration risk and the allowed outage time, in a very short time. Right now we use basically the same function, if you will, as a tool for the operator. Two components or two systems come back available to be released, but it can only do one at a time. Which one is the right one to use, so we can run the values? If I get this back operable in an hour versus this one back, which one is going to drop my risk the furthest?

If I also want to know oh, wow, the maintenance is going to take longer on these sets of components that's out-of-service now, I can extend that planned return to service time or I can go at what point will I bust a threshold, whether that's an E^{-6}, E^{-5}, whatever that is, how long can I have those components out-of-service? So those tools are already in there. The operators are using them and they will be very similar to how we would implement the risk-informed tech specs to determine the allowed completion time.

I have got a couple of examples in here really of how would this work. Example 1, we have got a routine Train Alpha work week and we'll have an emergent condition that occurs on another train. You can tell we started the work week. They had a number of systems, safety-related systems, out-of-service, our diesel, our essential cooling water, component cooling water, our high-head injection pump.

The current tech specs or the front-stop times, that term we'll become familiar with, are identified. Therefore, you have got seven days on most of those with the exception, we have an extended allowed outage or an allowed outage time on our diesels of 14 days.

CHAIRMAN APOSTOLAKIS: So excuse me. Again, I'm trying to make a connection with other things. South Texas has already received an extension of their allowed outage time of diesel generators to 14 days.

MR. GRANTOM: Yes.

CHAIRMAN APOSTOLAKIS: Using Regulatory Guide 1.1 what, 7?

MR. HARRISON: That sort of predated that, the fundamental.

CHAIRMAN APOSTOLAKIS: Okay. So what we're doing here is extending the capabilities or the flexibility that those guys provide.

MR. GRANTOM: That's correct, yes, and you will see that is an example of how that --

MR. PHELPS: Exactly. So with the planned work --

CHAIRMAN APOSTOLAKIS: I'm sorry.

MR. PHELPS: That's all right.

CHAIRMAN APOSTOLAKIS: So in the future there will still be a need for that guide, right, because that determines the front-stop?

MR. GRANTOM: Yes.

MR. PHELPS: Yes.

CHAIRMAN APOSTOLAKIS: That guide determines the front-stop. You have the 30 day ultimate backstop and then with this stuff you can go in between, between the front-stop and the --

MR. GRANTOM: Everything in between, yes.

CHAIRMAN APOSTOLAKIS: Now --

DR. SHACK: But everything in between is still covered by that Reg Guide. The only thing is they are going to be allowed to make that decision in real-time rather that coming in.

MR. GRANTOM: Yes.

CHAIRMAN APOSTOLAKIS: It's consistent with the guide.

MR. GRANTOM: Yes.

CHAIRMAN APOSTOLAKIS: Yes, absolutely. It's consistent with the Reg Guide. But my question is would you really need that guide anymore, because the front-stop, I mean, even if it had stayed three days for the diesels, with this capability now, it could be --

MR. BRADLEY: If a plant implements 4b, they are probably not going to need a lot of 1.177 --

CHAIRMAN APOSTOLAKIS: They would not need one.

MR. BRADLEY: -- changes any more.

MR. REINHART: But they still do use that Reg Guide in their annual evaluation. They haven't gotten there yet.

CHAIRMAN APOSTOLAKIS: What do you mean?

MR. REINHART: They look at their accumulated risk over a year and then go back and compare it to the Reg Guide 1.174. They haven't gotten there yet, so there is an ongoing need even in this application for that Reg Guide.

CHAIRMAN APOSTOLAKIS: Well, Reg Guides never die, right?

MR. PHELPS: All right. Moving along. Like I said it's a planned work week. The intention as you go into this is probably to stay within your current front-stop time and not utilize the additional times allowed as you move through this, so you don't run the program and say how long can I take this out-of-service or a calculated allowed outage time. Did it. We planned on remaining within the allowed outage time. And it's just a routine planned maintenance.

24 hours later, all those components have been out-of-service. We have accumulated some degree of risk as a result of that. We have the emergent condition come up or another high hit system has been declared inoperable. The front-stop will tell us, will say you've got six hours to apply and the tech spec number is an imaginary number, if you will, that will tell you how to implement this and the specific specs will tell you restore it with no more or apply this within this time frame.

So you run through and you determine what the allowed outage time now is with the new configuration. You've got Train Alpha and Bravo high pumps out-of-service now in this case. And it could calculate and tell you you have got 24 days that you can be in that specific configuration. You can see the increase and the accumulated risk per hour. And just to comment, correct tech specs in that condition would apply Tech Spec 303, which is shutdown.

CHAIRMAN APOSTOLAKIS: What is this per hour thing?

MR. PHELPS: Go ahead, Rick.

MR. GRANTOM: Well, it's -- we're dealing with a work week here. So everything is proportioned.

CHAIRMAN APOSTOLAKIS: So you take the CDF here?

MR. GRANTOM: Yes, and we're just doing it and saying so this is what the accumulation is per hour. Because we've got to be able to calculate an AOT, a time.

CHAIRMAN APOSTOLAKIS: Wait. This is not about the baseline risk or the delta risk.

MR. GRANTOM: The delta risk.

CHAIRMAN APOSTOLAKIS: The delta per hour?

MR. GRANTOM: Yes.

CHAIRMAN APOSTOLAKIS: So it's delta risk per hour?

MR. GRANTOM: Yes.

CHAIRMAN APOSTOLAKIS: What's the delta?

MR. GRANTOM: Okay. Yes, it's the delta.

CHAIRMAN APOSTOLAKIS: So if I multiply this now by 24, I will know what the increase in CDP?

MR. GRANTOM: CDP would be, yes.

CHAIRMAN APOSTOLAKIS: In --

MR. GRANTOM: Yes.

CHAIRMAN APOSTOLAKIS: I would like to figure it out myself.

MR. GRANTOM: But that's why we have the tool do it for him.

MR. PHELPS: Okay. We'll go to the next slide here.

CHAIRMAN APOSTOLAKIS: Actually, no.

MR. REINHART: If you'll wait a second.

CHAIRMAN APOSTOLAKIS: Wait, wait, wait.

MR. GRANTOM: Okay.

MR. REINHART: I need to make a comment on your slide there and I'm not sure what you are understanding, but on that first block where he has the different components out there. What we have told the industry is regardless of the front-stop, if they have multiple components out-of-service, we want a risk-informed completion time calculated for that configuration. Because there may come a time when you calculate a risk-informed completion time that is shorter than the front-stop and that's what they need to follow.

CHAIRMAN APOSTOLAKIS: Oh. When you are in multiple --

MR. REINHART: Multiple LCOs.

DR. SHACK: Well, you actually had a couple of examples, I thought, were even with one component, the risk-informed one was shorter than the front-stop.

MR. BRADLEY: No.

CHAIRMAN APOSTOLAKIS: Well, it's not unreasonable, given the way the regional allowed times are determined.

DR. BONACA: So just for information, so the way you calculate 24 days, it would give you almost a factor of 1,000, right? So the mental 24 days is based on a risk --

MR. GRANTOM: 10^{-5}.

DR. BONACA: -- 5, yes.

MR. BRADLEY: STP is a three train plant. A two train plant would not get 24 days for two trains.

CHAIRMAN APOSTOLAKIS: Right.

MR. GRANTOM: Very true.

DR. BONACA: Yes, I tried to understand the configuration.

MR. GRANTOM: Yes, we don't lose function with two trains.

DR. BONACA: That's an increase 10^{-5}.

MR. PHELPS: All right. So what's it look like rapidly or just the one you kind of wanted to see where the numbers tracked off on us. The initial part, the maintenance states are just in bar chart form down here. This is the initial 4 system out-of-service and indication of the increasing CCDP. We've got the right ones on there.

MR. GRANTOM: Yes.

MR. PHELPS: We've got the right labels on this one.

CHAIRMAN APOSTOLAKIS: I hope.

MR. PHELPS: Actually, that one came out of the package. It's an editorial problem that we didn't correct. So we said the time 24 hours right here.

DR. SHACK: It's incremental, so there's an I missing.

CHAIRMAN APOSTOLAKIS: You can't win.

MR. PHELPS: It's a reality.

MR. GRANTOM: The units are correct.

MR. PHELPS: The units are correct, yes. We're getting closer, the units are correct.

CHAIRMAN APOSTOLAKIS: Eventually, it will be a huge upgrade.

UNIDENTIFIED SPEAKER: In his own words.

CHAIRMAN APOSTOLAKIS: ICCDPOF.

MR. PHELPS: So we go through and we have the new component, the new state with the bravo training, high injection safety system. We see the new change in our actual Risk Plan versus the Planned Risk Plan. Once again --

CHAIRMAN APOSTOLAKIS: So there was an emergent condition on Tuesday?

MR. PHELPS: Yes, sir. That's our example there that we have got where we got down from the previous page. This is the graphical. So there goes your actual risk where you are moving ahead. The component gets restored to service. Once again, our slopes turn back into the -- basically the same from the initial work plan to the same aesthetic components that are out-of-service until everything is returned to service and that will give us our core damage probability for the week with a higher actual than the plan, based on the emergent condition that occurred.

CHAIRMAN APOSTOLAKIS: When everything is returned to service, shouldn't that drop down to zero if it's incremental?

MR. GRANTOM: Well, we just -- no, because we're just -- we flat line it out, because that's the level we accrued for that week. And then what you will find later on is we separately from control, from the control, we take all of this information back to the PRA group and we contiguously put these things together and then we are able to capsulate what was mentioned by Mark Reinhart earlier that we have that rolling 52 week look at what CDS did.

CHAIRMAN APOSTOLAKIS: But it does go down to zero, does it not?

MR. GRANTOM: It goes to the zero maintenance, maintenance stage.

MR. PHELPS: It's the zero maintenance stage. We started the next week --

MR. GRANTOM: Yes, we started the next work week, we would start from the zero maintenance.

DR. SHACK: If you haven't done anything this week, it would have remained zero all week. But that week he accumulated that much more.

MR. GRANTOM: We accumulated that, yes. We accumulated that.

MR. BRADLEY: And you have a weekly target?

MR. GRANTOM: Yes, see, our plan would have been that green line. And like you have seen on the previous slide, that was an actual one from the plant, you saw that our actual was slightly higher than the plant. Well, in this case, they would have reported that our actual was higher and they would have talked about why that happened and if any lessons learned from that. Yes, sir?

MR. JIN CHUNG: Jin Chung at NRR. I have two or three questions. Are you using the general maintenance model for this?

MR. GRANTOM: Yes. Oh, yes, yes.

MR. JIN CHUNG: My second question is that I presume you do have a 16 week rolling Maintenance Program.

MR. GRANTOM: 12 weeks.

MR. JIN CHUNG: 12 weeks. Okay. That in that schedule the maintenance work, I presume that you are going to suspend some of them if that piece created into this emergent or situation.

MR. HARRISON: We all do maintenance. Are you asking us would we not do maintenance to bring the cumulative down?

MR. JIN CHUNG: If you know the time period.

MR. HARRISON: We would do the maintenance that we need to do to maintain material condition of the plant.

MR. JIN CHUNG: You would go ahead with the plant scheduled maintenance?

MR. GRANTOM: Yes, we would do all the scheduled maintenance that we would need to do. And, Jin, as I mentioned before, you know, we collect this data and we provide that rolling 52 week average. And you can actually see over time what the core damage frequency does over time and that's another way to look at things. And you can start asking lots of questions about why the rises and the peaks and all that.

MR. JIN CHUNG: But you don't have an instantaneous CDF that you suddenly start doing things, that you say is intolerable?

MR. GRANTOM: Well, in the normalized down there, yes, we will. As an STP it's hard to get to it.

DR. SHACK: It's hard to get to understand that.

MR. GRANTOM: Yes.

MR. BRADLEY: In the (a)(4) guidance we have it that it's actually 10^{-3} is the number that is in the (a)(4) guidance and the RMG for 4b will have a similar speed limit on it.

MR. PHELPS: Yes. I mean, the reality is when the actual component broke on emergent conditions, what the operators need to do is they will go in there with a plan, return to service time, calculate what that projected increase is and the risk number that we're going to get. I'm going to say away from units, because you guys are all experts on that and they confuse me as we get up to some value. If there is -- if we approach the administrative limits that we have at site, V^{-6}, and there are additional compensatory actions or contingency actions that we may very well be required to take, we may move to working 24 hours a day, 7 days a week to return the most risk significant component to try to drive those numbers back down to avoid leading those. So those are some of the tools that they provide really to the on-shift crew to make those decisions on which way we need to move to return to service.

DR. BONACA: Well, this is obviously continuous in the presenters.

MR. BRADLEY: You have two trains. 10^{-3} a really high number depends on how you are --

MR. PHELPS: You have to remember the other presenters are presenting really their (a)(4). They are not 4b pilots. But that criteria is in the guidance that we have developed.

MR. GRANTOM: It's page 13 on the back of the slide of the initial presentation.

UNIDENTIFIED SPEAKER: Okay. Good.

MR. JIN CHUNG: Have you used the truncation level of 10^{-9} or 10^{-11}?

DR. SHACK: 10^{-11}.

MR. GRANTOM: 10^{-11}.

MR. JIN CHUNG: 11.

MR. PHELPS: And a lot of those are built in. Like I said, we've got 22,000. When this program first came into effect, it wasn't unusual during an emergent condition to have to call our PRA group to go run that one hour long program to determine that E^{-11} truncation levels. But with our experience right now, it's very rare that we encounter an emergent condition that's not available for immediate number from the operator that's already a set that's out there to pull that information back in for us.

CHAIRMAN APOSTOLAKIS: Is your second example shedding any additional light?

MR. PHELPS: No, that's what I was going to ask. The second example really just show you --

CHAIRMAN APOSTOLAKIS: The same thing?

MR. PHELPS: -- when we are called back in, it's about the same thing.

CHAIRMAN APOSTOLAKIS: Okay.

MR. PHELPS: So when you say if there are any other questions or desire to see that, we'll go over it. Other than that, if there are any other questions --

CHAIRMAN APOSTOLAKIS: Are there any comments or questions from the gentlemen around the table?

DR. BONACA: Thank you for the "gentlemen." That was generous.

DR. SHACK: The rest of us don't get a chance to ask any questions.

DR. KRESS: You are not allowed.

CHAIRMAN APOSTOLAKIS: Wait, wait, wait.

DR. SHACK: Yes, sir.

MR. FLACK: John Flack, ACRS. I guess I met Rick some time ago back in NRR when I was the branch chief over there in the PRA Branch. And I think you gave me the same answer on the loss of off-site power due to hurricanes. But more importantly, recently, of course, with the grid and the concerns about the grid and communication between a grid operator and the plant has come along.

And how do you reflect these changes and you are initiating by frequency on loss of off-site power, because the risk will be quite different if you are taking out diesels, for example, during certain times of the year than at other times of the year. But if you use a point estimate for the off-site power loss, you're going to miss that contribution from the risk if the grid isn't stable.

So again, I guess this follows up on Bill's question about how you are accounting for these changes in the grid performance during the year and how is that reflected in the risk model.

MR. GRANTOM: There's a couple of responses on that. First of all, you mentioned diesel generators. The diesel generators do account for the impact of on-site power and that would be reflected in the risk profile. But if we are talking strictly about the loss of off-site power frequency right now, some of the information you are talking about is going to be collected as we collect data and new updates of data of events that occur.

I'm really concerned about trying to go and say just because they have taken a transmission line out somewhere, that all of a sudden I have a basis by which to go and change PRA numbers. And the other part of it is we're currently right now, and I don't necessarily have a basis for doing that, the other part of the answer is we're trying to deal with a program here in 4b as something that we have control over.

And we can't do anything about the impact of that out there, other than to ensure that we have the required number of off-site power sources available, which is a tech spec requirement that's in there. We have to assure the availability of those items there. So there's not really a whole lot of basis for me to go and change the numbers. Now, we have talked, as I mentioned earlier, about the fact that during hurricane season, there might be enough specific data to actually go and look at that and say she would be using a slightly different distribution during that time period there.

And we have also talked as part of configuration risk management should be maybe not do diesel generators during that period of time. To me it's very undetermined as to whether I really have a strong enough basis to do this. So part of the answer to your question is currently we don't do anything. Our loss of off-site power frequency has an analysis behind it, based on data. That data is updated as the PRA is updated based on events that occur.

It will be reflected as such, so it could change in that regard. But because there may be a hot day and there may be some grid instability or anything, currently we don't do anything.

MR. HARRISON: Well, I do point out that in our risk management process and procedures if we will be going to be taking a diesel out-of-service for longer than it's normal allowed outage time, there are some actions that we do with regard to checking with the dispatcher.

MR. GRANTOM: Yes, well, let me finish. I'm speaking from a quantitative perspective.

MR. HARRISON: Right.

MR. GRANTOM: Now, quantitatively, in terms of risk management guidelines and those kind of things, operators are in contact with dispatchers. They are aware of those items. There are -- there could be some areas there that we might want to augment in terms of risk management guidelines to say if you have these kinds of conditions out there, check the availability of diesel generators, the turbine driven auxiliary feed water pump. Those kinds of things that we think would be appropriate that we think we could do from a qualitative or risk management guideline perspective.

John, I hope that helps with your question. I don't know if I answered it completely, because it -- we're not necessarily doing something quantitatively on that.

MR. FLACK: Yes, it does to some extent, but I would just clarify the situation there. But, I mean, if you are planning on taking diesels out for long periods of time, the question of whether you're going to do that during the summer months, as we know that the increase in likelihood of loss of off-site power is greater, would be considered in that decision. And obviously, the risk would play out in that decision. But if it's just being taken out as based on a point estimate, of course, you're not going to have that insight.

MR. GRANTOM: Well, you would see it in the -- you would see it in taking the equipment out of service. But I think where you would most likely see that would be addressing your question is in the risk management guidelines that we're presenting. This is hurricane season. What's the status of the grid? And we will have to do what we have to do to maintain the material condition of the plant, if there is a need to do something, but those other considerations, I think, would be outside of the quantification. But they would be part of the Configuration Risk Management Program. And we're talking about those kinds of things to put in there. Not only just for that, but other things.

CHAIRMAN APOSTOLAKIS: All right. Mark?

MR. REINHART: I need to go back to your slide 13 for one minute and just make a comment. On the third row down, the 24.00, you talked about the 3.0.3 situation and this is a little ambiguous to me, because you are a three train plant. But one thing that we, the staff, has said to the industry is we are not yet ready to calculate the risk-informed completion time for total loss of function. If they are in 3.0.3, they are in 3.0.3 and follow 3.0.3. We're not really ready yet to calculate a longer time.

MR. BOYCE: Yes, I was just going to try and address also John's question. I think we were -- the question was directed at risk-informed completion times for tech specs. But the real answer is Maintenance Rule (a)(4) still applies. You've got to assess and manage risk. If you've got an indication that the reliability of the off-site power system is degraded, that's covered under the (a)(4) program. And you have got to, you know, pull out of the maintenance. You've got to knock off work in the switchyard. That's not covered under this program. That's covered under the (a)(4) aspect.

Where this could meet the road is is if

the reliability off-site power degraded to the point where you declared your off-site power, there is a preferred and alternate sources of off-site power inoperable, at that point, you would go into your program and you would take those switches and you would say off-site power is unavailable and then you would recalculate your risk-informed completion times.

Okay. I think in practice we wouldn't get there. I think you would call up the transmission operator and say hey, we need to have a higher reliability of our -- of power coming to the site. That's my guess. We currently have a RIS, I think, that's trying to explore this issue further, by the way. So I think that's the answer to the question is (a)(4) that's primarily the governing factor here, not the risk-informed completion time aspect.

MR. BRADLEY: Yes, and there's actually -- it's explicitly in the (a)(4) guidance that you could go and look at, you know, the grid.

MR. GRANTOM: Right. And I know that EPRI has been looking at, you know, reliability studies. I mean, John Gaertner can talk about some of the things we're doing in that area, but those haven't translated into configuration risk quantification tools yet.

DR. SHACK: What was -- Mark, can you explain to me the implications of your comment again a little bit more? I'm not sure I understood it.

MR. REINHART: On the Tech Spec 3.0.3?

DR. SHACK: Right.

MR. REINHART: Basically, Tech Spec 3.0.3 says if you run out of something you do in the tech specs, like you have three trains, in their case, or two trains and say HPSI pumps and all of your components covered by that limiting condition for operation are inoperable, you have one hour to start a shutdown, etcetera. There is a Risk Initiative 6 that's trying to modify that. The industry --

MR. GAERTNER: If you have a required action for a loss of function in your specs, then you can apply Initiative 4b to it. If there is an explicit required action, you know, you've lost two trains, restore one train in six hours, you can apply that. What you can't apply, basically, Initiative 4b to are the 3.0.3 times themselves. If you are entering 3.0.3, then you've got to shutdown those pumps.

MR. REINHART: 3.0.3 gives you one hour to start the shutdown?

MR. GAERTNER: If the condition is not

addressed.

MR. REINHART: Well --

MR. GAERTNER: I'm sorry, Mark. Let me just finish. If a condition is not addressed, if you would have a loss of function and it's not in your specs, then you enter 3.0.3, then you can apply it to that situation. There isn't a condition to apply it. I'm sorry, Mark, go ahead.

MR. REINHART: It's an orderly shutdown, loss of function, and we're saying we're not ready to look at calculating those times, one hour to start shutdown, be in mode whatever in six hours, etcetera. We're not ready to calculate those times in risk-informed completion time method.

MR. GRANTOM: I would like to address something on this, too. I'm a risk manager and I would like to calculate the risk of that. Because if that's three trains of containment spray, you're asking me to go induce a transient on an operating plant for something that has nothing to do with core damage frequency. Okay. So there is an issue there about that.

I would tell you that if you calculated loss of function for many of the risk significant systems, you know, electric power, Solid State

Protection System, the risk is going to tell you 3.0.3 is right. You need to be going to 3.0.3. It's going to be telling you that, even in the accrued amount of time. But if you are dealing with other types of components, then it's -- or other systems that don't have the CDF impact like that, then there is an issue there. And that's kind of a little bit where I have a concern about that time frame.

MR. HARRISON: That's for Initiative 6.

MR. REINHART: Yes.

MR. HARRISON: At STP we use this example, because STP is a three train plant. We have a specific situation where we don't have a loss of function.

DR. SHACK: Okay. But this is specifically addressed then in Initiative 6.

MR. HARRISON: 6, right.

CHAIRMAN APOSTOLAKIS: I suggest that we recess at this point and after we have a chance to hear the other two presentations, maybe we can have a more general discussion. But remember, this meeting has to have another session this afternoon and, you know, we are really pressed for time.

MR. BRADLEY: Yes, we have 40 minute presentations from two others.

CHAIRMAN APOSTOLAKIS: Yes.

MR. BRADLEY: Then we have all the time.

CHAIRMAN APOSTOLAKIS: Yes, well, if they can make it 35 minutes, that would be great. Okay. We'll be back at 11:00.

(Whereupon, at 10:43 a.m. a recess until 11:02 a.m.)

CHAIRMAN APOSTOLAKIS: We're back in session. The next presentation is from the San Onofre folks. Mr. Gary Chung, the floor is yours.

MR. GARY CHUNG: Okay. Thank you. My name is Gary Chung. I'm a senior PRA engineer at San Onofre. Our other speaker assigned to presentation is Mike Phillips. He is the safety monitor software expert from Scientech and is the vendor.

What we'll be talking about this morning in 35 minutes or 40, okay, 35, safety monitoring, what is it? Some of the features of the safety monitor. Like the previous presenters, we'll talk specifically to the attributes and our personal usage and experience at San Onofre. With that, I'll turn it over to Mike.

MR. PHILLIPS: Thank you, Gary. My name is Mike Phillips, again from Scientech. Just a reminder, San Onofre is not participating as a pilot plant for the 4b Initiative, but we're the original users of the safety monitor and we wanted to provide some information on safety monitor and how it has been implemented.

None of the proposed 4b pilots will be our safety monitor plants, but safety monitor is capable of supporting the use of Initiative 4b. Safety monitor is one of the many configuration risk management tools. It is developed to be used by non-PRA personnel, specifically operators and maintenance planners and schedulers. It provides an actual solution in quantification of the PRA model or the modified PRA model for each specific configuration.

And it has been in use at San Onofre for over 18 years. And it is -- sorry, 11 years and at 18 other sites, both within the U.S. and outside. Some of the features of the software. We have performed what we call "real mode," which is tracking the actual historical status and configuration of the plant equipment. We can evaluate proposed maintenance schedules, evaluate the effects of removing and returning equipment to service, various environmental conditions, changes due to testing in progress, plant mode changes and for certain equipment we, actually -- the users actually define the specific alignments of which trains are running and which trains are in standby.

We also provide some information to the operators, as far as equipment that is out-of-service, what would be the return priorities and also information as to giving the current configuration, one of my most important pieces of equipment from a risk basis. It allows us to track risk against cumulative targets and also instantaneous risk targets.

CHAIRMAN APOSTOLAKIS: So the word "instantaneous" has become part of the vocabulary, although it's not correct.

MR. PHILLIPS: Yes, that's correct.

CHAIRMAN APOSTOLAKIS: Okay.

MR. PHILLIPS: We keep plant configuration and risk history databases. We can go back in time or users have the capability to go back in time and see what the configuration was and the associated risk and it provides dynamic modification of initiating event probabilities or frequencies and can also change human error probabilities based on time-to-boil during shutdown.

Some of the other features of the software provide -- we have the ability to automatically communicate with the plants tagging programs, operator logs or scheduling programs. The PRA model is imported from a number of PRA softwares. Internally, safety monitor uses the SIMEX quantification engine. We have a time dependent human reliability calculator that some plants are using for shutdown. And we have the ability to perform --

CHAIRMAN APOSTOLAKIS: This is the EPRI?

MR. PHILLIPS: No.

CHAIRMAN APOSTOLAKIS: No?

MR. PHILLIPS: Well, what would -- you can -- the HRAs are based on the HRA Calculator. What we would do is figure out when you are in shutdown conditions, the time the operator has to take the action can vary depending on the current water temperature, the current heat load and so the final HRA value may change because of the time they have to recognize.

CHAIRMAN APOSTOLAKIS: Yes, but you input that to your model. What model is that? The EPRI model?

MR. PHILLIPS: It depends on the plant.

CHAIRMAN APOSTOLAKIS: Oh.

MR. PHILLIPS: The number comes from -- the numbers here come from the PRA model.

CHAIRMAN APOSTOLAKIS: PRA.

MR. PHILLIPS: And you would use the same method to determine if I have a short time, what's my human failure probability and if I have, you know, say 10 minutes, it might be guaranteed failure. But if I have 10 hours, my human failure probability is much less, because I have a longer time to diagnose that inoperator action is needed.

CHAIRMAN APOSTOLAKIS: Are you talking about the San Onofre Risk Monitor?

MR. GARY CHUNG: Not specifically.

MR. PHILLIPS: This is --

CHAIRMAN APOSTOLAKIS: Yes?

MR. PHILLIPS: Well, San Onofre --

CHAIRMAN APOSTOLAKIS: No, no, first of all, I'm a little bit puzzled.

MR. PHILLIPS: Okay.

CHAIRMAN APOSTOLAKIS: About why we have this presentation today if it's not related to 4b.

MR. BRADLEY: The reason is that there are a number of plants that are considering moving to 4b and we're using the same essential tools for (a)(4) that we would be using for 4b. ACRS asked for a discussion of these tools. And this is just what we-- you know, this is the best information we have.

CHAIRMAN APOSTOLAKIS: Exelon is not using.

MR. BRADLEY: Exelon is using PARAGON. So we're going to give them, too. We're just trying to give you an overview of all the tools that are out there and we believe these all could be used for 4b once the regulatory boundary conditions are established.

CHAIRMAN APOSTOLAKIS: Yes, maybe we can go directly to the SONGS' applicable presentation.

MR. PHILLIPS: Okay.

DR. SHACK: Well, let me ask a question.

MR. PHILLIPS: Okay.

DR. SHACK: How can you do the calculations in real-time for a safety monitor when it takes South Texas an hour?

MR. GARY CHUNG: Well, the real-time solution typically takes five minutes or less and it's a matter of the solution engine and software being used in the form of the model and the truncation limits.

DR. SHACK: Well, you're at five times even minus 10, which is 10^{-} -- which is E^{-11}. Okay. I mean, is it the completeness of the model or it really is the algorithm, the computational algorithm?

MR. PHILLIPS: It's not so much the completeness of the model. It's more the algorithm. The San Onofre Model is a WinNUPRA Model that has been converted into a TopLogic solution to a single fault tree.

CHAIRMAN APOSTOLAKIS: In the monitor you have a fault tree that your SONGS --

MR. PHILLIPS: Right.

CHAIRMAN APOSTOLAKIS: And in the PRA you have a combination of event and fault trees.

MR. PHILLIPS: Right.

CHAIRMAN APOSTOLAKIS: Is that what slows it down?

MR. PHILLIPS: Yes.

CHAIRMAN APOSTOLAKIS: Okay. Well, you know, the monitor is a huge fault tree.

MR. PHILLIPS: Yes.

CHAIRMAN APOSTOLAKIS: The whole PRA is a fault tree?

MR. PHILLIPS: Yes, yes.

CHAIRMAN APOSTOLAKIS: And that's the only significant change you have to make from a PRA to go to a monitor?

MR. PHILLIPS: Yes.

CHAIRMAN APOSTOLAKIS: Because the Chinese scientists were here two or three weeks ago and they recalculate everything in two minutes using, you know, an engine and whatever in the risk monitor. So we're talking about a few minutes here and there.

MR. GARY CHUNG: Part of the answer and maybe Rick can answer this, they use RISKMAN, different software, different modeling.

MR. GRANTOM: Yes, and you don't know for certain if they are using it the same way that we're doing it or they quantify in this. I will tell you that they are looking at some advances in the software engines themselves and it has to go with some of these BDDs where they are looking at no truncation and they are going faster.

DR. SHACK: And you have never loaded your model into this and run it to see what happens?

MR. GRANTOM: No.

DR. SHACK: Since it takes a RISKMAN input.

MR. GRANTOM: Right. We haven't done that. But I'm not familiar with everything that is going on in that arena of what the Japanese are doing, but I do know that there are some real interesting work that is being done at the speed of quantifying these large models.

DR. SHACK: But the question is --

CHAIRMAN APOSTOLAKIS: Are you guys looking into the BDDs more seriously now to see whether you can say dying or not or is it something totally else?

MR. GRANTOM: Far future.

MR. GAERTNER: It's for the near future, because it won't work on the current computer operating systems.

DR. BONACA: My question was it uses a second safety monitor from Scientech as the front control on safety monitor, but in the back you are managing the PRA, right? I mean, I get the information from the PRA through the safety monitor?

MR. PHILLIPS: Yes.

DR. BONACA: Is it the complete PRA or is it a simplified PRA?

MR. PHILLIPS: It's complete PRA.

DR. BONACA: Okay. But still you get those kind of times.

MR. GARY CHUNG: SONGS 2 and 3 PRA is a whole PRA. It has all the internal events and external events, seismic, fire, explicitly modeled, our metrics, our core damage frequency and large early release frequency.

DR. BONACA: Okay. Just one last question.

MR. GARY CHUNG: Sure.

DR. BONACA: Do you have also a number of prequantified configurations as --

MR. GARY CHUNG: We do not. We calculate dynamically.

DR. BONACA: Okay. Thank you.

MR. GARY CHUNG: And safety monitor is used by the PRA engineers, work control and work planners and the shift technical advisor for each shift. We also, I didn't put the bullets on here, but, are peer reviewed against the ASME standard and also reviewed by the staff as part of the Reg Guide 1.200 pilot. Okay. Just to compare attributes --

DR. SHACK: Just out of curiosity, what's the contribution of fire to your CDF?

MR. GARY CHUNG: It's, approximately, a quarter, seismic is, approximately, a quarter and internal is, approximately, half.

CHAIRMAN APOSTOLAKIS: And the total opinion is on the order of?

MR. GARY CHUNG: $4E^{-5}$.

CHAIRMAN APOSTOLAKIS: Okay.

MR. GARY CHUNG: And that's part of when

we get into the discussion whether we should exclude external events for us, in particular. It may not be applicable to other plants.

CHAIRMAN APOSTOLAKIS: Because you are not in a seismically active area, right?

MR. GARY CHUNG: No, for that reason we do include it. We need to include it because it's another -- like a seismic event would be another way of getting loss of off-site power and all our loss of off-site power mitigating equipment would be affected when we do a risk-informed completion time. So we, in particular, have to include it.

The initiator dependencies are the same as the PRA, so we do have fault trees for loss of CCW, for example. The truncation levels are controlled by the PRA group. We have a truncation level of $5E^{-10}$, that was chosen primarily because it is five orders in magnitude above our baseline. The translation from the PRA model to the safety monitor is, for all intents and purposes, if you had a Venn diagram, there would be ovals overlapping circles. Just completely identical except for a couple of things. The average unavailability is removed.

CHAIRMAN APOSTOLAKIS: What is that Venn diagram?

MR. GARY CHUNG: Well, when we run it in real-time, it's a zero maintenance versus average maintenance or a maintenance basic event that has --

CHAIRMAN APOSTOLAKIS: The same zero maintenance of the SDP?

MR. GARY CHUNG: Yes, yes, the same language. It's the same.

CHAIRMAN APOSTOLAKIS: In other words, you are looking at the actual status of the components?

MR. GARY CHUNG: Yes, yes, yes.

CHAIRMAN APOSTOLAKIS: If it's up, it's up. If it's down, it's down. Forget about the average unavailability.

MR. GARY CHUNG: Right.

CHAIRMAN APOSTOLAKIS: Okay.

MR. GARY CHUNG: That's exactly right.

MR. PHILLIPS: Basically, you said all the average maintenance or the average tested maintenance base events to zero?

MR. GARY CHUNG: That's right.

CHAIRMAN APOSTOLAKIS: But then you have to go back.

MR. PHILLIPS: And that's the zero maintenance baseline or knowing baseline.

MR. GARY CHUNG: That's correct.

CHAIRMAN APOSTOLAKIS: So that means the component is available?

MR. GARY CHUNG: Yes.

CHAIRMAN APOSTOLAKIS: Unless you know otherwise.

MR. GARY CHUNG: Right. That's right. That's right. It's available, but still susceptible to other failure modes. And we use actual system alignments versus average alignments. Everything to reflect the real as-operated plant at that particular moment. Human action treatment is the same as in the PRA. We do map activities to basic events and that's pretty standard for all safety monitor plants to make the language accessible to the operators and work control planners.

Okay. The SONGS' safety monitor model and actually we actually just call it the PRA model, because it's essentially the same in the safety monitor. It's updated on the same frequency as the PRA. When we modify the PRA, which at the maximum we'll modify it once every refueling cycle, but we typically do it much more frequently, and each time that we do, we go through our control process and then transfer it into the safety monitor.

CHAIRMAN APOSTOLAKIS: How many engineers are in your PRA group?

MR. GARY CHUNG: We have seven.

CHAIRMAN APOSTOLAKIS: Dedicated to PRA group?

MR. GARY CHUNG: They are PRA engineers, yes. Treatment of common cause. It is treated just as if it were -- just as the PRA. Uncertainty is the same as in the PRA. If we typically -- again, we spoke of this earlier, it's really the best estimate value propagated to the fault tree for each of these basic events. We don't -- for our CRM purposes, we don't propagate the uncertainties through. We do it for the base PRA.

CHAIRMAN APOSTOLAKIS: Not to create a problem, but, I mean, we are dealing with very small numbers, 10^{-6} and so on. Are we sure that propagating the best estimate values is reasonable when the acceptance criteria is 10^{-6} on the incremental probability? I mean, shouldn't the uncertainties play some bigger role here?

MR. GARY CHUNG: I think when we're, for our purposes, doing our risk-informed completion time or a delta calculation, uncertainties are prevalent in the baseline and are prevalent after we take one or two components out-of-service.

CHAIRMAN APOSTOLAKIS: But the rule in Regulatory Guide 1.174 says that you have to be dealing with mean values when you make these calculations, the delta CDF, the delta LERF and delta CDP and also all those things. So at the end, we are making judgments using CDPs or delta CDPs on the 10^{-6}, 5 and so on.

MR. GARY CHUNG: Yes.

CHAIRMAN APOSTOLAKIS: Very small numbers in the report. How sensitive is this number to change in the input? I mean, if you are going with best estimates, you have uncertainty about these things. That worries me a little bit. I mean, how difficult is it anyway with modern computers to propagate distributions with Monte Carlo?

MR. GARY CHUNG: I can't answer that.

CHAIRMAN APOSTOLAKIS: It's not difficult I don't think. I mean, now you can do it very easy.

UNIDENTIFIED SPEAKER: To give you an explicit reference --

CHAIRMAN APOSTOLAKIS: Now, for real-time, of course, you know, if you want to do it in five minutes, we probably have a problem. On the other hand, I mean, if you have certain criteria and sensitive to it, you know, then so be it. I mean, the nexus can be with one hour.

MR. GRANTOM: Well, but that's, you know, doing the -- the point is, we could go do an uncertainty calculation. But it kind of goes back to a little bit of we're trying to figure out a completion time to the nearest hour or minute. We're not trying to figure completion time to the nearest millisecond.

CHAIRMAN APOSTOLAKIS: Yes, but all this is --

DR. SHACK: Well, but you're also worried about a risk of $1E^{-6}$. Now, it's really $1.5E^{-6}$.

CHAIRMAN APOSTOLAKIS: What if it's 5?

DR. SHACK: We're not going to lose too much sleep.

CHAIRMAN APOSTOLAKIS: But what if it's 5^{-6}? How do you know it's not? You don't know that. Because the best estimates that inputs here are really judgments. They are not -- I mean, if they were mean values, then you might say well, I'm losing something on the way, but it's not a big deal. Right? In fact, Doug True made the presentation here some time ago showing that numerically a lot of these things don't matter. But if you input what you call best estimate, we don't really know whether --

DR. SHACK: What he is going to input, George, is that same number he calls the best estimate. He is going to put an error range on it and make that his --

CHAIRMAN APOSTOLAKIS: But he's not.

DR. SHACK: No, but, I mean, if he did do that, he would go back and do exactly what you said. And so he would come up with the same answer. Because he really doesn't really know the uncertainty.

CHAIRMAN APOSTOLAKIS: No. For components we have uncertainty. We have data. We have all sorts of things.

MR. GRANTOM: Well, I mean, we could use--

CHAIRMAN APOSTOLAKIS: I mean, if we don't have that, we don't have anything.

MR. GRANTOM: Yes, well, we could use the 95^{th}. We could use any number of different things.

CHAIRMAN APOSTOLAKIS: It's not a matter of using them. It's a matter of using the correct mean.

MR. GRANTOM: Right.

CHAIRMAN APOSTOLAKIS: And then we're making too many arbitrary assumptions, it seems to me, and I wouldn't mind it, but at the end I see very small numbers to be used to make decisions. So it's a natural question. I mean, how sensitive are these very small numbers?

MR. BRADLEY: Well, these are required as part of being Capability Level 2 of the ASME standard and Reg Guide 1.200, I believe there are requirements in there, some of the supporting requirements of that standard that address the need to make sure that your values are means. And I don't think it directly requires you to propagate all the distributions through, but it does have inputs.

CHAIRMAN APOSTOLAKIS: No, but inputs, we don't even know whether the inputs are means. Somebody says they are. I mean, do they actually say this is the distribution of failure of these valves to open? This is the mean value. This is what I'm going to use. I don't think so. They say the mean is this. Why? Because by fiat.

MR. GARY CHUNG: Well, to the extent that each of the basic event probabilities, those are mean values.

CHAIRMAN APOSTOLAKIS: How do you know that?

MR. GARY CHUNG: Well, based on our source of data, there are log normals with the mean.

CHAIRMAN APOSTOLAKIS: So you do have

distribution?

MR. GARY CHUNG: Yes. Plant specific data, yes, in our --

CHAIRMAN APOSTOLAKIS: And it would be nice to see some sort of a sensitivity analysis on the side. I think the major convincing case of all these data CDPs of 10^{-6} and so on are indeed robust.

MR. GARY CHUNG: That's what they shouldn't do.

CHAIRMAN APOSTOLAKIS: I mean robust.

MR. BRADLEY: The work that Doug True did that you referred to earlier, I can't remember exactly to look at that part as --

CHAIRMAN APOSTOLAKIS: He didn't do --

MR. BRADLEY: We did do that. We did some of what you're talking about some time ago.

MR. GARY CHUNG: We have done it for the mean value. We have not done for the --

CHAIRMAN APOSTOLAKIS: Yes.

MR. GARY CHUNG: And so that's a legitimate question.

CHAIRMAN APOSTOLAKIS: I know.

MR. GARY CHUNG: So I intuitively believe it will come out favorably. It's a legitimate question.

CHAIRMAN APOSTOLAKIS: Well, it would be nice to see.

MR. GARY CHUNG: Yes.

DR. SHACK: Well, I mean, the differences of two uncertainties doesn't get any smaller. That much we know for sure.

MR. GARY CHUNG: Okay. CRM software quality and configuration control. Our safety monitors maintain and control under Appendix B Software QA Program that is maintained by the vendor. And on-site, our installation is controlled under our Plant Software Control Program. And our model is also verified and validated at the site.

Experience that we had at SONGS is that we originally did this long ago before we had (a)(4) added to the Maintenance Rule. We had the diesel generate AOT extension to 14 days. And as a commendment to that extension, we developed the CRM tool and program. Over the years, our accrued risk, I mentioned earlier it's $4E^{-5}$. It started out several years ago at $8E^{-5}$. And through plant modifications and reduction in model conservatives and we have got it to half that. And then over time, better plant understanding of risk impacts of planned and unplanned actions.

This is one of the notes he had here is automated data collection interface is in use at Perry. At San Onofre, we have the capability. We choose at this point not to use it, because it still requires manual review of each of the in-service times to see if it was actually out-of-service or big operable or little operable. At times, this could be quickly restored, even though it's considered inoperable. So we need to take a look at those situations.

There is automatic schedule evaluation input in place at many plants. Again, we do a modified version. I'll go into that in a little bit, but that is done at some plants. And data collection that SONGS has done for historical purposes, it is maintained within the 1.177 guidelines. So we do on an annual basis all our risk-informed applications we track the impact of those.

Here is a screen shot of the safety monitor. A couple notes, it's very busy. One of the things that we did is we still allow completion time and this allowed completion time is based on, for our plant, is this San Onofre we've got up here, yes, is $1E^{-6}$ accumulated probability delta over the week. So it's a delta CDP over the week of $1E^{-6}$. And so if we maintain that configuration, we can go this many hours before we accumulate $1E^{-6}$.

I may be jumping ahead, but how the work planners use this is four weeks in advance they will input their scheduled maintenance. Now, its time phase, how some equipment goes out earlier in the week, some later in the week. As a first cut, they will take them all out simultaneously and see if the risk is acceptable and whether the allowed completion time is great than in hours of a week. So in this case, it's much more hours than a week.

MR. PHILLIPS: Yes.

MR. GARY CHUNG: Now, we also do a list before our completion time for LERF. In fact, it's in blue highlight here, because that's limiting completion time between CDF and LERF.

CHAIRMAN APOSTOLAKIS: So this is not real back here. This is done when you plan maintenance?

MR. GARY CHUNG: Well, we do it in three phases. One is four weeks in advance to what they planned to do and so then if it's acceptable, then they issue out all the maintenance orders and those things. Things can happen in between four weeks in advance. And when they actually do, it's a one week advance they do the identical same thing. And then one day in advance of the actual taking place, they will run it one more time. And then when it is in play or these maintenances are occurring, each shift at STA will run the real configuration at that point to verify what the work planners have already done.

CHAIRMAN APOSTOLAKIS: When you say "they," you mean your group?

MR. GARY CHUNG: No. The only time we come involved is if there is an emergent issue that they can't handle.

CHAIRMAN APOSTOLAKIS: So who does this, the maintenance people?

MR. GARY CHUNG: In planning so maintenance and work control, when we are in the STA, the operations crew will also run it in real-time. So they will hand over -- when they do the calculation one day in advance, they keep that result and hand it over to operations and operations will run it on their own and if there are emergent additional items that come out-of-service, they will add that out-of-service to that configuration and see what they have got at that point.

And they are guided by procedure on what to do at that point. If they get a result that's too high, then they go into risk management actions. They recalculate or try to move things around or bring things back in-service. And if the result is they can't avoid it, then they will contact the PRA group or there are other compensatory measure or items that we can do to bring the risk down.

DR. KRESS: What are the three lines? What are they used for?

MR. GARY CHUNG: This is typically found on most plants, as far as colors, YELLOW, GREEN, RED. RED is the highest at $1E^{-3}$. You never enter there voluntarily.

DR. KRESS: Even with a spike?

MR. GARY CHUNG: Well, that's a good question, because the next slide -- here is a schedule. We've got some peaks above the RED. Now, this is in our plant, because we assume all the configurations occur one week, and so we would just get one block diagram. But if you did phase them in, this is what you would see. And if this was scheduled maintenance and you saw these peaks, then you would reorder or reshuffle your planned maintenance to bring the peaks down below to acceptable levels.

CHAIRMAN APOSTOLAKIS: But is this the annual CDF for a particular configuration?

MR. GARY CHUNG: Yes.

CHAIRMAN APOSTOLAKIS: What you call venues?

MR. GARY CHUNG: Yes.

CHAIRMAN APOSTOLAKIS: Okay.

MR. GARY CHUNG: Yes.

CHAIRMAN APOSTOLAKIS: So everything we see here in the vertical axis is core damage frequency per year.

MR. GARY CHUNG: Yes.

MR. PHILLIPS: Correct, correct.

CHAIRMAN APOSTOLAKIS: Given different conditions.

MR. GARY CHUNG: Yes.

CHAIRMAN APOSTOLAKIS: So for the peaks, certain equipment are out.

MR. GARY CHUNG: Right.

CHAIRMAN APOSTOLAKIS: But it's still annualized?

MR. GARY CHUNG: Yes.

CHAIRMAN APOSTOLAKIS: Okay.

MR. GARY CHUNG: Yes.

DR. BONACA: And so the big spike, you feel like the plant in that configuration forever, it would come out to the --

MR. GARY CHUNG: Exactly.

DR. BONACA: -- difference involved in the number of hours.

MR. BRADLEY: In this case, if it was at $9.5E^{-4}$, that would be your annualized.

DR. BONACA: That's a way, that's a way to look at it, yes. Yes, what I'm saying is, you know, each one of them presents a new plan.

CHAIRMAN APOSTOLAKIS: So can I have a core damage frequency which is 10 for two minutes?

MR. GARY CHUNG: 10.

CHAIRMAN APOSTOLAKIS: 10.

MR. PHILLIPS: Not by the current (a)(4) guidance.

CHAIRMAN APOSTOLAKIS: What does (a)(4) say?

MR. BRADLEY: The (a)(4) says never voluntarily get in a situation where you are --

CHAIRMAN APOSTOLAKIS: I am not volunteering.

MR. BRADLEY: -- $1E^{-3}$.

CHAIRMAN APOSTOLAKIS: I'm running and it is an emergent condition.

MR. BRADLEY: Yes.

CHAIRMAN APOSTOLAKIS: And all of a sudden I lose things and I see my CDF shut up to 10.

MR. BRADLEY: Yes.

CHAIRMAN APOSTOLAKIS: But then in a minute I bring it down.

MR. BRADLEY: You lost enough to get it up.

CHAIRMAN APOSTOLAKIS: First of all, do I have to notify these fellows here?

MR. BRADLEY: I'm pretty sure there will be a number of others interested to stand in.

(Everyone talking over one another.)

UNIDENTIFIED SPEAKER: Yes, there are a number of other --

COURT REPORTER: I can't hear.

UNIDENTIFIED SPEAKER: You would be at 3.0.3 a long time before that.

UNIDENTIFIED SPEAKER: She is having trouble following all this.

COURT REPORTER: Yes, I can't hear you two.

CHAIRMAN APOSTOLAKIS: Next time, just speak up, come closer. Well, I don't know. I mean, what is stopping us? 3.0.3?

MR. GAERTNER: There is a whole litany of things that would stop you from getting a CDF of 10.

CHAIRMAN APOSTOLAKIS: You don't have time to react. It just happens.

MR. GAERTNER: I can't even imagine what would be -- I mean, you would have to --

CHAIRMAN APOSTOLAKIS: I'm sure there would be an --

DR. KRESS: I can't imagine. I mean, 10 was simply pulled out of there. What if it's 3?

CHAIRMAN APOSTOLAKIS: Yes.

DR. KRESS: Or two.

CHAIRMAN APOSTOLAKIS: Two, two.

DR. SHACK: You would have to lose a lot of equipment.

MR. GAERTNER: Yes, you would have to lose a lot of equipment.

MR. PHILLIPS: I can't imagine getting -- having things fail to get in that position and not inducing a transient on the plant. That would probably result in an automatic trip.

CHAIRMAN APOSTOLAKIS: I think you're right. I think you're right. Most likely it was some sort of external event that defeated a number of equipment, right, and the CDF skyrocketed, but the same event caused the --

DR. SHACK: I mean, if it's involuntary, George, there's not a whole lot they can do about it.

CHAIRMAN APOSTOLAKIS: Oh, we punish involuntary just as much.

DR. SHACK: Punishment will be the least of their concerns.

CHAIRMAN APOSTOLAKIS: No, but theoretically though -- wait a minute. Nothing may happen. Remember, this is the average frequency, right? So you have to go to the Poisson distribution and find the probability. That is still low.

DR. BONACA: I think the reason why it's significant to look at it is that, you know, later on they are going to propose an instantaneous average annual CDF. And, you know, with every plant moving to that direction, we have to understand what that means in the aggregate. You have 103 plants.

CHAIRMAN APOSTOLAKIS: How many minutes are in a year?

DR. BONACA: Well, all you have to do is to make a couple of --

MR. GRANTOM: 63 hours times 60, 60 times 60.

CHAIRMAN APOSTOLAKIS: 8,700. So if you divide 10 by 8,700, that's a very low number. You're not going to have a core melt in two minutes.

DR. BONACA: You still have the two

minutes, huh?

CHAIRMAN APOSTOLAKIS: It's just compressions. I'm telling you. We are used to -- well, anyway. Gary, can you speed it up a little bit?

MR. GARY CHUNG: Sure. No questions, please. This is --

CHAIRMAN APOSTOLAKIS: By the way, Gary is my former student.

MR. GARY CHUNG: I'm used to this.

CHAIRMAN APOSTOLAKIS: I was about to say that you listen.

MR. GARY CHUNG: This is the interface to the operators when they removed components out of service, and so that's something that we use as well. This is a safety function display. Mike, maybe you can speak, because this is not something that we use this on.

MR. PHILLIPS: Yes. This is something that a number of safety monitor plants are now in the process of building, defense-in-depth models and qualitative models, to add to their current quantitative safety monitor models.

MR. GARY CHUNG: Okay. Similarities and differences between the base PRA and safety monitor PRA. I spoke to this pretty much earlier. They are essentially the same, except we use zero actual maintenance versus average and actual alignments versus average. The safety monitor can also adjust the initiating event frequencies, for example, adjusting loss of off-site power frequency, and also change failure probabilities to match real-time plant conditions.

I went over this at least the first bullet, how maintenance uses it. The second bullet is the STA also does it in a real mode with the current plant configuration. And then case studies are done using the safety monitor primarily for speed purposes. We use it in hypothetical mode.

CHAIRMAN APOSTOLAKIS: So is there an application of this that South Texas does that you don't do?

MR. GARY CHUNG: An application?

CHAIRMAN APOSTOLAKIS: Well, yes. I mean, do they use it for certain activities that you are not using it for yet?

MR. GARY CHUNG: I don't know of any.

CHAIRMAN APOSTOLAKIS: Okay.

MR. GRANTOM: Yes, I don't think so.

MR. GARY CHUNG: And in fact, we present this also, because we expect ourselves as SONGS to follow on the pilots to the 4b process.

CHAIRMAN APOSTOLAKIS: Oh, so you will?

MR. GARY CHUNG: We will eventually go through this. Model control. Are you interested in model control? We could bypass this.

CHAIRMAN APOSTOLAKIS: No.

MR. GARY CHUNG: Okay. Environmental test factors that are modeled. What these are primarily are adjustment factors that we use in real-time space or even in plant -- well, in plant space also as it applies. When we have people in a switchyard, we will adjust the loss of off-site power frequency. Our plant is located at Camp Pendleton.

If we have fires at Camp Pendleton near our incoming lines, we can adjust the loss of off-site power frequency. The same with tornado warnings. Rarely, but it does happen, we have kelp intrusion coming into the intake, tsunami warnings. I understand yesterday or this morning we had a tsunami warning on the west coast. Earthquake warnings also we spoke of earlier. The last bullet, degraded grid voltage. We're actively pursuing how we can do this and adjust the loss of off-site power frequency.

A lot of these are -- currently the adjustment factors are engineering judgment, but we insert them primarily, at this point, to sensitize operations and maintenance that there is an effect on the PRA when these particular factors occur.

Types of users. We went over that. The last bullet is significant only to the extent that most utilities do this. They have PRA engineers available to assist work planners and operations if they are in a position where they have to do a recalculation or, in like STP's case, there is a new configuration they haven't gotten in their database.

And to summarize, our Control Risk Management Model like other applications is affected by just general PRAs use primarily because it's the same model, and SONGS has successfully conducted the configuration of risk management using the safety monitor for over 11 years. And the safety monitor can provide a blended approach using the safety function display and core damage risk calculator.

CHAIRMAN APOSTOLAKIS: How many engineers do you have in your PRA group?

MR. GRANTOM: Three.

CHAIRMAN APOSTOLAKIS: How come you have seven? That's why it takes him an hour, right?

MR. GRANTOM: Well, I need to characterize that separately. I have three sections that report to me. I have the PRA Configuration Control, which are the people responsible for the model. That's three people. I did have four, but we had a loss of personnel recently. There was four.

I have another group that does applications and development. That's another three people. And then I have another group of people who do implementation of Option 2, the Exemption from Special Treatment Requirements. That's another two. So in total there's eight people, but the people who maintain the model is three people right now.

MR. GARY CHUNG: That would match up with ours. We have three that maintain it probably full-time, three on applications work including myself.

CHAIRMAN APOSTOLAKIS: I see.

MR. GARY CHUNG: Yes.

MR. GRANTOM: Yes. The organization for implementing a Risk Management Program at a station really needs to have the three elements, people who maintain the model, do analysis on the model, people who build tools that other organizations can use and make certain it's consistent with the PRA. And then in our particular case that's extended because of Option 2, which is so extremely broad in its application here you have to specifically work with program owners to amend procedures and it kind of tends to --

CHAIRMAN APOSTOLAKIS: Very good. Any questions for the two gentlemen up there from the table, the NRC, public? Thank you very much.

MR. GRANTOM: Thank you.

CHAIRMAN APOSTOLAKIS: The next presentation is by Mr. Hughes and Mr. Steinmetz. Hughes is the founder of Aaron, do you know that? Aaron Corporation?

DR. SHACK: Yes.

CHAIRMAN APOSTOLAKIS: PRA people to him. And Aaron now is captive with Exelon. It's a very rare move.

MR. HUGHES: I'm Gene Hughes, the Director of Risk Management for Exelon. Coming last is always a pleasure, so I will start by saying we tend to combine the EPRI cause-based method and the time reliability correlation in doing our HRA. We do it differently from station to station, but I noticed you had asked the question what people do. We have a best practice that we gravitate toward and so as we do three year updates, we move more and more toward reliance upon the EPRI cause-based method.

One other thing we do on HRA, we're

skeptical. So when we finish doing all of the HRA values within a study, we tend to stand back and look at them and see if they match up and if they are logical, then we spend time with operators where we try to validate it to see if it's coming out with something that makes sense.

The second thing. We believe -- I think there's about 35 people in the Exelon Risk Management Team. We have one person at each site. We have a team that maintains the models. I have got a slide that will just show you briefly what that is, so I will go through that.

The bulk of this presentation is aimed at showing you the process we use and the tool we use. I have got John Steinmetz here. He has been with the Commonwealth Edison side before the merger that made Exelon. He has been with Exelon ever since. He wrote one of the first procedures for how to do this type of work for Commonwealth Edison. He is currently assigned at the Dresden Station, so he is the guy there and I will explain what he does.

CHAIRMAN APOSTOLAKIS: So are you under the pilot for 4b?

MR. HUGHES: We are not a 4b pilot. We have attended the sessions that the NRC has held with the public and I would commend Mark for what he has pulled together, and I would commend all of you to consider attending. It's a very free flowing discussion and very useful. So we're interested. I think it has real potential, but we have not made the commitment to go forward.

We are merging, as you know, with Public Service Electric and Gas. The Hope Creek Station is a pilot and we are in the process of becoming engaged with that. So as of today, that operation from a risk management perspective does not report to me. It will in a few weeks to a month or two and then we'll begin to get engaged in how we pull that together. So we're in that process as we speak, but they would have to speak for themselves. I cannot speak for them.

How do I go down, Mike? Okay. How are we structured. All of the PRAs that we have that are for boiling water reactors are under Ed Burns. All the PWR PRAs are under Doug True. Within the team we have people assigned as model owners that have two stations per, so they work with what we call our best practices to move them in the right direction. We have Corporate Staff, Supporting Analyses and we support the Applications.

There is a key ingredient in this

organization, which is the one guy at each station like John who we call the "point of the spear" or the key guy who works intimately with planning, scheduling, work control, supports any NOED that needs to be done, any analysis that's done, works on the PRA updates, supports a host of things, is engaged right now heavily in MSPI, but he works as a member of the team.

So every Monday morning the entire Risk Management Team, including the 10 people that work at the stations, one per station, get together and we have about a half our phone call of what are we doing, where are we going. So that's the way we're structured.

We use a blended approach. We believe in it. The history of PARAGON, which is the tool you will see, is that it originally began as ORAM. ORAM was developed under EPRI. ORAM-Sentinel was developed under EPRI and PARAGON licenses EPRI technology in it. So it's consistent technology start to finish. Commonwealth Edison and PECO formed Exelon. PECO was heavily involved in the first ORAM development and also heavily involved in Sentinel for at power. So it's natural for Exelon to be heavily engaged in this.

It uses a blended approach, which is

fundamental in the way we view the analysis. We view the PRA as a process that generates insights. We are skeptical of the PRA. I have spent 30 years doing PRA analysis and I'm skeptical of it. I love it. It's wonderful, but it's only valuable when you understand it. So you have to come to it with a calculation, a review, a process, validate it, get the insights and understand it.

There are other things that may not be in the PRA that are important to us. So from the defense-in-depth side we worry about things like maybe there's something that's not a core damage event, but it's something we want to protect. We also think that there is a difference between two risk scenarios with the exact same number. You may have two 10^{-7} values, but if one is a single about which you know very little and one is a set of five failures about which you know a great deal, those are fundamentally different. So what you do in managing risk has to take into account all of your knowledge, and our goal at the bottom of this chart is risk management.

CHAIRMAN APOSTOLAKIS: Essentially, what you're saying is that the distributions are key.

MR. HUGHES: Absolutely. This is what the heart of the thing looks like. What we do is we calculate risk values for different end states using the PRA. We then segment the end states in this particular case going from -- eyesight is a horrible thing for a presentation. I'm too far to see that and not close enough for this one.

If you look at the number of emergency diesel generators, this is for Peach Bottom, the emergency service water, emergency cooling water and Conowingo, you go through these different end state determinations and then we have colors. And I will show you in a second what these colors mean and how we generate them.

Now, when we get to showing you the tool, John is going to show you what a planner does in looking, as Gary described, four weeks out, two weeks out, one week out. At Limerick, for example, some of our stations tend to look at a day or at a longer period. Some of them, Limerick is a good example, looks hour to hour. So the planning guy can move the window, the work window, up or back and see what the impact is.

He is going to then show you the operator view. From the operator view you see something very significant. The operator can look on the first screen and see what is the plant condition this model thinks I have. When the operator turns to it, he already knows what the plant condition is. That's his job. He knows what equipment has failed or what they are going to take out-of-service.

By having a tool that displays that back to him, he can immediately validate this is the right configuration or whoa, wait a minute. Then it shows him the risk information in a way that he can manage, and I will show you what the guidelines are for that. But this shows how we determine different cases.

This is one for Clinton. It doesn't have as many cases, but we go through. For defense-in-depth there is a structured process to generate input to this and no presentation to the ACRS is complete without a little of Doug True. He couldn't be here, but he generated this chart. Now, this chart we don't do every time, but I thought it was a very significant thing for you to see, because it helped us.

Early on when we were doing this, this is from 1997, we looked at so many different cases. How can you verify that it makes sense? How can you review them all? What can you do? And then we just were playing around, Doug plotted them like this, and then we started playing. Okay. Does that make sense? Why are the peaks the peaks? Why are the valleys the valleys?

CHAIRMAN APOSTOLAKIS: Tell us what -- where we're looking.

MR. HUGHES: What you're looking at is multiples against the core damage frequency for different combinations of things out-of-service. In other words --

CHAIRMAN APOSTOLAKIS: So --

MR. HUGHES: For a combination of SLC out-of-service and RCIC out-of-service, in that surface there is a bar that you can find.

CHAIRMAN APOSTOLAKIS: Okay.

MR. HUGHES: So if you find one and you say I want to look at that peak, you can pull it back and you can look at it and it has no value in the tool, except to just show that we play. We do the calculations. We look at them and we use it to help us ask questions.

Defense-in-depth, looking at Limerick, I have got two cases in the presentation and I apologize for not having more information on the background that led to the decision, but I just wanted to demonstrate the decision. It's a blended decision. What that means is here's a case where the core damage frequency goes up by a multiple of 15.61. We use 2, 10, 20.

When the core damage frequency increases by a factor of 2, we go from GREEN to YELLOW, a factor of 10 to ORANGE, a factor of 20 to RED.

Originally, one of our stations had 2, 10, 30. There is no fundamental basis that I can display for that, but logically it made sense when we looked at the cases that that was the kind of management we thought we should apply. We could in the future go to a fifth color and we are candidly, internally, quietly thinking about it. We have made no commitment to do it.

I would like to differentiate between 100 percent available and less than a factor of 2, so being GREEN could be 1.9 times core damage frequency, but as a practical matter you would not want and we do not want to sit there. So when you're GREEN, the goal is to still be at 100 percent and there might be a way to improve what we do and we're constantly looking at that.

So this is a case that is ORANGE. It's ORANGE with the core damage frequency ORANGE, but notice that the safety functions are displayed, so the operator can see that. The plant transients are looked at in terms of the risk contribution, where is it coming from, and this is the overall status.

Now, here is another case where the overall status is YELLOW, but the core damage frequency is GREEN. But from a defense-in-depth perspective, when we sat down with operations, with all the various people and we talked about what do we want to do, the consensus was we want to call this condition out. It involves suppression pool cooling loop out-of-service. We want to take action, so this is the right appropriate action to take.

Now, yesterday someone said well, is it possible that you could have a core damage frequency above 2, but you would still call it GREEN or above 10 and you would still go, and the answer is yes. We candidly could have such a case. What that would mean is we learned something in the process that was not in the model that we thought was something that was actually used, a procedure exists, and we'll commit to put it in the model later, but we can affect this right away.

Fire. I know you have asked questions about external events. Fire is not in the model. We have thought about it. We have done some preliminary investigation in it. We're actively engaged in building fire PRAs and bringing them up across the fleet, but we have not come to the point that we have a consistent process for putting it in this model.

Likewise, the 4b application. I could envision taking the end states that I had and associating with them a time at which it changes to another color or at a time at which actions are taken and we could do that, but we have not made that decision and we have not gone through the process of fine structuring the process. As Mark said, it's the PRA, it's the process all together.

And in terms of doing all these calculations, the PRA model that we use is the same PRA model. We change the truncation limit from a factor of 10^{-12} for a limit to 10^{-10}. We look at it. We worry about whether that's capturing the right thing or not, but we go through a process to try to get a large number of cases. We solve them ahead of time. We run them and then we put them in the model.

Planning and scheduling. What do they do? The site RME, like John, runs the PRA model and loads these things in the result. When we have an updated model, it's available. By the way, PARAGON is on the server, so it's available throughout the entire Exelon fleet. Any plant can see any other plant, any office can see anybody.

Emergent things happen. The PRA results

show up WHITE. So if we don't have the case pre-solved, we get WHITE from PRA. We get defense-in-depth information anyway, and so we have some information. We can contact John. We can run the case. We can verify it. So we tend to have the PRA people in the game of running the case, studying it, making sure it's right. They know what the limits are. They know what the assumptions are and we have the information presented.

I think I'm ready for John here in just a second. No, I have got a couple more slides. Real quick. When you're GREEN, the desire is to preserve operable equipment, worry about things that could affect spacial separation. We have procedures. They are normal procedures, normal work controls, but we don't want to violate the redundancy that we have without thinking about it. If we're going to bring scaffolding in, we want to know how that's done and we worry about preserving defense-in-depth.

This is a very brief summary. There is up here GREEN. I just covered YELLOW, correct the cause. It says as soon as practical. As a matter of course, most of the time if we're YELLOW, we work it around the clock. So we really go after YELLOW. We try to move it back up very aggressively.

If it's ORANGE, you have to get senior management review and approval prior to entering it. We minimize the exposure. We work it around the clock as a matter of directive. And RED, of course, we don't go there if we can possibly help it and if we're there, we get the heck out of there as quick as possible.

This happens not infrequently, that we'll enter YELLOW, come back out. We'll plan around actually entering YELLOW, but manage the risk. We look at contingency actions and we worry about that. Every day on the morning phone call at 8:00 across the entire Exelon fleet, every plant identifies what color it's in for the day and we run the operation to make sure we're working on that. And I think you're next, right, John? And here's John.

MR. STEINMETZ: With all due respect to the uncertainty of the clock, I would like to say good morning. I'm John Steinmetz. I am the Risk Management Engineer at Dresden Station. I have been there about a year in that capacity. Prior to that I was the PRA model owner for La Salle and Dresden.

What I would like to talk about is our process of how we use PARAGON in the planning process and also for emergent activities, and I will give you a work control perspective and the operator's perspective. I have got about seven screens to go through.

CHAIRMAN APOSTOLAKIS: Maybe this is a stupid question, but are you going to tell us what PARAGON is? I mean, is that what Gene --

MR. STEINMETZ: PARAGON is our risk tool and it's similar to safety monitor or RAsCal. PARAGON --

CHAIRMAN APOSTOLAKIS: All the discussions here, Gene, were around PARAGON?

MR. HUGHES: Yes.

CHAIRMAN APOSTOLAKIS: Okay. Go ahead.

MR. HUGHES: PARAGON I can't quite finish. I know it stands for Please, Ask Rick All something.

CHAIRMAN APOSTOLAKIS: Generic Outlandish.

MR. HUGHES: Generally Onerous came to mind.

MR. STEINMETZ: I would like to clarify that. I'm like the fourth level of defense to make sure we have risk done properly at the present station.

The operators, before they allow work, verify that the risk is okay and has been evaluated correctly. The work week manager has a responsibility to make sure that risk is appropriately analyzed for the planned work.

The cycle manager starts a year ahead of time and has the work laid out for the activities that affect risk a year in advance and, as we get closer to the work week, things may change. Things may be added to the schedule, but the planning process starts far before the work actually takes place. We try to stay -- the cycle manager tries to stay about three to four weeks ahead in the scheduling, so that operations knows what is coming in front of them also.

Here is a planning for the May/June time frame for 2005 at Dresden for the risk-related activities. On the bottom here are the risk activities and they are service water strainer, EDG, SBO diesel, containment.

CHAIRMAN APOSTOLAKIS: Excuse me. The PRA that is being used here has gone through the --

MR. HUGHES: Certification, peer review, yes.

MR. STEINMETZ: Peer review, independent review, ASME gap analysis, yes.

CHAIRMAN APOSTOLAKIS: I can't imagine anyone going into this kind of utilization of the PRA without.

MR. BRADLEY: All our plants have been through peer review.

CHAIRMAN APOSTOLAKIS: Okay. And they have complied, I mean, responded to the comments and--

MR. BRADLEY: We are in the process now of making sure that all the significant FNOs for the peer reviews are closed.

CHAIRMAN APOSTOLAKIS: So nobody is doing this using an IEP?

MR. BRADLEY: No.

DR. BONACA: But are all the Exelon plants of the same quality? And I use the word quality in a loose fashion.

MR. HUGHES: That's a very good question. I think quality is very difficult to quantify and all of the PRAs have been through certification. All of the PRAs have been, I think, looked at very, very good. Some have more items to address than others. We have looked at gaps to ASME. Some have more gaps than others.

As we do the updates, we are bringing them into the closest compliance. We have also looked at and we are looking right now as the industry is, for example, at MSPI. When we apply them to that, is there any gap that would affect that and what impact would it have.

When we bring the information into this blended approach and we come up with the color determination we have, we try to factor some of that knowledge in. We have recently redone Limerick and I think it is in great condition. Oyster Creek has been redone. It's in excellent condition. The other stations have all been. I would say they are all very good. So I'm quite pleased with them and I think they are all good, but we have yearnings.

MR. STEINMETZ: This program here has mapping in it that maps the activity code to plant variables that affect the defense-in-depth fault tree logic that we have embedded in this code, and also it has linkages to the PRA logic. So the activity will trigger a plant variable, which it will in turn trigger a PRA variable link and set a basic event unavailable. And from this program we can run the PRA, can link it to the PRA.

The program stores the results and it is not very often when we need to run PRA cases, but we will to it in the planning process, if required. Here you see our risk is generally GREEN through this period which is, approximately, six weeks. We work hard to minimize our YELLOWS. In the last four years we have not gone to ORANGE since we have used the blended approach. So we work very hard to schedule the work to avoid ORANGES or REDS and to minimize YELLOWS.

Now, the operator or the work control people can see on-line safety functions, which ones are effective. So, for example, dry weld and torus hard events are made unavailable at this time period here and it causes the containment pressure control safety function to go YELLOW. Now, if we had PARAGON real-time here, you could scroll down and see on-line plant transients. However, on-line plant transients would be -- the mitigating capability would be degraded at times and it would cause those transients to go YELLOW and it also would give PRA results in this schedule. It's a schedule tool.

MR. HUGHES: And by the way, we know you guys have another meeting this afternoon, but we would be more than happy today if there were any time to bring it up and show it. I think the others can do the same thing in real-time. And I would also certainly issue an invitation. Come to Limerick or Peach Bottom any time. They are close by. We would be glad to show you how it operates in the station.

CHAIRMAN APOSTOLAKIS: We might pursue

that in the future, Gene, you know, combine it with one of our visits to the regional offices. We have wanted to do this in Southern California Edison for a long time, but I don't know what to say, Gary.

MR. STEINMETZ: Chicago has cool weather this week. Visit in the summertime. If you double click on this configuration right here, the work control person can see greater detail. And for this configuration, at this point in time right here, the tool provides more detail. It provides the Safety Function Assessment Tree results, the Plant Assessment Tree results and provides the PRA results.

Now, we use a speed limit approach, the 2, 10 and 20. The CDF risk factor increases 1.21 times the zero maintenance baseline risk and LERF is just slightly above baseline risk as shown here for this configuration.

DR. SHACK: How many configurations do you compute?

MR. STEINMETZ: Any time between -- well, we have --

DR. SHACK: You store the configuration model, right?

MR. STEINMETZ: Yes, we store the results and we have, approximately, 800 in each of our units.

So it takes about one to two minutes to calculate a configuration also. Now, if you have three different components unavailable, you might have different combinations, which would take you longer, of course.

DR. SHACK: The baseline, the requantification takes one to two minutes?

MR. STEINMETZ: For any particular configuration, yes.

DR. SHACK: Per state.

MR. STEINMETZ: And we calculate it $1E^{-10}$ at Dresden, which is greater than four orders of magnitude less than baseline. And doing some analysis, the risk increase factor is generally conservative with higher truncation limits, because the base risk goes up higher.

And I probably shouldn't have mentioned that but that's, you know, one of the properties that you have. As you lower the baseline or the truncation limit, the baseline will also be reduced. So the multiplier effect is that this is, we think, a conservative number. We also have the capability in the tool, and I have it in the development model, but we don't employ it in our system to calculate ICCDP and ICLERP numbers.

Now, the operator's screen, the operators will normally use this screen and this has the capability of showing the schedule by using that background there, so the operator can look ahead. But primarily, his focus is on emergent conditions. Work control gives him the plan and as long as he stays within the plan, he doesn't need to use the tool. He can use the tool to validate if he has a question.

In this case, an isolation condenser for some reason may have not passed surveillance and it is called unavailable. And the operator would cause this to come up here. The case was already precalculated. The risk increase factor for CDF is 4.5 times the baseline zero maintenance risk, and he can see that primary systems have a piece of equipment unavailable and the other systems, there is nothing scheduled currently, because he is putting this isolation condenser, he is overlaying that over the present schedule.

And in here our isolation condenser helps maintain inventory. You don't really need makeup with the isolation condenser operating, and so we considered a high pressure injection system and also a heat removal system. With the redundancy we have with heat removal, we don't consider that degraded to the state, the place where we put it in YELLOW, but for high pressure injection we do consider that function degraded. Also, the iso condenser helps us out for loss of off-site power scenarios, transient scenarios and loss of 125 volt DC.

In establishing these color thresholds, we calibrate the end states with our PRA and we identify the equipment that has high importance in these different scenarios, and we make sure that those pieces of equipment are included in the logic trees that back up these functions, these risk colors.

So overall, we have YELLOW PRA in this case, YELLOW PTAT, YELLOW SFAT and the overall Unit 3 status is the worst case of these three, which is YELLOW. Now, if the operator wants to confirm that, he is looking at what he knows is unavailable in the plant. He hits the activities button here and it will confirm to him that the only thing unavailable at the time is the iso condenser, which he just input into the program.

DR. SHACK: So he's got nothing to bring on-line to help them out?

MR. HUGHES: Nothing to restore.

MR. STEINMETZ: Nothing to restore. Well, yes. If he had three items unavailable, he would have to determine which one he would want to restore first.

Now, we can use the return to service button here and it will show him if he returned this particular piece of equipment, it will return us to GREEN or if this one was returned to service, it would remain at YELLOW. So it helps him prioritize things as far as what to bring back into service.

Another question he may ask is with the iso condenser unavailable, what is important to protect? And PARAGON can evaluate the remaining pieces of equipment that are currently available and determine if we lost one of those pieces of equipment what would be our resulting color. And we can do it looking at SFAT and PTAT logic, which helps us identify equipment as redundant or diverse for particular safety functions or are important in initiating events, and it clearly identifies the equipment that's important to bring back.

We can also look at our PRA results and find out from the cut sets using raw values from the cut set what the important equipment is from a raw perspective and what would bring us into an ORANGE or RED condition. So after running the SFAT and PTAT analysis, he finds that there are certain breakers in the switchyard that we consider most important and if one of those would be unavailable, it would bring us into an ORANGE condition. So that would trigger to him that I need to protect the switchyard and activities that might threaten loss -- might lead to loss of off-site power.

High pressure coolant injection is RED and so that's a very important piece of equipment, and certainly they would post that. It turns out the high pressure coolant injection would turn our PTAT RED and also SFATs for high pressure injection I believe would be ORANGE since we still have feed water, maybe RED, but PRA would also be RED. So this is a very important tool and we work hard with operations and work control, so that they use this properly and protect equipment.

And I mentioned I was like the fourth level of defense. I would also say that our NRC resident inspectors are also very active in questioning our (a)(4) assessments and they will ask work control and ops questions frequently. If there's availability calls that are made, they will question whether we made the right call or not and, at times, I'm called in to give my opinion also by the residents.

DR. SHACK: Are you ever in a zero maintenance mode?

MR. STEINMETZ: With nothing unavailable?

DR. SHACK: Yes.

MR. STEINMETZ: Yes. In fact, when this iso condenser was taken out, which was yesterday, we were in the zero maintenance mode.

DR. SHACK: And what fraction of the time is that?

MR. STEINMETZ: I would say in the summer it's a significant portion of the time.

DR. SHACK: You just don't do stuff in the summer.

MR. STEINMETZ: In the winter it would be less, so I would hazard a guess. It's probably more than 50 percent of the time. And we're talking about equipment that is risk-significant, risk-related. Now, we can do surveillances and the equipment may be inadequate. If we have procedures and operators ready to react to put it on-line, it automatically realigns during the surveillance as considered available. Understand under 4b it would be called inop and we would put it on this list and do an analysis of it.

In this case, we had the iso condenser unavailable and, say, the EED or TSO operator may have called and said also tonight we have thunderstorms. We have lost the line nearby. We're afraid we may lose another line. There is a potential for a loss of off-site power. And we would trigger a high risk event for potential loss of power, and you can see the iso condenser is lit up here. Primary systems are affected. HRE is affected and the power system, the AC power system, is affected now with these two events here.

And you can see that the loss of off-site power PTAT has turned ORANGE, so that would trigger some actions where the operator would call the station duty manager and get support from the station. Probably in this case they would man the OCC and do whatever it takes to get us back into a condition that's more favorable. The CDF and LERF results are not recalculated. In this case we rely on the PTAT to tell us that we're in an ORANGE condition. So we do not alter the initiating event frequency.

So with that, that's the end of my presentation. Are there any more questions?

DR. BONACA: One question I have is addressed not only to you but, you know, this is really going in the direction of calculating ahead of time your risk level as it changes with activities and managing these risks. Does any one of you ever as a process look back, say in the past month of performance, and see how that profile has been changed by the actual events. I mean, do you have plans? It's all in the evaluation of what you're planning to do, but things happen at the plants which are not planned.

MR. STEINMETZ: I believe almost all plants are doing that, not all of them. The Maintenance Rule requires periodic assessment about how we are doing.

DR. BONACA: You are learning lessons about, you know, what kind of things happen and particularly for more risky evolutions, you learn lessons about what you should have done.

MR. STEINMETZ: Yes. We look back and quarterly we calculate the core damage probability and by doing that, we have to verify what actually was unavailable and we have the plan, too, also.

DR. BONACA: Right. That's right.

MR. STEINMETZ: Also being a Risk Management Engineer on site there, I'm involved with planning the status every day and when things get broke or whatever, I'm aware of it.

DR. BONACA: Is management interested in those insights?

MR. HUGHES: Oh, yes.

MR. STEINMETZ: Right. Looking back at what we have done, from a planning process we're very thorough and we make sure that things are scheduled in an intelligent manner. So management has the question, I guess, passed that I'm aware of. You know, looking forward, if they do question the work planners, the work week managers, for example, they will ask, you know, risk is YELLOW, which plant transients are affected here? What is driving it? And so they get into that level of detail in the morning meetings.

MR. HUGHES: And if we learn something through this process that potentially affects other stations, we use the Corrective Action Program to communicate it. We contact them verbally to communicate it and we make certain it gets closed and followed through and the lessons are learned, and we propagate it very quickly.

DR. BONACA: This is within the Exelon?

MR. HUGHES: Within Exelon or if it were something that would affect someone else, we do the appropriate communication.

CHAIRMAN APOSTOLAKIS: Any other comments or questions?

MR. STEINMETZ: I need to turn it back to

Gene for --

CHAIRMAN APOSTOLAKIS: Oh, you're not done?

MR. HUGHES: Well, I was going to skip the closure. I think the closure just says we enjoyed being here and it's always a pleasure.

CHAIRMAN APOSTOLAKIS: Okay. Any questions or comments from the Members, NRC staff?

MR. BOYCE: Just a reminder. On this presentation by Exelon and its relationship to I-4b, this is excellent as far as describing how you handle (a)(4) in assessing and managing risk. Under Initiative 4b there is no colorization scheme. All we're doing is using the PRA to calculate an allowed outage time for a piece of equipment. Most of this was how you assess and manage it goes to the I-4b.

CHAIRMAN APOSTOLAKIS: Great.

MR. SNODDERLY: George, the one thing I would like you to consider before we break is that, traditionally, the way we get involved with things is guidance that has been developed by EPRI to support this initiative would be endorsed by the Staff by a Reg Guide, which we would review and approve.

This case is a little unique in the sense that the guidance is being used for plant-specific tech spec changes, which we typically don't get involved with in reviews. And so maybe we would like to consider whether we would perhaps review and comment on the EPRI guidance and the letter would go to the Staff with guidance as to how this guidance is used in support of --

CHAIRMAN APOSTOLAKIS: Well, isn't the Staff approving this in some way?

MR. SNODDERLY: Yes. And so I guess what I'm saying is --

CHAIRMAN APOSTOLAKIS: So maybe we should --

MR. SNODDERLY: This is a specific case where we, as the Committee, are kind of isolated from the process. Bob and the staff have been very good about keeping us up to speed as to what's going on out there, but if we have not commented on --

CHAIRMAN APOSTOLAKIS: At which point will this become or is it already --

MR. SNODDERLY: That's what I --

CHAIRMAN APOSTOLAKIS: -- part of the way we do business with the blessings of the NRC?

MR. TJADER: I think that's on the Reg Guide. That would be with the issuance of the Reg Guide.

CHAIRMAN APOSTOLAKIS: So that's when we're going to get involved?

MR. TJADER: Oh, no.

CHAIRMAN APOSTOLAKIS: No?

MR. TJADER: That's a question. Do we need a Reg Guide? The thing is we have a Risk Management Guidance Document.

UNIDENTIFIED SPEAKER: Exactly.

MR. TJADER: And when we're satisfied with that, then we're going to go forward with the pilots and that would become part of the administrative control section of the tech specs of the pilots.

CHAIRMAN APOSTOLAKIS: When do you want us involved?

MR. BOYCE: That's right. We want the ACRS to write us a letter talking about Initiative 4b.

CHAIRMAN APOSTOLAKIS: When?

MR. BOYCE: The question is when.

CHAIRMAN APOSTOLAKIS: Right.

MR. BOYCE: And I think right now it's premature. We probably will come back to you in six months to a year and say this is an approved Risk Management Guide, okay, because there is a variant that's coming in within a month or two from industry.

CHAIRMAN APOSTOLAKIS: Yes.

MR. BOYCE: We still need to interact on it a bit more and we'll have that down. We'll know where we are in terms of Reg Guide 1.200 and its applicability to the pilot plants. We'll have some of the pilot plant results and I think we'll have a much better product to bring to you at that point. So what we're doing right now is bringing you information.

CHAIRMAN APOSTOLAKIS: Right.

UNIDENTIFIED SPEAKER: Sounds good.

CHAIRMAN APOSTOLAKIS: Yes.

MR. BOYCE: Draft information. You wanted to know about the tools and we need to come back and have you look at this.

CHAIRMAN APOSTOLAKIS: So at that time, there will be an NRC document commenting on what they are doing or approving?

MR. BOYCE: Right. And we'll have to lay that out.

CHAIRMAN APOSTOLAKIS: Because we always review NRC documents.

DR. SHACK: But will the EPRI guidance be endorsed by a Reg Guide?

CHAIRMAN APOSTOLAKIS: At some point.

MR. BOYCE: Well, the way I think we're doing it is we have a process for generic changes to the standard tech specs that we call TSTFs and that TSTF would articulate how this is implemented. So under the umbrella of that TSTF, we would say the plant -- there would be a license commitment that the licensee has to sign up for PRA quality, probably include a reference to Reg Guide 1.200.

We would say the licensee must commit in his license condition to following the risk management guidelines as opposed to a Reg Guide based on the current strategy, and then we would also have an inspection module that we would say this is how the NRC would inspect and do oversight and its relationship to the SDP part of the ROP and that sort of thing. And those are the three components that I think we're thinking of that we would need to bring back to you in a more mature forum.

MR. TJADER: Just a comment. They won't need to commit though, because it's going to be a requirement in specs. They won't have to commit to the guidance document. It will be a requirement.

MR. BOYCE: Right. If that distinction was -- I tried to make that distinction clear. When we issue a -- we're going to come in with a generic package. When a plant comes in, they are going to have to reference that package and adopt as a license condition all the commitments that I just described as a specific structure.

MR. REINHART: There is a piece we probably -- that we need to talk among ourselves is when we get the risk management guidelines, if we like it lock, stock and barrel, that's great. But if we want to somehow endorse it with exceptions, we have to find a mechanism to do that and it may be a Reg Guide. It may be something else.

CHAIRMAN APOSTOLAKIS: So anyway, we're going to see something in about six months?

MR. BOYCE: Six months to a year. That's the target time frame.

DR. SHACK: Are 4b and 6b going to come in as pieces? I mean, are you going to get 4b and then you'll tackle this problem of what to do when you don't have an actionable item in this 3.0.3 or whatever it is or is this all going to be done together?

MR. TJADER: No. Well, we're working on it. I mean, that's a discussion that I think we have had one White Paper from industry on what we call the nexus between the two. Right now, CE is the only one at the moment that is proposing an Initiative 6 Topical. And in reality, we have reviewed it and approved it, the topical, and we're just about ready to proceed with the initiative, but holding it back in reality is working out the interaction between the different initiatives.

I think simplistically, if you don't have Initiative 6, then that basically takes off the board a lot of the loss of function type things. If you have Initiative 6, then that opens up some loss of function to 4b and adjusting that time prior to entering loss of function. So fundamentally, I think probably that it's acceptable, but we just want to make sure. But I don't see that they necessarily have to be tied to each other just as long as we understand how they interact and then we go forward, that when we go forward we understand that and understand what we're granting them.

MR. BOYCE: We did not ask for separate input, because each initiative is under the Risk Management Tech Spec Program. We may want to get this presentation down with that whole program, we would probably only ask you for a letter on Initiative 4b. Initiative 6, which is what we have been talking about, is an issue within Initiative 4b and you would be provided the opportunity to comment at that point. Separately, we're working on approving that and we would come back to the ACRS if we are able to solve it in isolation.

CHAIRMAN APOSTOLAKIS: I also have a concern that is not perhaps directly related to this activity, but I know that this Agency has been developing a Human Reliability Model for 15 years now and we are still not in the state where we can actually use it routinely, ATHEANA.

And I don't recall us reviewing or the Staff reviewing an industry HRA model and now, I see that almost de facto we are accepting that these PRAs that are being used in the monitors and so on are using the EPRI calculator, which I have never seen, which I'm not sure the staff has seen. I mean, is that a de facto acknowledgement that we have failed and that this is really the way to go and maybe we ought to look into it and say, you know, this is it?

I mean, I don't know what to say anymore. ATHEANA keeps going on. We're spending a lot of money on it, but the real stuff is done using something else. So it makes me uncomfortable. I mean, this de facto situation, you know, why? Why does human reliability get this treatment?

MR. REINHART: Well, human reliability is one of X examples. The staff has never required the industry to have a PRA. Everything, almost everything, has been voluntary and 4b would be the first time it will be licensed.

CHAIRMAN APOSTOLAKIS: Ah.

MR. REINHART: Like we mentioned to you, the tech specs. Now, as we have been going forward, we have been saying okay, we'll have a standard here, we'll have a standard there, we'll have a Reg Guide. We have gone out and done some pilots but, again, we talked about this this proof of concept, we're not holding this up until this other multi-year evolution gets in place. So we're going to have to go and do a lot of specific review and approval of all these aspects.

CHAIRMAN APOSTOLAKIS: So would it behoove everyone to get a hold of the EPRI calculator and start looking into it, because if you say that this is the first time you're going to license something, then this may be the first time for me to raise these questions in a more friendly environment.

MR. REINHART: I think there's a number of things going on. HRA is one. Use of map is one. They use map a lot.

CHAIRMAN APOSTOLAKIS: Right.

MR. REINHART: I mean, all these things

have to be looked at.

CHAIRMAN APOSTOLAKIS: And all I'm saying, Mark, is that HRA should be up there, because I'm really concerned about all this. Yes, John?

MR. GAERTNER: Let me say one clarification about the HRA calculator. It's not a new method. It's a structured decision, logic way of using existing documented numbers, just so you know that.

CHAIRMAN APOSTOLAKIS: I take your word for it, but the truth of the matter is I have never seen it, but we should see it.

MR. GAERTNER: Okay. In case you thought it was a different kind of approach.

CHAIRMAN APOSTOLAKIS: We should see it. I mean, you are producing numbers, right?

MR. REINHART: Well, maybe the staff can go back to industry and say, given this question, is this something that should get submitted under some forum.

CHAIRMAN APOSTOLAKIS: The way I see it, I mean, if you start raising these issues, HRA and others that you mentioned, and you expect the staff to review them and approve them before we go ahead with this, I think that that's a long time, isn't it? We never review something in three days.

MR. BRADLEY: I guess I would -- can I make a comment? I view this as a subset of PRA capability. In Reg Guide 1.200 we have a whole set of supporting requirements in the ASME standard on HRA. It's not methodology-specific. It doesn't say use ATHEANA or this or that.

CHAIRMAN APOSTOLAKIS: It doesn't.

MR. BRADLEY: And there are people here that know more detail on this than I do, but there is a whole set of conditions and requirements in there --

CHAIRMAN APOSTOLAKIS: Right.

MR. BRADLEY: -- of what your HRA method has to do.

CHAIRMAN APOSTOLAKIS: But if the staff approves the use of a monitor, but uses a particular model, it seems to me that staff ought to know what that model is.

MR. GRANTOM: But the Reg Guide 1.200 defines what you have to do for HRA analysis. Reg Guide 1.200 has endorsed that and so everybody has to, regardless of what tool they are using, ensure that they are meeting those requirements of the standard.

CHAIRMAN APOSTOLAKIS: But these requirements are getting a little high level. I mean, now you are talking about the actual thing where you are saying the result is 3.2.

UNIDENTIFIED SPEAKER: I wouldn't call those high levels.

MR. GRANTOM: They are not really high level. They are specific. I mean, you know, I guess it's debatable if you want to go down to -- but, I mean, there are specific on what you got to do.

CHAIRMAN APOSTOLAKIS: Well, I would like to see that once.

MR. GRANTOM: Yes.

CHAIRMAN APOSTOLAKIS: Okay?

MR. GRANTOM: And I would care to tell you --

CHAIRMAN APOSTOLAKIS: I would like to see it and then die. I will not live.

UNIDENTIFIED SPEAKER: We're not going to show it to you, that's it.

DR. BONACA: Don't commit to that kind of thing.

CHAIRMAN APOSTOLAKIS: But why is there reluctance to show it to us? I would like to see it and I think the staff ought to see it. I mean, if you approve things like that, you better make sure that you know.

MR. REINHART: It could be that this is "what if" in the future when we get one of these to review when we are looking at those, the standards we have, if we can say okay, whatever method they are using meets these standards, okay. That's a way to do it.

CHAIRMAN APOSTOLAKIS: Well, that's one way and another way --

MR. REINHART: Is to review the model.

CHAIRMAN APOSTOLAKIS: -- is the question, which may not be relevant here, is why are we still spending money on ATHEANA if this is good enough? I mean, if we are willing to accept this EPRI approach and actually, instead of just talking about it, we see it implemented in risk monitors that are used by the real people, I don't know why ATHEANA has any place in the world.

MR. REINHART: That's a group separate from us.

CHAIRMAN APOSTOLAKIS: It is a group separate, but there is a record here.

MR. REINHART: Yes.

CHAIRMAN APOSTOLAKIS: You know, it really worries me. I mean, this has been going on for a long time, Mark.

MR. REINHART: Okay.

MR. BOYCE: Without solving the HRA problem --

CHAIRMAN APOSTOLAKIS: Oh, and I was hoping you would.

MR. BOYCE: Well, actually, I'm very concerned about it, because if we are going to get this application to work, I can't, we can't solve every PRA problem and what we have done here is articulate, at least EPRI has, 10 CRM attributes. And what we can't do is review every single model and solve every single PRA question.

So what we have done in order to make this application work, and our application meaning, we keep the big picture in mind, is we're just calculating the time where pieces of equipment can be out-of-service and, at that point, the plant has to do something or the NRC has to engage on a Notice of Enforcement Discretion or something. All we're doing is calculating the time.

CHAIRMAN APOSTOLAKIS: Right.

MR. BOYCE: So the tools have to be sufficient to calculate that time in terms of the big picture, but they don't have to be perfect in order to calculate that time.

CHAIRMAN APOSTOLAKIS: I'm not talking about perfection. I mean, number eight there says consideration of uncertainty and this is one of the major model uncertainties now that the PRA has. So you know, we have to somehow resolve this.

MR. BOYCE: That's right.

CHAIRMAN APOSTOLAKIS: I'm not saying it's unresolvable, but I just don't want to see it being implemented without anybody saying anything.

MR. BOYCE: Well, we haven't done that. Actually, the path forward at least that I see is that we have got to follow these 10 attributes and we have got to come up with a standard or some acceptance criteria, which is what you were asking before. What does it mean that we're looking at these attributes?

When a model comes in, is it good enough to meet this attribute or not? The staff does have to have some criteria to do that. Some of the answers might be in Reg Guide 1.200. Some of them may be elsewhere. But right now, the stage we're at is we finally, I think, come close to identifying the attributes for the Configuration Risk Models that we want.

All the discussion that I have heard in the PRA realm has always been focused on the quality of PRA. Now, we're being looked at specific models. By analogy, it's almost like spent fuel casks. You specify high level criteria for spent fuel, but then you certify each cask. We might end up doing that for these Configuration Risk Management Models depending on the results of having these attributes, but we aren't there yet and we are actually just starting down the road.

MR. REINHART: Maybe another point to add. We have one real full scope proposed application and we're going to have to review that model.

CHAIRMAN APOSTOLAKIS: Well, the point I'm making is that what research does in certain areas cannot be divorced from what decisions are being made in other areas and human reliability is a major model uncertainty and, somehow, has to be resolved here. Maybe it's irrelevant. I don't know.

Anyway, there is another meeting at 1:00, so we really have to wrap this up. Okay? Any major comments from anyone? Hearing none, thank you very much. It was very informative, and this meeting of the Subcommittees is adjourned.

(Whereupon, the meeting was concluded at 12:36 p.m.)

CERTIFICATE

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

Name of Proceeding: Advisory Committee on Reactor Safeguards Subcommittee on Reliability And Probabilistic Risk Assessment and Plant Operations

Docket Number: n/a

Location: Rockville, MD

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.

Rebecca Davis
Official Reporter
Neal R. Gross & Co., Inc.

Exelon.
Nuclear

Configuration Risk Management at Exelon

Prepared for:

The Reliability & PRA, and Plant Operations Subcommittees of the ACRS

Presented by:

Gene Hughes
Risk Management Director

John Steinmetz
Dresden Site Risk Management Engineer

June 15, 2005

Exelon Nuclear

Exelon Risk Management Structure

Corporate

Director of Risk Management

- Model Owners
- Corporate Staff
- Supporting Analyses
- Applications

Site

Engineering Programs

- Planning
- Scheduling
- Work Control
- OPS

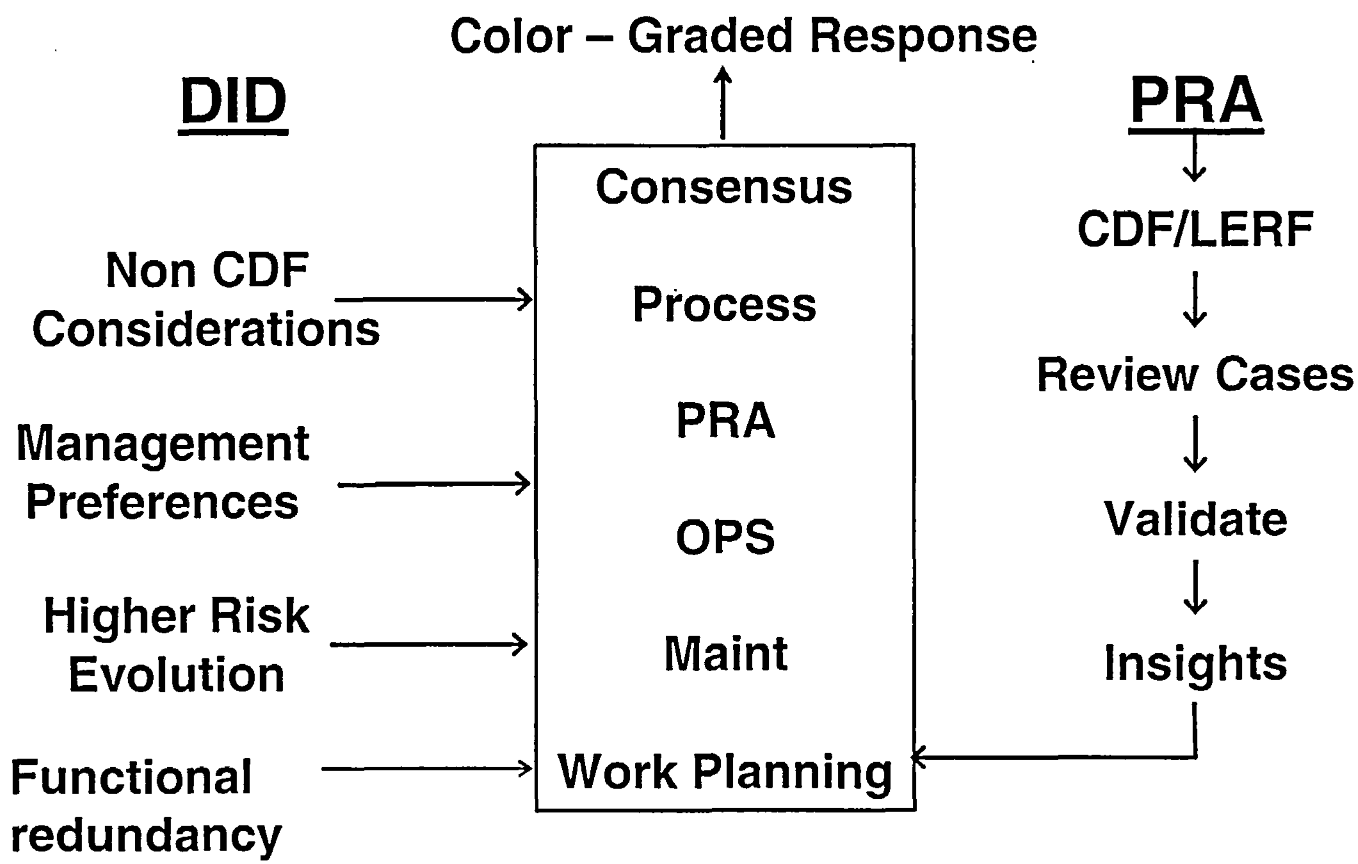
Site RME

"Point of the Spear"

- Risk Applications
- CRM

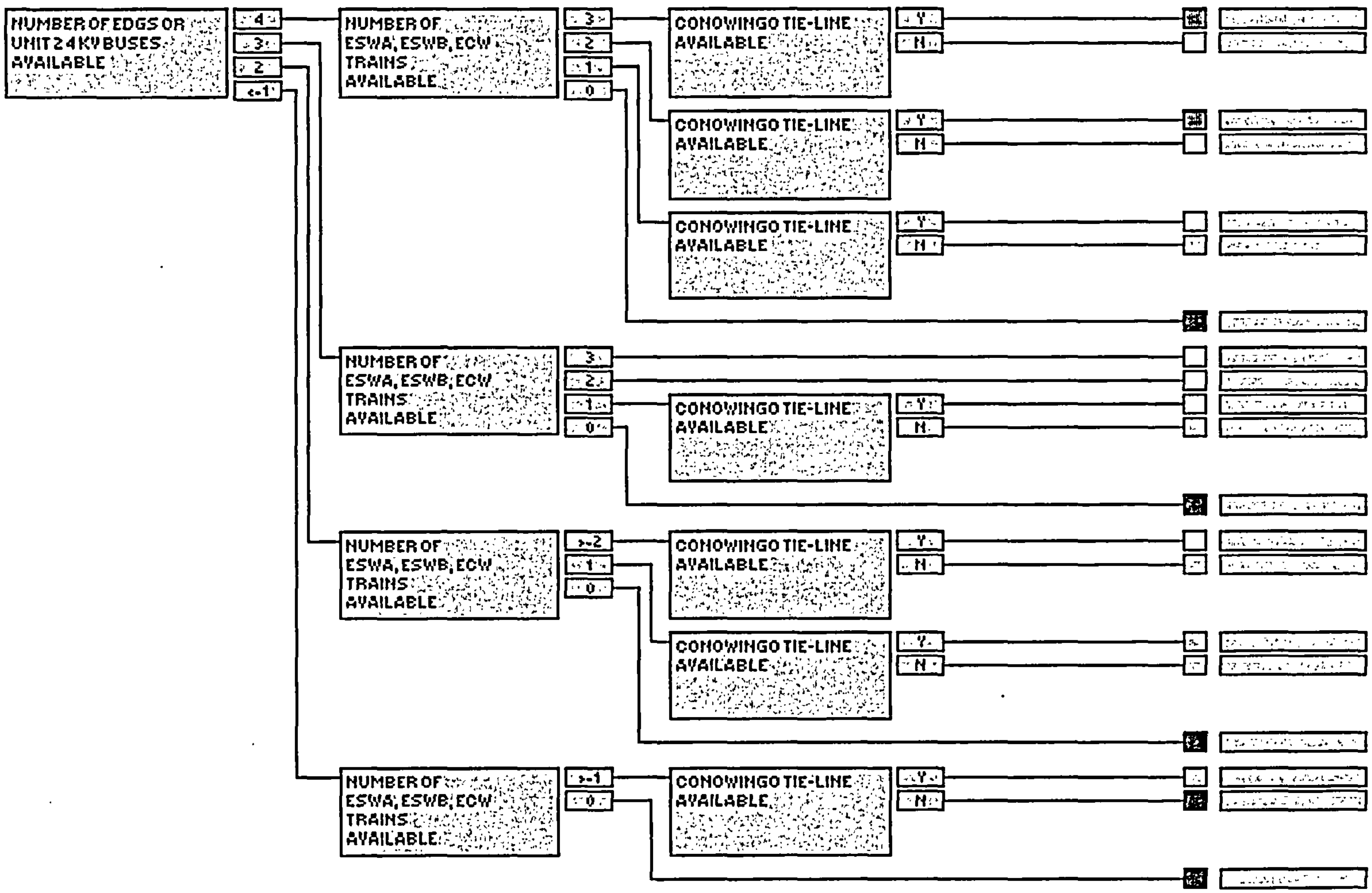
Risk Management Team

Blended Approach



GOAL = Risk Management

Defense In Depth – PBAPS
4 EDGs and Tie-Line to Conowingo Dam



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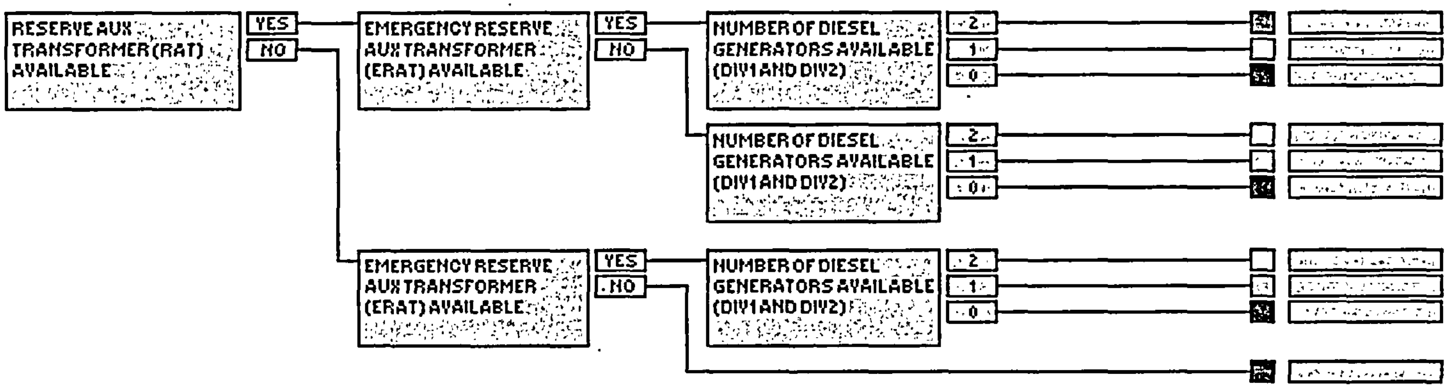
Defense In Depth – Clinton

2 EDGs and Auxiliary Transformers Only



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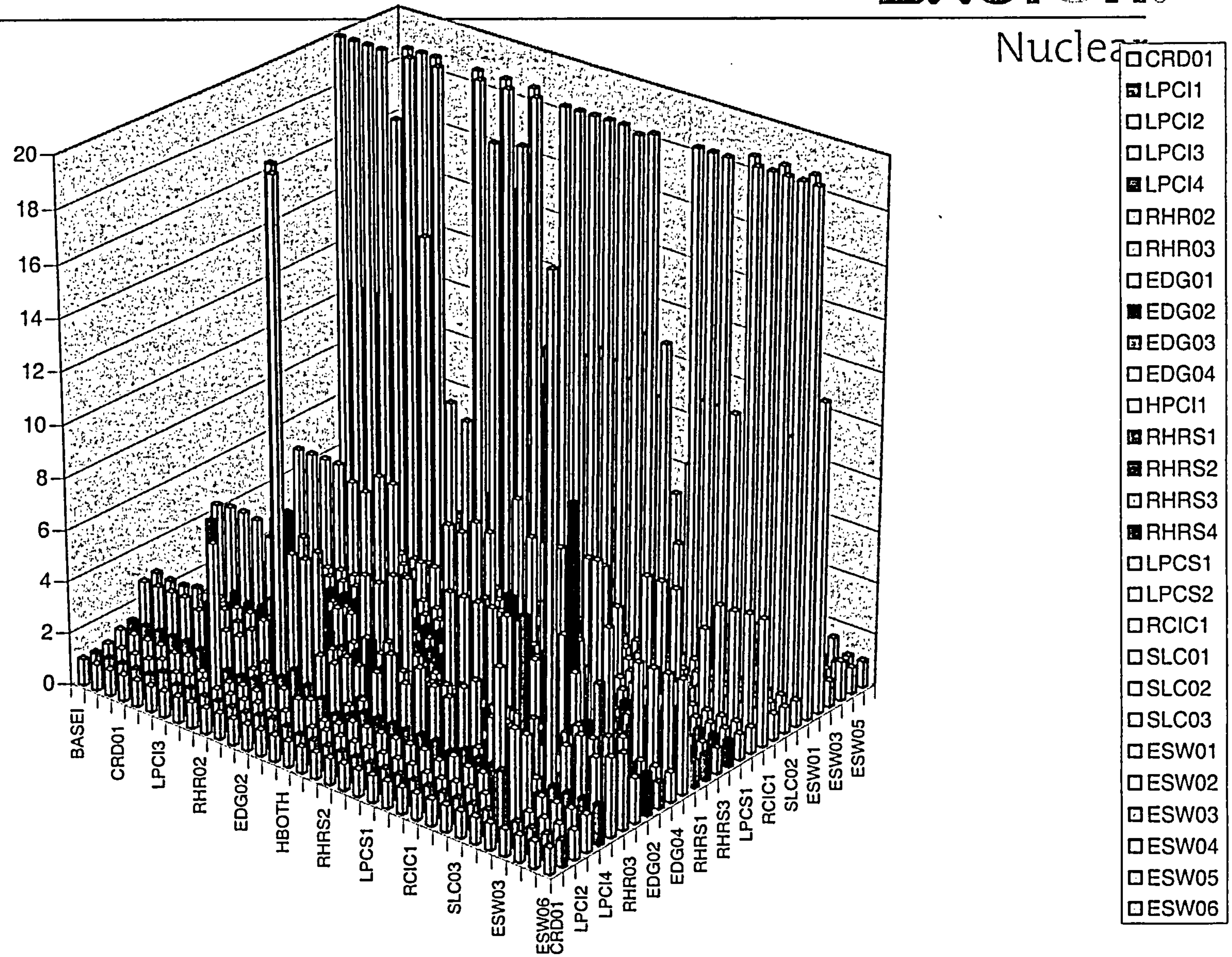


Exelon Nuclear

Blended Outcome - Limerick

144_R_H MCC & Instrument Air A OOS

ON-LINE SAFETY FUNCTIONS
- REACTIVITY CONTROL
- HIGH PRESSURE INJECTION
- PRESSURE CONTROL
- LOW PRESSURE INJECTION
- PRIMARY CONT. HEAT REMOVAL
- SECONDARY CONTAINMENT
- CONTAINMENT INTEGRITY
- ELECTRIC POWER
- CONTROL ENCL HABITABILITY

ON-LINE PLANT TRANSIENTS
- PLANT TRIP / MANUAL SCRAM
- LOSS OF OFFSITE POWER
- LOSS OF CONDENSER
- LOSS OF FEEDWATER
- ANTICIPATED TRANS W/O SCRAM

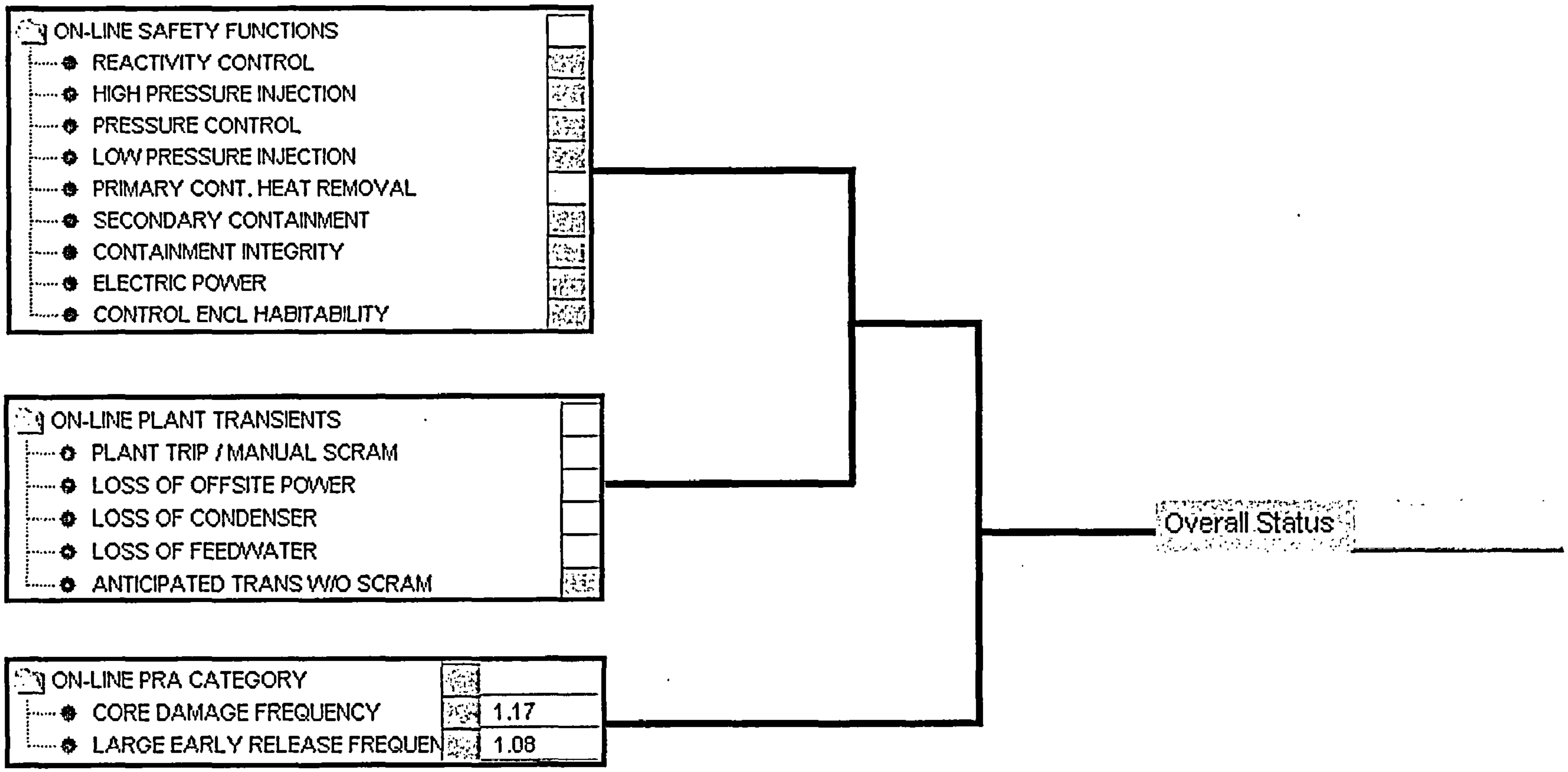
ON-LINE PRA CATEGORY	
CORE DAMAGE FREQUENCY	15.61
LARGE EARLY RELEASE FREQUEN	6.16

Overall Status

Exelon® Nuclear

Blended Outcome - Limerick

SPC LOOP A OOS



Exelon Nuclear

Fire CRM – Potential considerations

- Use Quasi-quantitative method to focus risk management actions on fire areas with increased risk
  - Use Fire PRA or IPEEE to identify important scenarios and configurations
- Scenarios with limited safe shutdown paths available
  - Protect remaining equipment
- Scenarios with no safe shutdown paths available
  - Actions to prevent fire
- Use Assessment Trees to provide color results, indicating level of action

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Configuration Results - PRA

- Planning and Scheduling
  - SRME runs PRA model and loads result into software
    - Ensure results make sense
  - Updated model results available to all personnel
- Emergent
  - PRA result shows up White, indicating unknown
  - Defense In Depth results are still available, and are generally bounding
    - Protect redundant and diverse SSCs – SFATs and PTATs provide this information
    - Establish compensatory measures, such as minimizing duration, defer other work
    - SRME contacted - may provide preliminary evaluation based on qualitative judgment pending completion of quantitative assessment

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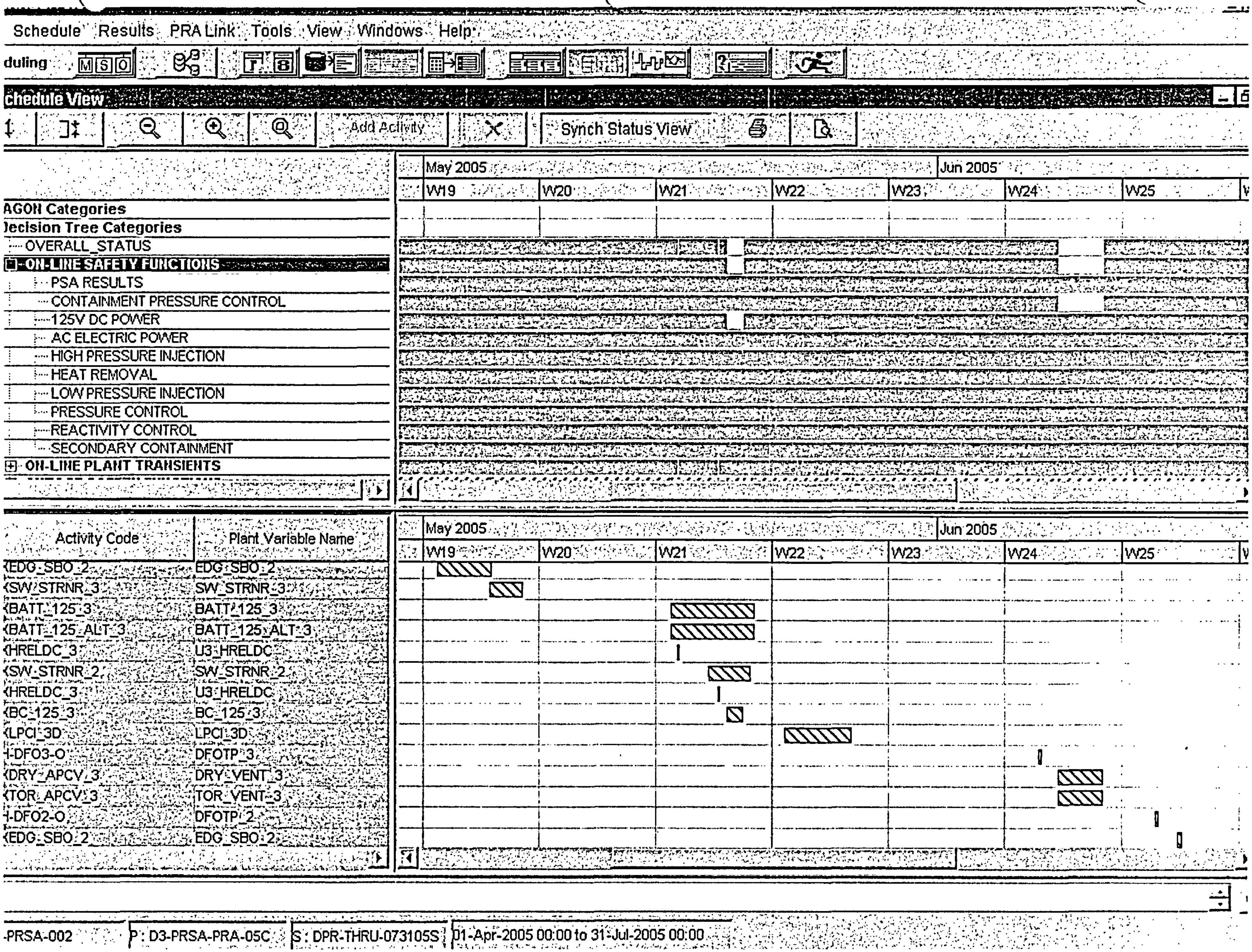
Considerations for GREEN

- CDF/LERF < 2x Zero Maintenance Baseline
- Minimal or no degradation in Defense-in-depth
- No Higher Risk Evolutions
- Normal Work Controls
  - Preserve operable equipment to the extent possible
  - Manage spatial issues that have the potential to impact defense-in-depth (preserve DID)
  - Consider small cumulative impacts of maintenance activities

Risk Management

COLOR	CONSIDERATIONS
GREEN	▪ Preserve operable equipment to the extent possible ▪ Manage spatial issues that have the potential to impact defense-in-depth (preserve DID) ▪ Consider small cumulative impacts of maintenance activities
YELLOW	▪ Correct the cause as soon as practical by considering the time in the configuration and resources available ▪ Assess the return to service of selected equipment and return to service as soon as practical ▪ Protect risk significant equipment ▪ Employ a "return to GREEN" mindset
ORANGE	▪ Requires senior management review and approval prior to entering this condition ▪ Minimize exposure using return to service priorities ▪ Work around the clock ▪ Develop and implement contingency actions ▪ Protect risk significant equipment
RED	▪ Never plan to enter "Red" if at all avoidable ▪ Minimize the time in "Red" – transition to Orange/Yellow/Green ▪ Extreme care should be taken to avoid trips or plant disturbances ▪ Active monitoring of all Maintenance/I&C/Operations activities ▪ Implement Contingencies



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Synch Status View
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Jun 2005
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W20
W21
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W24
W25
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OVERALL_STATUS
ON-LINE SAFETY FUNCTIONS
PSA RESULTS
CONTAINMENT PRESSURE CONTROL
125V DC POWER
AC ELECTRIC POWER
HIGH PRESSURE INJECTION
HEAT REMOVAL
LOW PRESSURE INJECTION
PRESSURE CONTROL
REACTIVITY CONTROL
SECONDARY CONTAINMENT
ON-LINE PLANT TRANSIENTS
Activity Code
Plant Variable Name
EDG_SBO_2
SW_STRNR_3
BATT_125_3
BATT_125_ALT_3
HRELDC_3
U3_HRELDC
SW_STRNR_2
BC_125_3
LPCI_3D
DFO3-O
DFOTP_3
DRY_APCV_3
DRY_VENT_3
TOR_APCV_3
TOR_VENT_3
DFO2-O
DFOTP_2
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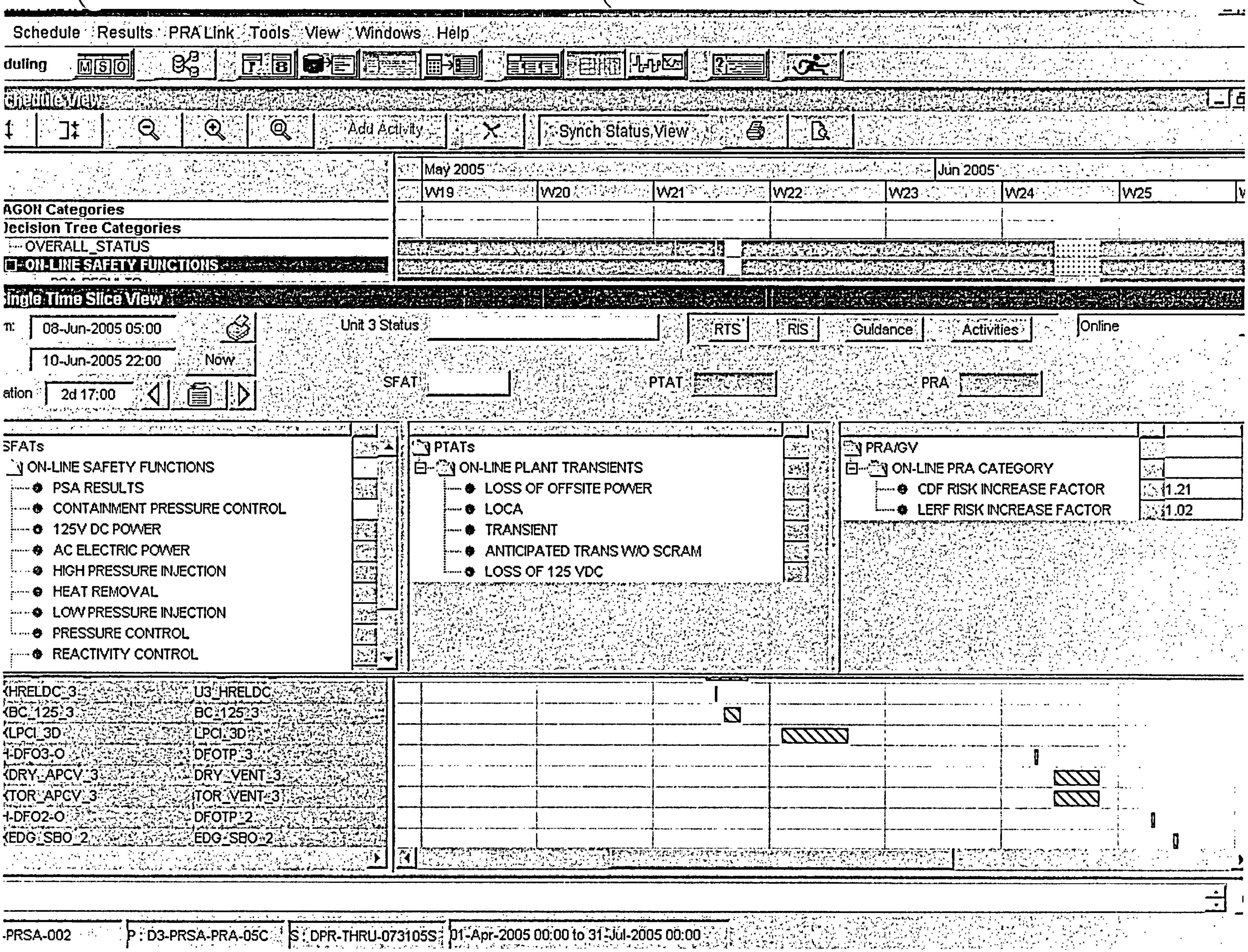
P: D3-PRSA-PRA-05C
S: DPR-THRU-073105S
01-Apr-2005 00:00 to 31-Jul-2005 00:00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Unit 3 Status
RTS
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125V DC POWER
AC ELECTRIC POWER
HIGH PRESSURE INJECTION
HEAT REMOVAL
LOW PRESSURE INJECTION
PRESSURE CONTROL
REACTIVITY CONTROL
PTATs
ON-LINE PLANT TRANSIENTS
LOSS OF OFFSITE POWER
LOCA
TRANSIENT
ANTICIPATED TRANS W/O SCRAM
LOSS OF 125 VDC
PRA/GV
ON-LINE PRA CATEGORY
CDF RISK INCREASE FACTOR 1.21
LERF RISK INCREASE FACTOR 1.02
HRELDC_3 U3_HRELDC
BC_125_3 BC_125_3
LPCI_3D LPCI_3D
-DFO3-O DFOTP_3
DRY_APCV_3 DRY_VENT_3
TOR_APCV_3 TOR_VENT_3
-DFO2-O DFOTP_2
EDG_SBO_2 EDG_SBO_2
-PRSA-002
P : D3-PRSA-PRA-05C
S : DPR-THRU-073105S
01-Apr-2005 00:00 to 31-Jul-2005 00:00

Schedule PRA Link Tools View Windows Help

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Operators Module View

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Unit 3 Status

RTS | RIS | Guidance | Activities

Online

Recalc w/PRA

What-If: Save | Reset

SFAT | PTAT | PRA

SFATs
- ON-LINE SAFETY FUNCTIONS
  - PSA RESULTS
  - CONTAINMENT PRESSURE CONTROL
  - 125V DC POWER
  - AC ELECTRIC POWER
  - HIGH PRESSURE INJECTION
  - HEAT REMOVAL
  - LOW PRESSURE INJECTION
  - PRESSURE CONTROL
  - REACTIVITY CONTROL

PTATs
- ON-LINE PLANT TRANSIENTS
  - LOSS OF OFFSITE POWER
  - LOCA
  - TRANSIENT
  - ANTICIPATED TRANS W/O SCRAM
  - LOSS OF 125 VDC

PRA/GV
- ON-LINE PRA CATEGORY
  - CDF RISK INCREASE FACTOR 4.52
  - LERF RISK INCREASE FACTOR 1.78

Iso. Condenser
- D043 - TRAIN A IC MAKEUP PUMP (S)
- D043 - TRAIN B IC MAKEUP PUMP (S)
- ISOLATION CONDENSERS

Button Grid | Schedule | Plant Vars

Power | DC Power | Primary Systems | Balance of Plant | All Comps/Trains | HREs / Configs

High Pressure	Low Pressure	Decay Ht Removal	Primary Cont.	Pressure Control	
HPCI System	LPCI	LPCI/CCSW Div. 1	Vacuum Breakers	ADS/SRVs	
Iso. Condenser	Core Spray	LPCI/CCSW Div. 2	Drywell Spray	Iso. Condenser	ARI/RPT Logic
		Shutdown Cooling	Torus Spray		High Risk ATWS
CRD Injection			Emerg. Venting	RCS Boundary	High Risk SCRAM
Unit 2 Pumps			Torus	High Risk LOCA	
Unit 3 Pumps			Primary Cont.		
Unit Crosstie			Secondary Cont.		
			SBGT		
			Sec. Containment		

-PRSA-002 | P : D3-PRSA-PRA-05C | S : DPR-THRU-073105S | 01-Apr-2005 00:00 to 31-Jul-2005 00:00

Schedule PRA Link Tools View Windows Help

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Unit 3 Status

RTS RIS Guidance Activities

Online

Recalc w/PRA

SFAT PTAT PRA

What-If: Save Reset

SFATs
- ON-LINE SAFETY FUNCTIONS
  - PSA RESULTS
  - CONTAINMENT PRESSURE CONTROL
  - 125V DC POWER
  - AC ELECTRIC POWER
  - HIGH PRESSURE INJECTION
  - HEAT REMOVAL
  - LOW PRESSURE INJECTION
  - PRESSURE CONTROL
  - REACTIVITY CONTROL

PTATs
- ON-LINE PLANT TRANSIENTS
  - LOSS OF OFFSITE POWER
  - LOCA
  - TRANSIENT
  - ANTICIPATED TRANS W/O SCRAM
  - LOSS OF 125 VDC

PRA/GV
- ON-LINE PRA CATEGORY
  - CDF RISK INCREASE FACTOR 4.52
  - LERF RISK INCREASE FACTOR 1.78

Button Grid | Schedule | Plant Vars

Power | DC Power | Primary Systems | Balance of Plant | All Comps/Trains | HREs / Configs

High Pressure	Low Pressure	Decay Ht Removal	Primary Cont.	Pressure Control	Reactivity
HPCI System	LPCI	LPCI/CCSW Div. 1			
Iso. Condenser	Core Spray	LPCI/CCSW Div. 2			
		Shutdown Cooling			
CRD Injection					
Unit 2 Pumps					
Unit 3 Pumps					
Unit Crosstie					

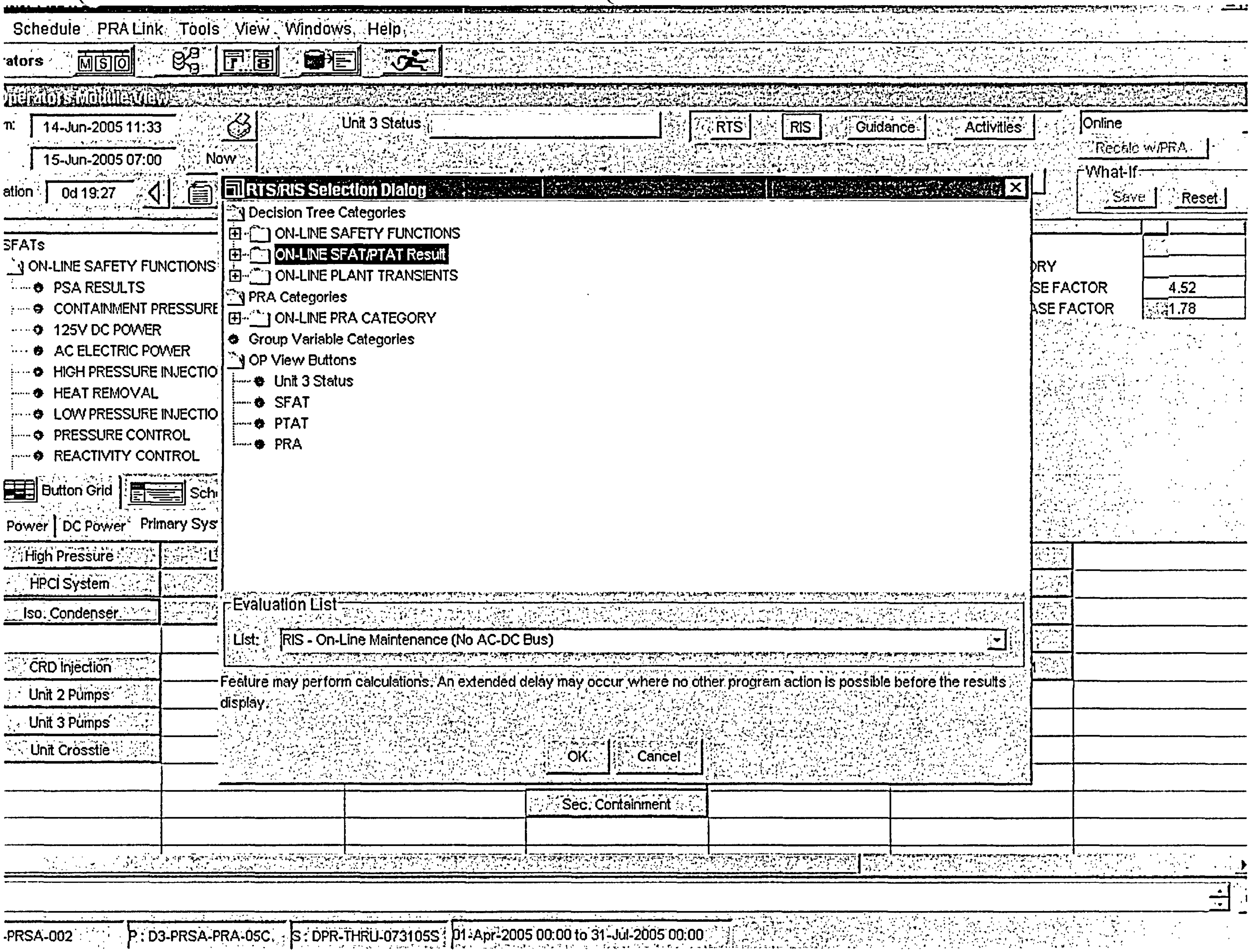
Current Activities View

Start Date/Time: 14-Jun-2005 11:33 End Date/Time: 15-Jun-2005 0...

Activity Code	Start	End	Description
ISO_COND_3_X	14-Jun-2005 11:33		New Activity...

Close

-PRSA-002 | P : D3-PRSA-PRA-05C | S : DPR-THRU-073105S | 01-Apr-2005 00:00 to 31-Jul-2005 00:00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Unit 3 Status
RTS
RIS
Guidance
Activities
Online
Recalc w/PRA
What-If
Save
Reset
RTS/RIS Selection Dialog
Decision Tree Categories
ON-LINE SAFETY FUNCTIONS
ON-LINE SFAT/PTAT Result
ON-LINE PLANT TRANSIENTS
PRA Categories
ON-LINE PRA CATEGORY
Group Variable Categories
OP View Buttons
Unit 3 Status
SFAT
PTAT
PRA
Evaluation List
List: RIS - On-Line Maintenance (No AC-DC Bus)
Feature may perform calculations. An extended delay may occur where no other program action is possible before the results display.
OK
Cancel
SFATs
ON-LINE SAFETY FUNCTIONS
PSA RESULTS
CONTAINMENT PRESSURE
125V DC POWER
AC ELECTRIC POWER
HIGH PRESSURE INJECTIO
HEAT REMOVAL
LOW PRESSURE INJECTIO
PRESSURE CONTROL
REACTIVITY CONTROL
Button Grid
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DC Power
Primary Sys
High Pressure
HPCI System
Iso. Condenser
CRD Injection
Unit 2 Pumps
Unit 3 Pumps
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P : D3-PRSA-PRA-05C
S : DPR-THRU-073105S
01-Apr-2005 00:00 to 31-Jul-2005 00:00

Schedule PRA Link Tools View Windows Help

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Operations Module View

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SFATs

- ON-LINE SAFETY FUNCTIONS
  - PSA RESULTS
  - CONTAINMENT PRESSURE
  - 125V DC POWER
  - AC ELECTRIC POWER
  - HIGH PRESSURE INJECTIO
  - HEAT REMOVAL
  - LOW PRESSURE INJECTIO
  - PRESSURE CONTROL
  - REACTIVITY CONTROL

Button Grid | Sch

Power | DC Power | Primary Sys

High Pressure

HPCI System

Iso. Condenser

CRD Injection

Unit 2 Pumps

Unit 3 Pumps

Unit Crosstie

D043

D043

RTS/RIS Results View

Remain In Service Results for:

ON-LINE SFAT/PTAT Result

Results:

D323 - HIGH PRESSURE COOLANT INJECTION	
345KV RING BUS BKR 10 TO 11	
345KV RING BUS BKR 8 TO 15	
345KV RING BUS BKR 8 TO 9	
345KV RING BUS BKR 9 TO 10	
D338 - TBCCW PUMP 3B (S)	
D037 - RBCCW TRAIN 2/3 (S)	
D337 - RBCCW TRAIN 3A	
D337 - RBCCW TRAIN 3B	
D315 - LPCI PUMP 3A	
D315 - LPCI PUMP 3B	
D315 - LPCI PUMP 3C	
D315 - LPCI PUMP 3D	
D075 - SBGT TRAIN A (S)	
D075 - SBGT TRAIN B (S)	
D311 - SBLC TRAIN 3A	
D311 - SBLC TRAIN 3B	
D310 - SHUTDOWN COOLING PUMP 3A	
D310 - SHUTDOWN COOLING PUMP 3B	
D310 - SHUTDOWN COOLING PUMP 3C	
D039 - SERVICE WATER TRAIN 2/3 (S)	
D239 - SERVICE WATER TRAIN 2A (S)	
D239 - SERVICE WATER TRAIN 2B (S)	
D339 - SERVICE WATER TRAIN 3A (S)	
D339 - SERVICE WATER TRAIN 3B (S)	
D239 - SW STRAINER 2 (S)	
D039 - SW STRAINER 2/3 (S)	

Print | Close

ties | Online

Recalc w/PRA

What-If: Save | Reset

ORY	
SE FACTOR	4.52
ASE FACTOR	1.78

-PRSA-002 | P: D3-PRSA-PRA-05C | S: DPR-THRU-073105S | 01-Apr-2005 00:00 to 31-Jul-2005 00:00

Schedule PRA Link Tools View Windows Help

ators M S O

Operators Module View

m: 12-Jun-2005 18:11

14-Jun-2005 00:00 Now

ation 1d 05:49

Unit 3 Status

RTS RIS Guidance Activities

Online

Recalc w/PRA

SFAT PTAT PRA

What-If: Save Reset

SFATs
- ON-LINE SAFETY FUNCTIONS
  - PSA RESULTS
  - CONTAINMENT PRESSURE CONTROL
  - 125V DC POWER
  - AC ELECTRIC POWER
  - HIGH PRESSURE INJECTION
  - HEAT REMOVAL
  - LOW PRESSURE INJECTION
  - PRESSURE CONTROL
  - REACTIVITY CONTROL

PTATs
- ON-LINE PLANT TRANSIENTS
  - LOSS OF OFFSITE POWER
  - LOCA
  - TRANSIENT
  - ANTICIPATED TRANS W/O SCRAM
  - LOSS OF 125 VDC

PRA/GV
- ON-LINE PRA CATEGORY
  - CDF RISK INCREASE FACTOR 4.52
  - LERF RISK INCREASE FACTOR 1.78

Button Grid | Schedule | Plant Vars

Power | DC Power | Primary Systems | Balance of Plant | All Comps/Trains | HREs / Configs

High Pressure	Low Pressure	Decay Ht Removal	Primary Cont.	Pressure Control	Reactivity
HPCI System	LPCI	LPCI/CCSW Div. 1	Vacuum Breakers	ADS/SRVs	SBLC
Iso		CCSW Div. 2	Drywell Spray	Iso. Condenser	
		own Cooling	Torus Spray		
Cl			Emerg. Venting	RCS Boundary	
Ur			Torus	High Risk LOCA	
Ur			Primary Cont.		
U			Secondary Cont.		
			SBGT		
			Sec. Containment		

HREs
- OL HRE - ABILITY TO SCRAM DEGRADED
- OL HRE - POTENTIAL FOR GROUP 1 ISOLATION
- OL HRE - POTENTIAL FOR REACTOR SCRAM
- OL HRE - POTENTIAL FOR TURBINE TRIP
- OL HRE - POTENTIAL LOSS OF 125 VDC DIV
- OL HRE - POTENTIAL LOSS OF INSTR AIR
- OL HRE - POTENTIAL LOSS OF OFFSITE POWER
- OL HRE - POTENTIAL LOSS OF PRI CNMT

Iso Condenser
- D043 - TRAIN A IC MAKEUP PUMP (S)
- D043 - TRAIN B IC MAKEUP PUMP (S)
- ISOLATION CONDENSER

-PRSA-002 | P : D3-PRSA-PRA-05C | S : DPR-THRU-073105S | 01-Apr-2005 00:00 to 31-Jul-2005 00:00

Exelon. Nuclear

Summary

- The use of color to represent risk provides a simple scheme for communicating across all site organizations.
- The color helps drive identification of which equipment or activity is impacting the level of defense-in-depth of each safety function.
- The use of a blended approach helps facilitate the inclusion of more than just the quantified risk

Exelon. Nuclear

Dresden CRM Model Compared with Base PRA Model

Initiator dependencies	Same
Truncation levels	Changed to accommodate equipment out of service
Translation from PRA model	Same
Human action treatment	Same
Activities mapped to basic events	Translation file part of program
Representing the as-built, as-operated plant	Same
Treatment of common cause	Same
Consideration of uncertainty	Same

Safety Monitor™
&
San Onofre Experience

ACRS Subcommittees on Reliability & PRA and
Plant Operations

6/15/05

Gary Chung, SONGS

Michael Phillips, Scientech LLC

SCIENTECH

SOUTHERN CALIFORNIA EDISON

Topics

- Safety Monitor – What Is It?
- Features
- Attributes
- SONGS Usage and Experience

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SOUTHERN CALIFORNIA EDISON

Safety Monitor™ - What is It?

- A Real-Time Risk Monitoring System Designed for Use by Plant Personnel
- Provides a Complete Boolean Solution of the Plant's PRA Model, But Can Be Used By Personnel With No PRA Experience
- Has Been Used at San Onofre for Over 11 Years, and Is Now Installed at 18 Additional Sites with 4 additional sites being added.

Features of the Software

- Plant Personnel Features
  - Perform Real and "What If" Risk Evaluations for Full Power or Shutdown Modes
  - Evaluate Proposed Maintenance Schedules
    - Supports Import of Data and Multiple Case Files
  - Evaluate Effects of Equipment Removal/Return to Service, Environmental and Testing Conditions, Mode Changes, and Operating Alignment Changes
  - Advice for Restoration of Inoperable Equipment
  - Advice for Important Operable Equipment

Features of the Software (continued)

- PSA Personnel/Maintenance Rule Support Features
  - Track Cumulative and Instantaneous Risk Against Targets
  - Plant Configuration & Risk History Data Bases
  - Dynamic modification of initiators and HEPs based upon equipment status

Features of the Software (continued)

- Other Advanced Features
  - Data communications features
    - Provides Automated Communication with Tagging Programs, Operator Logs, and Scheduling Programs
  - Direct Import for PRA Model/Data files from WinNUPRA, CAFTA, RISKMAN and Risk Spectrum
  - Time-dependent human reliability calculator for shutdown conditions
  - Performs Defense-In-Depth/Safety Function Assessments

SONGS Safety Monitor Attributes

Initiator dependencies	Same as the PRA
Truncation levels	Controlled by plant SM administrator SONGS = 5E-10/yr CDF (Tool solves model for each configuration)
Translation from PRA model	Direct Translation from PRA plus: • Average unavailability removed • Current environmental conditions considered • Actual equipment status used • Actual system alignments used
Human action treatment	Same as the PRA
Activities mapped to basic events	Specific maintenance activities & specific component outages are mapped to basic events

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SOUTHERN CALIFORNIA EDISON

SONGS 2/3 PRA

- Internal & External Events explicitly modeled
- CDF & LERF
- Shutdown model developed
- Safety Monitor used by PRA, work control, & STA

SONGS Safety Monitor Attributes

Representing the as-built, as-operated plant	Updated on the same frequency as the PRA.
Treatment of common cause	Same as the PRA
Consideration of uncertainty	Same as the PRA
CRM software quality and configuration control	Safety Monitor is maintained and controlled under Appendix B software QA program by Vendor. Installation controlled under plant software control program.
CRM model and software testing	SONGS model is verified and validated against the PRA.

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Experience at San Onofre & Other Plants

- San Onofre
  - Required to support original DG AOT extension prior to addition of a(4) to Maintenance Rule
  - Accrued Risk at Both Units Has Decreased
  - Better Plant Understanding of Risk Impacts of Planned/ Unplanned Actions

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Experience at San Onofre & Other Plants (continued)

- Automated data collection interfaces in use at Perry
- Automated schedule evaluation input in place at many plants.
- Data collection for historical purposes that was previously performed manually.

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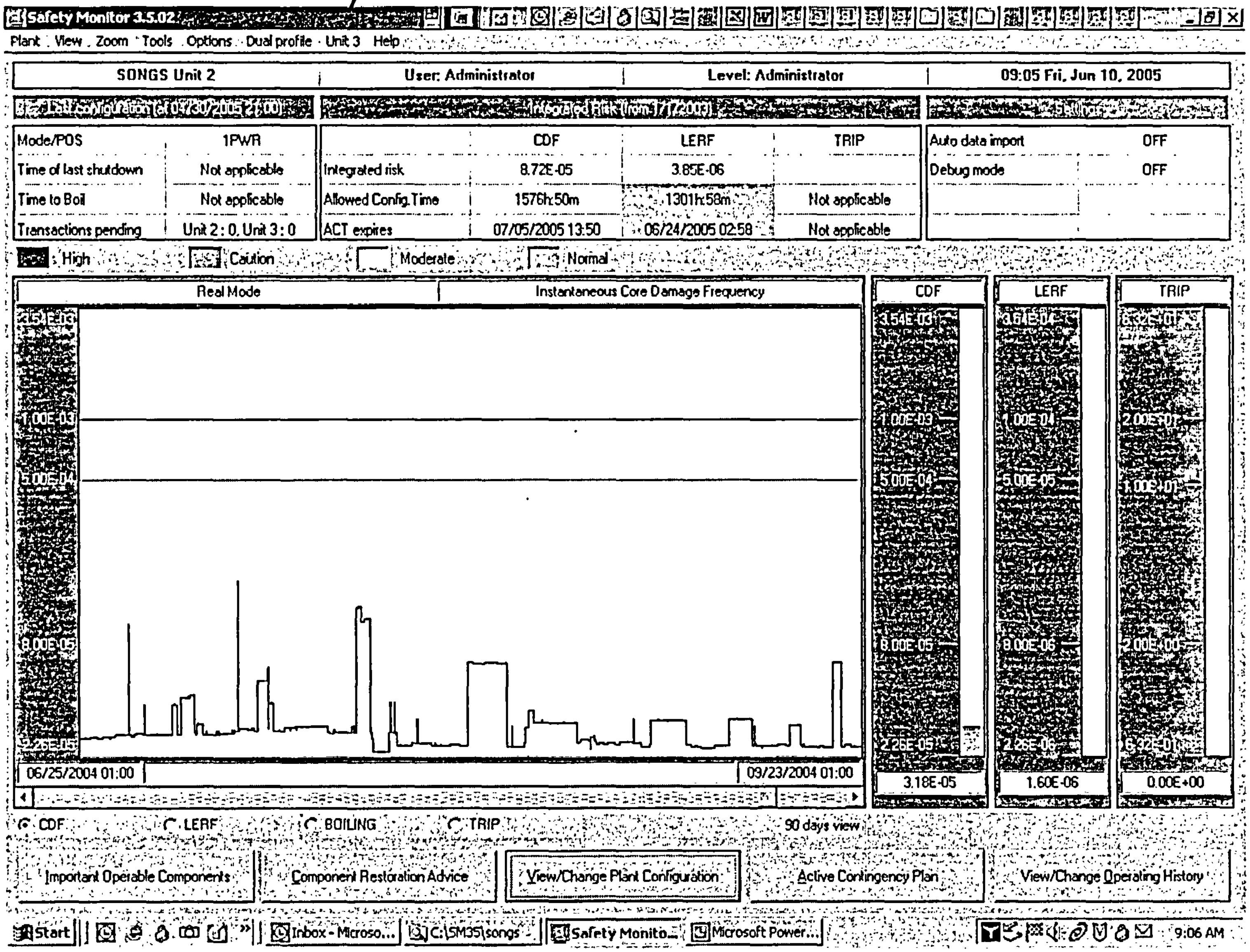
SOUTHERN CALIFORNIA EDISON

Safety Monitor Main Screen



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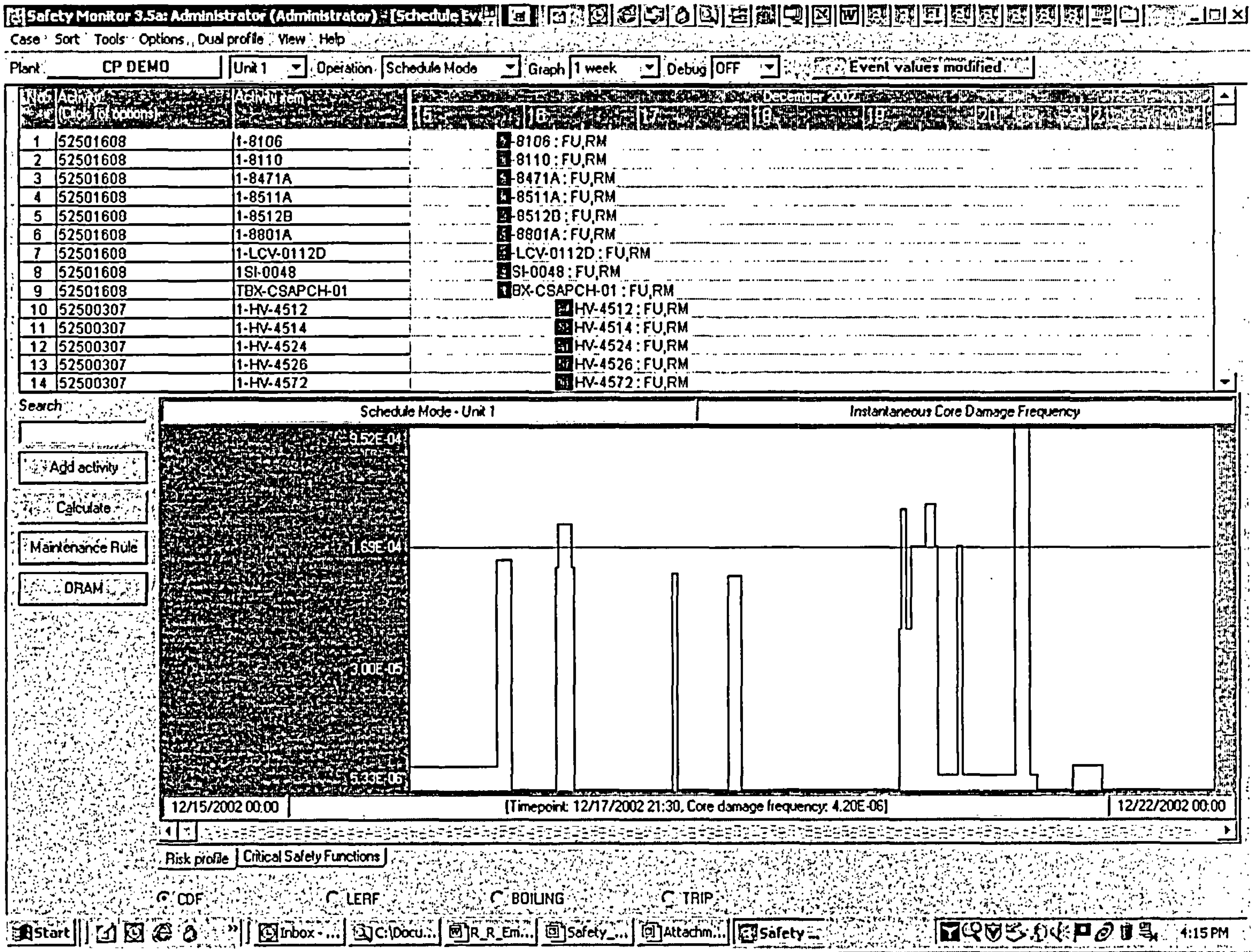
SOUTHERN CALIFORNIA EDISON

Schedule Evaluation Screen



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Component Selection Window

Component Status - Real Mode Operation

(•) List by System/Train

System: OTHER

Train: ALL

( ) List by name pattern

Find

P : PRA component
A : Advice available
M : MRule component
T : Trip related component
S : Shared component

Close

[ ] Show advice on removal

Viewing from 1 of 5

System/train component	Type	Description
2B1109	PT	LOADCENTER 2B11 SPARE BREAKER
2B1109 CTL	PT	LOADCENTER 2B11 SPARE CONTROL BREAKER
S21401WB115	PT	CONDENSER WATER BOX (NW) FROM CIRC PUMP 115
S21401WB116	PT	CONDENSER WATER BOX (NE) FROM CIRC PUMP 116
S21401WB117	PT	CONDENSER WATER BOX (SE) FROM CIRC PUMP 117

Last configuration change: 04/30/2005 21:00

Remove from service | Return to service

Date/Time	Item ID	Shared	Detail	Reason
09/12/2004 04:45	SA2417MW001	Y	OUT: RM/Unavailable	2-0401836 Investigate tripping on thermal overloads and repl
04/30/2005 03:03	SA2417MW002	Y	OUT: RM/Unavailable	WAR 2-0400205
04/30/2005 21:00	2L091CHC		OUT: RM/Unavailable	OOS due to erratic calibrated linear power. L2-05-399

Proposed component status changes:

Delete transaction

Date/Time	Item ID	Shared	Detail	Reason

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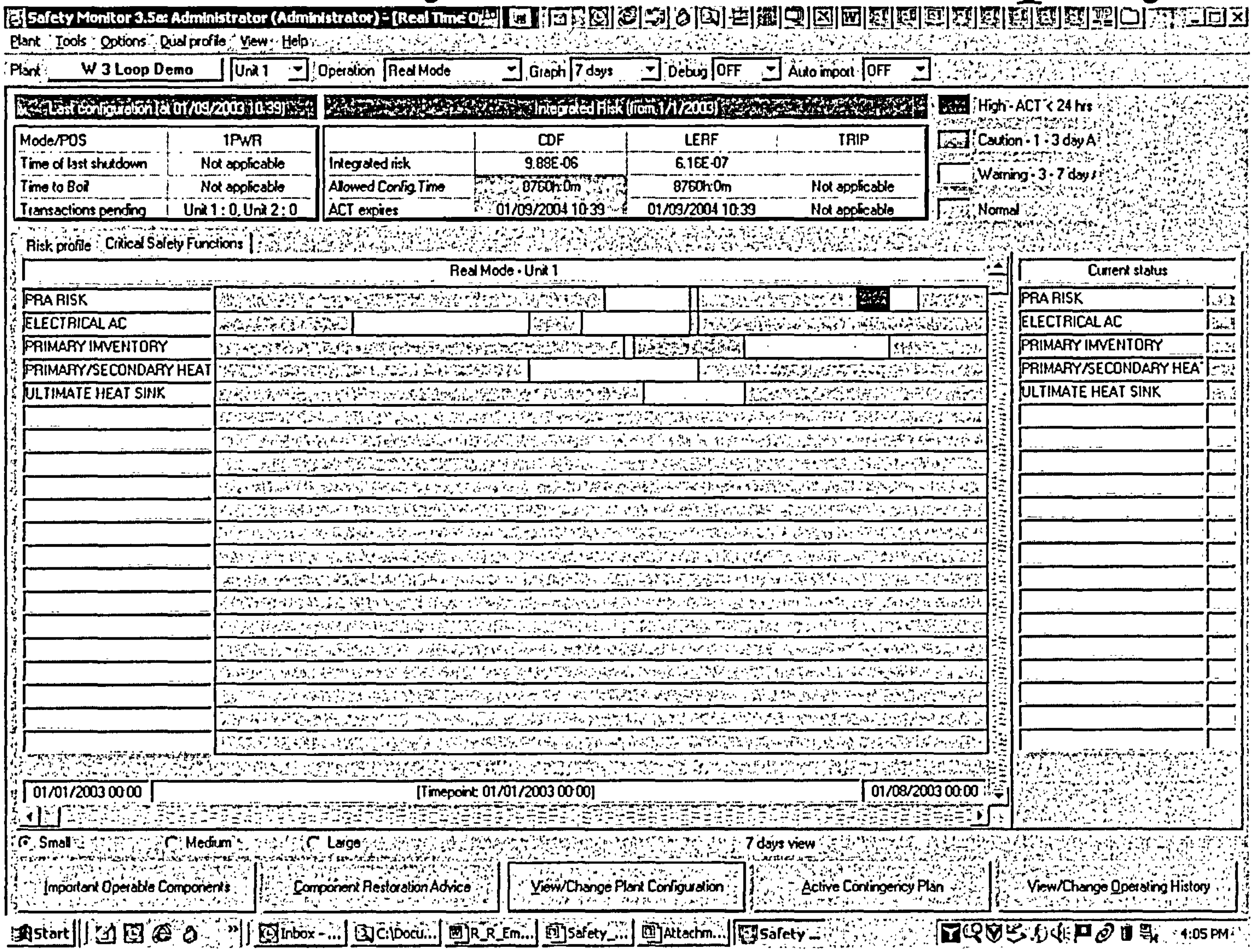
SOUTHERN CALIFORNIA EDISON

Safety Function Display



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Base PRA & Safety Monitor PRA Similarities and Differences

- Base PRA & Safety Monitor models are essentially the same (i.e., fault tree, data & accident sequences) except the Safety Monitor has:
  - Actual vs. Average equipment maintenance data
  - Actual vs. Average alignments
- The Safety Monitor can also adjust initiating event frequencies (e.g. LOP) and failure probabilities to match real time plant conditions.

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Current Safety Monitor Usage

- Planned maintenance evaluation under MR a(4)
  - First cut - Conservatively assumes the week's equipment outages occur simultaneously with switchyard maintenance for entire week
  - Run in '**schedule**' mode with **future** plant configuration
- Real time risk evaluation once per shift in the control room by STA
  - Run in '**real**' mode with **current** plant configuration
- Case studies performed by PRA Group
  - Run in '**hypothetical**' mode with **assumed** plant configuration

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Model Control

- PRA models are developed in WINNUPRA
- Models are converted to Safety Monitor
- Results are compared to ensure accurate conversion.
- Process is performed by the PRA group
- The controlled Safety Monitor software and the SONGS model are downloaded from the network.

Environmental/Test Factors Modeled at SONGS

- Switchyard Maintenance
- External Fires
- Tornado Warnings
- Kelp Intrusion at Intake
- Tsunami Warning
- Earthquake Warning
- Degraded Grid Voltage or Instability

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Types of Users

- Operators and work planners are able to:
  - Take equipment out of service
  - Adjust equipment/system alignments
  - Adjust Environmental/ Test Factors
- Operators & work planners cannot adjust PRA data and PRA model logic.
- PRA engineers are available 24 hours/day to assist work planners and shift technical advisors in the control room.

Summary

- CRM, like other PRA applications, is affected by general PRA issues such as scope & model boundaries.
- SONGS has successfully conducted CRM using Safety Monitor for over 11 years, well before Maintenance Rule a(4) requirement.
- Safety Monitor can provide a blended approach to CRM, both qualitative and quantitative assessment.

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SOUTHERN CALIFORNIA EDISON

Attributes of Configuration Risk Models for Risk Management Tech Specs

John Gaertner, EPRI

to

Advisory Committee on Reactor Safeguards

Reliability & PRA Subcommittee

Plant Operations Subcommittee

June 15, 2005

EPRI

Objective

- **Identify all necessary attributes of a CRM model that would not be addressed explicitly by PRA Standards and evaluated by Peer Certification.**
  - Most aspects of the CRM model are identical to the PRA from which it is derived
  - Some attributes are unique to the CRM application

So, a complete review of CRM technical adequacy requires:

Peer Review	+	Standards Assessment	+	Verification of Attributes

EPRI

Current Status of CRM Models

- U.S. plants use quantitative CRM models for Maintenance Rule (a)(4) requirements at power.
- CDF and LERF are the figures of merit, but LERF is sometimes not part of the CRM model.
- Internal events are always in the quantitative CRM model, flooding usually, fire sometimes, seismic sometimes, ...
- CRM models are an integral part of regulatory compliance, work management, and operations processes at NPPs. Their use is essential to plant performance.
- CRM models and their use in (a)(4) is subject to ROP oversight and actions.

Ten CRM Attributes

1. Initiator dependencies
2. Truncation levels
3. Translation from PRA model
4. Human action treatment
5. Activities mapped to basic events
6. Representing the as-built / as-operated plant
7. Treatment of common cause
8. Consideration of uncertainty
9. CRM *software* quality and configuration control
10. CRM *model* testing and configuration control

Attribute 1 – Initiator dependencies

- **Dependent initiating events in the CRM Model should address external conditions and the impacts of out-of-service components**
- Initiators impacted by external conditions typically include Loss of Offsite Power and plant trips
  - Typically these are represented by point estimates
- Out-of-Service Components can particularly impact support system initiating events
  - May be represented by point estimates or by fault tree models for the initiating event

Attribute 1 – Initiator dependencies (cont)

- External Conditions Example:
  - Documented seasonal differences could increase LOOP frequency
- Out-of-Service Components Examples:
  - Removing a SW pump from service for maintenance could change Loss of SW initiating event frequency

Attribute 2: Truncation levels

- **CRM model truncation levels must be adequate to represent incremental risk for configurations even with multiple equipment out of service.**
- Different truncation levels from PRA might be desirable for timely solutions
- Important model elements must not be removed through truncation
- Delta risk less sensitive to truncation than absolute risk
- Considerations vary for different solution methods:
  - Dynamic solution of model
  - Pre-solved configurations from the model
  - Pre-solved configurations from cut sets

Attribute 3 - Translation from PRA model

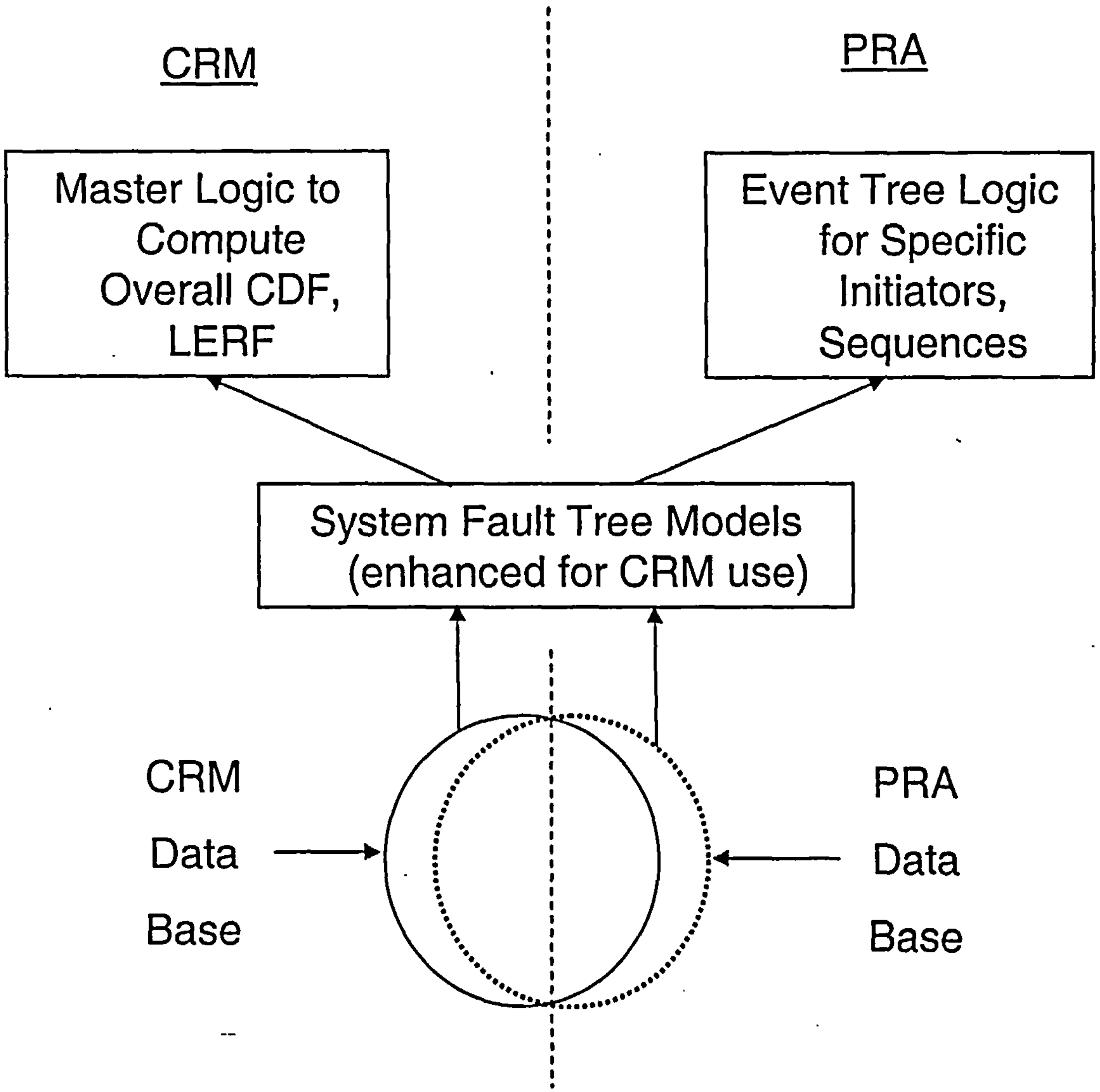
- **Model translation from the PRA to the CRM model must be appropriate, and the fault trees should be traceable to the PRA.**
- CRM and PRA models are closely related, but some differences are possible:
  - Direct use of the PRA model for CRM (e.g., to populate a "library" of configuration-specific results) usually requires little or no change to the PRA model
  - Development of a dynamic solution CRM model usually requires some model development to transform the PRA's ET structure to a single fault tree model

EPRI

Attribute 3 - Translation from PRA (cont)

- Development of CRM ***Models*** has led to enhancements to PRA system models
  - to remove asymmetries
  - to incorporate initiating event models
  - To allow multiple configurations (with house events)
- Some ***data*** changes will be made for RMTS:
  - Average maintenance unavailabilities will be set to zero
  - Adjustments to initiating event frequency for the plant's availability factor are not used in the CRM model
  - Adjustments may be made to some data to reflect periodic variations (e.g., summer vs. winter conditions) to provide a more realistic risk simulation in the CRM tool
  - High values (beyond "rare events") to be reviewed
  - All other averaging changed to a discrete configuration

Typical Relationship of CRM to PRA Models



EPRI

Attribute 4: Human Actions

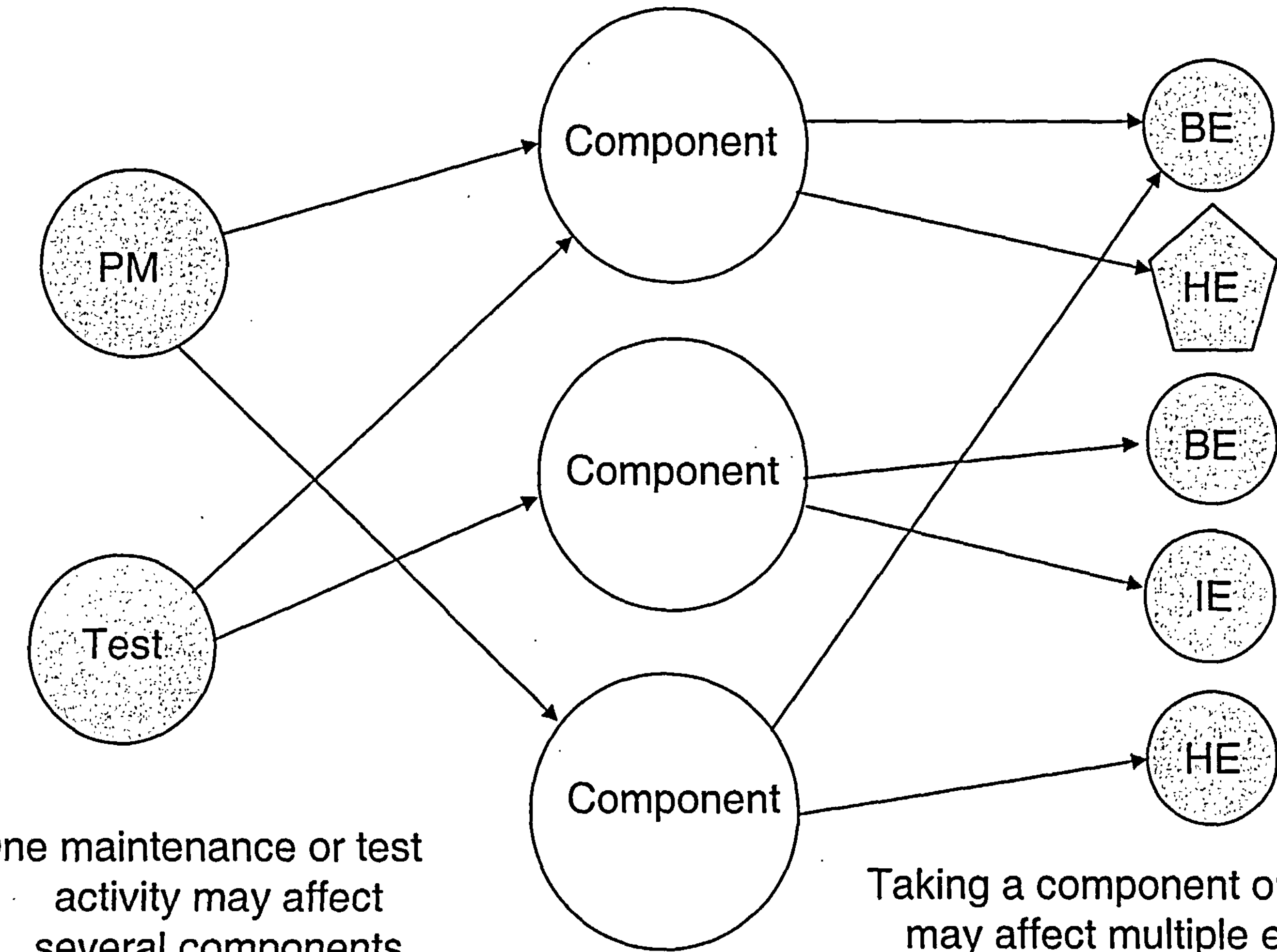
- **Human action events in CRM models which are dependent on equipment take appropriate account for out-of-service equipment.**
- Example: Backup for cooling water is a fire water pump, requiring manual connection and remote start by an auxiliary operator.
- In the CRM model, this human action must account for pump unavailability
  - HRA is set to "failed" when pump out of service, or
  - Pump is explicitly modeled in combination with the HRA

Attribute 5 – Activities mapped to basic events

- **Expected Plant Configuration must be correctly mapped from plant activities to the CRM Model.**
- Generally, two levels of mapping:
  - From the scheduled activities (PMs, tests, etc.) to discrete lists of PRA-modeled component IDs that are impacted by the activity
  - From the PRA-modeled component IDs to the specific basic events in the PRA model that will be affected
- Indirect effects included in the mapping set

EPRI

Attribute 5 – Activities mapped to basic events (cont)



One maintenance or test activity may affect several components

Taking a component out of service may affect multiple events (basic events, initiators, human actions) in the model

EPRI

Attribute 6 – Representing the as-built / as-operated plant

- **Each configuration-specific risk evaluation must reflect actual plant conditions**
- Other attributes (e.g., 3, 4, 5) help the plant's *PRA staff* to address how the CRM model and its supporting data properly reflect the plant design, operation, and current configuration
- However, *plant staff* that use the CRM model/tool (e.g. work planners, operators, etc.) must also ensure that all configuration data is properly input to the model. Examples include:
  - Ensuring that the planned work schedule includes all risk-affecting activities
  - Ensuring that risk-affecting changes in system conditions are identified and input

Attribute 6 – Representing the as-built / as-operated plant (cont)

- Also, CRM model might reflect plant conditions that can vary over the operating cycle (as opposed to the "time-average" treatment that is provided in the traditional PRA model.
  - Seasonal variations in success criteria and system/component failure likelihood

Attribute 7: Treatment of common cause

- **Common cause failure (CCF) probabilities must be properly modeled in light of the unavailability of one of the components in the common cause grouping.**
- Upon failure of a Tech Spec component, operators will determine whether the failure is a CCF candidate.
  - failed component set to "true" and common cause treatment for the rest of the grouping.

Attribute 8: Consideration of uncertainty

- **Any new uncertainty introduced into the CRM model that is not evaluated in the PRA is identified and evaluated prior to use.**
- New model elements *not in the PRA* to be evaluated for uncertainty according to the same criteria as the PRA
  - Example: Fire locations that are "screened" in the PRA but are "unscreened" in the CRM.
- Configurations that introduce high uncertainty to be identified.
  - Example: A component is unavailable that is highly reliable and not normally removed from service. Failure rate of the backup equipment is not well known.

Attribute 9: CRM software quality and configuration control

- **CRM software should be accepted and maintained by an appropriate quality program.**
- Each commercial CRM product has an established users' group and has software quality processes
  - Utility-developed software is also maintained under a specific software quality program
- Each software users' group funds software enhancement, software testing, and communication of important issues to each user.
- It is the responsibility of each individual utility to incorporate software quality documentation into its own programs, based upon plant-specific requirements

Attribute 10 - CRM model testing and configuration control

- **The CRM model (and overall implementation program) must be tested to verify that Attributes #1 to #9 are satisfied.**
- Such validation would be re-performed after each significant update of the model or mapping information to ensure the changes were properly incorporated
  - Design, operations, and data changes to be dispositioned for their CRM impact
  - The CRM model (if "different" from the PRA) is tested against the PRA model to insure that the models yield consistent results and that any differences are understood.

STP Nuclear Operating Company

STP Quantification of Configuration Risk for Risk-Informed Technical Specifications

Reliability and PRA, and Plant Operations Subcommittees of the Advisory Committee on Reactor Safeguards

June 15, 2005

Introduction

- STP Participants
  - Rick Grantom — Risk Management Manager
  - Jay Phelps — Operations Manager, STP Unit 2
  - Wayne Harrison — STP Licensing

Agenda

- Overview of STP's PRA and On-line risk assessment tool, Risk Assessment Calculator (RAsCal)
- RAsCal Attributes
- Current Applications at STP
- Application to Risk-Informed Technical Specifications

STP's PRA Overview

- Full scope Level 1/2 PRA
  - RISKMAN® software
  - Internal events
  - External events including fire, external flood, high wind and seismic
  - Spatial interactions, HRA, detailed common cause
  - Updates per PRA configuration control program
    - Complies with Appendix B Software QA requirements
  - Used for STP applications since 1989
  - Has undergone industry peer review
  - RG 1.200 pilot for PRA quality

RAsCal Overview

- STP PRA is quantified for each configuration in the RAsCal database
- RAsCal's database is populated with CDF results
- RAsCal developed in-house
  - Has been in use at STP for 9 years
    - Used by Control Room operators and Work Control Planners/Schedulers

RAsCal Overview

- Database of >20,000 maintenance states
  - Does not calculate CDF or LERF itself
  - Can make some adjustments for specific conditions
    - Trip risk initiator based on plant configuration
- User friendly interface developed in cooperation with STP users

RAsCal Attributes

Initiator dependencies	Same as the PRA
Truncation levels	RAsCal database populated by PRA run at E^{-11} truncation limit.
Translation from PRA model	RAsCal reflects PRA results & does not perform the CDF/LERF calculation
Human action treatment	N/A. HRA is included in the PRA
Activities mapped to basic events	Specifically tailored to be the same as PRA based on tag-out procedures

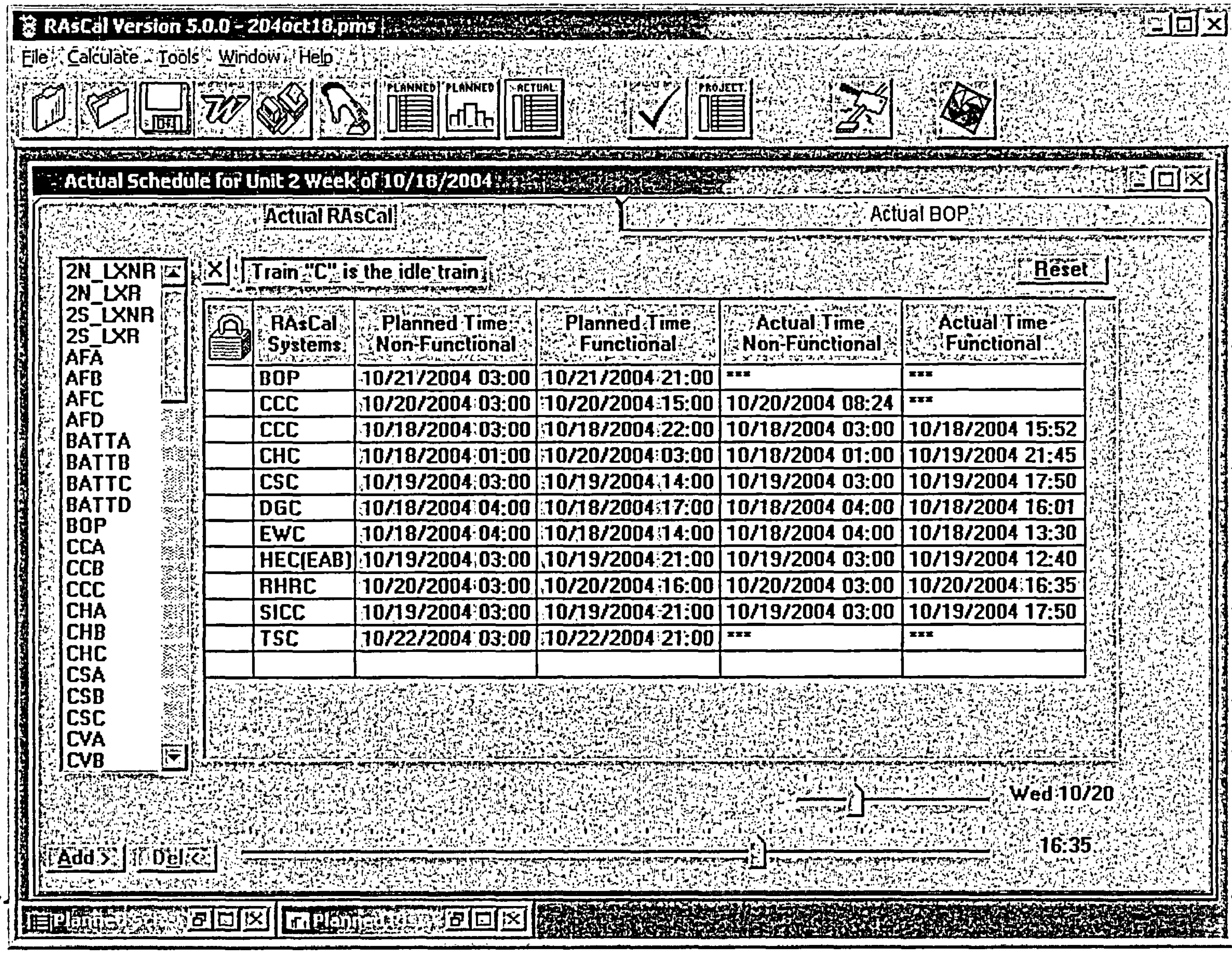
RAsCal Attributes

Representing the as-built, as-operated plant	Updated as the PRA is updated
Treatment of common cause	N/A. Common Cause analysis is included in PRA
Consideration of uncertainty	CDF uncertainty in base PRA model.
CRM software quality and configuration control	In the STP Appendix B SQA Program
CRM model and software testing	

Current Application of RAsCal

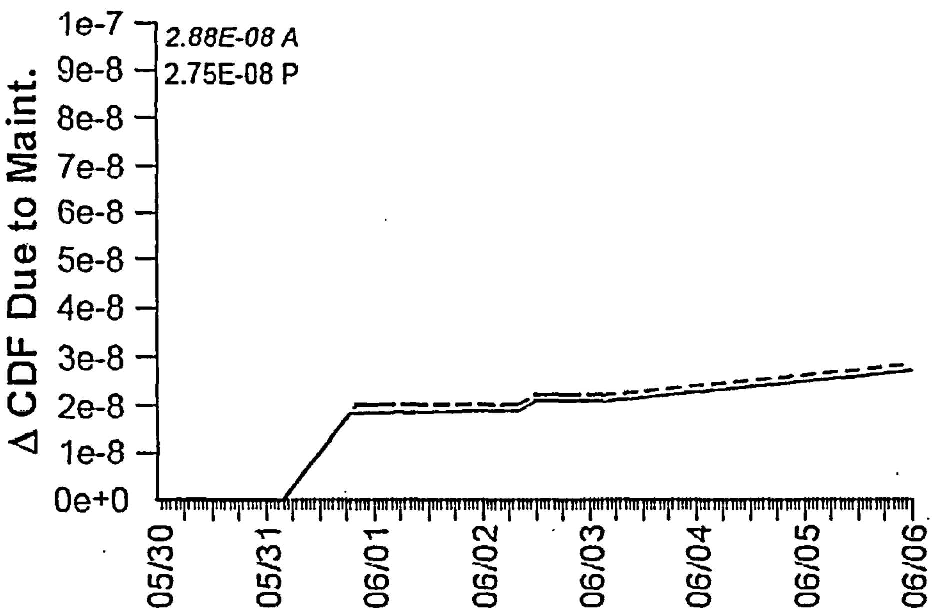
- Applies the STPNOC Configuration Risk Management Program (CRMP) procedure
  - Same program used for 10CFR50.65(a)(4)
- STP has extensive experience in applying the CRMP
  - Routinely used to manage weekly work

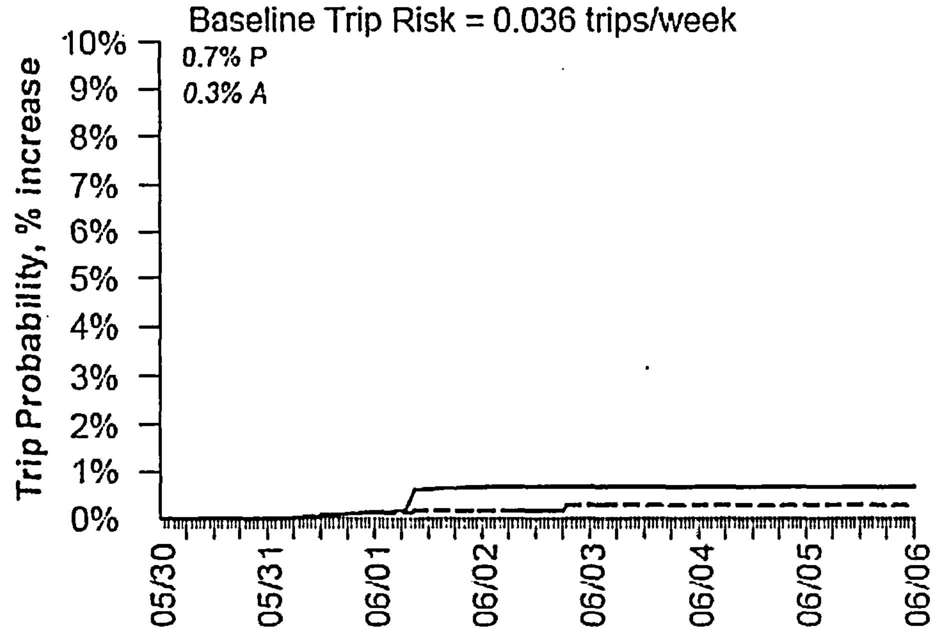
RAsCal input screen



	RAsCal Systems	Planned Time Non-Functional	Planned Time Functional	Actual Time Non-Functional	Actual Time Functional
	BOP	10/21/2004 03:00	10/21/2004 21:00	***	***
	CCC	10/20/2004 03:00	10/20/2004 15:00	10/20/2004 08:24	***
	CCC	10/18/2004 03:00	10/18/2004 22:00	10/18/2004 03:00	10/18/2004 15:52
	CHC	10/18/2004 01:00	10/20/2004 03:00	10/18/2004 01:00	10/19/2004 21:45
	CSC	10/19/2004 03:00	10/19/2004 14:00	10/19/2004 03:00	10/19/2004 17:50
	DGC	10/18/2004 04:00	10/18/2004 17:00	10/18/2004 04:00	10/18/2004 16:01
	EWC	10/18/2004 04:00	10/18/2004 14:00	10/18/2004 04:00	10/18/2004 13:30
	HEC(EAB)	10/19/2004 03:00	10/19/2004 21:00	10/19/2004 03:00	10/19/2004 12:40
	RHRC	10/20/2004 03:00	10/20/2004 16:00	10/20/2004 03:00	10/20/2004 16:35
	SICC	10/19/2004 03:00	10/19/2004 21:00	10/19/2004 03:00	10/19/2004 17:50
	TSC	10/22/2004 03:00	10/22/2004 21:00	***	***

Actual Risk Profiles for Unit 1 Week of 05/30/2005





PRA Component	Planned Time Non-Functional	Planned Time Functional	Duration (hh:mm)		Actual Time Non-Functional	Actual Time Functional	Duration (hh:mm)
AFD	05/31/2005 04:00	05/31/2005 19:00	015:00		05/31/2005 04:00	05/31/2005 20:21	016:21
BOP	N/A	N/A	N/A		06/02/2005 14:30	06/02/2005 15:14	000:44
BOP	05/31/2005 03:00	06/01/2005 20:00	041:00		05/31/2005 03:00	06/01/2005 01:39	022:39
ETRANS	06/03/2005 03:00	06/06/2005 00:00	069:00		06/03/2005 03:00	06/06/2005 00:00	069:00
IA12/22	05/31/2005 03:00	05/31/2005 15:00	012:00		05/31/2005 03:00	05/31/2005 13:30	010:30
PORVA	06/02/2005 08:00	06/02/2005 12:00	004:00		06/02/2005 08:01	06/02/2005 11:50	003:49
PORVD	05/31/2005 04:00	05/31/2005 14:00	010:00		05/31/2005 04:00	05/31/2005 16:45	012:45

BOP Component	Planned Time Non-Functional	Planned Time Functional	Duration (hh:mm)		Actual Time Non-Functional	Actual Time Functional	Duration (hh:mm)
AC12/22	05/31/2005 07:00	05/31/2005 09:00	002:00		05/31/2005 10:15	05/31/2005 10:39	000:24
CAR12/22	05/31/2005 03:00	05/31/2005 21:00	018:00		05/31/2005 03:00	05/31/2005 12:10	009:10
CD12/22	N/A	N/A	N/A		06/02/2005 18:39	06/02/2005 18:57	000:18
CD12/22	N/A	N/A	N/A		06/02/2005 18:06	06/02/2005 18:19	000:13
CD12/22	06/01/2005 07:00	06/01/2005 09:00	002:00		06/01/2005 08:30	06/01/2005 08:45	000:15
CW12/22	05/31/2005 03:00	06/01/2005 21:00	042:00		05/31/2005 03:00	05/31/2005 22:32	019:32

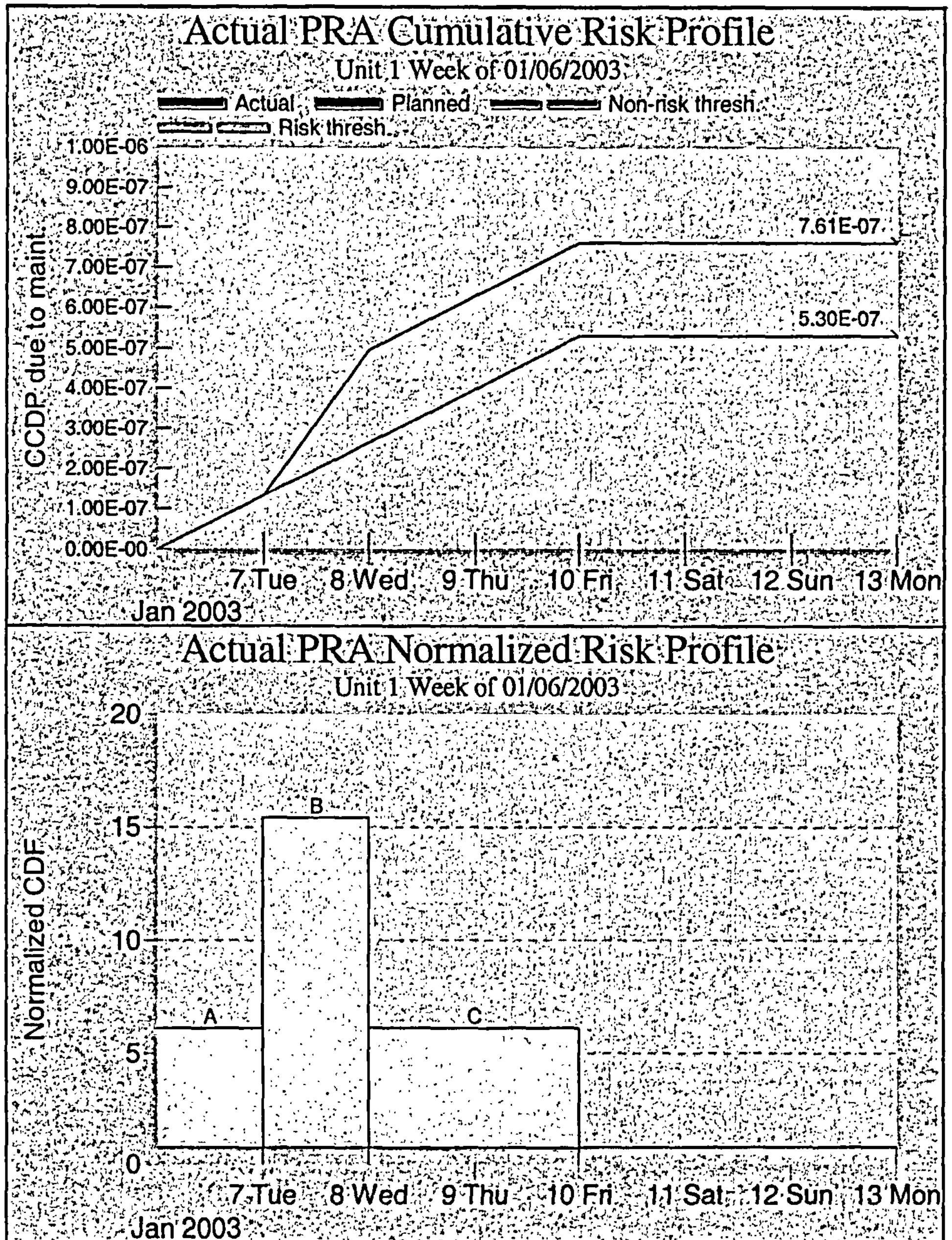
Application to Risk-Informed Technical Specifications

- Will use the same tool - RAsCal
  - Some enhancements planned for user interface
- Capable of determining configuration risk and allowed outage time in a very short time

Application of RITS

Example 1: Routine Train A work week with emergent Train B condition

Time	Event	Frontstop	Calculated AOT (1E-05)	Risk (/hr)	Comment
00:00	Begin Train A work week (ECW, SDG, CCW, HHSI)	ECW – 7 days SDG – 14 days CCW – 7 days HHSI – 7 days	NA – plan to remain within frontstop AOT	5.5 E-09	Routine planned maintenance
24:00	Train B HHSI found inoperable	6 hours to apply TS 3.13.1	24 days	1.5 E-08	CTS requires application of TS 3.0.3. RITS would permit normal work control
36:00	Train B HHSI restored	Exit TS 3.13.1 Back on the work week clock with 36 hours elapsed	NA	5.5 E-09	



Example 1:

CCA DGA EWA SICA scheduled out for 4 days (96h)

At t = 24h, SICB becomes non-functional for 1 day.

CCA – CCW Train 'A'

DGA – SDG Train 'A'

EWA – ECW Train 'A'

SICA – SI common Train 'A'

SICB – SI common Train 'B'

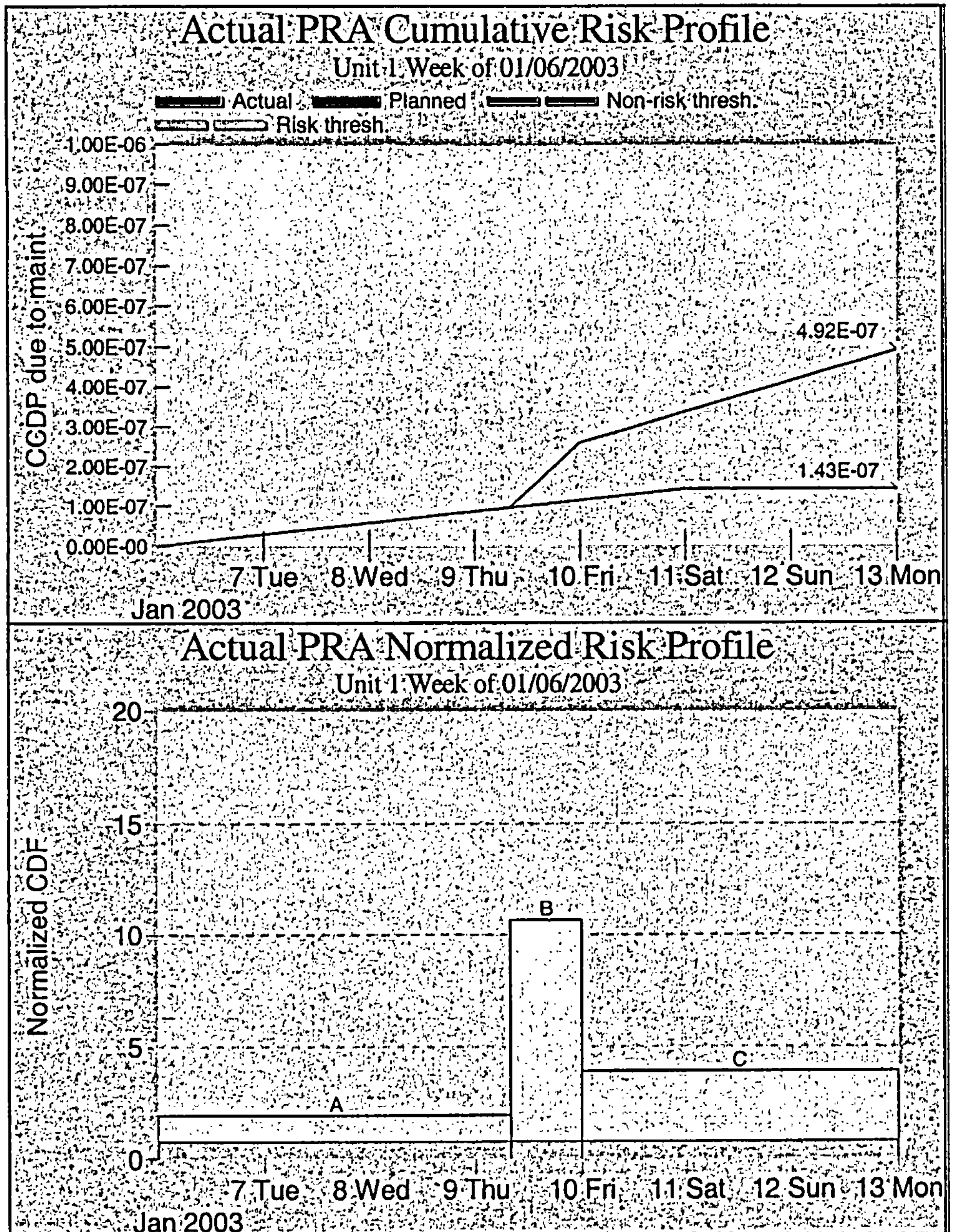
State A/C = 5.52E-09 / hr

State B = 1.51E-08 / hr

Application of RITS

Example 2: Emergent condition while TS 3.13.1 is in use

Time	Event	Frontstop	Calculated AOT (to 1E-05)	Risk (/hr)	Comment
00:00	Turbine-driven AFW out for 5 day planned refurbishment	72 hours per CTS	350 days (30 day backstop would apply)	1.19E-09	TS 3.13.1 requirements apply after 72 hours. The risk is calculated from the time AFW is removed from service.
80 hrs	Train A ECW pump found inoperable. Dependent systems also inoperable.	ECW, CCW, ChW, SI – 7 days SDG – 24 hr. (with inop AFW)	40 days (30 day backstop still applies)	1.02E-08	Regardless of the frontstop time for ECW, etc., TS 3.13.1 applies because TDAFW is beyond its frontstop.
96 hrs	TDAFW restored			3.23E-09	



Example 2:

AFD scheduled out for 5 days (120h)

At t = 80h, EWA becomes non-functional for indeterminate amount of time

AFD – Turbine-driven AFW

EWA – ECW Train 'A'

State A = 1.19E-09 / hr

State B = 1. 02E-08 / hr

State C = 3.23E-09 / hr

Risk Management Technical Specifications (RMTS) Initiative 4b Risk Informed Completion Times, PRA & Risk Monitors

Presentation to the Reliability & PRA, and Plant Operations Subcommittees of the Advisory Committee on Reactor Safeguards

June 15, 2005

Presentation Participants

Tom Boyce
NRR TS Section Chief

Mark Reinhart
NRR SPSB Section Chief

Bob Tjader
NRR TS Section

Initiative 4 – Risk-Informed Completion Times

- Description: "Real-Time" calculation of CTs based upon current plant configuration. Extend completion time from a nominal value up to a predetermined "backstop" maximum using configuration risk management.
- Implementation: Under development, to include: approved decision-making process; implementation guidance; requirements for PRA technical adequacy; quantitative configuration & cumulative risk metrics.
- Status: STP & Fort Calhoun (CE TSTF-424) pilots submitted in CY 2004; Hope Creek & Prairie Island pilot submittals expected in CY 2005.

Initiative 4b Example

- See proposed 4b Tech Spec; discuss concepts
- Initiative 4b concepts
  - Front Stop; current CT
  - CRMP-based CT
  - Back Stop
  - Risk Assessment Tools provide reliable results in a timely manner
  - Use of reliable Decision Making Process

TABLE 3-1
GENERIC RISK-INFORMED CTs WITH A BACK-STOP: EXAMPLE FORMAT

Actions Condition	Required Action	Completion Time
B. One [HPSI] subsystem inoperable.	B.1 Restore SI subsystem to OPERABLE status.	72 hours
	OR	
	B.2.1 Determine that the completion time extension beyond 72 hours is acceptable in accordance with established RMTS thresholds.	72 hours
	AND	
	B.2.2 Verify completion time extension beyond 72 hours remains acceptable.	In accordance with the RMTS Program (i.e., within 24 hours of a subsequent configuration change)
	AND	
	B.2.3 Restore subsystems SI to OPERABLE status.	30 days or acceptable completion time , whichever is less.

PRA Capabilities

- Level 1 & LERF
  - Internal Events
  - External Events:
    - Fire, Flood, Seismic, Severe Weather
    - Impact Captured [model preferred] in Quantified RICT
  - Modes 1 & 2
    - Assurance that Model Bounds Other Modes
    - Containment Configuration Changes Captured
  - All Significant Sequences Modeled
  - Expectation to Satisfy Capability Category 2
    - Exceptions Must be Justified
- Satisfies Available Standards & Guides
- Maintained Current

RMTS INITIATIVE 4b and PRA QUALITY

- Use of plant configuration risk results to determine Completion Times in near real-time is a significant change to Technical Specifications
  - Licensee's use of PRA
  - NRC Review & Oversight
- PRA must be of adequate quality for the application
- Configuration Risk Management process must be able to reliably assess risk
- Reliance on CRM tool requires licensee QC and NRC review

PRA QUALITY MUST BE ADEQUATE TO SUPPORT I4b

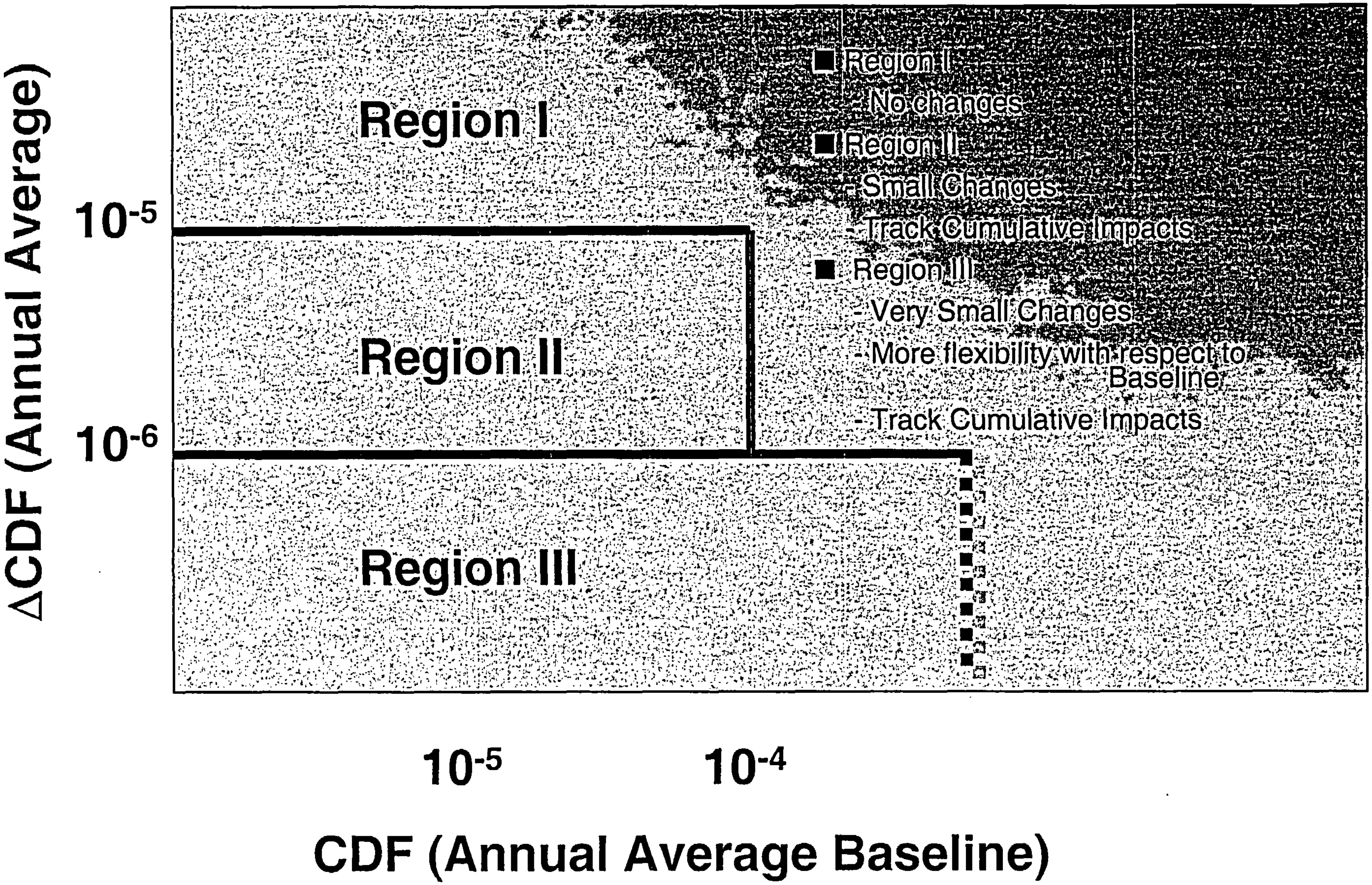
- Quality is defined in terms of scope (initiating events, plant operating modes), level of detail, and technical adequacy
- Pilot plant reviews for RG 1.200 assesses only internal events PRA
- Staff will need to perform PRA reviews for external events
- Current thinking is that the I4b scope should include internal & external initiating events, Modes 1 & 2 with Model Bounding Other Modes

On-Line Risk Analyzer Attributes

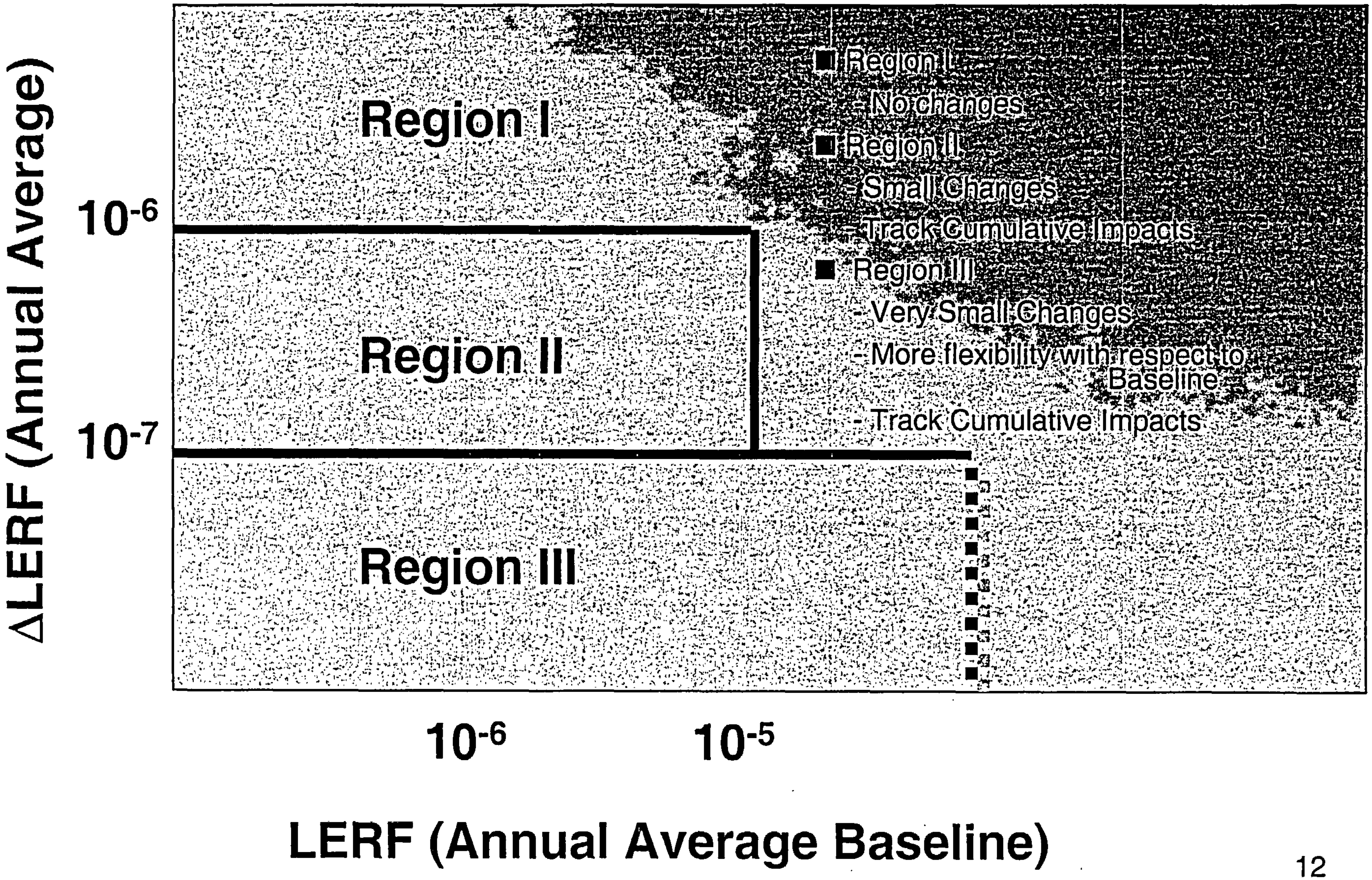
- Initiators
- Truncation Levels
- Model Translation
- Software Control & Configuration
- Dependent Operator Actions
- Testing
- Fault Trees Traceable to PRA
- Model Alignment with Real Time Plant Configuration
- Component Mapping
- Uncertainties
- CRM Aspects not in PRA
- Interface
- Defense in Depth
- Safety Margins

Backup Slides

Acceptance Guidelines for Core Damage Frequency

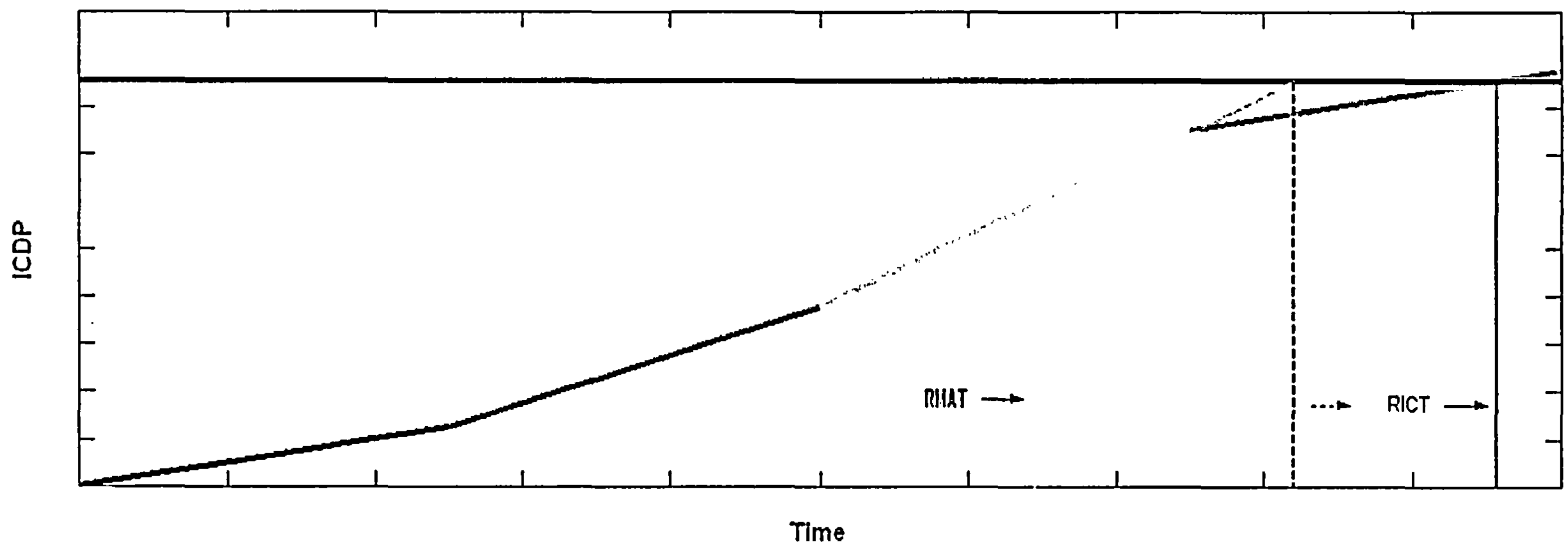


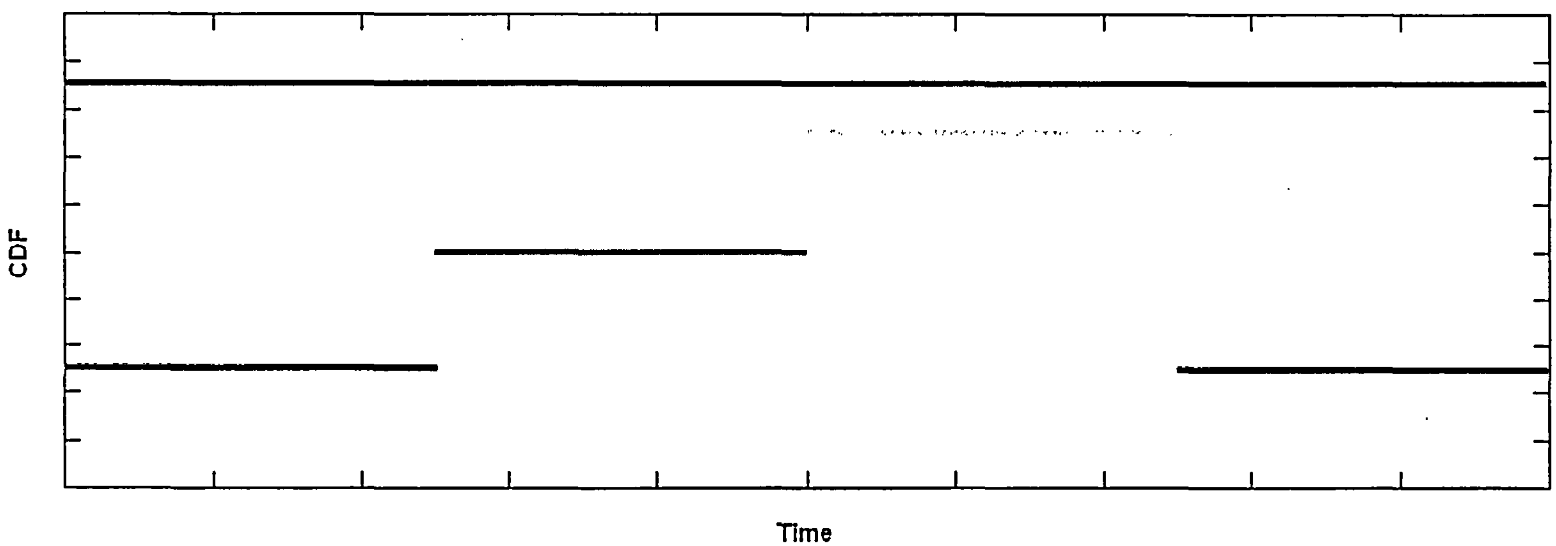
Acceptance Guidelines for Large Early Release Frequency



Proposed RMTS Limits

- "*Instantaneous* Average Annual CDF"
  - $1x10^{-3}$ per Year
- Maximum ICDP Limit
  - $1x10^{-5}$
- Planning ICDP Limit
  - $1x10^{-6}$
- Annual Assessment
  - Satisfy Guidelines of RG 1.174
- Risk Difference Calculated Using Zero Maintenance Baseline
- Backstop: 30 days


ICDP
RHAT
RICT
Time


CDF
Time

Benefits of RMTS RICT

- Risk Informed
- Integrate Plant Risk
  - Manage Multiple SSC Outages
  - Manage Broader Scope of SSCs
- Flexible Configuration Management
  - Base Decisions on Real-Time Insights
  - Focus on Repair, Not Necessarily Transient
  - Licensee Control
- Ongoing Risk Awareness

STATUS OF INITIATIVES

- Reliance on existing (a)(4) Program
  - Initiative 2: Missed Surveillances (NRC Approved)
  - Initiative 3: Mode Change Flexibility (NRC Approved)
- Analysis of Specific Plant Configurations
  - Initiative 1: Modified End States (1-2 yrs)
  - Initiative 6: LCO 3.0.3 Action Times (1 yr)
  - Initiative 7: Non-TS Support System Operability;
    - Snubber Inoperability (NRC Approved)
    - Hazzard Barrier Inoperability (1 yr)
- Quantitative Risk Assessment
  - Initiative 4: Flexible Completion Times (1-3 yrs)
  - Initiative 5: Surveillance Frequency Program (1-3 yrs)
- Rulemaking
  - Initiative 8: Relocate non-risk significant systems from TS (3+yrs)