Official Transcript of Proceedings ACRS T-3215

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
496th Meeting

PROCESS USING ADAMS
TEMPLATE: ACRS/ACNW-005

Docket Number: (not applicable)

Location: Rockville, Maryland

Date: Friday, October 11, 2002

ORIGINAL

Work Order No.: NRC-581 Pages 264-394

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1323 Rhode Island Avenue, N.W.
Washington, D.C. 20005
(202) 234-4433

TR04

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

496TH MEETING, DAY 2

+ + + + +

FRIDAY,

OCTOBER 11, 2002

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

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

COMMITTEE MEMBERS:

GEORGE E. APOSTOLAKIS	Chairman
MARIO V. BONACA	Member
F. PETER FORD	Member
THOMAS S. KRESS	Member
GRAHAM M. LEITCH	Member
DANA A. POWERS	Member
WILLIAM J. SHACK	Member
JOHN D. SIEBER	Member

COMMITTEE MEMBERS: (CONT.)

VICTOR H. RANSOM	Member
STEPHEN L. ROSEN	Member
GRAHAM B. WALLIS	Member

ACRS STAFF PRESENT:

JOHN T. LARKINS	Director
SHER BAHADUR	Associate Director
HOWARD J. LARSON	Special Assistant
SAM DURAISWAMY	Technical Assistant

OTHER NRC STAFF PRESENT:

PATRICK BARANOWSKY

JOHN FLACK

CHRISTOPHER GRIMES

N. PRASAD KADAMBI

SCOTT NEWBERRY

PATRICK O'REILLY

I-N-D-E-X

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

8:33 a.m.

CHAIRMAN APOSTOLAKIS: The meeting will now come to order. This is the second day of the 496th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting, the committee will consider the following: Program Plan for Low-Power Shutdown Standardized Plant Analysis Risk Model Development and Cancellation of Revision 4i of SPAR Models, Guidance for Performance-Based Regulation, Reconciliation of ACRS Comments and Recommendations, Future ACRS Activities/Report of the Planning and Procedures Subcommittee, Report Regarding Recent Operating Events, Proposed ACRS Reports.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee act. Mr. Sam Duraiswamy is the Designated Federal Official for the initial portion of the meeting.

We have received no written comments or requests for time to make oral statements from members of the public regarding today's session. A transcript of a portion of the meeting is being kept, and it is requested that the speakers use one of the microphones, identify themselves, and speak with

sufficient clarity and volume so that they can be readily heard.

Any comments from members?

(No response.)

CHAIRMAN APOSTOLAKIS: Okay, so we go move on to the --

MR. BAHADUR: Mr. Chairman.

CHAIRMAN APOSTOLAKIS: Yes.

MR. BAHADUR: I just wanted to mention that --

CHAIRMAN APOSTOLAKIS: Who are you, for the record?

MR. BAHADUR: Sher Bahadur from the ACRS staff. Just to add one thing, that we will not be having the reports regarding recent operating events.

CHAIRMAN APOSTOLAKIS: Yes.

MR. BAHADUR: We had it yesterday, and I don't think we want to continue that.

CHAIRMAN APOSTOLAKIS: Okay. So the first item on the agenda, the Opening Remarks of the ACRS Chairman, we did that.

(Laughter.)

CHAIRMAN APOSTOLAKIS: The second one is the SPAR model development, and Dr. Powers again. You led us yesterday, you're leading us today.

MEMBER POWERS: A chilling thought, isn't it. Let's see, a little background on this particular issue. The first background is of course that the ACRS has -- just about every time it writes a research report asks for information about the SPAR modeling activities.

They also ask for it at points in between research programs. The staff was reviewing its budget plans with the Commission and indicated to Commissioner McGaffigan that they were going to sunset Revision 4i on the SPAR models.

Mr. McGaffigan asked if they had discussed it with the ACRS, and they indicated that they were fixing to, and this is the fixing. When George asked me to take the lead on this program, I said, "That's great George. What is Revision 4i?"

And he says, "Well, that's your first chore, to find out what Revision 4i is."

And to date I've been unsuccessful in finding out what Revision 4i is, but I have learned a wealth about Revision 3i. The staff sent me really a quite nice topical report prepared by INEEL called Low-Power Shutdown Operations Standardized Plant Analysis Risk Model Template for PWRs.

However, the staff did label this one

Sensitive Homeland Security Information, not for Public Disclosure, and when you work for an NSA laboratory and you carry such a document around, you get an unending amount of attention from the security forces. May not be entirely welcome.

But it was a useful and interesting document. In addition, Pat Baranowsky sent us really a very nice memorandum outlining what he thought the needs were for development of SPAR models to treat the low-power and shutdown issues, and that memorandum is enclosed in your notebook here, and that's really a quite useful document to read to understand their needs.

Our objective here, I believe, is to respond to Commissioner McGaffigan on the wisdom of sunsetting this Revision 4i, if we ever find out exactly what it is. But I suspect what we're going to learn is a lot more about the SPAR modeling, especially for the low-power and shutdown.

That's been a great interest to this committee as a whole, and in particular to Mr. Rosen and I. With that introduction, I don't know who I turn to first. Pat are you going to lead it out?

MR. BARANOWSKY: Okay, that's a good introduction, and what we're going to do today is

first, Dr. O'Reilly from my branch who's the head of the SPAR development will give the briefing.

He's going to cover the low-power shutdown SPAR model development, because I know that's been an item of interest, and not much has been made available except for that report that we recently sent to you.

Then the second thing is we are going to cover what we mean by "4i" which was a little bit nebulous, maybe to us even.

(Laughter.)

MEMBER POWERS: We're dying to know how you sunset a program that never started.

MR. BARANOWSKY: Well, yes. Why don't I cover that when we get to that exact point. Save myself from trouble.

MEMBER POWERS: Oh, I doubt it will save you trouble Pat.

(Laughter.)

MR. BARANOWSKY: Well, with that I'd like to turn it over to Dr. O'Reilly.

DR. O'NEILL: Thank you Pat. I'm Pat O'Reilly from the Operating Experience Risk Analysis Branch in the Office of Research. My presentation today consists of three parts, and I'll try and get through the first two so we can get to the heart of

the matter, the one that Dana is so interested in.

MEMBER POWERS: No, no. Make it very clear, I am much more interested in the first two than I am in the third.

(Laughter.)

DR. O'NEILL: Oh, good, we've given the right weight to the right topics here. Well, we'll go over a high level --

MEMBER POWERS: Sometimes Professor Apostolakis is a bit out of focus.

(Laughter.)

DR. O'NEILL: Well, it's Friday morning and it's 8:30, so.

MEMBER POWERS: Who's bright-eyed and bushy-tailed now?

DR. O'NEILL: After I cover the program plan, we had an opportunity in August to do an on-site QA review of the low-power shutdown SPAR model for the Surry plant against the plant's shutdown PRA.

I'll give you a brief summary of what we found out from that review, and then we'll get to the big topic, cancellation of the Revision 4i SPAR models development effort.

The first thing I'm going to address is the low-power shutdown SPAR model development plan.

But before I do that, it's probably best to give you just a little bit of background of where this effort came from.

In Fiscal Year 1996, the first low-power shutdown SPAR model development project that was initiated produced a PWR, a low-power shutdown SPAR model, that was based on the Detailed Surry Shutdown PRA.

MEMBER POWERS: You know, this is the point at which we get a bit confused.

DR. O'NEILL: Sure.

MEMBER POWERS: Because when I speak to the authors of this particular document, they describe it as a scoping and exploring model shutdown PRA for Surry, and say that -- and emphasize its proximate nature and limitations associated with it.

You have given it capital "Detailed". Now is this just a difference in the perspectives?

DR. O'NEILL: Probably a difference in perspective, Dana, but when I get to the results of our review of the Surry low-power shutdown PRA that we conducted in August, you'll see that perhaps the authors that you were talking to sort of downplayed what they did.

In essence, the Surry shutdown --

MEMBER POWERS: It would be the first time they ever downplayed.

(Laughter.)

DR. O'NEILL: I understand that. I know who you're talking about. The shutdown PRA for Surry that was performed by BNL back then, it turns out is the basis for the current Surry shutdown PRA, and we were rather surprised at that.

So that tells me that the approach that Brookhaven took and the technical bases were quite robust, in spite of what you might have heard by way of disclaimer.

MEMBER LEITCH: Say Pat, I think you're maybe a little ahead of where I am in this.

DR. O'NEILL: Sure.

MEMBER LEITCH: Could you just step back a little bit and say a word about SPAR? I'm not sure -- I mean, I know the acronym, but just exactly what is a SPAR model. What are we using it for? Can you just give me a little bit of the background on it?

DR. O'NEILL: Okay, all right. I don't have a slide for this.

MEMBER LEITCH: Oh, that's fine.

DR. O'NEILL: I'm going to give a presentation at the Nuclear Safety Research Conference

at the end of this month on the history of the SPAR model development program, but the SPAR model development program goes back to the days when the accident sequence precursor program was first established.

Joe Mennorick (phonetic) and Oak Ridge National Laboratory were doing the analyses. The ancestors of the SPAR models are really those of event tree-based models that Mennorick and company used in the ASP analyses.

They've evolved over the years, and I wish I had -- I have a slide that would point that out, that there are certain milestones in that chronology. A good place to read up on it is NUREG/CR-4674, the various volumes that were published on the ASP program annually, up until 1998.

CHAIRMAN APOSTOLAKIS: Are they mini-PRAs? Is that what they are?

DR. O'NEILL: No. You mean --

CHAIRMAN APOSTOLAKIS: The SPAR model, is it a mini-PRA?

DR. O'NEILL: Well, when we get to Revision 4i, George, that's exactly what we'd be talking about, in so many words. Yes.

CHAIRMAN APOSTOLAKIS: For the benefit of

Mr. Leitch --

MEMBER WALLIS: I think for the benefit of several of us, and for the benefit of the record. It would help if you would answer his question.

DR. O'NEILL: I'm getting there, I'm getting there.

MEMBER WALLIS: Well that's where they are.

DR. O'NEILL: It's a long journey. They started out as very simple event tree-based models. They had -- I believe there was one set for PWRs and one set for BWRs. They modeled about two or three initiating events for both types of reactors.

They evolved later into -- they had, I believe, six or seven for PWRs, and three or four for BWRs. They were still event tree-based. About the middle '80s, they got a little bit more complicated, because they developed some modules for handling and treating losses of off-site power that led to station black-out situations, in conjunction with the station black-out rule that Pat Baranowsky and company were shepherding at that time.

So they were combined -- So the were still event tree-based until the early 1990s. At the same time that this was taking place, NRR was also working on the prompt assessment of operational events, so

that they then could inform senior management at NRR what type of risk-significance would be associated with a particular event or condition that was discovered, so that NRR management could take the appropriate regulatory action.

These two efforts came together. When they came together, NRR had taken the event tree-based models from the ASP program, and they had started doing custom modeling, adding fault trees for the systems in the appropriate places, with some of the models.

This was on a case-by-case basis now. When the two programs got together, we decided that it would be more efficient use of staff resources and funding if we would develop a set of models that could be used consistently throughout the agency for doing these kinds of analyses.

These involved into a simplified event tree, fault tree link type model, which would be plant-specific to a certain degree down to the train level, and that's how the SPAR model effort got started as SPAR models.

CHAIRMAN APOSTOLAKIS: And these are computerized?

DR. O'NEILL: They're computerized. They're

made to run with the SAPHIRE suite of PRA codes. We've developed an interface, we call it a Graphical Evaluation Model Interface, that makes a lot of the analyses transparent to a novice user.

A PRA analyst who has got quite a bit of experience would not have any problems with it, but they're now being used, developed for use by staff analysts in all types of regulatory activities.

I have another 15-minute presentation that I could give you on that.

MEMBER LEITCH: Among those activities are the significant determination process?

DR. O'NEILL: Correct. Phase Three analyses and the significance determination process to be exact. Now, in the beginning, the models covered only full power operation and later they were expanded, because of needs expressed by staff analysts to get into other areas, such as low-power shutdown, external events.

I'm talking now about floods, flooding, fires, seismic events, and Level Two and large early-release frequency, LERF. So we now have model-development efforts going on in each one of those areas.

I mean, that's a quick --

MEMBER LEITCH: That's fine, I appreciate that.

CHAIRMAN APOSTOLAKIS: Why simplified models and not the complete one?

DR. O'NEILL: Why so many?

CHAIRMAN APOSTOLAKIS: Simplified.

DR. O'NEILL: Simplified? Ah, George, I said it was simplified originally.

CHAIRMAN APOSTOLAKIS: Oh, now they are completely?

DR. O'NEILL: Yes, the Rev 2 models were simplified, but in order to add support systems and some other things that the analysts said they needed in order to do their work more efficiently, the word "simple" doesn't appear in the description.

CHAIRMAN APOSTOLAKIS: So where are we now, Rev 3?

DR. O'NEILL: We're at Rev 3. Rev 3i. The "i" stands for "interim".

CHAIRMAN APOSTOLAKIS: Ah, okay.

DR. O'NEILL: We have a two-part quality assurance program, and until a model has completed the entire program, we call them "i" for "interim". That means you've got to use them with very great caution, because they haven't been QA'd completely, especially

against the licensee's PRA model.

CHAIRMAN APOSTOLAKIS: So right now we are in Rev 3?

DR. O'NEILL: We're at Rev 3. Right.

CHAIRMAN APOSTOLAKIS: It has completed -- It has gone through the review process.

DR. O'NEILL: We're going through the review process. We have, out of 72 models, we have 65 models produced. We have 41 of those models have received an on-site QA review, and probably about 35 of them right now we call Revision 3.

We've said that they meet our QA acceptance criteria.

MEMBER BONACA: And those 72 have consistent methodology?

DR. O'NEILL: Correct. Across the board.

MEMBER BONACA: And that's an advantage.

DR. O'NEILL: Right, we believe that we've captured about 80 to 85 percent of the total CDF for the plant.

CHAIRMAN APOSTOLAKIS: Speaking of methodology, you know, Dr. Kress and I were at the -- and Baranowsky -- we were at the PSA conference earlier this week, PSA '02, and there was a software -- there were software exhibits, and we saw something

interesting.

I don't know if you saw it, but the ABS one. One of the consultant firms --

MR. BARANOWSKY: I heard about it.

CHAIRMAN APOSTOLAKIS: Yes, and they're using now, they're converting their computer models to binary decision diagram-based models, BDDs, which -- They are claimed to solve the fault trees and event trees exactly, without the need of rare event approximations and cut-off levels for frequency.

That has been a perennial problem from day one, you know, where do you truncate -- yes, the truncation. It can be -9 or 10. Anyway, those models solve the -- this approach solves the problem exactly.

They had a -- Well, of course, they picked an example that was a little bit impressive. It was a service water system for a plant, and it was a four train system. So you have higher levels (phonetic).

And they found that with the old way of doing business, you get a certain unavailability. With the BDDS, you get something that's about 35 to 40 times larger.

MEMBER ROSEN: Times?

CHAIRMAN APOSTOLAKIS: Yes, just because there is no cut-off frequency, truncation. So that's

something to investigate, it seems to me, because if it's true, it's a pretty significant change.

MEMBER BONACA: It seems surprising.

MEMBER ROSEN: It's not believable.

CHAIRMAN APOSTOLAKIS: Well, the guy was there demonstrating it and insisting that that's correct.

MEMBER BONACA: Was the truncation being done correctly?

CHAIRMAN APOSTOLAKIS: In the new method there is not truncation.

MEMBER BONACA: I understand that, but you know, when you are doing truncation you also have a lot of verification of that which you can lose.

CHAIRMAN APOSTOLAKIS: Obviously, we did not dig in --

MEMBER ROSEN: With the fast computers we have now, truncation -- You probably don't even have to truncate. The only reason we truncated was because it went too long. And now with these very fast computers, you go to the -- you can go to the 10^{-12} even, and --

CHAIRMAN APOSTOLAKIS: There is a move now to convert all these programs to BDDs. It's not just our company.

MEMBER KRESS: Well, it's more than truncation.

CHAIRMAN APOSTOLAKIS: Yes. There are all sorts of approximations which we have been using because computers were not very fast.

MEMBER ROSEN: Sorry I was so late, so I'm jumping in here. Let me ask a question that may have already been asked.

CHAIRMAN APOSTOLAKIS: Go ahead.

MEMBER ROSEN: These -- All you're doing now. Do you think your answers are converging on the licensee? I mean, are you getting closer and closer together?

DR. O'NEILL: Actually, in some cases we are able to reproduce the results exactly.

MEMBER ROSEN: So why do it? Why not just use the licensee model, if that's where you end up?

DR. O'NEILL: That's a question that's been asked. One of the reasons is is they haven't undergone a thorough review, and they differ from plant to plant.

We have all kinds of quality out there.

CHAIRMAN APOSTOLAKIS: Well, there may be situations where you disagree with the licensee.

DR. O'NEILL: Absolutely, and when I said

that, I said we have the capability. If we use the licensee's numbers, we can reproduce the licensee's results.

I'm not saying I agree with the licensee's numbers.

MEMBER BONACA: And the approach --

MEMBER POWERS: Mr. Chairman, if I could. I need some guidance here. I look at the package of slides of which we're on the background right now, and the fact that I have many, many to go through before I ever find out what 4i is, and a 10:00 drop dead date here.

If we want to go into this kind of detail on this subject, I wonder if it might be more appropriate to schedule a PRA subcommittee meeting to explore Revision 3i in exhausting detail and the theory behind it.

CHAIRMAN APOSTOLAKIS: With that threat, I would rather reduce the questions.

(Laughter.)

MEMBER POWERS: What I would like to do is fit this within the allotted time slot.

CHAIRMAN APOSTOLAKIS: I guess these are general questions. Anyway, what I wanted to say is that maybe the staff should investigate this BDD

business.

MR. BARANOWSKY: Well, I talked to you a little bit about this at the meeting, and we're aware of it and looking at it.

MEMBER ROSEN: Notwithstanding Dana's comment, I don't think I got a fair answer to my question.

MEMBER POWERS: Well, I don't mean to cut you off. It's just that he yelled at me yesterday when I went ten minutes over schedule, and I don't want him to yell at me again today.

CHAIRMAN APOSTOLAKIS: Well, as long as we got you once. We won't go for a second time.

MEMBER POWERS: But I want to find out what 4i is.

CHAIRMAN APOSTOLAKIS: Oh we will, we will, and maybe, Pat, as you go on you can skip some of these slides. We don't need all of them, but I think you should give an answer to Mr. Rosen.

DR. O'NEILL: Well, my answer to that is simply if we knew what we had when we approached a licensee's PRA model, it might be different, but the quality of those PRAs varies all over the place. There is no standard.

There's a draft standard that's out there,

but it hasn't been accepted both by the industry and by the NRC.

CHAIRMAN APOSTOLAKIS: But your end state is not necessarily the licensee's PRA?

DR. O'NEILL: That's correct. We have data, operational, that we've taken from actual operational experience, and some cases, in order to have a consistent set of models, right now we're using pretty much average values from reviews of data across the industry.

If we have enough licensee plant-specific data, we can put those into our models. Another big area of disagreement usually is the human reliability analysis method that's used.

Again, those methods vary from place to place, and we have a consistent methodology that we apply within our models.

MEMBER ROSEN: Is yours right and theirs wrong?

DR. O'NEILL: I didn't say that. I wouldn't go either way. We have used the best parts, we feel, of various recognized HRA methodologies. We haven't developed our own. This is nothing -- we haven't done anything original here.

MEMBER ROSEN: Well, I guess I'm just

making a general point here. I was always curious why the staff and the licensees couldn't work together on this.

DR. O'NEILL: That's a question I can't answer.

MEMBER ROSEN: The staff -- The licensees, at least the ones I know, are really trying to do the very best job they can.

DR. O'NEILL: And there are some.

MEMBER ROSEN: And there are some.

DR. O'NEILL: Yes.

MEMBER ROSEN: -- who would be delighted to have the staff have their model and work with them if they have a question about a human reliability analysis parameter or a maintenance parameter.

I mean, using judgments, ultimately reasonable men can come to the same answer, or if not at least you know what the difference is. It seems to me a much better way than to develop a fully independent model so that later on you can yell at each other and speak different languages and never come to a conclusion.

MR. BARANOWSKY: Well, excuse me, let me just interrupt here. There's no yelling that actually goes on, and the models -- I think you might have

missed some of the evolutionary discussion -- started out quite simplified and different, and over time evolved into a fairly, much more complicated models that were of somewhat comparable depth, but not quite the same depth.

They're also standardized in the way that they're developed, and the way that we're able to use them. We have to be able to let our staff not learn a different methodology plant to plant, and then different types of assumptions that go on from utility to utility, so that we can have a consistent way of doing our business.

While there are some cases where we can produce exactly the same results as the licensees, quite a few times when we've taken our best cut at the plant, we get some significant differences.

In some cases, we think it's the way that we've done the modeling, and in other cases, we've discussed it with the licensees, and they've determined that they need to make some changes too.

So if we hadn't had these, where would we be? Well we wouldn't certainly have that checked. So one of the things that's being talked about now is what kind of value there is in having this independent set of models that was derived quite differently from

the way the licensees derived theirs.

But it does give us a standard set that allows staff with certain level of expertise to learn how to use them, and that's where we are. Now, maybe someday there will be one model, but I can tell you that most of the French, the German, the Swiss, the Swedes, they're all -- the regulators have their own models, they're doing about the same thing we're doing, except their models are even more extensive than ours.

MEMBER ROSEN: Well, I think that's a fair answer. I'm not sure I agree with it, but at least it's an answer.

CHAIRMAN APOSTOLAKIS: Pat, I really want to see you exercise judgment and skip slides.

DR. O'NEILL: Okay, it's not a problem. All right, I'll skip the first three. The first three slides can be skipped, because we ended up at the point where we were in Fiscal 2001 with two PRA SPAR models for low-power shutdown.

One was a BWR (Grand Gulf). It was based on the Sandia report, NUREG/CR-6143, and with one for Surry. We then took those two models and developed from them some standardized low-power shutdown SPAR templates.

The one for BWRs we based on the Surry low-power shutdown model, and basically what it is. It's a working low-power shutdown PRA that has all the plant-specific system fault tree information deleted and replaced with undeveloped events. That's, in a nutshell, what that is.

In order to create a low-power shutdown SPAR model from a template, you have to expand those undeveloped events. I'll spend just a couple of minutes and talk to you about those.

CHAIRMAN APOSTOLAKIS: So where are you now? Which --

DR. O'NEILL: I'm just now getting into expansion of templates and to low-power shutdown SPAR models, lead plants. Because at this point --

CHAIRMAN APOSTOLAKIS: Can you put it up there?

DR. O'NEILL: Sure. We have --

MEMBER WALLIS: First you put numbers on the graphs.

CHAIRMAN APOSTOLAKIS: Deus ex machina.

DR. O'NEILL: We take the template and we expand it by adding the system fault trees from the Revision 3i or 3 model for the plant. And in doing so you have to go through some other steps which are all

spelled out.

They're in that report that we provided to Dana to give to the committee. We're now at the point where --

CHAIRMAN APOSTOLAKIS: So this is the essence of it?

DR. O'NEILL: There we go.

CHAIRMAN APOSTOLAKIS: Oh, this is the essence.

DR. O'NEILL: We have divided the plant population, now, into eight plant classes. This classification is consistent with the same classification that we're using for the full-power, the Revision 3/3i SPAR models.

Right now, tentatively, we have a list of lead plants. We would solicit the committee's input on this, if you have any information that will help us. What we'd like to do is have a lead plant in a plant class that has a shutdown PRA.

We know of several that have a shutdown PRA per se. We know of other plants that have a risk monitor, they have EOS, they have something on that nature.

MEMBER POWERS: I simply want to remark that the South Texas project is not included in your

list of lead plants.

DR. O'NEILL: Right.

MEMBER POWERS: But they are reputed to have a quintessence of excellence of all PRA models. I also note that San Onofre is not on this list, and they too claim to have a quintessence of excellence of all PRA models.

MEMBER ROSEN: Well, if you're trying to use South Texas as a lead plant to represent other plants, it doesn't work very well. Its design is so different, even though it is quintessential in many respects.

DR. O'NEILL: Okay, that's a good point. Right now, the lead plant for the later generation of CE design plants is Palo Verde. We know that they have a PRA also, shutdown PRA.

So any of the plants that you know of that have one, we'd just appreciate if you'd let us -- drop us a note or something, because we're still searching. We have set up arrangements with several of the licensees for these plants to review our low-power shutdown SPAR model, and we will go there and compare our model with theirs, and do an on-site review sometime in the future, probably early next year.

MEMBER BONACA: So Seabrook -- I'm

surprised Seabrook is not there.

DR. O'NEILL: Seabrook? Do they have a -- See we have a problem, in that Seabrook and Millstone 3, Diablo, they're all in the same plant class. We can only pick --

We may have enough funding to support doing one or two other models, in which case we could consider Seabrook.

CHAIRMAN APOSTOLAKIS: So what is the point now, that each lead plant SPAR represents a class of plants. So you will not have unit-specific SPAR models?

DR. O'NEILL: What we would have --

CHAIRMAN APOSTOLAKIS: Is that what it means?

DR. O'NEILL: We would have class-specific, but we would provide as much information as we have available to us in a tabular form that would enable a fairly adept analyst to take the lead plant's model and convert that over to a model for another plant.

Because they would have the Revision 3 SPAR model for that plant, so they would have the system-specific fault tree information, George, that they would need to bring into the template to create the model.

CHAIRMAN APOSTOLAKIS: Now I'm confused. Let's pick one plant that belongs to the class of Millstone 3.

DR. O'NEILL: Correct.

CHAIRMAN APOSTOLAKIS: Give me one. X. Plant X.

DR. O'NEILL: Okay, Diablo.

CHAIRMAN APOSTOLAKIS: Now, I have to do a Phase 3 SDP for X.

DR. O'NEILL: For low-power shutdown?

CHAIRMAN APOSTOLAKIS: Yes. What do I have for X right now? Do I have the Millstone 3 --

DR. O'NEILL: You would have the -- We have a draft Millstone 3. It has not been reviewed. But we have -- You would have the Millstone 3 low-power shutdown model and you would have the PWR template, which we have reviewed.

CHAIRMAN APOSTOLAKIS: And?

DR. O'NEILL: And you also have the directions, or the instructions, within the template itself on how to make that into a detailed low-power shutdown model.

CHAIRMAN APOSTOLAKIS: I see.

DR. O'NEILL: So with a --

CHAIRMAN APOSTOLAKIS: And after I do that,

do I store that someplace so next time I don't have to do it again?

DR. O'NEILL: Yes. .

CHAIRMAN APOSTOLAKIS: So I will then have a SPAR model for X?

DR. O'NEILL: Correct. Once you've done that, you won't have to go back and do it again. That's right.

MR. BARANOWSKY: But there -- When you think about shutdown, I think there's also going to be some amount of modeling that has to be done because of the unique situations that arrive during shutdown, which is why they're taking this approach, versus the full-power, where it's almost push-button in nature.

Couldn't quite do that for shutdown. So what they did was, through the example PRAs, identified the states that could be modeled within a plant class, and then the deviations that have to be taken into account through custom modeling case by case.

DR. O'NEILL: Right. There are about 16 plant operating states during shutdown.

CHAIRMAN APOSTOLAKIS: Okay.

DR. O'NEILL: We've taken what we consider, and based on the work that Brookhaven did, the most

risk-significant during low-power shutdown operation, and we've modeled them.

CHAIRMAN APOSTOLAKIS: Okay, I understand now. Let's go on.

DR. O'NEILL: Okay.

MEMBER POWERS: One particular aspect of the -- what I would call the scoping studies, maybe the detailed studies of shutdown. Where they went through and broke the operating states down into those that they thought were risk-significant and those that aren't.

It has always bothered me, because it strikes me that one of the worst shutdown events we've had from a conditional core damage probability occurred within a state that was judged to have low risk-significance, because it occupied so little time.

Why wouldn't you just hold the operating state?

DR. O'NEILL: I'm not sure I understand your question, Dana. Are you asking why didn't we do all of them?

MEMBER POWERS: Yes.

DR. O'NEILL: It's a matter of, number one, resource and budget considerations, and number two, the more you go into that, the more plant-specific you

get, and so you're going to end up doing a plant-specific low-power shutdown PRA for every plant.

I'm not sure that the funding is there to support that kind of an effort.

MR. BARANOWSKY: We don't miss those cases in the accident sequence precursor program, nor would we, I think, in the SDP process. It just means that we're going to have to do more custom model work, which we have done.

I mean, we've analyzed a number of shutdown events in the accident sequence precursor program by taking the original three SPAR 3 models, making a lot of adjustments, a lot of changes to the event and fault trees, and it takes a lot of effort.

So what we're trying to do is put models together here that cut down on the amount of custom work that you have to do, so we can do them more quickly.

But I don't think we can have every possible state and scenario represented. But if there was enough information from prior risk analyses that we should expand the models in those areas, we would. Right?

DR. O'NEILL: Right. In the case you're talking about, for a particular plant design, Dana,

that specific configuration is very risk-significant, then yes, we would make a special effort to go do that for that particular instance.

MEMBER POWERS: The problem I always have with that kind of approach is the disaster has to either occur or be approached to know to do these things.

DR. O'NEILL: That's true.

MEMBER POWERS: And it doesn't strike me as an optimal strategy.

MEMBER SIEBER: One of the plants that could be on the list perhaps is Limerick. But it is one might say not only identical to Peach Bottom, and it started out that way from the nuclear steam supply system, almost, to be identical to Peach Bottom, but yet when you go into the next level of detail there's a whole lot of dissimilarities.

I mean, it would be very significant in this approach. I mean, they're different in the number of diesel generators, they're different in the arrangement of the service water system, the ultimate heat sink, all those kinds of things.

So, you know, just picking similar nuclear steam supply systems doesn't necessarily assure a similar outcome.

DR. O'NEILL: That's true to some extent, but if the event trees are similar in structure, that's the important thing here. Because the system information that you're talking about would come in from the plant-specific Revision 3 or 3i SPAR model.

The success criteria and the system fault tree structure, obviously, would be different, but the event tree structure might be similar, in which case we could use Limerick rather than Peach Bottom.

MEMBER KRESS: I see how these models will be very useful for something like ASP and the significance-determination process, but how do you see them being useful for, say, a 1.174-type application?

DR. O'NEILL: Well, for 1.174 you would have to couple these to a LERF model. We're working on LERF SPAR models right now, and we will have the capability to link the two.

MEMBER KRESS: What I had in mind is 1.174 is supposed to represent an average risk over the lifetime of the plant, and in the lifetime of the plant you have future shutdowns, which are both planned and unplanned, and of somewhat unknown configuration.

How do you account for unknown configurations of unknown time periods during

different states for future shutdowns?

MR. BARANOWSKY: Really, do we have a baseline risk number for shutdown like we do for full-power?

MEMBER KRESS: That's extrapolate --

MR. BARANOWSKY: That we can just average, that we can work from.

MEMBER KRESS: That's extrapolatable into the future.

MR. BARANOWSKY: And I don't think we do.

MEMBER KRESS: No.

MR. BARANOWSKY: We don't have a -- This is not -- That's something that should be clear. This is not going to generate a shutdown risk estimate that's going to be able to analyze the implication of being in different configurations or failures during shutdown.

Or at least, we'd have to do something quite different.

MEMBER KRESS: I think that was my point. There is something for research to work on.

MR. BARANOWSKY: That would be a shutdown risk study, which you could use these models to do some of that.

MEMBER KRESS: That would be a starting

point for it.

MR. BARANOWSKY: Yes.

DR. O'NEILL: One other point I'd like to make before we move on is that another part in the expansion of the templates into a plant-specific model consists of you have to, also, modify the human error probabilities, because you have longer times, both to take action and also conditions are evolving much more slowly than they would be during full-power operation.

The QA of the model that you would produce once you have expanded the fault trees, you have modified the human error probabilities and done the other actions that the instructions tell you to do.

Two parts. First, we have an internal QA of the model at the contractor, and this is Idaho National Engineering and Environmental Laboratory that is developing these models for us.

You review the event trees, the fault trees, the basic event data, the common cause failure modeling, the GEM and GEMDATA. That's the graphical interface that does the calculation for the staff analyst using the SAPHIRE engine.

You look at human reliability and recovery. You maintain a log of revisions that have been made to the model, but you have to do this both

with the model and also you have to make sure that the documentation of the model is in agreement with the graphical model.

Event trees are standardized for a plant class, so there's not much that has to be reviewed there. The fault trees, as I said, most of them are plant-specific.

Some of them are generic, because every plant has the same kind of configuration for a particular system. There aren't too many of those. Basic event data, that is plant-specific for the most part.

Common cause failure modeling, just like the revision --

MEMBER KRESS: Let me ask you, basic event data. Do you have a plant-specific database for how plant's past shutdowns, where you have what equipment was out of service and how long, and during which operating phase of the shutdown, and you know, just a database from what all of the past shutdowns looked like?

DR. O'NEILL: I have two answers to your question. There's a short-term answer and there's a longer term answer. The short-term answer is, no, we don't have one.

We would use -- right now, for a PWR, we'd use the information that was obtained and compiled for the Surry shutdown PRA as a surrogate. During the on-site review that we perform, that's one of the pieces of information that we go after to see if we can get that information updated for the specific plant that we're looking at.

MEMBER KRESS: Do plants keep that information in a log somewhere?

MR. BARANOWSKY: Not always. You have to go through the logs.

MEMBER ROSEN: Some of them that have used the Sentinel, for example, and have been integrated to where they manage the outage, have become quality records. They're kept in great detail.

DR. O'NEILL: Good, because that's information that we would need in order to make these models more plant-specific.

MEMBER ROSEN: And I would say that it's very important that you recognize the major difference in duration of outages plant to plant. Some plants run, except when they have major modifications, like a steam generator replacement, but for a normal -- just a refueling outage, some plants run with 20- or 22-day outages.

Some plants seem incapable of getting below 30 or 35 days, and that's a huge difference in duration. Now if the duration difference between those two plants I just mentioned is actually in a low-risk state, it won't matter much.

But some plants spend much more time, for instance, in hot-early mid-loop than others, and that's the most risk-significant plant operating state for a PWR.

So there can be very big differences plant to plant, and the risk that the outages represent.

DR. O'NEILL: This was an iterative process, and we recognize that, and that's why we'll put that in as a placeholder and we'll go and try and get as much information as we can.

That's a good piece of information to know, because the only experience we have right now with an on-site review is with Surry, and we already had most of that information already. So we'll put that in the protocol for the on-site review. Thank you.

MEMBER KRESS: That may be one criteria for how you choose the lead plants.

DR. O'NEILL: That's true. That's true. We certainly would like to have as a lead plant one that

has a robust PRA as well as a very well organized and documented --

MEMBER ROSEN: Could tell you the history of every outage since it began and how much time it spent in each operating state.

DR. O'NEILL: Right.

MEMBER ROSEN: And what the risk per unit time was.

DR. O'NEILL: Right, because that's very important. We could adjust our model accordingly.

MEMBER KRESS: What systems were out of service and unavailable, and how long --

MEMBER ROSEN: That's how you get the risk per unit of time.

DR. O'NEILL: Okay, the second part of our QA process consists of a review of the draft low-power shutdown SPAR modeling against the licensee's low-power shutdown PRA.

We took the QA procedure that we've developed for the Revision 3 SPAR models, and it has been used extensively, because we've performed over 40 of these reviews by now.

We cover items such as the event tree structure, success criteria, the dependencies, various plant operating states, operating state groups. Now,

the plants themselves would not have operating state groups.

We've done that within the context of the standardized templates to simplify the effort. The time windows, as Rosen pointed out, that's very important, because some plants spend more time in the more risk-significant operating states.

MEMBER KRESS: Do you plan to compare these plants with the AMSE standard when we get it for low-power shutdown?

MEMBER ROSEN: That's ANS.

DR. O'NEILL: That's ANS for low-power shutdown, right.

MEMBER KRESS: For low-power, that's right.

CHAIRMAN APOSTOLAKIS: Well, it's a chicken and egg. Maybe they are writing the standard based on this.

DR. O'NEILL: Actually, we would like for our models to meet the standard, not necessarily the same option as a plant PRA would be expected to meet. We're looking at Option 2.

MR. BARANOWSKY: All of the SPAR work right now is being done in light of the ASME standard, even if it's not finalized. I think the main area we've determined we need to improve on is some of the

documentation.

DR. O'NEILL: That's one.

MR. BARANOWSKY: We're doing all the kind of QA and verification checks, but I'm not sure all of it's fully documented according to the standard. So we're going back and looking at what we have to do.

MEMBER ROSEN: Have you ever considered inviting a peer review team from the industry in to look at your model?

MR. BARANOWSKY: I guess we thought that by going plant to plant we were getting somewhat of the equivalent of that. Also, I think we send some of these to the owners' groups, so we don't have a specific peer review --

DR. O'NEILL: That's right.

MEMBER ROSEN: You might want to consider that, because the peer review teams are getting very robust, and it's, you know, you want to pick a time when you feel like you've gotten up on a plateau.

So that for the input to get yourself to the next plateau, if you had a peer review of this, they come off a little different than the ones that they're doing in the industry for specific plants. But I think it could give you good insights on where you're weak.

Just a thought.

MR. BARANOWSKY: Good thought. Thanks.

DR. O'NEILL: I'd like to spend a minute here on the HRA methodology.

CHAIRMAN APOSTOLAKIS: So the reason why you're going over all this is you are setting the stage for explaining what 4i was?

DR. O'NEILL: Yes.

MR. BARANOWSKY: Also to satisfy queries that were raised about low-power shutdown program, which actually were raised at the last ACRS meeting I think we were at --

MEMBER POWERS: We've been badgering you about them for years.

MR. BARANOWSKY: Yes, we've been badgered a lot.

MEMBER POWERS: Well, I mean this stuff is great, except there's a pent-up demand for these slides that's inconsistent with our time schedule right now.

MR. BARANOWSKY: Well we're trying to make progress.

MEMBER SHACK: Just before you -- You mentioned comparison with the ASME standard. I heard a category 2, is that where you think SPAR is at?

DR. O'NEILL: We think that would be appropriate. That's the goal that we had set.

MEMBER SHACK: Well, occasionally it's been mentioned in this room that SPAR was category 0.5 I think was the number I heard.

DR. O'NEILL: It didn't come from us. I don't know who made the statement or what context it was made in.

CHAIRMAN APOSTOLAKIS: So category 2 is what, your standard baseline PRA, right? Category 3 is the shiny, normal --

MEMBER SHACK: That's where you think you're at.

DR. O'NEILL: That's what we're shooting for. We're not quite there yet. We have a couple of areas where we need to improve, and we're working on them right now.

But I think when we get finished we should be at a Category 2. The HRA methodology was first developed back in 1994 for use in the accident sequence precursor program.

It was later revised in 1999 to incorporate desirable aspects of other HRA methods and sources, and was tailored specifically to SPAR model usage. It takes parts of universally recognized HRA

methods, and puts them together in a form that can be used readily by the analysts.

Some of the programs that it borrows from are ASEP, THERB, CREAM, HEART, ATHENA, just to name a few. But basically what it consists of is a three-page worksheet where the analyst rates a series of performance-shaping factors and dependency factors and arrives at a screening level of human error probability for a given task.

The three-page worksheet consists of three parts. It looks at diagnosis task, it looks at actual action, and finally, any dependencies. By starting with a baseline value for each of the -- probability for the diagnosis and for the action, it increases or decreases that value based on the performance-shaping factor ratings.

The performance-shaping factors cover a number of things, such as the time available to do a task, the stress level, complexity of the task, experience and training of the operator, the quality of the procedures that they're using, fitness for duty, and finally, work processes.

Now, the full-power HRA we checked out. They were developed on a sequence-specific basis. We used the tech training center facilities in

Chattanooga to do some exercises that checked out the performance-shaping factors.

But we didn't have an explicit application for low-power shutdown, because as I pointed out before, the times that are available to take actions may be much longer than those at full power.

The work processes may be much different, because there are a lot of things going on during a plant's shutdown mode of operation. So we are in the process of upgrading our HRA methodology to take that into account.

MR. BARANOWSKY: But just to clarify, most of the times when we get into an analysis that has any significant HRA, we have to get a lot of information. Because we can start out with a baseline, but the specifics of each incident become important.

I know you did a lot of work recently on that.

DR. O'NEILL: Right. It can boil down to taking the specific procedures that the operators were either supposed to use or were using and going through them step by step and doing an HRA evaluation on that type of --

CHAIRMAN APOSTOLAKIS: So who's doing this now?

DR. O'NEILL: Idaho. Dave Gertman (phonetic).

CHAIRMAN APOSTOLAKIS: Well, Dave Gertman is doing the development.

DR. O'NEILL: Right.

CHAIRMAN APOSTOLAKIS: But I mean, the user.

DR. O'NEILL: The user? Okay. The user, George, would be the staff analyst in the PRA branch in NRR.

CHAIRMAN APOSTOLAKIS: So somebody understands these tools?

DR. O'NEILL: Correct. We also -- The SRAs in the regions, to some extent.

CHAIRMAN APOSTOLAKIS: Or the SDP.

DR. O'NEILL: Right.

MR. BARANOWSKY: But we're usually going and consulting with an HRA specialist, because --

CHAIRMAN APOSTOLAKIS: This is not trivial.

MR. BARANOWSKY: -- we don't have that kind of -- No, it's not trivial.

DR. O'NEILL: It's not trivial. You're right.

CHAIRMAN APOSTOLAKIS: Very good, very good. Are we getting close to 4i?

MR. BARANOWSKY: Getting close.

DR. O'NEILL: Yes. I wanted to say a couple of words about the on-site QA review for Surry. All right. I won't --

CHAIRMAN APOSTOLAKIS: Is this for Mr. Rosen's benefit?

DR. O'NEILL: I won't dwell on that, but we went there on the 15th of August. We were there in conjunction with NRR's review of the low-power shutdown SDP analysis tool that they've developed to perform a Phase 2 analysis of low-power shutdown issues.

The participants are listed there. Again, we went over the normal scope of the review. The next page, plant-specific review insights. In general, we found that there was good agreement between the low-power shutdown SPAR model, and the Surry low-power shutdown PRA.

Not surprising, because both of them were based on NUREG/CR-6144. The Surry low-power shutdown PRA uses the same initiating event frequencies that were in that report.

CHAIRMAN APOSTOLAKIS: How many studies have been done for Surry? Does anyone keep track?

DR. O'NEILL: Good question.

MEMBER POWERS: But George, the distressing thing is that every time they do a new one, they find something.

DR. O'NEILL: The low-power shutdown SPAR model for Surry is a little different from the licensee shutdown PRA, because we separate out loss of HRH that's caused by a loss of level control.

The reason for that is basically, NRR has a lot of low-power shutdown-related inspection findings that deal with this, and their low-power shutdown analysis tool separates it. So we wanted to be consistent with their approach.

We did find a number of generic review insights. I won't go through those.

MEMBER KRESS: Let me ask you about the first one. You know, the reason the sump gets plugged up, sometimes you're having an accident which you're depressurizing, and all that high-pressure steam and water comes out and tears things up, and transports it to the sump.

Now during low-power shutdown, you don't have that driving force. Why would you have concluded that just because there's an increased level of personnel activity, you would have a higher likelihood of a sump plugging?

DR. O'NEILL: Just basing that on what we saw in the Surry PRA. We hadn't really given that much consideration until that time. Now, is that an anomaly? I don't know, because we've only done one of these reviews.

If we do another one or two and we find a similar tendency, then yes --

MEMBER KRESS: That really would have surprised me.

DR. O'NEILL: What the basis for that is, I don't know.

MEMBER ROSEN: I'll try and answer it for you. You've got the bullet there, due to increased level of personnel activity in the containment during low-power shutdown.

It's not just people, but it's what they bring into the containment.

DR. O'NEILL: And what they leave there.

MEMBER ROSEN: And what they leave. Should there be an accident or radiation release which tells them to exit the containment as quickly as possible, they can't take all the materials that they brought in to do a job.

There may be drop cloths, they may be painting, who knows what.

MEMBER KRESS: Yes, but that stuff doesn't have much potential for blocking the sump.

MEMBER ROSEN: I guess I disagree. All kinds of things can be brought in, and there's probably no central authority that says, 'That's too much because of plugging concerns of the sump.'

DR. O'NEILL: We'll have a better feel for it as we do more of these reviews and see how they're going. The summary, the evaluation of the review results, unfortunately it was inconclusive relative to our QA acceptance criteria.

Reason being is that the licensee's contractor was not available for this meeting, and it was difficult to get a lot of detail as a result of that.

So further discussion with the licensee is planned on this particular plant model. So I really don't have a lot of conclusions yet.

MR. BARANOWSKY: Okay, you ready?

DR. O'NEILL: Are you ready?

CHAIRMAN APOSTOLAKIS: And we have 26 minutes.

MEMBER POWERS: This is just the cancellation, I want to see -- Take the "Cancellation" part off and say "Plans for Revision 4k".

MR. BARANOWSKY: Maybe we should just say, "Are there any other discussions?"

(Laughter.)

CHAIRMAN APOSTOLAKIS: Okay, let's go on.

MEMBER ROSEN: Dana, are you saying you have a prejudiced for this already?

MEMBER POWERS: I have no prejudice whatsoever here. Commissioner McGaffigan just wants to know if we go along with cancellation of this 4i. But I don't know what it is. I can't answer his question.

DR. O'NEILL: Okay. I will now attempt to tell you. The second bullet on the first slide says that the Revision 3 SPAR models were developed by improving the Revision 2.

Well, what the Revision 4 SPAR models consist of would be further improvements and embellishments and enhancements to the Revision 3 models, which is what you normally would anticipate in an evolutionary process such as the SPAR model development program.

We would add even more initiating events to the Revision 3 coverage than we have right now. To get --

CHAIRMAN APOSTOLAKIS: Now when you say "Revision 3" you mean those seven or eight lead

going to show you something about cost of this. This sort of goes back to the issue that Steve Rosen raised.

This is the point at which we're not sure it's practical anymore for us to have the kind of expenditure for NRC-specific models to capture that extra 10 to 15 percent for all the plants that have it sitting there.

Now we can modify any of the SPAR 3 models for a fairly modest cost if an issue comes up in that 10 to 15 percent by our own experience, plus looking at the licensee's PRA, and still have an independent analysis.

DR. O'NEILL: Absolutely right.

MR. BARANOWSKY: But we just drew the line at that point and said, 'That's the point where it's probably not practical.'

MEMBER ROSEN: It's getting asymptotic.

MR. BARANOWSKY: Yes, and it can always get more and more detail in there, but --

CHAIRMAN APOSTOLAKIS: So 4i, or 4, 4 would not have been the ultimate state. Then it would have been followed by a 5?

DR. O'NEILL: Yes. They just keep developing, George, and the question is, 'Where do you

plants?

DR. O'NEILL: No, no. I'm now talking full-power George. This is full-power. This is not low-power shutdown.

CHAIRMAN APOSTOLAKIS: So now we are talking about full-power.

DR. O'NEILL: Full-power. Right.

CHAIRMAN APOSTOLAKIS: So this is every single unit?

DR. O'NEILL: Every single -- We have 72 full-power level one Revision 3/3i models right now. We would be taking them to Revision 4i. In a nutshell what that would be is we're talking about a mini-PRA for every plant.

When I get through enumerating all the things we'd add to it, that's what you'd have. We'd add more initiating events. We could do things like low-voltage AC. We could do other support systems that aren't covered right now by the Revision 3 models.

Revision 3 models cover support systems, but a limited scope of them. We have service water, we've got component-cooling water, we'd go even further.

MR. BARANOWSKY: We capture 80 to 85 percent of the internal events right now, and he's

reach the point of diminishing return, from a cost-benefit standpoint?'

MEMBER ROSEN: From a regulatory perspective.

DR. O'NEILL: Yes.

CHAIRMAN APOSTOLAKIS: So, I don't understand now. We don't plan to move on then?

MR. BARANOWSKY: No. What we're going to have is -- is that in here anywhere?

DR. O'NEILL: Yes, the last slide.

MR. BARANOWSKY: Okay, he's going to cover that. We're not just standing still doing nothing, but we're not going to go and put all these models together for every possible thing.

In other words, the equivalent of a San Onofre or a South Texas type PRA, just not practical for us to do that. Maybe you can explain it here.

DR. O'NEILL: The estimated total cost of Revision 3 SPAR model development is roughly $3.8 million. It turns out that on an average per model basis we're talking about $35,000, that's rough.

In order to develop Rev 4 would require that we do on-site visits. We would have to do walk-downs of systems. We'd have to go over plant procedures. We estimated that it would be at least

twice as much per model as the Rev 3, maybe even more in some cases.

MEMBER POWERS: It sounds like a bargain, no matter -- I mean, $35,000 a model versus $70,000 a model sounds pretty cheap to me.

MR. BARANOWSKY: I guess it's relative.

DR. O'NEILL: It's relative.

MR. BARANOWSKY: But we're not sure that the pay-off is there. If we can make an argument for it in terms of the amount of usage that we would get out of that extra accuracy, I think we would do it.

But right now, we think that by -- I think he's got a line on here on maintaining existing SPAR models.

DR. O'NEILL: Right.

MR. BARANOWSKY: As we find factors through operating experience or other licensee analyses that we think need to be incorporated, we'll make small changes, and not call them --

DR. O'NEILL: Revs.

MR. BARANOWSKY: That would be Rev 3, but they'll be (a), (b), (c), something like that.

DR. O'NEILL: Right.

CHAIRMAN APOSTOLAKIS: So you have 3ia?

MR. BARANOWSKY: No, "i" will be gone.

We're going to get rid of the "i"s in the not-too-distant future.

DR. O'NEILL: "i" goes away by the end of the fiscal year.

CHAIRMAN APOSTOLAKIS: So you're still talking about full-power, right?

DR. O'NEILL: Correct.

CHAIRMAN APOSTOLAKIS: So a 4i refers to full-power?

DR. O'NEILL: Yes.

CHAIRMAN APOSTOLAKIS: Now you mentioned, Pat, that you would have to go and do walk-throughs and look at the procedures. So you haven't done any of that for the existing Rev 3 models?

DR. O'NEILL: Not walk-throughs, per se, George. On a specific case, we may have had to go to the site, get the resident inspector to track some things down for us, because we had questions about certain items.

But that would be regular.

CHAIRMAN APOSTOLAKIS: You don't have internal floods and fires.

DR. O'NEILL: Not right now, no.

CHAIRMAN APOSTOLAKIS: Because it's much more important then.

DR. O'NEILL: Yes. We have an external events modeling effort that we're going to get started with --

CHAIRMAN APOSTOLAKIS: So what is it, what effort was competing with this, and won? I mean, instead of spending --

MEMBER POWERS: George, I'm more lost than that. I don't even understand what the effort is in 4. I mean, there is no list that says, here, 'In 4, I would do this, this, this, this.'

I see statements that say, 'Gee, we've got the SPAR models capped for 80 to 85 percent of the internal events.' That doesn't sound very good to me.

MEMBER BONACA: The thing that surprises me, the exclusion right now is for the component-cooling water. That's a medium and large LOCAs on the models right now. I don't understand.

DR. O'NEILL: No. We have that now. We would go beyond that.

MEMBER BONACA: Oh, okay, I'm sorry.

DR. O'NEILL: We would have every initiating event that the licensee has in its PRA, as an example. That's probably where we would go.

MEMBER BONACA: Why don't you give me some example of some initiators you do not model right now?

DR. O'NEILL: Plant steam line break.

MEMBER BONACA: Okay.

CHAIRMAN APOSTOLAKIS: Isn't that important?

MEMBER POWERS: My understanding is they don't have core cooling water here. I mean, that's the way I read the draft.

MEMBER BONACA: No, I just --

MEMBER ROSEN: To come back to the point of 80, 85 percent. If you've already got that much, and whether that's good enough. We talk about PRAs being accurate sometimes within orders of magnitude or a factor of five, maybe.

But to say that it's within ten or 15 percent and want to do better than that seems excessive.

MEMBER POWERS: It doesn't say it's within ten or 15 percent. It says it's captured 80 to 85 percent of the internal event.

MEMBER ROSEN: Well, that's within ten or 15 percent. Or 20 percent.

MEMBER POWERS: No it's not.

MR. BARANOWSKY: The results don't have that kind of consistency. That's of the sequences, right?

DR. O'NEILL: Correct.

MR. BARANOWSKY: And I think I could add onto that that we aren't missing any dominant sequences.

DR. O'NEILL: No. That's right.

MR. BARANOWSKY: But I wouldn't be surprised to see a factor of two, three, four, even five difference in the total core damage frequency. Probably two is more typical, I think.

MEMBER ROSEN: Difference between what and what?

MR. BARANOWSKY: What we would get and what the licensee might get.

DR. O'NEILL: Right.

MEMBER KRESS: That's not what the bullet says. On the previous slide, it says it captures 80 percent of the CDF.

MEMBER POWERS: No, it says "of internal events".

DR. O'NEILL: Internal events.

MEMBER KRESS: CDF has to be on there for some reason.

MR. BARANOWSKY: Maybe it's a little bit deceptive wording.

MEMBER POWERS: Well, I guess the question

I would ask is how well do you think you estimate things like Fussel-Vesely with this kind of approach?

MR. BARANOWSKY: Well, we think we do pretty well, and we're testing it out now against the number of licensee's PRAs as part of a pilot project that's going on.

DR. O'NEILL: We checked those out on the on-site QA review, Dana. We look at the rods.

MEMBER POWERS: Yes, but you're not going to share it with me?

MR. BARANOWSKY: I guess, you could tabulate the information.

DR. O'NEILL: Yes, we could give you a tabulation of those that we've done thus far.

MEMBER BONACA: Well, why don't you consider to go 100 percent on one plant, and see what it brings in for that particular plant with respect to the 3 and get a sense of that. That may support your conclusion which you're trying to do --

DR. O'NEILL: Well, I can give you a specific example, because I participated in it personally, and that was at San Onofre. When we got to San Onofre, we ran the SPAR model in a number of scenarios, and the licensee ran their PRA model for the same scenarios.

We compared the results, and we had -- from a CDF standpoint, the internal events CDF, we had within a factor of three agreement with the baseline CDF.

However, the contributors that we had were somewhat different than those the licensee had. So, that then became the point of starting out on our technical discussion.

We went into the sequence by sequence differences, and we discovered that the configuration of the plant's support system, specifically the salt water and service water systems, had changed since we were last aware of the system design.

This was post-IPE, and it was actually post-first update of their IPEs, so we made those changes. We re-ran the scenarios and lo and behold, we started coming closer to agreement.

We finally determined that the reason for the disagreements at the end of this exercise were twofold. One was the equipment failure probabilities that had been input to some of the systems, and the other one was the human error probabilities.

When we took the equipment failure probabilities that the licensee used, and the human error probabilities, put them into the SPAR model for

San Onofre, we got the same CDF with the same dominant contributors in the same order.

CHAIRMAN APOSTOLAKIS: But I think the issue, though --

MEMBER ROSEN: That's a spectacular story. Very interesting.

DR. O'NEILL: Doesn't always happen though.

CHAIRMAN APOSTOLAKIS: I want to understand something. We have put you in a position now where you are really defending the technical adequacy of what you have done.

But what I would like to understand is, was the budget dictated to you and you did the best you could with it, or if you had the budget, you would actually go ahead and develop good models?

MR. BARANOWSKY: We think we have good models, and --

CHAIRMAN APOSTOLAKIS: Well, I don't mean -- Complete models.

MR. BARANOWSKY: The budget -- It was up to us to make a proposal on the budget. We went through and looked at this and amongst ourselves, we said, 'We're not sure it's really worth going forward.'

Now maybe it will be sometime in the future, but right now, we don't see it, and it was

planned for whatever fiscal year.

DR. O'NEILL: It started in '05.

CHAIRMAN APOSTOLAKIS: Now if a licensee did this though, would we criticize them? If they said, 'Well, gee, we think we covered 80 percent of the CDF.'

MR. BARANOWSKY: Depends on what he's going to use it for. Remember, I'm not trying to establish, necessarily, the baseline risk for the plant. That's already been done, mostly by the licensee.

Now we may have some disagreements about certain factors. The human reliability numbers and things that give you moderate differences. But that's done. We need to use this for other things: significance determination and accident sequence precursors, that kind of activity.

MEMBER KRESS: And risk-informing the regulations.

MR. BARANOWSKY: And to the extent that the models cover the things that we're doing, we can do that. If they don't, we believe we can go and make changes, or use insights from these models and the licensee's PRA at this time.

When that becomes cumbersome, and we need a more extensive model, we'll either look at using the

licensee's model, if it's been QA'd through, say, ASME standards, or, if we have to, we'll expand our models.

But what if the licensees all do go through the ASME process, and they become good models in 2005 or '06.

CHAIRMAN APOSTOLAKIS: I think it's more likely they will go through the NEI process.

MR. BARANOWSKY: Whatever certifies them.

MEMBER ROSEN: Let me clarify. The ASME process references the peer certification process, the NEI process. They're really the -- They're linked. What I'm told is all but two licensees have gone through that peer certification process.

MEMBER POWERS: Mr. Chairman --

MEMBER ROSEN: There's a lot of misinformation here. Just to clarify.

MEMBER POWERS: Mr. Chairman, I will not yield, compose, any kind of response to Mr. McGaffigan about this question, based on the information I've heard today.

CHAIRMAN APOSTOLAKIS: Well, what else would you like to know?

MEMBER POWERS: I'd like to know what's in 4i, what was to be in 4i.

CHAIRMAN APOSTOLAKIS: Can you answer that

Pat?

DR. O'NEILL: I thought I did.

MR. BARANOWSKY: I think the problem is we didn't spec out the 4i in detail. What we were going to do was, by observation, we looked at what we're missing and in order to do the kinds of tasks that Pat O'Reilly identified, that would expand the models to capture, say, 99 percent, we estimated it would at least double the amount of cost to do it.

We haven't gone and charged the contractor to go and do a feasibility study, if you will, which would give us the kind of, I think, detail you might be talking about.

MR. NEWBERRY: Scott Newberry. Pat mention the timing of 4i again so the committee understands when we would have started the activity?

MR. BARANOWSKY: Well, we would start the planning activity in 2004 and implementing it in 2005.

MEMBER POWERS: Right now what I'm going to say, and in any kind of draft response is going to read something like, 'They got this kind of interesting SPAR activity underway. They are continually improving the model. They're up to Revision 3. They were thinking about 4.

'Since they had no idea how good it had to

be for the applications, they couldn't justify going to the cost for 4 and so they canceled it.'

MR. BARANOWSKY: I think that might be slightly unfair --

MEMBER POWERS: It'll be more unfair if I actually thought about the wording.

(Laughter.)

MR. BARANOWSKY: Keep in mind what we've done is we've made a judgment call that a SPAR model maintenance project would allow us to make what I might call focused revisions to the SPAR 3 models at a more efficient cost.

You may want to disagree with that, but that's our judgment, and I think that should be taken into consideration.

MEMBER BONACA: Now, if you, for example, did a verification of some 1.174 application, San Onofre, and now you know already that you have some difficult agreements, so you have the means of performing an independent evaluation, and have credibility for the absolute body of CDF.

Now conversely you might find another plant where you go, there is an application, you find large differences at the end of the process. Do you feel that you still would be able to identify the

sources of those differences?

DR. O'NEILL: Yes, definitely.

MEMBER BONACA: You would? So, what you're saying is that the model that you have allows you to support your regulatory evaluation?

MR. BARANOWSKY: The SPAR 3 full-power models are way, way more advanced than anything else that we have. I'd like to put more effort into the level 2 LERF models, the shutdown model, and the external events, so that I can at least get them up to some reasonable --

CHAIRMAN APOSTOLAKIS: That's what I asked you earlier. This was competing with what in cost?

MR. BARANOWSKY: Okay, it's competing in my branch with that activity because I have so many people and roughly so many dollars I can start planning with.

But no one came up to me and said, 'You have to keep your budget at X for 2005.' I was asked what do I think I need? And I got a look at what's realistic in terms of staff that's going to be available and what our needs are.

And our needs are much more in these other areas right now. We need to get that -- And that's going to run several years before we get those models.

DR. O'NEILL: The priority, George, has been determined by the user's needs as they expressed them. We asked them, 'Okay, we have these areas. What are your highest priorities here?' and the full-power revision 3 models came out on top.

MEMBER POWERS: George, I'm coming to the point that I think we should not respond to this question, and for a couple of reasons. It seems to me that the decision that has been made is a legitimate function of the management, and outside of our domain.

It's a judgment call they made based on their expertise as managers, which we don't pretend to compete with. What we are better suited at doing is looking at this overall strategy they have, and all these other things, and saying, 'Is this what you really need here?' rather than this question of keeping or not keeping 4i.

CHAIRMAN APOSTOLAKIS: Sure, and I, you know, if you were to ask me, should I improve on 3 at the expense of not having a fire SPAR model I would say, "No."

I would say go ahead and build something on fires. So it doesn't sound to me like this decision was off-base.

MEMBER ROSEN: From what I've heard I think

you've got it right exactly.

CHAIRMAN APOSTOLAKIS: But why did you advertise 4i? I don't understand.

MR. BARANOWSKY: You know the way the budget process goes. You have to start looking many years ahead, and you forecast, okay? And that's what we did. That 4i was in place I think before I was Branch Chief in charge of the SPAR stuff.

MEMBER BONACA: But are you saying the 4i will never happen?

MR. BARANOWSKY: No. I'm saying --

MEMBER ROSEN: Be careful about saying "never".

MEMBER BONACA: No, I'm asking that question.

MEMBER ROSEN: That's a very good point.

MEMBER BONACA: I understand. I'm saying so therefore, you're saying that at this time --

CHAIRMAN APOSTOLAKIS: It's better to bring fire and earthquakes up to speed.

MEMBER BONACA: And then maybe later on you'll do this next step.

MR. BARANOWSKY: Well, I'm not putting it on the books for the future either, unless there's a need for it.

CHAIRMAN APOSTOLAKIS: See, that's the point that we are falling into the pitfall that many other people are also falling into when they defend PRA. You shouldn't be defending 4i versus 3.

You should be saying, 'Instead of 4i, I want to do this.'

MEMBER BONACA: At this time.

CHAIRMAN APOSTOLAKIS: Now. Then it's a different story.

MEMBER ROSEN: Later, who knows. Maybe we'll improve something else. The value of a PRA process is it allows you to continuously improve, and keep the PRAs in the plants living PRAs.

That's what you found at San Onofre. You went out there and you found that the model had changed. Why? They'd made some modifications, and they had better estimates of the unavailabilities and reliabilities of their equipment.

So they were keeping it up. That's what most plants are doing. That's what the standard requires. That's what the peer certification checks. So that's a good thing. That's exactly the same thing the staff should be doing with its models.

CHAIRMAN APOSTOLAKIS: So, speaking of the peer review, for example. Let's say this had gone for

a peer review and gotten a few Bs and Cs. Instead of fixing those, they are saying, 'I would rather go and develop something for fire and earthquake.'

MEMBER KRESS: Yes, but we don't want to lose sight of the fact that 4i eventually would be desirable. And this just postpones it.

MEMBER ROSEN: I think it goes too far to say it's desirable. It's a piece of work that could be done, and it has to always be assessed in the context of everything else.

MEMBER KRESS: Well, that context is what eventually will SPAR models all be used for. I envision more expanded use in helping craft risk-informed regulations, and there I think, for really crafting risk-informed regulations, I think you need 4i.

CHAIRMAN APOSTOLAKIS: Amen. I agree with you 100 percent.

MEMBER KRESS: So, eventually it would be needed. Maybe not now. So I hope it's just postponed, and maybe would come about in an incremental way somewhere --

MR. BARANOWSKY: Well, I think that's possible. But before we would put together a big project to add a new element of detail to these

things, we'd want to make sure that the use had some value.

MR. NEWBERRY: Scott Newberry from the staff. I think the committee finally came around to the point where you were simulating the discussion by management on 4i, with one possible exception.

That is if you look at Pat's resources, both dollars and staff, the other thing that he does is to help the agency move ahead on the programs. That is, not just coming up with tools, but to help NRR work on improving risk-based performance indicators, the new performance indicator process, better analysis, better actual decision-making.

So those were the things that were also competing with 4i, not just tool-development. I just wanted to --

MEMBER BONACA: There's always going to be a limitation anyway, to the degree to which you are going to be able to reflect plants, because the plants change.

It takes years, many years of work to update the PRAs.

MEMBER POWERS: But Mario, the change cannot be very fast, because if they go and they use the shutdown models that were done back in the late

'80s for Surry, and they find good agreement, this is not heroic changes.

MEMBER BONACA: No, no, I'm talking about -- I'm looking forward and saying, there are going to be 100 plants, each one of them is going to have a full-power PRA. Even if you had SPAR models that well represent those plants, every outage they go through, these plants have modifications, and if you had to --

So there is a limit to how much, probably, the staff can keep up. So I think you have to make a judgment on what you need to perform a good comparison and ask intelligent questions of the licensee.

The licensee is probably going to have good answers for the differences. But it gives a platform for the NRC to ask intelligent questions. I think that's an important point to look at.

MEMBER POWERS: Well, I mean -- I have to say that I have an enthusiasm for this program. I think it's doing an outstanding job, and what I know from talking to the senior reactor analysts out in the region is they're extremely enthusiastic about getting more and more and more --

And they use this stuff. This is used material, and whatnot. I guess I am coming down on saying you've got no right intruding into this

judgment of balancing resources decision, because it's a management decision.

But I haven't got a clue what your development plans are for this code. I mean, there are huge numbers -- there's an infinite amount that could be done, and a lot of it seems to me to be desperately needed.

Like being able to do good fire analyses and things like that are -- I mean, people hunger for that in the regions. I would really enjoy listening to a grand strategy for the next ten years for the development of this. With a little work to do.

I mean, I enjoyed your memorandum on what you needed --

CHAIRMAN APOSTOLAKIS: Has Commissioner McGaffigan asked the ACRS? He asked the staff has the ACRS reviewed.

MEMBER POWERS: Yes.

CHAIRMAN APOSTOLAKIS: Are we under any obligation to write a letter to him? I mean, he didn't ask us.

MR. DURAISWAMY: Well, George, the same question was asked. He asked the ACRS too.

CHAIRMAN APOSTOLAKIS: When?

MR. DURAISWAMY: The same time he asked the

staff.

CHAIRMAN APOSTOLAKIS: There's no SRM is there?

MR. DURAISWAMY: No, he asked -- The question was posed, I think, after he reviewed the budget and a proposal, I think he asked the question, sent the question to the staff. At the same time it was sent to the ACRS too.

CHAIRMAN APOSTOLAKIS: Okay.

MEMBER POWERS: It seems to me that the best advice I can give Pat here is why don't you hit him up for some bucks and some time to develop a grand strategy on this thing, rather than doing it each budget cycle and whatnot.

MR. BARANOWSKY: It's not quite like that. We do have a program plan that takes us through 2005, and the strategy is one that's derived at by Office of Research, discussing with NRR, and regional folks, in terms of what their priorities are.

But it doesn't go beyond --

MEMBER POWERS: 2005 I probably -- It would be fascinating to read. I mean, you can send it to me and let me read it, and you won't have a bunch of questions.

MR. BARANOWSKY: If you want, if there's

something else we can give you, we'll send you that document and whatever else.

MEMBER POWERS: Because, I mean this is really an important undertaking as you well know from our visits to the regions. These guys, I mean all they want is more, and they use it all the time. They're full-time, busy, and I notice you had lots of user-friendly things on there.

They're hungry for that, trust me. And being able to address more topics like fire and earthquakes is probably more important to them, I take it, than to be able to get that last 15 percent. I mean I think that's true.

But I mean, I don't know what we'd do as a final response. My advice to you is to go back to McGaffigan and say, 'The ACRS doesn't think it's any of their business to make management decisions.'

I mean, you guys get big bucks for doing that.

CHAIRMAN APOSTOLAKIS: What did you say? Doesn't think it's any of your business or its business?

MEMBER POWERS: ACRS' business.

CHAIRMAN APOSTOLAKIS: Oh, ACRS' business.

MEMBER POWERS: I mean we just don't do

that. I mean, we shouldn't be asked to do that. We can't possibly know all the pressures you're under.

CHAIRMAN APOSTOLAKIS: Okay. So anything else that we need on this?

MEMBER POWERS: Well, I think -- I want to compliment the speaker for a very information-packed set of view-graphs, and apologize for him that the forum was just too short to go into those in detail.

I want to thank you guys for sending me what you did send, because I found it fascinating reading. I could probably quibble with you for more than two days on your template, but it was still fascinating reading, and very informative.

Again, I think it's extraordinarily important work that you're doing.

MR. BARANOWSKY: Thank you.

DR. O'NEILL: Thank you.

CHAIRMAN APOSTOLAKIS: Okay, thank you, gentlemen. We'll recess until 10:20.

(Whereupon, the foregoing matter went off the record at 10:05 a.m. and went back on the record at 10:26 a.m.)

CHAIRMAN APOSTOLAKIS: The next slide I think is mine, and it has to do with Performance-Based Regulation and the Guidelines the staff has prepared.

We wrote a letter on this back in September of 2000 to the Executive Director essentially supporting the staff's proposal to develop the guidelines and making a few comments regarding the level at which the monitor parameters should be set and so on.

So today Mr. Prasad Kadambi will bring us up to date. Right Prasad? Thank you.

MR. KADAMBI: I sure hope so, Mr. Chairman. Thank you very much. I'm joined in the presentation by the Branch Chief for the Regulatory Effectiveness and Human Factors branch, John Flack.

Technical assistance on this project has been for some years -- we have received quite a bit from Bob Youngblood of ISL, so if I have any questions of detail I'll call on Bob.

John, did you want to?

MR. FLACK: Yes, again I'm John Flack, the Branch Chief of Regulatory Effectiveness and Human Factors branch. We have the research responsibility for the performance-based regulatory initiative in developing the guidance document, which you'll hear about today.

There's a larger initiative, coherence, which you'll hear about next month. Chris Grimes from NRR has the lead on that particular initiative. So

we're talking about a certain piece of that overall initiative.

What we'd like to do is walk you through the document today, show you some illustrative examples. Really the document, what it does is it has one ask questions, which is very important in the process.

Basically they stem from the three "why, what, how" questions. Why do we have this regulatory concern? What are the ways we can deal with it and look at performance base as one of the alternatives and options in that? Then, how do we go about implementing that initiative or that option?

Again, as Prasad had mentioned, the objective is to get the committee's views via a letter and feedback and to reach closure on this part of the process, which is the guidance document.

CHAIRMAN APOSTOLAKIS: John, you mentioned the letter. What is the question? Is the question to release the document as a NUREG report or what?

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

CHAIRMAN APOSTOLAKIS: And what happens if you release it as a NUREG report? I mean, other offices begin to use it?

MR. FLACK: It's something to point to as

part of the implementation of the performance-based initiatives, as this is a process about how to go about working performance-based approaches as part of regulatory decision-making.

CHAIRMAN APOSTOLAKIS: But if you don't publish it, they will still go ahead and do these things, right?

MR. FLACK: That's right. There's still --

CHAIRMAN APOSTOLAKIS: They will just lack this guidance.

MR. FLACK: That's right. Hopefully, this guidance will support that initiative and set --

CHAIRMAN APOSTOLAKIS: So this is the question. Should this be published?

MR. FLACK: Yes.

CHAIRMAN APOSTOLAKIS: And of course, if we have technical comments we can also make those.

MR. FLACK: Absolutely.

CHAIRMAN APOSTOLAKIS: Are you done John?

MR. FLACK: Okay, yes.

MR. KADAMBI: Thank you, Mr. Chairman. The outline of my speech is up there. I just want to point out that the report that you received a few weeks ago has a different illustrative example than the one that I will use.

I wanted to use for this presentation the latest information, and the ones that would clarify the guidance best in our judgment. I want to begin by summarizing what I hope will be the message from my presentation, which is that at this point, the research and development effort on performance-based approaches, I believe, is over.

We have developed the necessary infrastructure and now it's time to move on to the implementation and execution. The guidance document provides the broad architecture for more case-specific applications.

It is meant to apply to all three arenas of agency activity, reactors, materials and waste. As you know, we've been working on this for some years now at the Office of Research, and personally I believe that the sum total of this work shows that the commission's direction on risk-informed performance-based approaches was the right way to go.

The direction and the strategic plan and the white paper on the risk-informed and performance-based approaches provided very high-level direction, which, as we have applied in specific cases, and put into practice, we find does provide definite improvement.

Of course, the strategic plan also has some cautionary notes on using performance-based approaches where appropriate, and that is also to be noted. Now, on regulatory coherence that John mentioned, the ACRS did get a little bit of a briefing on it in July.

To cut to the chase on this, it's basically the performance-based initiative will become part of the overall risk-informed and performance-based activity, eventually.

Of course, as you mentioned Mr. Chairman, the ACRS has been involved in this activity for some time. The high-level guidelines were approved and some recommendations were made two years ago.

So right now it is important that we get the feedback from the committee to know that we are on the right track closing out this activity, as it were.

I don't want to spend too much time on the historical background. As you all are well aware, it goes quite a ways back into DSI-12, et cetera, but we've been issuing just about every year a commission paper that brings the commission up to date on what has been happening.

Right now, there is a status report to the commission with the EDO, and it reports on the

milestones that we had developed last year, and the pilot projects that we were looking at.

We did make a commitment to develop user-friendly guidance, and that's essentially what we have done now. A communications plan was issued in April of this year.

I'd like to begin by addressing really why we need a guidance document. The high-level guidelines that we developed two years ago pose the question, what does a performance-based approach to a regulatory issue look like?

What are the attributes? And it drew from the white paper that the commission had issued. But it didn't offer very much guidance to people involved in specific projects on what kind of actions they should take in order to get from here to there.

What we have tried to do is use the theory that has been developed in the formal approaches to decision methods, and to apply it in order to really search for a systematic -- to put together a systematic search for performance parameters that will address the safety needs of a particular regulatory issue.

The first attempt we made at this turned out to be a highly formal and overly general

presentation of decision theory, and not sufficiently user-friendly.

So we went back, and what you have with you is really our second cut at this. But I believe that it is still based on the theory that has been developed, and is fully consistent in terms of terminology with the background theory.

What we intend to do with this document is make it a companion document to the regulatory analysis guidelines, which is a key supporting document to rule-making.

But the regulatory analysis guidelines also provide support to any new development of regulatory requirements. So we believe that when it becomes a companion document in the Management Directive 6.3, then it will provide the necessary framework within which staff would look into performance-based approaches for their activities.

The guidance document really provides an approach to regulation. As John mentioned, it focuses on asking certain questions. The information developed by answering these questions provide the basis for making regulatory decisions.

Now, the way the questions and the steps have been set up, we believe that it represents an

internally self-consistent way of meeting the objectives that the commission has set out in the risk-informed and performance-based approach.

I would note that the actual content of the guidance bears strong resemblance to formal decision theory, but there is a lot of flexibility in terms of how much formality and how much quantification would be required in going through these steps.

But the nature of the information is such that it naturally integrates risk-informed and performance-based regulation. It uses terminology that is really part of the literature, and so it should be able to be applied quite widely.

Now, the fact that the guidance document is somewhat simplified is not an impediment, we believe, because most of the regulatory issues that we believe the staff would undertake would be covered by the guidance document.

Now I'm going to use for illustration purposes three activities of the staff. At least two of them I'm sure the committee is much more aware of and much more knowledgeable about than I am.

But I don't want to become too absorbed in the examples themselves. I just want to use these to

clarify some of the guidance steps. The reactor oversight process is risk-informed and performance-based.

It covers one part of the regulatory framework. Another example that I'd like to call on is the rule-making that the staff has undertaken in 50.44, and that incorporates a specific performance-based approach for hydrogen monitoring.

This is in the proposed rule package that is out for public comment. I would also like to use as an example a rule-making package that is now out for 10 CFR Part 72. It has to do with independent spent fuel storage installations and monitored retrievable storage facilities.

This rule has to do with doing geological and seismological analyses for siting of these facilities.

MEMBER LEITCH: Are you contrasting here between the reactor oversight process being risk-informed than performance-based, and the hydrogen monitoring as being just performance-based? Isn't that also risk-informed?

MR. KADAMBI: Well, the rule-making itself is risk-informed and performance-based. I'm only trying to clarify certain of the steps in the guidance

document to show how we used the -- in the hydrogen monitoring aspects of this rule-making, certain performance-based aspects.

MEMBER LEITCH: I'm just trying to understand why in your first bullet you have risk-informed and performance-based, and on the second bullet you omit the words "risk-informed". I wondered if there's some significance to that?

MR. KADAMBI: No, I didn't mean to have any extra significance to that. It's just that one is much more developed. The others are sort of in process, as it were.

MEMBER LEITCH: Okay.

MR. KADAMBI: But I would categorize all of these examples as risk-informed and performance-based.

MEMBER LEITCH: Okay, thanks.

MR. KADAMBI: These and other examples have shown us that in order to pursue a performance-based approach, there isn't any magic formula or cookbook necessarily.

But what it involves is a systematic search for less prescriptive measures. But during this type of a search, the formalism that is provided by the high-level guidelines and the steps laid out in the guidance document we believe would be helpful to

bring about consistent application of the performance-based concepts.

Now in developing the actual steps of the guidance process, what we have tried to do is reflect on the life cycle of a regulatory issue. In a sense, a regulatory issue exists only after it has been assigned within the staff organization.

That implies that a certain arena, reactors, materials or waste, and within the arena the particular staff organizational elements. While management considers these aspects of it, there would also be some thought given to the performance goals that would be supported by the activity.

Generally, the instructions given to staff would capture the preliminary identification of performance goals and what are the end products. In theory, it could involve rule-making or any of the elements of the regulatory framework which the commission has identified in the strategic plan as covering a wide range, all the way from rules down to inspection and enforcement guidance procedures.

So, the basic idea is that some initial thought is given to, you know, what are the types of activities involved in the regulatory issue and its context?

The step two would be to identify the specific safety functions that would assure that, for example, that the maintain safety aspect of the staff's performance would be observed carefully.

In something like the reactor oversight process, the work that has gone on in terms of developing a structured approach I believe makes this easier to use. It represents something that could be applied to any reactor regulatory issue.

Now for something like hydrogen monitoring in the 50.44 rule-making, the kind of thinking that went into identifying the safety functions was part of looking into where in the framework the particular aspect that was chosen for a performance-based approach would best fit.

What we decided was that it fits best in the regulatory guidance, for example. So that's where the hydrogen monitoring is, in fact, captured.

For something like the ISFSI, the concern over there is related to what could happen under earthquake situations, because that's the central issue that was being dealt with, siting and considering seismological factors.

The kinds of safety functions that were considered, stability again, soil liquefaction,

sliding of the casks, and displacement, those were the sorts of things that went into identifying the safety functions.

CHAIRMAN APOSTOLAKIS: Well, I have a question here, Prasad. It seems to me that the definition of the safety functions is critical here, because your safety margins in the next step are tied to this. Right?

MR. KADAMBI: Certainly, yes.

CHAIRMAN APOSTOLAKIS: And then the performance parameters and so on. So this is really critical. As you know, the term "safety function" is not well-defined.

I mean, a safety function is cooling the core, or a safety function could be hydrogen monitoring, right? All these are under the general term of safety function.

I wonder whether you should draw people's attention to this fact, or maybe become a little more specific, because the safety margins, especially, that you mention later --

Maybe I should let you cover that, too, and then I'll make my comment. Go to the next slide. Safety margin could be, you know, how much margin do I have before I have core damage?

Or it could be, how much time do I have before I lose some minor system? In fact, in your example in the guidance, you mention the spent fuel pool, how much time do I have before the water starts boiling away?

Well, yes, that could be an objective, or a safety function, or something later. When the ACRS in the earlier letter said that the performance levels and the parameters should be set at the highest practical level, I think that recommendation is tied to this comment.

What is a safety function? What margins are we going to be dealing with? I mean, is it core damage? Is it reactors losing the ability to cool the core? Or is it before that losing high-pressure injection?

I mean, the whole thing -- I mean, defining those would make a big difference, would it not?

MR. KADAMBI: If I may draw your attention at this point to the guidance document itself under step two, what it says is --

CHAIRMAN APOSTOLAKIS: Page? Page? Tell us what page.

MR. KADAMBI: Oh, that's page nine.

CHAIRMAN APOSTOLAKIS: Page nine. That's in the document now. That's tab nine? You said what page, I'm sorry?

MR. KADAMBI: Page nine.

CHAIRMAN APOSTOLAKIS: Nine, yes. That's where my questions are.

MR. KADAMBI: It says, step two is identifying the safety function, and the purpose is to identify the safety functions and systems that affect the regulatory issue.

So, the attempt over here is to focus in on the particular nature of the level at which the regulatory issue has arisen, and to consider the safety functions at that level.

But it doesn't mean that the other levels will not be considered. For example, if you look at the reactor oversight process, it would be which cornerstone would be affected. And what are --

MEMBER WALLIS: It's still very vague. It's still verbal. What you really need is a metric for the safety function and you need a mapping of that metric onto risk.

You need something like, if you maintain the level in the core, you need a measure of that level, and you need to say what's the risk implication

of having the level of a certain amount? That's what you need.

This document is good, but it's still at a qualitative, verbal level.

CHAIRMAN APOSTOLAKIS: I thought the intent was one of saying if I rely on a performance-based, by the time I find a degraded performance, I still have margin.

MR. KADAMBI: Exactly. That is what I'm sort of getting to, but before we start even looking at margins and what performance parameters will give us assurance of the margin, we want to be much more clear on what are the safety functions that we are most concerned about in dealing with this regulatory issue.

So, I mean, I take your point that the level -- and by this I don't mean the water level, necessarily. It is the level in the hierarchy of the value --

MEMBER WALLIS: No, I was not confusing the two levels.

MR. KADAMBI: Oh, okay. I wasn't sure if I understood you.

MEMBER WALLIS: No, no, I understand the hierarchical level and the water level.

MR. KADAMBI: Okay. Well, that's why in step two, it's more of a general characterization of the regulatory issue itself, and identifying the equipment systems, what procedures are affected and things like that.

So we haven't really gotten into the exploration of the performance-based --

MEMBER WALLIS: But the margin is a very waffly sort of term. If you're standing on the edge of a cliff, and you've taken a step forward of one foot, then you go over the cliff.

But if it's a slippery slope, with an increasing slope then it's a different definition of how far you can go without getting into trouble. You have to define these things in some more than just "word" way in order to know what you mean by "margin".

MR. KADAMBI: Right. The one thing that is very clear about margin is that it is very context-specific. That's why considering that this is a document that is meant to apply to all three arenas of regulatory activity, one doesn't want to get too specific about it.

But what is important, I believe, is to communicate the concepts. What I've drawn on is the direction in the white paper that, you know, you have

to set up your performance-based approach in such a way that even if you violate a parameter, you don't get into an immediate safety concern.

So that is how close you are to a cliff.

MEMBER WALLIS: Yes I had a bit of trouble with that criteria, and what you meant by it.

MR. KADAMBI: Okay, the way I have integrated that for the purpose of this guidance is to say that there are two kinds of margins. There's a physical margin and there's a temporal margin, where you have time to take corrective action.

In other words, if you have certain parameters that you would be monitoring, and you have made sure ahead of time that there is margin within that parameter, and if you find that whatever criterion you've set has been violated there's still time to back away.

MEMBER WALLIS: But that probably isn't the cliff either. I mean, to say the operator has 30 seconds to take an action doesn't really reflect what would happen if he took 31 seconds. The consequence of it.

So I guess you have to look at -- If you want to be more elaborate, at a deeper level of understanding or specification, you'd have to look at

those sorts of things.

MR. KADAMBI: I fully agree with you that when you're dealing with things where 30 and 31 seconds may make a difference. It's a different kind of situation than --

CHAIRMAN APOSTOLAKIS: Let me give you another example. Several years ago someone argued that this agency is charged by Congress to protect the health and safety of the public.

So this agency really should focus on level 3 PRAs, individual risk, and societal risk. What happens inside the plant is none of its business. As long as the individualist level is kept up --

And of course that view was rejected outright. But why not? Why? I mean, that's a margin. I can always measure how much time I have before I kill somebody.

Why isn't that a reasonable way to proceed?

MR. KADAMBI: I believe that whatever margin there might be would be too difficult to monitor from a regulatory standpoint.

CHAIRMAN APOSTOLAKIS: For that particular objective. Okay, so, we go down then to core damage frequency. Why can't the core damage frequency be the

margin for reactors? I mean, the objective.

MR. KADAMBI: Well, I mean, to some extent it can be and I believe it is used in many ways for the reactor oversight process. But it is used in conjunction with other performance parameters also.

Whether it's performance indicators or the whole inspection program and you know --

CHAIRMAN APOSTOLAKIS: You mentioned the cornerstones. Why can't we say the reactors -- it's the cornerstones. You should measure your margins from the cornerstones.

If we made such a blanket statement, what would be wrong with that?

MEMBER BONACA: Well, the way I see it, it's the thresholds, in fact, represent the performance-based criteria. They give you a measure of the margin. The more you get to a certain degradation level, your margin has been reduced enough that you say it's not good enough.

So, to some degree it does that.

CHAIRMAN APOSTOLAKIS: Well no, that's not margins, that's peer comparison. That's not margins. The margin is on the SDP. The SDP really measures the margins, the significance-determination ones, from core damage.

MEMBER BONACA: Yes, well, you get to 20 SCRAMs or 23 SCRAMs... I'm only saying you have a measure there.

CHAIRMAN APOSTOLAKIS: But that's a measure of peer performance, how well you're doing with respect to your peers. It's not a margin. The significance-determination process is a margin.

MEMBER BONACA: The way the evaluation data, it is --

CHAIRMAN APOSTOLAKIS: That's why it's wrong.

MR. GRIMES: Dr. Apostolakis, my name is Chris Grimes, and I would like to emphasize that this guidance is developed in order to assist the staff in developing requirements.

As Prasad pointed out, there's a context-sensitivity to that, and he's provided a nice range of examples of how the margin is relative to the purpose. We would like, in a risk-informed and performance-based environment, to be able to look at the particular regulatory need that's being served.

We do look at margins to core damage, or to LERF, when we're talking about the oversight program and we're looking across a very broad program for which we have performance measures directly to the

agency's performance goals.

That is, to maintain safety, to be efficient and effective, to reduce unnecessary burdens. So the cornerstones provided us with that link at a very high level.

But then if you go down to the specific circumstances where the commission directed us to take action, for combustible gas control requirements, in that instance we're looking at examples of --

The margins associated with measuring hydrogen and what does that mean? Ultimately they need to be related back to containment function. Because that is the safety function associated with combustible gas control and its import to the overall public health and safety.

So, for the purpose of a process guideline, this guidance is necessarily flexible in terms of reminding the user that it's their responsibility to go look at the regulatory purpose they're trying to serve, in much the same way that NUREG/BR-0058 provides regulatory analysis guidelines on how one does a cost-benefit calculation relative to averted person-rem exposure.

So I think that we appreciate that there are margins and there are margins, and that part of

the responsibility for the user of this guidance is to make sure that they're being very clear about what margin they're talking about.

CHAIRMAN APOSTOLAKIS: I understand that, but the question is, if you have such flexibility regarding the objectives, then is it reasonable to have this requirement that you should have sufficient margins?

I mean, if I define an objective at the very low level, why should I have sufficient margin? The whole idea of the original definition of performance-based regulation was that you don't want to define your performance criteria at the level so that if they are violated you are in trouble.

MR. GRIMES: Right.

CHAIRMAN APOSTOLAKIS: Right. So I can see that with core damage and maybe LOCA, you really don't want to say, 'Gee, we didn't perform well and a LOCA is imminent.'

No, I don't want that, because LOCA is at a certain level. But if I go down and I have other objectives at a fairly low level, I don't see why I should have sufficient margins for those.

If they're violated it's no big deal. See that's the interplay.

MR. GRIMES: I understand, and I think that that actually argues in favor of there needs to be a necessary flexibility in terms of the user might conclude that you don't need a lot of margin. You may not need any margin.

CHAIRMAN APOSTOLAKIS: Can we make that clear in the document, though? That's what I'm saying. I mean, I'm not really -- I think the steps you have already is enough.

The things that the user probably will have to scratch his or her head at all trying to amend this, and then it has to be made clear that at sufficient margin it's something that is also flexed.

It depends on where the objective is.

MR. KADAMBI: I think the reactor oversight process in many ways reveals the kinds of issues that you're raising, because of its structure, and because of the ability to observe how margins that are set at a low level do, in fact, get reflected in other metrics higher up.

In a sense, the success of the reactor oversight process shows how that kind of a structured approach should be practice elsewhere, and really that's what this is driving at.

Developing the appropriate kinds of

metrics --

CHAIRMAN APOSTOLAKIS: Not all of us are convinced that it is a successful process. Especially in light of the developments over the last several months at the particular plant.

So I don't know that I'm buying the argument that the success of the process shows. I have doubts about it. But I agree with you that this is probably the only process in the agency that has stated explicitly what its objectives are.

That's probably a true statement.

MR. KADAMBI: And that's really what I'm --

CHAIRMAN APOSTOLAKIS: With the cornerstones -- You're right there, there's no question about it.

MEMBER WALLIS: That's a profound statement. It's the only process in the agency that has stated its objective?

CHAIRMAN APOSTOLAKIS: That's what I think. Now making statements like that is always risky.

MEMBER WALLIS: That's a dangerous statement.

CHAIRMAN APOSTOLAKIS: Because I remember how much effort it took to have the staff develop the hierarchy, you know, that goes down to the

cornerstones.

I'm sure the objectives are not unwritten, but this is probably the only place where they're actually explicitly stated. Well, I personally would like to see some elaboration, maybe a paragraph, reflecting this discussion.

Is that out of the question?

MR. FLACK: I think we could --

CHAIRMAN APOSTOLAKIS: That's all I'm saying. I mean, it's not -- But some -- Help the user, in other words. There are issues here, and what margin means is not always well-defined. It's tied to the level of the objective.

Because remember, one of the reasons of desiring to move towards performance-based regulation is to give flexibility to the licensee. So if you say, 'Well, we had a problem before, but then we asked them to do this, and this and that. Now how do I preserve this, this, and that, but not call it performance-based?'

Maybe you're defeating the purpose. You have to go higher, right? Like the maintenance rule on availability.

MR. KADAMBI: Well, there are competing objectives over here. As I mentioned that our first

attempt at this didn't turn out to be quite a success because, as I recall, we started with constructing a value tree, because that's where you start to think about some of these things.

When you think about making a user-friendly process, we have tried to avoid getting the user sort of faced with terminology that they may not be familiar with in their day-to-day work, and therefore unable to apply the guidance at all.

So, I mean, this is an attempt to --

CHAIRMAN APOSTOLAKIS: I think that's fine. All I'm saying is, we've had this discussion.

MR. KADAMBI: Sure, sure. I think we will certainly do what we can to --

CHAIRMAN APOSTOLAKIS: There may be these issues as you try to identify safety margins and safety functions, that it's not a straightforward thing.

MR. KADAMBI: Oh, absolutely.

CHAIRMAN APOSTOLAKIS: Maybe in reactors they have an advantage over the rest of the agency, because they have already defined certain things. But this is something that is not --

Like, I'll give you another example. When Quad Cities came up with five or six tenth to the

minus three core damage frequency because of that fire analysis they did. Everybody reacted immediately. The agency sent people there, and the utility ordered a shutdown of the plant.

It turned out that the analysis was off a little. But that's the information we had at the time, right? We had to act on that. I'm really thinking about the margins, though. Really think about it.

Even if it is $5/10^{-3}$. That means that over a year, right, on the average, I have 200 years before I get into trouble. I get the inverse.

MEMBER WALLIS: With one particular plant.

CHAIRMAN APOSTOLAKIS: Yes, it's about 200 years. Now that doesn't sound to me like it's an imminent disaster. And yet we all reacted, and you know why? Because we're biased.

We're all thinking in terms of CDF, and the moment you see 10-3 you think that disaster is hitting you next week. But really if you look at it with a cool eye, you say, you know, okay I have to do something, but I don't have to fly out --

MEMBER ROSEN: Yes, I agree with you George, but there's also the question of uncertainties and how one deals with that.

CHAIRMAN APOSTOLAKIS: Okay, so instead of

200 years, maybe under conservative assumptions it's 50? It's still something that's not imminent.

MR. GRIMES: But -- this is Chris Grimes. I agree with you, and from my perspective, as we try to look at how are we going to integrate the risk-informed guidance to the staff, and how they go about trying to improve on the Reg Guide 1.174 thinking, and the performance-based guidance to the staff, which really fits better into the rule-making process where we talk about the way that requirements are constructed.

There is a construct to where is this guidance about treatment of margins and the importance and values associated with the particular regulatory issue at hand, which is what this guidance speaks to.

Where does that best fit so that it's recognized by the user? I could argue that we could put it almost anywhere. We could put it in a risk-informed guidance, we could put it in the performance-based guidance, or we could put it in the rule-making process handbook that's going to try and bring the two together.

That's why we said that we felt it was important to put coherence around all this stuff and explain how these things work together. Quite frankly,

I think that in the long run, the explanation that you've just described needs to be articulated, and will be, it's just a matter of --

And where will do that in the best possible way?

CHAIRMAN APOSTOLAKIS: Anyway, my comment was maybe some elaboration would be helpful to the user.

MR. FLACK: Yes, we'll take that --

CHAIRMAN APOSTOLAKIS: By the way, John, what it comes down to is really bias. It's very interesting, human perceptions. It's very interesting, the Nobel Prize in Economics was awarded to Professor Kahneman yesterday who wrote the pioneering paper, "Biases," in 1974.

I think we have a tremendous bias here. We think that if the core damage frequency goes to $3/10^{-3}$ boy, we were really about to die, without thinking that we're talking about a rare event. It's still a rare event.

MR. FLACK: That's a bigger issue, though.

CHAIRMAN APOSTOLAKIS: It is a bigger. We will not resolve that here. Mentioning Nobel prizes is an achievement already. So the other thing is, two, three and four, the steps are really tied together.

MR. KADAMBI: Yes, they are, and in fact, going from two to three to four, is where we get into implementing the recommendations of the ACRS, which is basically if you know that margin exists, and that the margin is verifiable through performance parameters at the appropriate level in the hierarchy, then some degree of flexibility should be considered as part of resolving this regulatory issue.

That's really what the staff would be drawn into by these steps.

CHAIRMAN APOSTOLAKIS: One other thing, Prasad. Should there be any discussion in connection with the parameters of how easy it is to confirm that margins have been exceeded and so on? Wouldn't that be an issue?

MR. KADAMBI: I think that would be an issue in terms of a more formal treatment of where you would identify the parameters and what are the trade-offs involved in the specific level that you would choose.

The thing is I'm still trying to deal with the broad range of issues that cover most of the staff's activities, and again, I keep getting drawn into having the perfect not become inimical to accomplishing what I believe we can.

CHAIRMAN APOSTOLAKIS: It's not a matter of perfection, it's a matter of drawing attention to the issues. This is really not a trivial matter.

MR. KADAMBI: No, it is not.

CHAIRMAN APOSTOLAKIS: I don't know, maybe you do that already, but I didn't --

MR. FLACK: Well, I think it's part of the process. I mean, when you come up with the target, performance, and it's not meeting its target, either you've chosen the wrong target, performance-level, or there's something wrong that needs to be fixed.

I think that's part of the whole process.

CHAIRMAN APOSTOLAKIS: Well what I'm saying is you have on page 10 three bullets, step four. The middle one says can objective criteria be developed either indicative of process and permit corrective action.

There, perhaps, you can ask, can it be clearly demonstrated that the objective criteria have been met or not? Draw attention to the fact that confirming that may not be a trivial matter. That's all.

MR. FLACK: You have to think about that.

CHAIRMAN APOSTOLAKIS: Yes, you have to think about that. In some instances, if it's a

deterministic calculation, it's probably okay, but when you bring in now uncertainties, it's something that you want to think about.

MR. FLACK: Okay.

CHAIRMAN APOSTOLAKIS: So now that we almost destroyed your presentation, you want to go back to it?

MR. KADAMBI: Well, no, actually I mean --

CHAIRMAN APOSTOLAKIS: You're done?

MR. KADAMBI: The purpose of the illustration is served by the examples that you have brought up. I believe it clarifies the specific steps.

CHAIRMAN APOSTOLAKIS: Right. Now, another thing that's fascinating here is you say that there's NUREG report someplace that is really decision theory-based?

MR. KADAMBI: Well, we are in the process of --

CHAIRMAN APOSTOLAKIS: Did you do that just to make me write a good letter here, or is it really true?

MR. KADAMBI: Well, I mean, if it brings about a good letter I will not complain.

(Laughter.)

MR. KADAMBI: But the fact is that we've

been working on this. As I mentioned, our first attempt at preparing one document got sort of side-tracked, because it turned out to be too difficult.

Now what we see is that formal decision methods also has applicability elsewhere in the kind of work we are doing in the Office of Research. And so trying to capture all of this methodology in one NUREG document that would be applicable to the sorts of activities in the Office of Research and elsewhere in the agency seems like the right way to do it.

Anyway, if I could just keep going. Step five is, of course, the deliverable of the whole process in the sense this is where the output of the guidance document results in an alternative that can be compared with other alternatives that might be developed using other approaches and subjected to the kind of decision-making choices.

MEMBER BONACA: I had a question on that, the chart in figure one? The flow chart? The way it's put together gives the impression that you get into one of four possible alternatives and you evaluate all of them.

It seemed to me that the traditional approach would be almost the default approach. What I mean is that you're attempting to move from a

traditional approach to risk-informed and performance-based, or risk-informed, or performance-based.

If they are not viable because of not enough margins or whatever, you would default to the coordinate approach?

MR. KADAMBI: Yes, certainly. That's the way it was meant to work.

MEMBER BONACA: It doesn't convey that message, and I think the text probably does, but I would assume the traditional approach not put together with those. I would have liked to see it more as a default approach, which is, if none of the others are viable then you stay with what you've got.

MR. KADAMBI: Well, okay, that's the intent then. If it needs to be clarified --

MEMBER BONACA: Well, it's just a suggestion.

CHAIRMAN APOSTOLAKIS: And since you're on the figure, I have a couple of comments on the figure myself.

MR. KADAMBI: Sure.

MEMBER BONACA: Just to complete, because I think the intent of this is to go performance-based and risk-informed, right?

MR. KADAMBI: Yes. I mean that's the

direction of the commission --

MEMBER BONACA: Absolutely.

MR. KADAMBI: -- is to pursue --

MEMBER BONACA: So, yes. It's a suggestion. I would have liked -- Yes. Anyway.

CHAIRMAN APOSTOLAKIS: At the top, you have four boxes. On page 8, tab 9. Operating Experience, Commission Directions, Stakeholder Suggestions, Staff Initiatives.

I can understand how the last three lead to the NRC identifying their modification, but the operating experience itself would not do that. The operating experience will do it through staff initiatives or commission direction.

So I would suggest that you drop that box. Operating experience is just information, right?

MR. KADAMBI: Well, maybe it's something that feeds into --

CHAIRMAN APOSTOLAKIS: It feeds into stuff, yes. But it's not at the same level. And also I don't understand the last arrow back from Define Proposed Modification near the bottom?

You have an arrow that goes back to this box that contains three other boxes.

MR. KADAMBI: Well, the idea of the shaded

box is really to point out stakeholder involvement. In other words, if there is a --

CHAIRMAN APOSTOLAKIS: So that's an economic process, that's what you want to say.

MR. KADAMBI: That's right. That's all.

CHAIRMAN APOSTOLAKIS: I mean, the way it is now it means that you're going there forever. Whereas, on the left, where you have another arrow going back, you have a box the selected option does not meet.

So when it doesn't I go back. But here I don't know when I'm going back and when I proceed down to Developing Regulatory Framework. Under what conditions do I keep going down and up then back?

Some explanation --

MEMBER BONACA: I think Stakeholder Involvement should be attached to that arrow back up.

CHAIRMAN APOSTOLAKIS: If necessary, or if there are still disagreements with the stakeholders, or something.

MR. KADAMBI: If I may, Mr. Chairman, this picture has come up in two other papers before. In fact, it first came up in the paper in the year 2000, SECY-00-191, and then it came up again in one of the risk-informed regulation implementation plans that --

There was more guidance offered in those, perhaps, so I'm sort of relying on a continuing thread of, you know, here's roughly the way things are --

CHAIRMAN APOSTOLAKIS: Well, typically though, hewn you have an arrow that takes you back, there is some explanation why. Otherwise, it is no --

MEMBER SHACK: There's a decision box. What is the decision?

CHAIRMAN APOSTOLAKIS: Yes, exactly. What is the decision? I mean, the stakeholders are unhappy, or something.

MR. FLACK: We'll put a smiley face in there.

CHAIRMAN APOSTOLAKIS: Okay.

MR. KADAMBI: But anyway, as I mentioned, developing the performance-based alternative based on the information that we have developed is the whole point of it.

At the end of it, this alternative would be compared with other, perhaps, it could be a traditional approach, but that also offers an alternative.

CHAIRMAN APOSTOLAKIS: And of course, you had to bring defense in depth into this, right?

MR. KADAMBI: Well, that is definitely part

of considering --

CHAIRMAN APOSTOLAKIS: So at which line here you are asking what if I am wrong?

MR. KADAMBI: Well, yes, I mean it really begins with have you defined the safety functions correctly? It is meant to be an iterative process. It's not just marching through the steps.

Anyway, this brings me to where we are in the process that was started two years ago with the high-level guidelines that we developed, we published. We have tried to maintain fidelity what was done through public interaction then.

At that time, if you recall, we proposed that there be two groups of guidelines. Viability guidelines, which basically address whether a performance-based approach can be developed. Assessment guidelines considering whether it's worthwhile to do it.

Then sort of a check on, you know, let's look at all the commission's principles and just make sure that we're not doing something inadvertently. What we've said is that the only changes we are making from that structure that we published is that because of the importance of the margin, if you look at the formal guidelines in Appendix A in the document, it

puts margin first, and it used to be last, in the first publication of it.

The other thing that we've done differently is that we've given much more prominence to the possibility of having qualitative attributes considered within the performance parameters.

Other than only look at measurable or calculable, which is what the white paper said. So other than that, it's basically the same.

CHAIRMAN APOSTOLAKIS: But isn't that going against the idea of performance-based? What do you mean by that?

MR. KADAMBI: Well, I mean if you can use parameters that can be sufficiently, clearly constructed.

CHAIRMAN APOSTOLAKIS: Oh, the structure. Yes, yes, yes. I see what you mean.

MR. KADAMBI: So, anyway, it's basically just going through the various steps in order to arrive at a judgment on the net benefit, and propose an alternative based on that.

So let's see. In conclusion, really, the point that I'd like to make is that we are really at the stage where we ought to be much more broadly implementing performance-based approaches.

We are looking for ACRS support in this. We believe that the regulatory coherence activities will be the place where all of these will come together. There is an interoffice group called the Risk Management Team, which will have oversight responsibility in this.

For many of the tougher issues that are perhaps not covered by this guidance document, we do intend in FY '03 to develop this NUREG document. So that's my presentation, Mr. Chairman, and any questions.

CHAIRMAN APOSTOLAKIS: Any questions from the members? Okay, well, there are a couple of things that I don't understand in the report. Like --

MEMBER WALLIS: Well, I guess I have a question for you. I think this is a very useful document, but presumably it's driven by some need. You've got this figure one which shows Operating Experience, Commission Directions, Stakeholder Suggestions, Staff Initiatives, initiating all this effort.

What is the magnitude of this driving force? I mean, is it likely to come up with requests for 100 performance-based regulations to appear next year or one or zero or what? What's the size of this?

MR. KADAMBI: Well, the commission has said in the strategic plan that in each of the arenas we should consider risk-informed --

MEMBER WALLIS: I know they said that, but what's the reality of whether it's going to happen or not?

MR. KADAMBI: Well, I mean, up to now what we have heard is that these concepts of risk-informed and performance-based regulation presents certain difficulties which has prevented more of the regulatory activities being covered by this.

We still see in the regulatory activities plan a number of activities identified as risk-informed and performance-based, so hopefully at least those will then come under the purview of this.

MEMBER WALLIS: So there are a few in the pipeline?

MR. KADAMBI: Yes. I mean, they have been identified already.

MEMBER WALLIS: There isn't a great clamor from next door for you to get on with it and do more of this, or is there?

MR. KADAMBI: Well, I mean, I guess I am not in a position to answer that question.

MR. GRIMES: This is Chris Grimes. I'll

venture an observation. I think the drivers for regulatory change aren't going to be substantially effected by this guidance.

I think that the guidance is going to be more useful and better served in the rule-making process and in the regulatory guide process. By pointing the staff to a better way to come up with criteria, it's conceivable that when this guidance is published, some of our traditional petitioners might be stimulated to think of some new and better ways to do things.

But I don't see it doubling or tripling our petition workload. I think that the staff initiatives are going to continue to be driven largely by commission direction and the review of operating experience.

MR. KADAMBI: Well, thank you very much Mr. Chairman.

CHAIRMAN APOSTOLAKIS: Thank you. It was very useful. Well, we have a couple of minutes. I really need advice from the members what to put in the letter.

So what is your -- Should it be a short letter endorsing it and making a few comments, or what?

MEMBER SHACK: Yes, I mean I think the process -- I think we're all in general agreement with the process. It seems to me the guidance is useful and I think the difficulty will always come with specific application.

We've been on a performance-based steam generator regulation for as long as I've been on the ACRS, and we'll probably be going on with it when I leave.

CHAIRMAN APOSTOLAKIS: But this will help a little bit of course.

MEMBER SHACK: It'll help, yes.

MEMBER SIEBER: It's not cast --

CHAIRMAN APOSTOLAKIS: It's just a new -- So we will improve as --

MEMBER SIEBER: I think they're in a learning process now. Let them learn.

MEMBER SHACK: I think it will have more important implications as we think ahead to future reactors, where we're not so -- We're pretty well fixed now, but you know, in our whole discussion yesterday, I think that to me it will be very useful in the way we ought to think about future reactor regulation.

But to go back and -- Regulatory stability

is a quantity that we frequently unappreciate on the ACRS. We're too rationalist, even those of us who are structuralists.

(Laughter.)

CHAIRMAN APOSTOLAKIS: Any other comments from the left? Graham?

MEMBER WALLIS: Well, I think it's a useful document. I think it's a good start. I sort of agree that we need to see more examples of the implementation.

We've got a few examples, but not really enough. But I think it's a good thing to do at this stage.

CHAIRMAN APOSTOLAKIS: Vic?

MEMBER FORD: I agree, assuming the commission wants to have it. This could be a regular -- by the time we got some --

The commission have said that this is the way we should go, I think it's a great way to go. About time we had some regulations and actions. The quicker the better.

CHAIRMAN APOSTOLAKIS: Steve?

MEMBER ROSEN: I have nothing to add.

CHAIRMAN APOSTOLAKIS: Okay. But you gentlemen would not object to saying these nice things

and then saying we also suggest or recommend that the staff emphasize the issue of the definition of margins, that this would be a difficulty, especially since they are planning to cover all the agency activities.

Maybe some discussion would be justified at this point, but we'll add more as we do it. And the other is the issue of demonstrating that the criteria have been met or violated. That needs some discussion.

I wouldn't go into the figure unless you insist, because that's a -- you know, they got the message.

MEMBER WALLIS: Keep it short.

CHAIRMAN APOSTOLAKIS: The letter will be short, yes. I'm not even sure it's worth putting bullets with conclusions and discussions. I mean, it would be just like the old letters, two or three paragraphs.

Any other comments? It is not necessary to have comments.

MEMBER POWERS: We'll probably have added comments.

CHAIRMAN APOSTOLAKIS: Why? Yes sir.

MEMBER SIEBER: I think it would be interesting to observe how the staff identifies what

margin they have, because I don't think that they know in every case.

CHAIRMAN APOSTOLAKIS: Exactly. And now we don't need to see this document again, right? We're just making comments, and it's up to the --

MEMBER SHACK: We'll see the fruits of it, I suspect, again and again.

CHAIRMAN APOSTOLAKIS: Yes. We don't need to see it again, but we trust that you will take this into consideration, the comments.

MR. FLACK: We certainly will.

CHAIRMAN APOSTOLAKIS: Good. So, essentially it seems that we have a letter that will be along these lines. Okay? So I'll try to draft something with Gus' help.

I don't know if we can come back to the committee later today. If it's a short letter, probably we will. Definitely tomorrow, because I can't come to you two days from now.

MEMBER SIEBER: One last question.

CHAIRMAN APOSTOLAKIS: Yes.

MEMBER SIEBER: What do the initials "B.R." stand for on the -- ?

CHAIRMAN APOSTOLAKIS: Brand something. B.R.?

MR. KADAMBI: That is supposed to stand for Brochure, actually, abbreviated B.R. That's what the formal guidance on documents from the commission says. But the sense in which I'm using it is to say that it is a companion to the regulatory analysis guideline, which has a NUREG/BR notation on it.

So it is just to keep it in the same notation.

MEMBER SIEBER: So the linkage is tenuous.

CHAIRMAN APOSTOLAKIS: Okay, thank you very much gentlemen. Appreciate it. Now the next item is really very short, so let's do it. Reconciliation, I think there is only one reconciliation.

Is that yours, Tom?

MEMBER POWERS: Mr. Chairman?

CHAIRMAN APOSTOLAKIS: Okay, what?

MEMBER POWERS: I have two items that perhaps would be of interest to the committee. I have pictures of a fire that went on Monday at Watts Bar. I don't know any of the details, except that it's burning.

MEMBER KRESS: That was a Watts Bar hydroelectric plant.

MEMBER POWERS: Hydroelectric plant, yes. It looks like it's over on the switch yard someplace.

MEMBER ROSEN: Not in the nuclear yard.

MEMBER KRESS: That's inside the operating building.

MEMBER POWERS: Is it?

MEMBER KRESS: Yes.

MEMBER SIEBER: It's about 30 miles away or something like that.

CHAIRMAN APOSTOLAKIS: And the second one?

MEMBER POWERS: And the second item is, I've gotten some word on the schedule for the (phonetic) workshops, that they will hold for the ACR reactor. The core physics and fuel channel workshop in the first week of December will be at Chalk River.

Thermal hydraulics will be held at Winnipeg, pending the level of interest in touring the full-scale test facility. The rest of the sessions they're planning to have in Rockville or the Washington, D.C., area.

MEMBER FORD: Winnipeg in the middle of winter?

MEMBER POWERS: A guy that lives in Vermont cannot complain about that.

CHAIRMAN APOSTOLAKIS: When you say you have pictures of the fires, so will you just pass it around?

MEMBER POWERS: Okay.

CHAIRMAN APOSTOLAKIS: And we can do this at the same time. We can do two things at the same time. And if you give us a piece of gum, we do that too. Okay, tell us what you want to do.

MEMBER KRESS: All right, this reconciliation has to do with our letter on the risk metrics and criteria for re-evaluating the technical basis of the pressurized thermal shock groove.

And we in our letter had made a couple of comments. Mainly it was that the proposed options that they chose for the acceptance criteria did not properly reflect the potential impact of an air oxidation source term on risk.

And they basically agreed with us and said, "Yes, we agree." They're going to go plan to make additional studies, the outcome of which we'll learn about later. So, as far as I'm concerned, that's acceptable.

CHAIRMAN APOSTOLAKIS: Okay.

MR. BOEHNERT: Mr. Chairman?

CHAIRMAN APOSTOLAKIS: Yes.

MR. BOEHNERT: Do you want this on the record? I think the woman's still recording over there.

CHAIRMAN APOSTOLAKIS: Let me think. There is nothing in the afternoon that should be recorded, right?

MR. BOEHNERT: Yes, but you're being recorded right now, too. I don't know if you want that.

CHAIRMAN APOSTOLAKIS: I know. So we are done with the recording. Thank you.

(Whereupon, the foregoing matter went off the record at 11:38 a.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, 496th Meeting

Docket Number: N/A

Location: Rockville, Maryland

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

/s/ Matthew Needham

Matthew Needham
Official Reporter
Neal R. Gross & Co., Inc.

LOW POWER/SHUTDOWN SPAR MODEL DEVELOPMENT

PATRICK D. O'REILLY (301-415-7570)
OPERATING EXPERIENCE RISK ANALYSIS BRANCH
DIVISION OF RISK ANALYSIS AND APPLICATIONS
OFFICE OF NUCLEAR REGULATORY RESEARCH

PRESENTATION TO ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

OCTOBER 11, 2002

OUTLINE OF PRESENTATION

- Low Power/Shutdown (LP/SD) SPAR Model Development Program Plan.
- Onsite QA Review of LP/SD SPAR Model for Surry 1 & 2.
- Cancellation of Revision 4i SPAR Model Development.

LOW POWER/SHUTDOWN (SDP/SD) SPAR MODEL DEVELOPMENT PROGRAM PLAN

BACKGROUND

FY 1996:

- Produced PWR (Surry) LP/SD SPAR Model:
  - Based on Detailed Surry Shutdown PRA Developed by NRC/BNL (NUREG/CR-6144).
  - Developed for use with DOS version of SAPHIRE.
  - Not user-friendly.
  - Not peer reviewed.
  - Adapted Human Reliability Analysis (HRA) methodology from full power (Revision 3) SPAR model development effort for use in LP/SD SPAR models.

BACKGROUND (Continued)

FY 2001:

- Produced BWR (Grand Gulf) LP/SD SPAR Model
  - Based on Detailed Shutdown PRA Developed by NRC/SNL (NUREG/CR-6143).
  - User-friendly.
  - Compatible with Windows-based SAPHIRE/GEM.
  - Internal peer review of model.
- Developed LP/SD SPAR Model Specification, Prototype Templates, and Associated Guidelines for Developing Other LP/SD Models
  - Received technical guidance from interoffice SPAR Model Users' Group (SMUG).
  - Determined usefulness of current LP/SD models originally developed for ASP Program for current applications.

BACKGROUND (Continued)

FY 2001:

- Reviewed LP/SD events analyzed in ASP Program to determine if model content was sufficient to address these event types; identified necessary changes.
- Met with SMUG and key model users to identify users needs and desired model characteristics.
- Developed and Demonstrated Prototype Templates to SMUG:
  - All PWRs.
  - BWR 5/6s.
  - BWR 4s.

LP/SD SPAR MODEL TEMPLATE FOR PWRs

- Starting Point for Developing a Plant-Specific LP/SD Risk Model That Includes Core Damage Risk Resulting from:
  - Loss of RHR events.
  - Loss of offsite power events.
  - Loss of inventory events.
- Essentially a Working LP/SD Model with No Plant-Specific Fault Tree Logic
  - Event trees generally applicable to all PWRs.
  - Some fault trees also generally applicable to all PWRs.
  - Remaining fault trees include undeveloped events in place of the logic required to model system failures at any particular plant.
  - To expand the model to represent a particular plant - expand undeveloped events into appropriate fault tree logic.

EXPANSION OF TEMPLATES INTO LP/SD SPAR MODELS
Lead Plants

- **Identified Lead Plants in Eight Plant Classes (Classification Consistent with Revision 3i SPAR Models):**
  - **Millstone 3**
  - **Byron 1 & 2**
  - **Oconee 1, 2, & 3**
  - **Millstone 2**
  - **Palo Verde 1, 2, & 3**
  - **Peach Bottom 1 & 2**
  - **Surry 1 & 2**
  - **Grand Gulf**
- **Start with Existing LP/SD SPAR Model Template**
  - **PWR**
  - **BWR 5/6**
  - **BWR 4**

EXPANSION OF TEMPLATES INTO LP/SD SPAR MODELS
Lead Plants (Continued)

- Add All System Fault Tree Logic from the Corresponding Revision 3i SPAR Model.
- Add All Basic Event Information from the Revision 3 SPAR Model.
- Revise LOOP and EDG Recovery Probabilities to Reflect Longer Recovery Times during LP/SD.
- Modify System Logic so that System Configuration is Properly Represented in Each Plant Operating State Group (POSG).
- Review System Success Criteria.
- Add New Test and Maintenance Events and Modify the Values to Reflect LP/SD Conditions.

EXPANSION OF TEMPLATES INTO LP/SD SPAR MODELS
Lead Plants (Continued)

- Revise the Recovery Rules as Necessary to Consider New Technical Specification-Disallowed Maintenance Combinations in Effect during LP/SD.

- Modify Human Error Probabilities (HEPs) to Reflect Longer Action/Recovery Times Available during LP/SD Operation.

- To Develop a LP/SD SPAR Model for Another Plant in the Same Class:
  - Follow same steps as those identified above for the lead plant.
  - Document development process and incorporate in Users Manual - include assumptions.

INTERNAL QA REVIEW OF DRAFT LEAD PLANT MODEL

MODEL AND DOCUMENTATION REVIEW

- **Review:**
  - **Event trees.**
  - **Fault trees.**
  - **Basic event data.**
  - **Common cause failure modeling.**
  - **Graphical Evaluation Module (GEM) and GEMDATA.**
  - **Human Reliability and Recovery.**
  - **Revision log.**

- **Model Testing:**
  - **Perform appropriate (PWR or BWR) suite of tests.**
  - **Document results of model testing in prescribed format.**

ONSITE QA REVIEW OF DRAFT LP/SD SPAR MODEL AGAINST LICENSEE'S LP/SD PRA MODEL

- QA Procedure Developed from Procedure Used for Onsite Review of Rev. 3 SPAR Models.

- Areas Covered by Review:

  - Event Tree Structure.
  - Success Criteria.
  - Dependencies.
  - Plant Operating States (POSs).
  - Plant Operating State Groups (POSGs).
  - Time Windows (TWs).

- Documentation of Onsite Review

  - Reported in separate appendix to revised Users' Manual.

SPAR HRA METHODOLOGY

- First Developed for NRC by INEEL in 1994 for Use in Accident Sequence Precursor (ASP) Program.
- Revised in 1999 to Incorporate Desirable Aspects of Other HRA Methods and Sources and Tailored to SPAR Model Usage.
- Uses a Three-Page Worksheet to Rate a Series of Performance Shaping Factors (PSFs) and Dependency Factors to Arrive at a Screening Level Human Error Probability (HEP) for a Given Task.

UPDATED HRA METHODOLOGY AND DOCUMENTATION FOR SPAR MODELS

- Purpose of Improvements:
  - Ensure that methodology and documentation comply with proposed ASME Standard on PRA.
  - Provide a referenceable document on SPAR HRA methodology.
- Add Uncertainty Analysis Capability
- Review Existing Full Power PSFs ; Identify Needed Changes.
- Add Specific Application to Analysis of LP/SD Events/Conditions.
  - Review insights regarding PSFs during LP/SD operation obtained from other LP/SD work.
- Document Improved Methodology in a NUREG/CR Report.

ONSITE QA REVIEW OF LP/SD SPAR MODEL FOR SURRY

ONSITE REVIEW OF LP/SD SPAR MODEL FOR SURRY

- Conducted August 15, 2002.
- Held in Conjunction with NRR's Review of LP/SD SDP Analysis Tool.
- Participants: NRC HDQ Staff, Region II SRA, INEEL Staff, BNL Staff, Licnsee's PRA Staff.
- Scope of Review of LP/SD SPAR Model:
  - Event tree structure.
  - Success criteria.
  - Dependencies.
  - Plant Operating States (POSs).
  - Plant Operating State Groups (POSGs).
  - Time Windows.

ONSITE REVIEW OF LP/SD SPAR MODEL FOR SURRY
(Continued)

PLANT-SPECIFIC REVIEW INSIGHTS:

- In General, Found Good Agreement between LP/SD SPAR Model and the Surry LP/SD PRA.
  - Both based on NUREG/CR-6144.
  - Surry LP/SD PRA uses IE frequencies taken from NUREG/CR-6144.
  - LP/SD SPAR model also uses NUREG/CR-6144 IE frequencies.
- LP/SD SPAR Model for Surry Separates Out Loss of RHR Caused by Loss of Level Control from Loss of RHR Initiating Event Group.
  - Differs from treatment in Licensee's LP/SD PRA model.
  - Based on implications of recovering RHR - from NRR review of LP/SD-related inspection findings.
  - Consistent with NRR's LP/SD SDP Analysis Tool.

ONSITE REVIEW OF LP/SD SPAR MODEL FOR SURRY
(Continued)

GENERIC REVIEW INSIGHTS (Consider in Future Model Development)

- Potential for containment sump plugging during LP/SD operations appears to have a higher likelihood compared to that at full power.
  - Due to increased level of personnel activity during LP/SD.
- Some plants operate in mid-loop with the RCS closed.
- Reflux cooling is only possible when RCS is closed, and can be modeled as a passive phenomenon.
- If the RCS is depressurized, some losses of inventory are self-terminating.
  - Any losses of inventory caused by over-draining will only drain to the bottom of the hot leg.

ONSITE REVIEW OF LP/SD SPAR MODEL FOR SURRY
(Continued)

- At some plants, preferred method of RCS makeup (given a loss of inventory during LP/SD) is gravity feed from the RWST.

- When considering the possibility of gravity feeding the RCS from the RWST, the analyst should consider the need to make up to the RWST.

- The analyst should consider the possibility of crediting the accumulators for makeup to the RCS.

  - Might increase available time for recovery.

EVALUATION OF REVIEW RESULTS:

- Inconclusive Relative to SPAR Model QA Acceptance Criteria.

- Further Discussion with Licensee Planned.

CANCELLATION OF PLANS FOR REVISION 4i SPAR MODEL DEVELOPMENT

CANCELLATION OF PLANS FOR REV. 4i SPAR MODELS

- Current and Future Plans for SPAR Model Development and Associated Budget Specify Plans for Developing Level 1 Models for Full Power and Low Power/Shutdown Operations, Level 2/LERF Models, and External Events (e.g., fires, flooding, seismic, etc.) Analysis Capability.

- Revision 3 SPAR Models Developed by Improving Revision 2QA Models To:

  - Add more initiating events (e.g., med. & large LOCAs, sec. system IEs).
  - Model other support systems (SWS,CCW, etc.) besides emergency ac power.
  - Enhance treatment of CCFs.
  - Add uncertainty analysis capability (for equipment performance).
  - Add new HRA methodology (currently being enhanced to add uncertainty analysis capability).

- Revision 3 SPAR Models Capture ~80-85% of Internal Events CDF.

CANCELLATION OF PLANS FOR REV. 4i SPAR MODELS
(Continued)

- Est. Total Cost of Revision 3 SPAR Model Development = $3.8 million.
  - Produce/conduct onsite QA reviews of 72 models.
  - Project on schedule.
- Consequences of Canceling Development of Set of Rev. 4i SPAR Models.
  - No extensive effort to revise Rev. 3 SPAR models.
  - Line items in future SPAR Model Development Program budget:
    - Maintain and improve existing SPAR models.
      User-Friendly front-end Interface for SDP
      Staff/contractor monitor technical issues - model revisions
    - Provide technical support to model users.

Briefing for ACRS

on

Guidance for Performance-Based Regulation

N. Prasad Kadambi, NRC/RES/REAHFB

October 11, 2002

OUTLINE

- Summary
- Historical Background
- Why "Guidance?"
- General characteristics of process.
- Illustration of process through example.
- Revised high-level guidelines.
- Conclusions.

Summary

- The developmental phase of the NRC's performance-based regulatory initiative is now complete with the availability of a suitable guidance document.

- The research work on the principles of performance-based regulation, and the applications on specific projects, have given us confidence that a broader range of activities should be encompassed by this work.

- The staff's plans to incorporate performance-based regulation within the scope of "regulatory coherence activities" will enable wider application of the concepts, including exploration of areas of research that may benefit from formal decision methods.

- If ACRS supports the staff's approaches and actions so far, the agency will have come closer to realizing the goals of the Commission's White Paper on risk-informed and performance-based regulation which is to have an integrated regulatory process.

Historical Background

- DSI-12, Commission White Paper on "Risk-Informed and Performance-Based Regulation", and Strategic Plan

- SECY-99-281, "The Vision of the RES Role":

"To achieve the agency's goals to maintain safety while reducing unnecessary burden through realistic assessments, RES will: ...
coordinate agency efforts to become more risk-informed and performance-based;"

- SECY-00-191, "High-Level Guidelines for Performance-Based Activities", and NUREG/CR-5392, "Elements of an Approach to Performance-Based Regulatory Oversight" were published after Advisory Committee reviews

- SECY-01-0205, "Status Report on Performance-Based Approaches to Regulation"

- Actions and milestones:
  - An integrated process in accordance with White Paper (on-going)
  - Pilot projects (individual milestones)
  - User friendly guidance document -- FY 2002
  - Communication Plan -- Mid-FY 2002

Why "Guidance"

- Feedback from Performance-Based Regulation Working Group [PBRWG] indicated that high-level guidelines are at too high a level. They articulate attributes, but do not provide direction on implementation.

- Staff's first attempt at developing implementation guidance resulted in a highly formal and overly general presentation of decision theory. Hence, the staff has adopted a two-step process in which the simplified guidance is expected to be sufficient in most cases, and a more formal approach pursued if necessary.

- Although the White Paper on "Risk-Informed and Performance-Based Regulation" provided definitions for all important terms, including "Performance-Based Approach", a consistent application for "performance-based regulation" (PBR) is not being realized (eg. see "Rulemaking Activities Plan"). Feedback indicates the need for user friendly guidance.

- Instead of a Management Directive, staff informed Commission in SECY-01-205 that a user friendly guidance document would be developed as a companion to NUREG/BR-0058 "Regulatory Analysis Guidelines".

General Characteristics of Process

- Guidance document completes the developmental phase of the staff's PBR efforts.
- It represents an internally self-consistent approach to regulation originating from the "White Paper" and applicable to the three arenas of regulatory responsibility.
- Process aspects of "Guidance" bear strong resemblance to formal decision theory with the flexibility for varying degrees of formality and quantification.
- Guidance naturally integrates "risk-informed" with "performance-based" regulation.
- It fulfills expectation expressed in SECY-01-205, and substantially responds to commitment made to ACRS:
  - "Eventually, an integrated process is expected that, in accordance with the Commissions's White Paper, combines the "risk-informed" and "performance-based" elements to regulatory decision-making."
  - Uses terminology employed by the published literature in the area of formal methods for decision-making.
- Expected to meet the needs for including PBR alternatives in majority of regulatory issues.

Illustration of "Guidance" Process

- Illustration of steps in the guidance process will be based on recent performance-based actions:
  - The Reactor Oversight Process (ROP) is demonstrably risk-informed and performance-based.
  - The proposed rulemaking on 10 CFR Part 50.44 incorporates a performance-based approach to hydrogen monitoring.
  - The proposed rulemaking on 10 CFR Part 72 relative to ISFSI and MRS facilities incorporates a performance-based approach to cost-beneficial geological and seismological analysis for the regulatory analysis.
- Pilot projects show that finding performance-based elements in a regulatory action requires, not a formulaic approach, but a systematic search for less prescriptive measures.
- The formalism provided by the high-level guidelines and the guidance steps helps maintain consistency and coherence.

Illustration of "Guidance" Process (continued)

- *Step 1: Define regulatory issue and its context:*
  - Arena is generally clear, but sub-arena may require internal discussion
  - Potentially addresses all four NRC performance goals.
  - Expected outcome is to provide appropriate regulatory requirements and supporting framework.
- *Step 2: Identify safety functions:*
  - ROP structure provides benefit not available for the other examples.
  - The rulemaking on 10 CFR 50.44 identified hydrogen monitoring as the safety function for application of a performance-based approach.
  - For the ISFSI, example safety functions were identified as stability against soil liquifaction during vibratory motion, and cask sliding and resulting displacements during an earthquake event.

Illustration of "Guidance" Process (continued)

- *Step 3: Identify safety margins:*
  - Safety margins in ROP are expressed as DCDF from inspections or PIs.
  - Performance targets for hydrogen monitoring function are based on reliability, availability and capability. Comparison with observed performance through servicing, testing and calibration provides a measure of safety margin.
  - Safety margins for ISFSI are substantial because casks are designed for challenges of handling and transportation.
- *Step 4: Select performance parameters and criteria:*
  - The level at which performance will be evaluated is considered here.
  - ROP may institute time at risk-significant configuration as a performance parameter at shutdown. This is an example of setting a high-level parameter. The criterion would have more considerations than risk model computations.
  - The regulatory analysis application for ISFSIs is an example of a performance-based approach to cost effective implementation of a regulation.

Illustration of "Guidance" Process (continued)

- *Step 5: Formulate a performance-based alternative:*
  - The considerations inherent in the staff's responses in Steps 1-4 would have decided the viability of a performance-based approach. If it is viable, the information developed includes candidate performance parameters.
  - The context of the regulatory issue (including consideration of defense-in-depth) determines which parameters are selected and how they are used in a regulatory action. Eg: Level of detail for analysis supporting siting of ISFSI.
  - The resolution of the regulatory issue should consider optimization within the regulatory framework, using prescriptive elements as needed. Eg: Regulatory guidance incorporating hydrogen monitoring into the maintenance rule program.
  - Any flexibility provided by a regulatory action may include consideration of appropriate licensee incentives to perform in a superior manner. Eg: ROP approach to risk significant shutdown configurations.

Revised High-Level Guidelines

- Three groups of guidelines maintain substantial similarity to those discussed in public and stakeholder interaction:
  - Viability guidelines *(Can a performance-based approach be developed?)*
  - Assessment guidelines *(Is it worthwhile to develop a performance-based change?)*
  - Guidelines for consistency with regulatory principles *(Are we being consistent with basic regulatory principles?)*
- Viability guidelines are same as "White Paper" definition with rearrangement to put margin first and include qualitative measures.
- Assessment guidelines include consideration of NRC's performance goals, assessment of net benefit, and optimal use of regulatory framework.
- Regulatory principles include defense-in-depth considerations, Option 3 framework, and RG 1.174 philosophy.
- Formal treatment of defense-in-depth will be incorporated into later document.

Conclusion

- Staff requests a letter that provides ACRS views on the approach taken by the guidance document, and on the completion of the developmental phase of the performance-based regulatory initiative with the guidance document (subject to finalization).

- Staff plans to incorporate its PBR efforts into "regulatory coherence activities". This will enable more rapid progress toward increasing the use of performance-based approaches in a broader range of activities.

- An inter-office group, the Risk Management Team, will coordinate and provide policy direction to implementation of PBR activities.

- RES will develop a NUREG document in FY-2003 that provides more detail on formal decision methods as applied in support of performance-based approaches as well as other applications of such methods.