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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

November 18, 2005

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

RELIABILITY & PROBABILISTIC RISK ASSESSMENT

SUBCOMMITTEE MEETING

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FRIDAY,

NOVEMBER 18, 2005

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The meeting was convened in Room T-2B3 of Two White Flint North, 11545 Rockville Pike, Rockville, Maryland, at 8:30 a.m., Dr. George E. Apostolakis, Subcommittee Chairman, presiding.

MEMBERS PRESENT:

GEORGE E. APOSTOLAKIS Chairman

MARIO V. BONACA ACRS Member

RICHARD S. DENNING ACRS Member

THOMAS S. KRESS ACRS Member

ACRS STAFF PRESENT:

ERIC A. THORNSBURY ACRS Staff, Designated Federal Official

ASHOK C. THADANI Deputy Executive Director, ACRS/ACNW

NRC STAFF PRESENT:

PETER APPIGNANI	RES/DRAA/OERAB
MICHAEL CHEOK	RES/DRAA/OERAB
NILESH CHOKSHI	RES/DRAA/OERAB
DON DUBE	RES/DRAA/OERAB
ELI GOLDFEIZ	RES/DRAA/OERAB
CHAD HUFFMAN	RES/DRAA/OERAB
CHRIS HUNTER	RES/DRAA/OERAB
STEVE LONG	NRR/DRA
DON MARKSBERRY	RES/DRAA/OERAB
JEFF MITMAN	RES/DRAA/OERAB
DAN O'NEAL	RES/DRAA/PRAB
SELIM SANCAKTAR	RES/DRAA/OERAB
JAMES VAIL	NRR/DRA/APOB

ALSO PRESENT:

ROBERT BUELL	Idaho National Laboratory
JOHN LEHNER	Brookhaven National Laboratory
CHUEN-CHING LIN	Brookhaven National Laboratory
ZORAN MUSICKI	Self-Contractor
JOHN SCHROEDER	Idaho National Laboratory

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PROCEEDINGS

(8:31 a.m.)

CHAIRMAN APOSTOLAKIS: The meeting will now come to order.

This is the second day of the meeting of the Advisory Committee on Reactor Safeguards, Subcommittee on Reliability and Probabilistic Risk Assessment.

I am George Apostolakis, chairman of the subcommittee.

Members in attendance are Mario Bonaca, Richard Denning and Tom Kress.

The purpose of this meeting is to discuss the Standardized Plant Analysis Risk model development program.

The subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full committee.

Eric Thornsbury is the Designated Federal Official for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting, previously published in the Federal Register on November 1, 2005.

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

It is requested that speakers first identify themselves, and speak with sufficient clarity and volume so that they can be readily heard.

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

We now proceed with the meeting, and I call upon Mr. Michael Cheok to being the presentations.

MR. CHEOK: Good morning.

Today we are going to talk about the SPAR model for external events, LERF and low power shutdown.

Before I get into that, though, I would like to bring one thing up from yesterday. When we were looking at the SBO charts for all the plants and the range for all the SBO results for all the plants, I guess there was a comment made that there were several plants close to the 10 to the minus five CDF range. And I guess I'd like to follow up on that.

The intent of the SBO rule was to get plants to be in the - let me read it directly - to

have an average contribution to core damage frequency from station blackout to be about 10 to the minus five per reactor U.

So I guess the SBO rule in a sense did work, and it did keep plants for the most part below 10 to the minus five, and only one or two close to 10 to the minus five. So.

Okay, back to today's presentations, our objective for the three SPAR models that we want to talk about today is to expand the scope of the models to provide agency staff with tools, PRA tools, consistent with the guidance in 1.174 and Reg Guide 1.200.

We have to keep in mind that unlike the Revolution 3 models which we talked about yesterday, these models are still in the developing stage.

As a matter of fact, the developments for the external events is only going on for the last six months.

So what is the general intent for all these models? We will carry a Q/A process that will be similar to the Rev. 3 models to the extent possible. We discussed that a little bit yesterday, and again today we are going to say that absent licensee models it's a little hard for us to Q/A the

models. We will have to come up with new strategies as to how we can QA the models.

CHAIRMAN APOSTOLAKIS: I'm sorry, I missed that.

MR. CHEOK: QAing up our models for low power shutdown, external events, low power shutdown, it's going to be a little harder for us. Because we cannot directly go to the licensees and Q/A our models against their models, unless they have models themselves.

Not all licensees have low power shutdown models.

CHAIRMAN APOSTOLAKIS: And a lot of them have done bounding analysis, right?

MR. CHEOK: They have, right.

CHAIRMAN APOSTOLAKIS: And that would be a big problem?

MR. CHEOK: Correct. And you know even in external events, you are right that there is bounding analysis and screening analysis. How do we QA ourselves against those analyses?

So it's a challenge we face in these models that we don't face in the Rev 3 models.

CHAIRMAN APOSTOLAKIS: Right.

MR. CHEOK: Also, we are in the process of

defining what standardized means in this case. There are certain things that we want to standardize that would keep the models somewhat similar. Again it was a little bit simpler for the Rev 3 models. We will have to define that a little bit better for our external events models, low power shutdown models.

MEMBER DENNING: Mike, will you also talk about uncertainty analysis for these? Because I think that that also is a big challenge, that the characteristics of uncertainty can be quite different from this, what we really typically address in model one?

MR. CHEOK: Absolutely. And again, we are at the stage now that I don't think we have uncertainty defined at this point. And I think we will have to define it as we use it.

And I think it's critical to keep in mind today that we QA our Rev 3 models by using the licensee's QA their PRA models by using them. I mean you can only look at the models so much, at the desktop, and keep refining it. You have to use them in situations, apply them for events analysis, and as you use them look at the results to see if they make sense, and then add or subtract or make changes.

So our goal basically is to start using

these models, and basically, keep improving on them, get lessons learned, and provide feedback to the model development process.

So that's our challenge, and by doing that we can also define, better define, what we mean by uncertainties, and where we need to characterize our uncertainties better.

The model specifications, for example, the scope, level of detail, the limitations, et cetera, will be better defined by the use of models in the applications. So we will continue to do that.

So without too much more intro, I would like to get Selim Sancaktar up here to talk about the external events models.

MR. SANCAKTAR: Good morning.

My name is Selim Sancaktar. I work for research. I would like to give you a --

CHAIRMAN APOSTOLAKIS: Say good morning again.

MR. SANCAKTAR: Okay, good morning for the fourth time. My name is Selim Sancaktar. I work for research.

I would like to give you a presentation on SPAR external events effort that we are performing as we speak, and in the next few years.

Currently, the ASP analysts include external events that accumulate in their assessments, and they use whatever methods and information available to them at this point.

ASP analysts also are very much interested in including a complete view of the risk as opposed to a limited view, and we've been going into more and more of actually modeling external events as we proceed in ASP analysis, and we would like to do that systematically and in a comprehensive way.

So there is already a specific and ongoing need and effort, and we would like to make it - provide tools to help it be done systematically and easily.

So looking at the - what I would call a successful evolution of the SPAR models for internal events, what I mean by that is, it started with a limited number of models, and it developed by use, not theoretically, not in the mental capacities of the people, but actually by use, and it has been improving since then, and it continues to improve just like any other model we use.

And we would like to integrate external events, LERF, and low power and shut down models naturally into the existing SPAR models. And I am

only limiting myself to external events in core, which happens to include internal flooding because it wasn't in the internal events.

I'll take the liberty of throwing it in here, but we realize that it is formally not an external event.

So we are adding them to the existing SPAR models, so we don't have a separate model; we don't have a separate tool. Whatever tool we have, we are expanding it.

And to do it, as you can see, there are almost infinitely many challenges that one has to go through.

What we are focusing on is, if latest licensee PRA information is available, we try to use that as a starting point. It's not the end point; it's a starting point. We are approaching it with a healthy dose of skepticism, but not with the tremendous skepticism that would stop us dead in our tracks.

So if possible we try to get information from the licensees. Actually we have done that for at least two clients so far, Limerick and Salem, because NRR had an activity, ongoing activity, to get this kind of information for SDP purposes.

So we kind of tagged along with them, and we have received the latest possible information, and we try to use that.

If this information is not readily available, we will go through the IPs, IPEEEs, and of course, IP for internal flooding, skim the information available and try to put it in.

And also, STP external events worksheets, which relate to this first item. This third item is the one that I mentioned with Limerick and Salem that's created the need to go to the sites.

And next year in 2006 in NRR is planning to continue their activity here to go to the sites, and we intend to go with them to get as much information as possible.

And we will be using existing SPAR model event trees, fact trees, et cetera, as much as possible. They already are defined for us, the plant response to certain situations, and then we will of course customize them to do scenarios, external event scenarios, as needed, which are briefly discussed.

So we are adding basically scenarios. I am using the word scenario in terms of what you would expect it to be, just like an initiating event. It's not really an initiating event, but it has its own

event three, it has its own plant response, and we keep adding as many of them as possible, and we don't really have a limit. There is no limit in the software that you can only add 10 or 20. We can add 10,000 if necessary. But there is a practical limit in the usability of course.

So scenario is defined in terms of its frequency, type of reactor trip caused which is already studied in the SPAR model - it might be a transient, with certain equipment and operator actions affected. It might be loss of outside power. It might be something totally different, maybe something that is not already studied.

A prime example of that is of course our main control room evaluation after a fire is not studied. There is no counterpart in the current SPAR model, so we have to make a model for it.

CHAIRMAN APOSTOLAKIS: Another major difference, it seems to me, is that these external events, most of them anyway, depend heavily on where the event occurred, location. And so it's not just the frequency; and location, right?

MR. SANCAKTAR: Right, that defines - that tell us which SSEs are affected.

CHAIRMAN APOSTOLAKIS: Right, but that is

a major difference.

MR. SANCAKTAR: Yes, so we have to specify to the software in this scenario what is affected.

MEMBER DENNING: Let's talk about that a little more if we can, this - the difference between area analysis that is required for many of these versus the non-area analysis type of events.

If you look for example at fire risk assessments, one has to have a great deal of information about the location of equipment and this type of stuff within the plant, and that's the type of thing that I see that SPAR has been able to avoid in the internal events, but it seems to be unavoidable when you think about flooding risk, fire risk, they are so dependent upon the particular plant layout and that type of stuff.

Does it introduce a major limitation as to what you can do with SPAR for these events?

MR. SANCAKTAR: Well, what you said so far, your characterization is absolutely true. Now to answer your question, it - we are going to avoid it at this point by depending upon already analyzed scenarios, because as you can appreciate, maybe millions of dollars went into each of these studies. And we don't want to, and we cannot, and we will not

start from scratch and build it up.

So we have to depend upon available information, initially, and then as we move forward, we have to either supplement it or check it to make sure that it is relevant; it covers the necessary equipment, but it could have been a problem if we said that we are going to start with a clean slate.

We are not starting with a clean slate.

MEMBER DENNING: Again, I think we are running into a difference between objectives of why utility should undertake a flooding PRA or a fire PRA, and what you'll do with your version of a PRA. Because I think the way - if we look at the kind of thing you're going to be able to do, you're not going to be able to really identify vulnerabilities that really exist in plants. Whereas the tremendous value of the flooding PRA, or the fire PRA, for the utility is to identify those vulnerabilities.

Do you agree?

MR. SANCAKTAR: Yes.

MEMBER DENNING: Somehow your objectives are different.

MR. SANCAKTAR: Right. I have to go back - that is very important, because when we say external events, when we say the incorporation of external

events, people have different visions. They have different needs in their minds.

If I talk to 10 people from 10 different branches about this subject, there will be I'm sure in the back of their minds 10 variations of what this is and what it should be.

So out of these I have to select a sound ground that I can stand on and move forward and expand on. And that is a balancing act, and it is not an easy thing to achieve, and there is a lot of skepticism and so on that has to go on. That's why I have to again come back, which I will also - let me mention -

MR. CHOKSHI: I think, Dr. Denning, your point is very well taken. We have a lot of internal debate what we can use for, how we can apply from what incarnation, what we can build. And it is an ongoing debate until we develop some models, start using them, and understand the limitations, what kind of applications are possible.

I mean speaking from my perspective, event assessment is the next part of my objective, to be able to evaluate.

But you are absolutely right. We have to be very careful, and this is not - we supply this too.

Because we are going to be limited by the information available, and how much we can really - these are so plant specific.

CHAIRMAN APOSTOLAKIS: Well, but in addition to the issue of location, I wonder how you will handle the fundamental logical models that are involved.

As you know this agency and EPRI have joined forces to develop an updated fire risk assessment methodology in the seismic area. There are all sorts of models that one should use for the occurrence of the earthquake; the continuation of the wave; and so on.

I'm wondering how you are going to handle that. You can't use just Boolean algebra there. Are you going to have a subroutine that does the calculations?

MR. SANCAKTAR: I see it as one step at a time. The way I tried to characterize it in the past is to try to explain it to people, can't come up with a Cadillac. I can come up with maybe a Volkswagen bug or whatever.

CHAIRMAN APOSTOLAKIS: But not a Yugo.

MR. SANCAKTAR: Hopefully not a Yugo. As you can see I have a little bit more ambition than

that. But I cannot start with a Cadillac, although our goal is to go to a Cadillac eventually.

And I want to do this within my lifetime, and I want to do this within a reasonable budget.

So I'm trying to work these into the equation with different constraints, some of which are technical, others of which are nontechnical. And for example, coming back to what you were saying, the NUREG, EPRI/RES NUREG-6850 is a tremendous work as you all know. I did not bring it here just to make a point, but it is this thick. It is as thick as the whole internal events procedure guide, if there was a recent one.

We are certainly referring to it, okay. In this context, in the context of event analysis. But the starting point is, we are putting in scenarios that are already whether we believe in them, whether they are complete or not, is not the issue yet. But it will become an issue.

We are putting them into the model, so now the models will give us, when we quantify a plant condition or an event, it will tell us some new information, and we will look at it and say, does this make sense? It will give us a chance to act on it, to think concretely as opposed to thinking in --

CHAIRMAN APOSTOLAKIS: So Selim, when you say scenarios, and the way I understand it is, in the first case, you will go to PEEEs or other sources, and you will say, okay, for this plant, JACA (phonetic) found that if there is a fire of a certain magnitude in this room, this is what's going to happen. And you are going to put that in your model.

MR. SANCAKTAR: Right.

CHAIRMAN APOSTOLAKIS: Without questioning whether it's right or not.

MR. SANCAKTAR: Right.

CHAIRMAN APOSTOLAKIS: And then after you gain some experience with these - you are going to have a hell of a problem as we said earlier with most of the licensees, because they haven't really done this work.

Then you are going to start questioning whether a fire occurred in there, is a reasonable thing to postulate, or what is the frequency of that? Where else could a fire occur?

The other thing, of course, is that I don't think any licensees have done an analysis of the impact of smoke, as far as I know.

CHAIRMAN APOSTOLAKIS: They have discussed it.

MR. SANCAKTAR: There is a lot of research findings. And that is an important initiative or contributor to the scenario.

MEMBER BONACA: There are many inspections that take place at the plant. Do you have an ability to communicate with the inspectors if there is an inspection for fire concerns?

MR. SANCAKTAR: Well, one of the things I'm trying to do is to get this stuff into the hands of the actual users, the SRAs at the regions, as well as people in NRR, and let them feel comfortable with it. Let them look at it.

In fact I will mention it in one of my further slides. One of the most important principles of this project was, this model should be seamless with the existing model.

So when I take the model and give it to our existing user who used the internal events, my instructions are zero. There is no training. I give it to the person. He or she puts it on the computer. The SAPHIRE code comes back, you saw. And there is nothing alien in it. You don't have to learn any new ways to run it.

CHAIRMAN APOSTOLAKIS: I think you are too optimistic. Because there are unique features of

these events. I mean you can't just say here is the model. If you go to the eternal event scenarios and see the impact. No, there is more, much more to it that that.

MR. SANCAKTAR: We'll get to that.

CHAIRMAN APOSTOLAKIS: How far - how long are you here?

MR. SANCAKTAR: Well, if I go to a few more slides --

CHAIRMAN APOSTOLAKIS: Why don't you do that? Yes, let's do it.

Don't go backwards.

MR. SANCAKTAR: No, we only move forward. Although sometimes we may appear not to do so, but we still move forward.

I added the extension dash E to include the external events. But again let me emphasize that SPAR-EE includes the internal events. They are there too. It's not like a separate item.

And eventually, when all 72 SPAR models, or maybe all 103 plants, have their own models, we will drop this EE and it will be SPAR again.

Typical, for example, let's say a typical SPAR-EE model might have 15 to 20 internal event categories which are already there, five to 10

internal scenarios, 20 to 30 internal fire scenarios --

MEMBER DENNING: Can you help us a little bit on that, like when you discuss 20 to 30 internal fire scenarios, would you for example, that would be fire in the cable spreading around, fire --

MR. SANCAKTAR: Fire in the main control room, fire in the turbine building, and then special areas that they identified.

MEMBER DENNING: Okay.

MR. SANCAKTAR: By the way, as we move forward, we have done six of these, as we move forward, we see good things in some of the models. And we try to incorporate it. We try to make it into a standard.

So from that point on we use that.

CHAIRMAN APOSTOLAKIS: Do you have access to the PRAs that have done a detailed job? There are several PRAs that - like Indian Point, Zion, Seabrook, and those PRAs have done a very detailed job.

MR. SANCAKTAR: Yes, in fact, we've just done Indian Point three external events, and that was the best I've seen so far among the six we've done so far. That was the most comprehensive.

And each time we see something and we say,

oh, this is good, this makes sense, I try to make it into a kind of a step to be followed later on.

CHAIRMAN APOSTOLAKIS: There was a lot of effort in that.

MR. SANCAKTAR: Again, there are no limits here. Like for Salem, we said, let's put everything in, all the fire scenarios in, so we have like over 100 in there.

Now it makes the effort longer. I don't know if it buys anything or not. But we put them in just to see if something will break, will it reach a limit either running time wise or anything.

But there is no intrinsic limit at this point.

MEMBER DENNING: But is there - when you look at things like associated circuits, and you look at spurious opening of systems that normally wouldn't be on the event tree, doesn't that give you - say, I have to really expand well beyond the --

MR. SANCAKTAR: Eventually, yes. Eventually, yes. Yes, just to give you a feeling about this, for example, recently - you may already know - Kewaunee had a design issue with internal flooding. I don't know if you are familiar with that, a design issue that internal flooding in a

nonthreatening area might go into a safety related area.

And it was not really thought of before. And now, are we going to catch it with this? No, we won't. This model will just go through it, will not even know it where you quantify it. And just like it did for the last 20 years or whatever, just at the beginning, it didn't model the scenario.

Of course that scenario doesn't exist any more, because they took care of it. I mean it just existed up to a point.

CHAIRMAN APOSTOLAKIS: But you could, though, evaluate the significance of such a point if you had the model?

MR. SANCAKTAR: Exactly, once I have the models, I can tweak them, I can clone them. The user has now an easier path to making either clones or small variations.

CHAIRMAN APOSTOLAKIS: So what you are doing now, Selim, obviously you are familiarizing yourself with what has happened. But let's take Indian Point that you just finished. Are you going to try to develop a SPAR model for external events for Indian Point. Or at this stage are you just collecting information?

MR. SANCAKTAR: No, we have it. It's running; we have it. I can show you the six models we have. They exist.

MR. CHEOK: I guess let me clarify a little bit, George.

CHAIRMAN APOSTOLAKIS: The next slide says what you have, but you don't have the models.

MR. CHEOK: Basically, I guess what Selim is doing and what we're doing is trying to incorporate as much of the licensee information available right now into the SPAR models.

We are not trying to define the fire damaged states from each room, or the flood damaged states. That will come when we review and study more the Sandia work, and that research work, and that will help us define the associate circuit probabilities, what temperatures the rooms would get to, and what damage states - the different damage states as we have bigger rooms, the more ventilation or smoke.

What we are doing now is just studying the feasibility of these models, using what we get from licensee information. You would eventually in the long term - I don't even foresee us doing room lock downs of cable tracing to tell you the truth; that is impossible. We will still have to depend on licensee

information for that purpose.

Where we will standardize is in the methods that we will use from the Sandia slash research study to standardize our planned damage state allocations.

CHAIRMAN APOSTOLAKIS: So we have to wait for SPAR-EE draft three, right?

MR. SANCAKTAR: Yes, something like that, yes.

MEMBER DENNING: What about SAPHIRE itself, is it conveniently capable to handle these overlays of area kind of things?

MR. SANCAKTAR: That is an excellent question, and there are two different answers to that.

CHAIRMAN APOSTOLAKIS: Yes and no.

MR. SANCAKTAR: I will give you both of them, and I will certainly accept criticism. This is my personal point of view; anybody who wants to criticize it is welcome; I may be wrong.

SAPHIRE is a very sophisticated tool as you may have already noticed in your last days exposure to it, or before. And it has already been envisioned like parallel depths, like a second - another depth - dimension of putting area events, fire, seismic, and so on.

And when we started this we had a feasibility study done with Limerick. And there, we were excited that we should use these capabilities. And the way we did was, for Limerick, we took the seismic capabilities built into it, which associated a seismic failure with a basic event. Like a pump, and you could associate a seismic failure with it.

But you don't really see it. It's very deep in there. And it is beautiful, it is intellectual stimulating, and so on. But after awhile, I looked at it and I said, users will - most users will just -- will not recognize this, and it is going to become a burden on them.

So the later ones I personally chose to abandon the use of that, and explicitly put the seismic failures, so that you can see them. You can physically as a user look at the model, and you see how it's modeled, how it's coming in. You can criticize it, you can relate to it.

So we lost the compactness of the model, the nice features of it. But in return, we have gained a bit more explicit approach.

So I'm trying to put myself in the shoes of a typical user, and in fact consider myself a typical user, because on the side I do ASP analyses

just to my hands in the stuff and see what is happening and why things are happening one way or the other.

So does that answer your question?

CHAIRMAN APOSTOLAKIS: Well, the issue with external events is really that they are a huge common constraint. So you have to do that. You can't just bury it.

MEMBER DENNING: Yes, but I know that some tools are very difficult to do these area analyses. Because it is a complicated tying together of the causes.

MR. SANCAKTAR: For example, in SAPHIRE, you can mark, if you want, you can mark the equipment or basic events by area. And then I'm sure there is a way to say then, fail them all.

Which is - theoretically it is a good, good thing. But as you see in 6850, the new fire analysis guidelines, people are running away from massive bounding failure of everything in a given room, and focusing on more and more realistic scenarios, depending on where are the ignition sources, and what can it get and so on.

So we are no longer saying, knock out everything in this room, which to me is very easy. I

don't mind.

CHAIRMAN APOSTOLAKIS: So are you going to show one of these to us?

MR. SANCAKTAR: I'd love to, and I can - or I don't have it here, but I can. Whatever your wishes or management's directives are.

CHAIRMAN APOSTOLAKIS: How long would it take to do that, Selim?

MR. SANCAKTAR: I would load one in --

CHAIRMAN APOSTOLAKIS: No, I understand that. But how long would it take to demonstrate?

MR. SANCAKTAR: I don't know if the people - I'm always ready.

CHAIRMAN APOSTOLAKIS: Why don't we go ahead with your prepared presentation - oh you have it here?

MR. SANCAKTAR: Yes, I have all six here.

CHAIRMAN APOSTOLAKIS: So how long will it take?

MR. SANCAKTAR: Five minutes.

MR. CHEOK: I tell you, why don't we go through with his prepared presentation, and while the next presentation is going on he can load it up, and we will just break for five minutes later.

CHAIRMAN APOSTOLAKIS: But the actual

demonstration is a few minutes, several minutes.

MR. SANCAKTAR: As many minutes as you choose to. I can keep it to five, 10. I am always willing to show rather than discuss.

CHAIRMAN APOSTOLAKIS: Okay, why don't you finish then your high level presentation.

MR. SANCAKTAR: I have only a couple of slides left anyway.

However, let me mention one more thing that I think is important for me, I don't know again if other people will agree or not, that is a different story.

When I quantify these things, I really don't have a CDF objective in mind or anything. Again, it's commonsense. If we get a 10 to the minus two at the end, we would look. And we sometimes do. Something is wrong.

Or if you get 10 to the minus eight, total, something is wrong.

But I do not really have a preconceived idea as to, a plant should have 80 percent internal, 15 percent fire, 3 percent flooding and 2 percent seismic. It would be nice, but I have no preconceived ideas.

So it doesn't bother me what we get out of

it. I don't try to manipulate it to get something. Whatever comes out, comes out.

So if you see something and say, why is it 90 percent here, and then in another plant it is 10 percent. Maybe it should bother us, but not at this point. Maybe at the next stage.

At this point, I'm going to put them in. People can look at it. Criticize it, use it, tweak them, adjust them, and then we try to line them up so that they are consistent within themselves, and then also consistent with outside standards, which kind of is the subject of one of the other slides.

Okay, quickly wrapping this up, related activities. There are a couple of little activities that kind of support this. One of them is we are trying to add a few things into SAPHIRE so we can make and use these models faster and better.

We are trying to create some external event handbooks that are practical for focus - focused on the analysts making an event analysis, not doing PRA. We are not trying to repeat, or we are not trying to replace, existing technical documents. We are not trying to reinvent the wheel. But simply simplistic, how would you use this model in this situation if you had such an event, and so on.

We have - I talked about this coordination with ongoing NRR site visits, and we will continue this. I'm going to go to the WOG meeting, and try to convince them that they should voluntarily give us their external event information in any form they want - paper, electronic form, photograph it if they want. We don't want new analysis. We don't want any additional effort. Can we get them? And I will try to explain to them that this is a win-win situation.

CHAIRMAN APOSTOLAKIS: The best way to get these, coming back to your earlier point, you start producing numbers like 10 to the minus two, and you will see people very willingly give you anything you want.

MR. SANCAKTAR: That is my stick in the back that I'm not showing, but this is implied, that if we don't receive - if you don't get the information - here is what you have. You are using it. If it's wrong, please tell us what's wrong with it, we'll fix it.

We are not immune to that.

Let me wrap this up. I don't want to take too much of other people's time. Future plans: complete SPAR-EE models for all plants. And my

original objective was three years. I still think that it should be three years.

We can with a heroic effort we can do it in three years, but not at the rate we are going.

However, I should have also mentioned something very positive, which I believe is very positive. Four of those six models I mentioned were done in house, in house being inside the NRC, with a joint effort between NRR and RES. So we can actually produce these in house, and we can do it as a combined project between divisions.

CHAIRMAN APOSTOLAKIS: So you can't really use the models yet to analyze accident sequences? That's the plan?

MR. STANCAKTAR: As we speak now, Turkey Point is being done. And we will use it - have events that we want to use it on. And then we will use at least two. When I say two - to me two is a very doable and actually underachievement kind of goal. We can do more than two if necessary.

We also promised to the SRAs, I know that it is upon us, that if an SRA sees an event that they want to study, and it needs external events, if they give us information about the plants, in 30 days we will make a model and come back and give it to them to

use if they want to.

Of course we want to validate the SPAR-EE models to the same level as SPAR models, and try to combine, et cetera. Same stuff as you would expect.

Challenges: Obtain the latest possible licensee accelerant models.

CHAIRMAN APOSTOLAKIS: We've talked about all this.

MR. STANCAKTAR: We talked about that. Achieve standardization within - we have to be careful what this means. I do not think of standardization as all of them are the same. Because as you just mentioned, they are dependent on the characteristics of the plant.

Even a single SPAR models, the two units on the same side, it works with external events, may need possibly two external events, variations, if there are locational differences.

So we recognize this. Everybody recognizes it. But so some sort of a standardization within, and standardization with respect to the surrounding environment.

We also define scope and detail, how much detail we will go to the agreement of people, and then we have to understand where we can use it,

specifically recognize where we can use it, where we cannot use it, and in places where we cannot use it yet, if you want to go there, how do we go there, what is involved, et cetera.

So I think that is my last slide.

MEMBER DENNING: Can I make a comment, or a couple comments at this point.

I think what you are doing is just exactly what is required at this point. But it is definitely at an exploratory and a research level, this right now. I mean I don't think that you can decide at this point how am I going to go forward to all the plants, because actually it isn't obvious how you do that. I mean clearly you can't do what you said you were going to do in three years, because the plants aren't going to be able to give you the information. So that there is clearly a period here of development and application. And then after that you are going to have to decide just what are we really going to do in this area.

But no criticism at all of anything that I heard today. It's just that I think we're going to want to keep in touch here. Because I don't know whether it is going to be nine months or a year, when you will have had a couple of examples and be able to

come back and say how things are going.

But I think we would certainly like to be involved in that. And then I think we'd be involved in the decisions you are going to have to make as to just what are our real objectives in this area? Are we going to do all the plants? And at what level?

CHAIRMAN APOSTOLAKIS: Yes, the intent, Rich, is to have a series of subcommittee meetings. This is the first one. We will have an overall view of the programs. And then as necessary in consultation with Nilesh and his colleagues we will have other subcommittee meetings where we will discuss individual projects and progress.

And this is certainly one of them. The other one probably is LERF.

MR. CHOKSHI: As I said in the very beginning, we are in the formative stage. A lot of judgments involved. A lot of complexities. And I think that will be wonderful for us to get this feedback.

CHAIRMAN APOSTOLAKIS: So I believe our next task is to review SPAR-H. And then we will schedule a subcommittee meeting sometime in the spring.

MR. CHOKSHI: As you said, let us try out

a couple of things to understand ourselves what they are doing.

CHAIRMAN APOSTOLAKIS: We have a model now, the way we participated in the development of Regulatory Guide 1.174 that this is a participatory review, and we are welcoming ideas, and hopefully we will try to help too.

Because this is a huge effort. Okay, Selim, thank you very much.

MR. STANCAKTAR: Thank you very much.

CHAIRMAN APOSTOLAKIS: So who is the next presenter?

MR. CHEOK: It's going to John Lehner and Eli Goldfeiz on LERF.

CHAIRMAN APOSTOLAKIS: Okay.

MR. GOLDFEIZ: My name is Eli Goldfeiz. I am the LERF project adviser. Just briefly an introduction to what we are to be doing here, and I give it to Dr. John Lehner, if you have any questions.

This project started as a request that the NRS to have the ability to be in completeness (phonetic) of the PRA. The project start in the mid of 2001. The first one of the project was developed in the Liverpool, existing Liverpool LERF model at that time.

Actually there were a few models built for the ASP analysis. It wasn't connected to development. It just was level two for analysts to use.

The first two was preparing the detailed program, and the first three was implementing the program. We are in the stage - phase three. We created three models, one for - the models, the way we build the model is that we went by containment type reactor.

The first model is for large dry containment like at Comanche Peak.

The second model was a BWR, Mark I used at Peach Bottom.

And the third model was ice condenser at Sequoyah.

And the other - we're in the process of the fourth model, and it is almost completed, under Dr. John Lehner can explain more about that now.

DR. LEHNER: Good morning, I'm John Lehner from Brookhaven National Laboratory. And we are working with Eli Goldfeiz on the large orderly release frequency modeling that was part of the SPAR model development.

I should mention that much of the technical work was done by C.C. Lin of Brookhaven, and

our consultant, Zoran Musicki, former of Brookhaven, who are both here today.

So as Eli mentioned, the objective here is to really meet the needs of the SPAR models users group who need some relatively simple but fairly thorough analysis tools to make assessments of LERF, and of course they want that LERF portion to be both well integrated with the Level 1 model, so basically as we heard before, seamless with the Level 1 model.

We had three phases, I'll skip over this quickly. As Eli mentioned, the first one was to look at some previous LERF models that were dong on the SAPHIRE platform but that really were not ideal for what the SPAR model usually wanted to do with LERF models.

Phase two was preparing a program plan, and then phase three is implementing the program plan, that is, developing the actual models.

So the first two phases were completed in 2001, and we're now in the implementation part of the plan.

MR. GOLDFEIZ: The main purpose was it should be traceable to Level 1. If we have a sequence of Level 1 and go to Level 2, we have to be able to traceable completely to background, to Level 1.

DR. LEHNER: So in our approach to model development we wanted to be as up to date as possible, so we wanted to include the most current information we could get. That included starting with 1150 type information, but then of course the IPEs. Depending on the type of plant we're looking at. We've looked at some of the documentation of research since then for evidence on direct-containment heating, lighter melt-through. A lot of work has been done induced steam generator tube rupture.

We've also tried to look at utility documents that document some of their findings on these issues.

So we obviously are trying to take the most recent developments into account when we develop the Level 2 technology.

We also want models, as I mentioned before, that are not as complicated as the 1150 models, so that they can have better run times and are more scrutable, but that do have more detail than some of the simplified models in NUREG/CR-6595.

I don't know if you are familiar with that.

CHAIRMAN APOSTOLAKIS: What is that?

DR. LEHNER: That is a report, it's

mentioned in the ASME standard for PRA that is acceptable for a category one type of PRA. And essentially that report has, for the five different containments, it has an event tree, a simplified event tree for each of the five containment types.

So it's split fractions are already provided in there. So if you want a very, well, quick way of calculating LERF, those are models you can use.

MEMBER DENNING: This is the Brookhaven report?

DR. LEHNER: Yes, 6595. That's right.

CHAIRMAN APOSTOLAKIS: The reason why NUREG-1150 was so detailed was that there were significant disagreements among experts as to what would happen under certain conditions.

And they resorted as you know to expert opinion, a dissertation, that was a very elaborate process, the Cadillac really at the time.

How are you going to handle that? Are you going to now settle and say, well, NUREG-1150 settled on this curve, and we are going to use that curve? Or is there any other way?

Yesterday, I got the impression that for internal events the SPAR people felt that they really only had a problem with structural uncertainty, and no

other. I mean there is uncertainty in human reliability. Well, we'll use SPAR-H and forget about it.

How are you going to handle that?

DR. LEHNER: Well, I think that unlike - you know this goes back to the purpose of the models. So we're not criticizing 1150 here. We're just saying that 1150, as you said, was a way to investigate a lot of different controversial issues and see what the outcomes would be depending on what weights you put on the outcomes.

I think some of those issues have been clarified since that time. For instance, I mentioned direct containment heating. There has been a lot of work done that's shown that the significance of direct containment heating in the large dry containments, and even the ice condenser containments is not as much as it was in 1150.

The same thing is true of Mark 1 lighter melt-through. There has been quite a bit of work done there.

So the models that we are developing are - again, the purpose here is not as a research tool to look at possible new failure modes or unique failure modes, containment failure modes. We're basically

looking at the consensus, the current consensus, on what are the important failure modes for the plants that are out there?

And based on that consensus, do a LERF model that includes those failure modes for that type of plant.

CHAIRMAN APOSTOLAKIS: But is there such a consensus?

DR. LEHNER: There is in many areas. I think there are some areas where there is still - for instance, induced steam generated tube rupture I think is something that the NRC is still spending quite a bit of effort on to investigate. So there is in some areas; not in all certainly.

MEMBER DENNING: I think we have to get here to what is the basic definition of LERF.

Incidentally, I don't really like LERF, but it's become a structured way of dealing with things.

But I assume that when the utilities do LERF, they really use 6595. Is that almost universally true, that they rely on 6595 to indicate what the probabilities are for a particular damage state, as to what the probability is of early containment failure? Do you know the answer, John?

DR. LEHNER: I can't really speak for the utilities, but my impression is that they will use 6595, but the answer may be too conservative. In other words, it may be - they will use 6595 if it is a quick way of getting an acceptable answer for LERF.

But in the IPEs of course the utilities did develop their Level 2 models. And while those Level 2 models for the IPEs did not directly calculate LERF, the better Level 2 models had enough information in them that they could calculate a LERF equivalent using those Level 2 models.

MEMBER DENNING: Well, I think the basic concept of a large early release is 20 percent. Is that the way you look at it?

DR. LEHNER: Well, the definition that is sort of - the definition of LERF is that it's a release large enough to cause an early fatality at the site boundary.

So the reason that I think the utilities like to use LERF, and that it's a good tool for the NRC to use as well is the fact that it simplifies things by not really calculating force terms.

In other words, what you are really doing is, you're saying, if I have a containment failure, or a bypass, that is early enough that I am going to

assume I'm going to get an early fatality, and I am not going to go through all the source term calculations.

MEMBER DENNING: But people don't do the source term calculations. And of course we recognize, it really does make a difference whether you are an 800 megawatt electric plant or a 1,500 megawatt electric plant as to what the implications are of a 20 percent release. And we completely ignore that in that - for most applications. That is okay within the range of uncertainties.

Where I am headed with this is, I'm trying to find out, are you getting away from kind of the underlying concepts of NUREG/CR-6595? How are - when you think about improving over that, that gets into the definition of what do you mean by improvement? What do we really mean by LERF? What is the definition?

And so that is what isn't clear to me is to how you decide what is an improvement, and in what sense is it an improvement? Because you are not going through release saying, do I get early fatalities or do I not?

DR. LEHNER: Well, I think the improvement is that we're taking more plant-specific factors into

account as to would you actually get to that failure mode, would you actually get to that bypass? And if you do, are there mitigating factors that you could claim would prevent you from having a release large enough to be a LERF.

MEMBER DENNING: So what's the likelihood of really getting that failure mode?

DR. LEHNER: That's right.

MEMBER DENNING: And you stylize what the failure modes are that are associated with early fatalities, in a sense. But you are going to do a better job of trying to estimate the - or represent the probability that you will get it?

DR. LEHNER: Exactly. Rather than have one event tree for all large dry containments, we have plant-specific information that allows you to get a more precise estimate.

MEMBER DENNING: Thank you.

DR. LEHNER: And of course as I mentioned, we want to link the Level 1 and 2 information, as Eli mentioned as well, directly, so you can trace the LERF contributors not just back to the plant damage states, or the containment failure modes, but to the initiating events, or any other Level 1 failures that may play a role.

We want to provide easy adaptation at other plants in the group, but I'll discuss that more in the next slide what I mean by that, because we haven't talked about the plant groupings yet.

We also want to construct the models in a way that you can, if it is so desired at a later date, that you can expand them to actual Level 2 models so that you can calculate late failures, not just the LERF portion.

MEMBER KRESS: Let me ask you, is every failure that is not an early failure a late failure?

DR. LEHNER: Well, in terms of --

MEMBER KRESS: I want to understand what the definition of a late failure is. My impression is that every one that is not an early is a late.

MEMBER DENNING: I think that is true, right?

DR. LEHNER: That is true, yes.

MEMBER KRESS: So you really get all the failures in there?

DR. LEHNER: It would be a complete Level 2.

MEMBER KRESS: And you could call it a conditional containment failure if you added them up right?

DR. LEHNER: Yes.

MEMBER KRESS: Okay.

DR. LEHNER: Whether those late failures lead to a significant release is another story.

MEMBER KRESS: This Committee as, as Rich said, I don't like it much either, we are leaning more towards liking the old conditional containment failure probability for a variety of reasons.

It looks to me like that would get you there.

MEMBER DENNING: But recognize that this Committee never acts as one, and believes the same thing.

MEMBER KRESS: I didn't speak for the Committee. I never do.

DR. LEHNER: And then finally I mentioned the user-friendly interface, which of course is actually done by the Idaho National Laboratory. But we've made some suggestions there in terms of what a LERF - someone who using LERF might want to see there.

Okay, now I mentioned plant groups. Unlike the Level 1 models, we don't intend to have an individual LERF model for every plant. Instead we have as you can see here about 10 groups where we would develop a LERF model for what we call a lead

plant, a specific plant in that group, and then that lead plant model can be easily adaptable to the other plants in the group.

And this just shows the lead plan group, or the grouping that we have. We have the five large dry models, that include the Westinghouse 2, 3 and 4 loops; the Combustion Engineering, 2 loops; and the B&W 2 loops.

We have an ice condenser model. We have two Mark I models. One was an isolation condenser, and one was a RCIC system.

And then a Mark II and a Mark III model.

So again as Eli mentioned earlier, currently we've developed a model for a Westinghouse PWR 4 loop, a BWR 4 with RCIC that has a Mark I containment; and a PWR with an ice condenser containment.

And when I say these models are completed, they've undergone internal review by us as developers; they've undergone NRC review; they have not yet been benchmarked against utility models, so that is still a step to be carried out, and we certainly intend on doing that.

This just shows you this idea of having a seamless model with Level 1.

CHAIRMAN APOSTOLAKIS: Can we have a one-page picture of this and the next one? Or magnifying glasses one way or the other.

MEMBER DENNING: I think we would like to get copies too.

DR. LEHNER: All we're trying to illustrate here is that in the usual - the most common analysis, you go through the Level 1, wind up with some core damage states that you then use a bridge of entry to fill in some missing information that you need for Level 2 analysis and get plant damage states. And then these plant damage states actually act as the initiators for --

CHAIRMAN APOSTOLAKIS: It's best to point to the screen, John, or do something, use the cursor there.

DR. LEHNER: Does this work?

CHAIRMAN APOSTOLAKIS: Yes, start from the beginning.

DR. LEHNER: Okay. So all we're trying to illustrate here is that if you have the Level 1 analysis here, which gives you some core damage states, and then what is usually done is that you then use a bridge of entry, which is this vertical portion of the diagram here. The Level 1 information does not

necessarily give you all the parameters you need for your Level 2 progression.

So the bridge of entry then gives you some additional initial conditions for your Level 2 analysis. And then what is usually done --

CHAIRMAN APOSTOLAKIS: Can you read the labels out of the boxes, on the bridge of entry?

DR. LEHNER: Oh, okay. Yes, the bridge of entry says, core damage states here, then this says additional level one system status, so in other words you get the information that is not already in this Level 1 tree, or Level 1 system --

CHAIRMAN APOSTOLAKIS: Such as? An example of that?

DR. LEHNER: Okay, well, Level 1 systems, I guess containment sprays, since that is what they're tied to, the injection systems, for instance, what would be the status? Level 1 you don't care what the status is.

CHAIRMAN APOSTOLAKIS: Containment spray? What did you just say?

MR. CHEOK: The containment spray system.

CHAIRMAN APOSTOLAKIS: Yeah, what about it?

MR. CHEOK: That in a Level 1 analysis,

you would not care what the status is of the containment spray system. So when you get to the core damage state, it is not necessarily an explicit status of the containment spray system at that point.

CHAIRMAN APOSTOLAKIS: You don't care at Level 1?

MR. CHEOK: Right.

MEMBER DENNING: You don't care what the spray is going, unless you had some tie back to a failure before core damage.

MR. CHEOK: The containment sprays would be important in things like a large LOCAs, but for transients, the containment sprays would only be important in the Level 2 space and lower space.

CHAIRMAN APOSTOLAKIS: For large LOCAs, it would be important, right? In Level 1?

MR. CHEOK: It could be important, that's correct. So they will be in those Level 1 entries.

DR. LEHNER: In some cases there will be.

CHAIRMAN APOSTOLAKIS: Yes.

DR. LEHNER: Sorry. But not in many cases - well -

MEMBER KRESS: What are some examples of core damage states?

DR. LEHNER: Well, these are just - by

core damage states I don't mean - I don't things like core vulnerable or things like that. These are all core damage states. It just means that the systems that have failed to get you there are different, different end states. That's all I mean by core damage.

MEMBER DENNING: It is just the end states of the Level 1 PRA?

DR. LEHNER: Yes, just the end states of a Level 1 PRA.

MR. CHEOK: I think all John is trying to say is, if you look at the event trees from yesterday, we either had core melts or okays.

DR. LEHNER: So - and he's referring to the core melts. So how you got to the core melt, and you carry over that information to the plant damage state. But as I said, that information may not be totally complete for what you need for a Level 2 analysis, so that's where this bridge tree comes in.

MEMBER DENNING: Now the bridge tree, is that a single tree? Or a main conceptual, it doesn't make any difference at all anyway. But you happened to break it into two pieces with additional Level 1 system status, and Level 2 system status?

DR. LEHNER: It's a single tree.

CHAIRMAN APOSTOLAKIS: But it's a standardized tree? Or is it unique to the plan damage state?

DR. LEHNER: It's different for different models, I mean for different plants. Because there are different systems involved in the status of the systems.

CHAIRMAN APOSTOLAKIS: Absolutely.

DR. LEHNER: So yes.

CHAIRMAN APOSTOLAKIS: But those are for different plant damage states, I guess. You have different branches.

MEMBER DENNING: I think he meant for core damage states. Is that what you meant? For different core damage states, do you have a common event tree?

DR. LEHNER: Yes, I mean it's - basically - well, you are actually working a little bit backwards here. You want to know what are the important system states that are going to be important in your accident regression.

So then you are going to see, what do I need here to fill in my plant damage information. And your bridge tree is going to ask those questions that you need to get those damage states.

I have an example --

CHAIRMAN APOSTOLAKIS: I think plant damage states and core damage states are the same thing.

DR. LEHNER: Well, not quite. They're close, but --

CHAIRMAN APOSTOLAKIS: They are not the same set. I mean, no, some users use the terminology, plant damage states, and others core damage states.

DR. LEHNER: That's true.

MEMBER DENNING: But here he has made a distinction. Here he does separate it.

CHAIRMAN APOSTOLAKIS: Well, some of the plant damage states do not lead to LERF, I guess. But a lot of them do. You really have to have serious core damage, don't you?

DR. LEHNER: In a sense, the plant damage states are like the initiators here. In other words, they are a snapshot of the plant at the time of core damage that you start with to how the accident progression --

CHAIRMAN APOSTOLAKIS: So you are making a distinction then? You are saying the output of the bridge event tree is the plant damage state?

DR. LEHNER: Yes.

CHAIRMAN APOSTOLAKIS: Fine, as long as

you make it clear.

DR. LEHNER: The distinction is simply that I don't have all the information here for my accident progression, so I used a bridge tree to get that information.

CHAIRMAN APOSTOLAKIS: Okay, that's fine.

MEMBER BONACA: So you may have more than one plant damage state for each core damage state?

DR. LEHNER: You may, but in general you will collapse the core damage states into plant damage states.

MEMBER BONACA: I understand. But I'm saying that you have the potential for that.

DR. LEHNER: Yes, certainly a particular core damage state may fit into several plant damage states. But a particular core damage state may fit into several plant damage states. And then a number of core damage states could be fit into a single plant damage state.

And in the scheme that we have, we filled the core with bridge tree, but we're attaching the bridge tree directly to the Level 1 tree, and the containment event tree directly to the bridge tree so that we have one continuous tree structure if you like.

So we've got to pinch down at this point and start over with plant damage states, we continue from initiators all the way through.

CHAIRMAN APOSTOLAKIS: I don't understand now. What is the difference between A and B? Oh, the large event trees are different with a bridge.

DR. LEHNER: Well, generally, what's done is that you bend the core damage states into plant damage states, and then you start your Level 2 analysis with plant damage states.

So you don't explicitly carry all this information over. You collect it and start over again.

What we're doing is, we just keep going with a continuous tree so we can have all the information.

CHAIRMAN APOSTOLAKIS: I thought that's what was done in 1150?

DR. LEHNER: No.

CHAIRMAN APOSTOLAKIS: No? I remember them insisting that this was an innovative thing they did, that they did not collapse the sequences.

DR. LEHNER: No, 1150, this was definitely a pinch point in the 1150, where you didn't --

CHAIRMAN APOSTOLAKIS: John, I can show

you the tapes. It is really irrelevant to what you are saying, but I was impressed when they said that. And that's why I remember it. They said, we are going all the way through.

DR. LEHNER: As a matter of fact, 1150, there is another pinch point here where you then collect your source terms and here your Level 3 --

CHAIRMAN APOSTOLAKIS: Anyway, it's a detail. You do it this way.

MEMBER DENNING: Surrogate source terms are qualitative?

DR. LEHNER: Surrogate source terms, you really need LERF or no LERF.

CHAIRMAN APOSTOLAKIS: So that's the last box, right?

DR. LEHNER: Yes.

CHAIRMAN APOSTOLAKIS: So you could have omitted it? What you really want is LERF?

DR. LEHNER: LERF, yes, it should really say LERF or no LERF basically.

CHAIRMAN APOSTOLAKIS: Okay, LERF or no LERF doesn't make sense.

DR. LEHNER: LERF and everything else.

CHAIRMAN APOSTOLAKIS: Large area release frequency, yes or no. I mean come on.

DR. LEHNER: You'll see that no LERF in a bunch of places.

Okay, this just gives you a little bit more insight into what we mean by these plant damage state parameters. This is for a ice condenser model, where you would want to know at the beginning of the Level 2 analysis what is the status of your RCS pressure. What is the secondary site pressure? What's the power status? What is the status of main/auxiliary feedwater? The RCP seal status, and of course, whether there is a bypass or not.

CHAIRMAN APOSTOLAKIS: So there are only six of them now?

DR. LEHNER: For this - this is for the ice condenser model, yes.

So because we've connected the models in the way we have, we can trace the results. In other words, how did we get to LERF? By containment failures modes, or plant damage states, which are the usual Level 2 parameters you can trace things by. But you can also trace it by an initiating event, or any Level 1 parameter really.

And the next few slides show some of the results for the ice condenser model, where this first one just shows you the total core damage frequency,

and what percentage of that ends in a LERF endstate.

And of course as I said, we keep track of what we call no-LERF here, because we don't throw those out for two reasons. One is, we want to make sure that we've captured the total - we've accounted for the total core damage frequency, but also, as I said, if we expand these models to be complete Level 2 models, then obviously we want to keep these sequences in the model so we can develop --

CHAIRMAN APOSTOLAKIS: I really think you should say, no LER, no release. No frequency doesn't mean anything.

DR. LEHNER: That's true.

CHAIRMAN APOSTOLAKIS: I'm glad you agree, John. I mean no LERF. It's really no LER.

DR. LEHNER: I can't argue with that.

MEMBER DENNING: Now you haven't talked about uncertainties, and can you?

DR. LEHNER: Yes. Very briefly. These are point estimate models. So you can do sensitivity studies with them varying parameters. But currently there is no uncertainty being propagated in the model.

CHAIRMAN APOSTOLAKIS: So these are point models?

DR. LEHNER: These are point estimates.

MEMBER DENNING: Well, we know how well we understand these Level 2 things. And I guess there is just no uncertainty about it.

MEMBER KRESS: Yes, we can pinpoint it.

MEMBER DENNING: It does raise a real question in my mind, really, when I look at what utilities submit and stuff like that and wonder what is really behind them.

There is a tremendous amount of uncertainty here, and the question is, should we be making a better attempt to characterize it.

DR. LEHNER: Well, I think that is certainly something to be considered.

MEMBER DENNING: And of course part of it is just again, what do we mean by LERF? What really is the definition? And if you get into these questions of - if you just said, 20 percent release of iodine, even there there is a tremendous uncertainty among these things, and do we - and should we be attempting to capture that in LERF?

And the problem that I see is that if you did try to do it, that the NRC's results would be so different from the results that are going to come from the applicant that you can't put the two together.

DR. LEHNER: Well, it would be a huge

uncertainty band.

MEMBER DENNING: These huge uncertainty bands and stuff, and the impact that it might have on your LERFs, I'm not sure that you can then really compare the apples and apples. And so maybe it is better to go with a point estimate on LERF. Is that a horrible thing to say?

CHAIRMAN APOSTOLAKIS: Yes.

MEMBER DENNING: Good, then I'm glad I said it.

CHAIRMAN APOSTOLAKIS: But I'm sure they are going to develop a SPAR dash LERF that would eliminate all modern uncertainty, like they did with SPAR-H.

MEMBER DENNING: Mike, do you have any comments here as to where they ought to go, or should they be going anyplace, on uncertainty?

CHAIRMAN APOSTOLAKIS: Well, but there is fuzziness also in the definition of core damage; it's not just LERF. But I think if there are large area releases, I remember the definition in 1.174, or the interpretation, was large unscrubbed releases before evacuation. That's what it says.

DR. LEHNER: Well, in a way it's sort of - I think it says a large release that will cause an

early fatality before evacuation. In other words --

CHAIRMAN APOSTOLAKIS: I don't remember it saying fatality. It says, unscrubbed, large, before evacuation. But again, that doesn't get away from Rich's point. I mean what is large?

DR. LEHNER: The definition in the ASME standard --

CHAIRMAN APOSTOLAKIS: But core damage I think has the same problem. I think we are talking about, what, 5 to 10 percent release of noble gases, is that the definition? And being unable to maintain coolable geometry, a LERF.

But uncertainties here are certainly much more important than Level 1.

DR. LEHNER: Well, they are much larger, certainly.

CHAIRMAN APOSTOLAKIS: Much larger.

DR. LEHNER: Yes.

CHAIRMAN APOSTOLAKIS: So I don't know a point estimate of 3.6E-6 means. I mean could it be 10 to the minus 5? Could it 510 to the minus 5?

DR. LEHNER: As I said, you can do sensitivity studies --

CHAIRMAN APOSTOLAKIS: Don't do sensitivity instead of 170. Why do uncertainty? It's

a tough problem.

DR. LEHNER: It is a tough problem.

CHAIRMAN APOSTOLAKIS: It's a tough problem, there is no question about it. But sensitivity studies will never save you.

You see the fundamental problem with sensitivity is that you start changing things, until you consider a case where you violate something. And then you back off without - oh, this is unreasonable. I mean give us some uncertainty.

I'm not talking about you. There is a fundamental problem with sensitivity analysis. These are relics of the old way of doing business, when engineers did not consider uncertainty, and they changed things a little bit to see what happens.

Now we have a very different environment. Now we are working with probability curves.

So I know you have big problems ahead of you, but you have to keep in mind that uncertainties here somehow have to be handled.

MEMBER DENNING: So if we look at uncertainties in LERFs that would be presented here, they really all come from the Level 1 piece; is that a true statement, or is that not true?

DR. LEHNER: Yes. You mean if you looked

at your LERF results here, and you included the uncertainty in the Level 1, there is no uncertainty included in the Level 2.

CHAIRMAN APOSTOLAKIS: The SPAR Level 1 already has the capability of doing that.

MEMBER DENNING: Oh, definitely.

DR. LEHNER: There wouldn't be any uncertainties at the Level 2 phenomena.

CHAIRMAN APOSTOLAKIS: Very good.

DR. LEHNER: And then this just shows some more results. This is by containment failure mode. This is all for the ice condenser model, where we have the - really the only significant failure mode is the hydrogen burn. The rest are really various types of bypass scenarios.

Skin tube rupture as an initiator, interfacing systems LOCA.

CHAIRMAN APOSTOLAKIS: Why didn't you put percentages there?

DR. LEHNER: Why didn't we put percentages?

CHAIRMAN APOSTOLAKIS: Yes, the hydrogen burn seems to be a little more than 50 percent. And steam generator tube rupture is what? 30, 40 percent?

DR. LEHNER: I don't have the actual

numbers in front of me, but if you are interested we can certainly provide those.

MEMBER DENNING: No, we don't need numbers. It's just an example, right?

CHAIRMAN APOSTOLAKIS: And the interfacing system LOCA, is which one? You used two whites.

DR. LEHNER: I'm sorry? Oh, it looks better on the computer screen that it does up there. This is the flow chart.

CHAIRMAN APOSTOLAKIS: Wasn't that the major finding of the reactor safety study that this is a major failure mode? It doesn't look like it's very important here.

DR. LEHNER: Which?

CHAIRMAN APOSTOLAKIS: ISLOCA. You are bypassing containment, right?

DR. LEHNER: Yes. Well, I mean these, these are all really bypasses here. The induced - the steam generator tube rupture is an initiating event. The ISLOCA, this is mainly for the RHR system, and the induce steam generator tube rupture.

MEMBER DENNING: Which we didn't even know about in NUREG-1150.

CHAIRMAN APOSTOLAKIS: What is it you didn't know?

MEMBER DENNING: Induced stem generator tube rupture. I don't think we did that.

DR. LEHNER: And then this is broken up by initiating event where loss of off-site power is obviously the - that includes station blackout, if the water is a contributor, steam generator tube rupture, initiator. As I said, the ISLOCA initiating the RHR system, and then the others is just a small portion over here. This is the ISLOCA.

MEMBER DENNING: But that's driven by the frequency of those initiating - of those point damage - of those core damage states, right?

DR. LEHNER: Yes. But these are the actual initiating events in a Level 1. Yes, sure. And then this is just breaking out the station blackout contributions. This is the station blackout that was part of the loss of offsite power. And the slow station blackout, the fast station blackout, and then all contributors to LERF.

So station blackout accounts for a little more than 50 percent of all the LERF end states.

MEMBER DENNING: Was that the hydrogen burns?

DR. LEHNER: Well, yes. I mean the station blackout means the igniters are not working.

And so that's when your containment is vulnerable to the hydrogen burns, that's right.

CHAIRMAN APOSTOLAKIS: Good.

DR. LEHNER: And then this just shows, because we go all the way back to the initiating events, we can look at the importance of various basic events, both from a Level 1 and the Level 2, so this just gives you a list here of Fussell-Vesely importance for some Level 2 events, and some Level 1 events.

CHAIRMAN APOSTOLAKIS: So you know, there is quite a number of them that have the same Fussell-Vesely.

DR. LEHNER: Yes.

CHAIRMAN APOSTOLAKIS: Did you all do RAW, the risk achievement worth?

DR. LEHNER: We didn't do it --

CHAIRMAN APOSTOLAKIS: But you can do it?

DR. LEHNER: We could do it, yeah. We do any of the important measures for LERF that we do for CDF.

CHAIRMAN APOSTOLAKIS: Are you going to do Birnbaum also?

DR. LEHNER: If you like.

Okay, so the current status is that we

completed the three models I've talked about. They still need to be benchmarked against the utility models.

And currently we have a Mark III model which is almost completed, and we're starting work on the Mark II model.

MEMBER DENNING: And you haven't told us when everything is going to be done?

DR. LEHNER: Everything should be done in 2008.

MEMBER DENNING: Isn't that a long time in the future?

CHAIRMAN APOSTOLAKIS: It's a fuzzy definition of a long time.

MEMBER DENNING: But right now, when we use SPAR in these studies, we also make an estimate of LERF, don't we? It's just that we don't use this consistent model. Or in the various applications -- I'm trying to remember. In the station blackout study that was there, anything done on LERF?

MR. CHEOK: On specific studies when LERF is important the staff will do it on a case by case basis, translating CDFs to LERFs, using mostly 6595.

MEMBER DENNING: Got you, thanks.

DR. LEHNER: Now on this last slide, I

just wanted to mention that one of the tasks we're undertaking this year is to develop this more automated Level 1 LERF interface, because we're attaching our LERF model directly to a Level 1 model, and the Level 1 models are still being updated.

Then a user then has to - if one model changes, the LERF model is no longer good to use with that changed Level 1 model. So we're trying to get around that by basically looking at the Level 1 models, grouping them in ways that they have similar structures that are close enough within a group so that we can do what we call automated Level 1 LERF interface, so that if there are some slight changes in the Level 1 model, it does not affect - the LERF model, you don't have to go back and redo the LERF model, that that would be automatically taken care of. But that's really the last slide I had.

MEMBER DENNING: Any major comment?

CHAIRMAN APOSTOLAKIS: You have one more don't you?

DR. LEHNER: I don't think so.

CHAIRMAN APOSTOLAKIS: No, you don't. Thank you very much.

Are there any questions?

MEMBER DENNING: I think this is

absolutely right on. I think this is exactly what ought to be done as an add-on to the SPAR.

CHAIRMAN APOSTOLAKIS: Wonderful. Thank you very much, gentlemen.

So at this point we'll take a break until 10:20.

(Whereupon, at 10:00 a.m. the proceeding of the above-entitled event went off the record, to return on the record at 10:23 a.m.)

CHAIRMAN APOSTOLAKIS: Okay, next is Mr. Mitman.

Go ahead.

MR. MITMAN: Good morning. My name is Jeff Mitman. I work for research in the OERB branch. First thing I wanted to do is hand out a set of large slides.

CHAIRMAN APOSTOLAKIS: This is called learning from experience.

MR. MITMAN: Going to talk about the SPAR models in the low power shutdown area. These models were developed by INL for research, and we will go through and first we'll look at an overview of what the project is about.

The objective of the project is to develop low power shutdown models to use in event

assessment and support risk informed applications.

The goal is to develop a set of plant models covering all plant classes. That is the initial step we're working on at this point.

The approach is to build on the existing '72 models, the Rev. 3 internal events model, in conjunction with some low power shutdown templates that we have developed.

It's got all the standard features of a typical PRA model, event trees, fault trees. For low power shutdown, we've had that in plant operating states, which I'll talk a little bit more about.

Initiating event frequencies, reliability/unavailability data, and HRA/operator actions.

Now the way the models are built is, we develop special event trees for low power shutdown, and then as often as possible we link into the existing models, the internal events models.

So we link in the fault trees, the reliability/unavailability data as applicable, HRA and other operator actions.

MR. CHOKSHI: These models presume you know the states that the plant is in?

MR. MITMAN: The models are structured to

calculate an average outage CDF.

MR. CHOKSHI: And you get that average by what, going back in time and seeing what has happened with outages before?

MR. MITMAN: Well, the models are an outgrowth of new Reg CRs on Surrey and Grand Gulf that were doing in the early '90s.

MR. CHOKSHI: I remember those.

MR. MITMAN: Published in '94.

MR. CHOKSHI: Yes, I remember those.

MR. MITMAN: And in there they calculated, they came up with what they considered to be an average outage.

The average outage has evolved. Outage times have come down significantly since that time period. So what we have got is a new baseline average outage. But it is an average outage. It is not a plant-specific average; it's an industry average. And it's averaging the POS durations, the equipment availability/unreliability, everything across the spectrum.

Does that answer the question?

MR. CHOKSHI: Yes, I understand what you are doing.

MR. MITMAN: So to date we've got 11

models completed, and we've completed QA on all the models to different degrees, and we've done onsite QA reviews of four of the models.

The models that have been completed are listed here. It's 11 models covering, if I'm counting right, 19 reactors. So almost 20 percent of the fleet.

The scope of the models for PWRs we're doing hot shutdown, cold shutdown and refueling.

For the BWR models we're doing cold shutdown and refueling.

Initiating events covered: There are really three groups here. There are LOCAs, traditional LOCA pipe break which leads to loss of inventory impacting decay heat removal.

You also have another class of LOCA called an HLOCA which is a drain down event which also will impact, cause a loss of inventory potentially impacting decay heat removal.

We've got a LOOP initiating event, and then two that affect decay heat removal capabilities directly. That is the loss of shutdown cooling, and the shutdown cooling system isolation. Both of those will cause a loss of decay heat removal.

Things that are not in the model, and I'll

talk a little bit about the reasons. LTOP is not in the model. That is because the probability of having a vessel or a pipe rupture is very small, so that part of LTOP has been excluded.

Likewise reactivity events are excluded, again, because of very low probabilities.

Spent fuel pool is not currently in the scope.

MEMBER DENNING: Implication that it will be in the future?

MR. MITMAN: Spent fuel pool?

MEMBER DENNING: Yes.

MR. CHEOK: We haven't really thought about it, to tell you the truth. We will include it, I guess, if the agency has a big need for it.

CHAIRMAN APOSTOLAKIS: But the others would be included?

MR. MITMAN: LTOP and reactivity?

CHAIRMAN APOSTOLAKIS: Yes. Oh, it's low probability you saw.

MR. MITMAN: They are very low probabilities.

MEMBER KRESS: On the spent fuel pool, it doesn't limit itself to just low power shutdown risk. It ought to be the whole thing. It looks to me like

it's be almost a separate PRA that you do and just add it in at the end.

MR. MITMAN: The links back to the internal events model are fairly weak in a lot of ways. I mean some of the systems are shared between the two, but there are also a lot of independent systems.

MEMBER KRESS: External events are currently excluded?

MEMBER DENNING: Again, it's a current question. Fire obviously is something of concern, and I suspect it's not going to be in the other fire, you know, in the external events PRA. So it seemed logical to include fire here.

And I've never seen flooding. I've never seen what the impact of flooding is on these conditions. But it's another thing to consider.

MR. MITMAN: It's another place to consider. To have complete models you'd want that, but that's later on down the road.

MR. CHEOK: I think eventually external events and Level 2 will be included in the model. So you're right, if you look at initiating frequencies for fires and floods, they tend to be higher during low power shutdown modes.

MR. CHEOK: It seems to me like if you are expecting a tornado or a hurricane, you might be tempted to shut down the reactor, so simultaneous events of having a hurricane and a tornado, and being at low power shutdown. It seemed to be highly likely.

MR. CHEOK: But I guess one reason we do that though is that we have already predetermined, I guess, that it's less risky for the plant to be shut down during a hurricane or tornado, as opposed to being at power.

But you are right, we still need to continue to evaluate the risk as the event is happening.

MR. MITMAN: And if you are in an outage, you - in some ways you can be more vulnerable to internal and external events. Internal flooding, for instance, you've got barriers removed.

Likewise external events, you've got transformers out of service for maintenance; you don't have your main generator as a source of power. So you can actually be more vulnerable sometimes during low power shutdown.

MEMBER KRESS: You just assume that the conditional probability of the LERF is one?

MR. MITMAN: Here, we don't go that far

even. In BWR Mark I/Mark II containment, the containment is open while you are moving fuel. So our primary containment is open while you are moving fuel.

MEMBER DENNING: It ought to be a zero, not a one.

MR. MITMAN: As we talked about earlier, the models build on the BWR and PWR templates, which again, build on top of the Grand Gulf NUREG/CR-6143 and the Surrey NUREG/CR-6144 studies.

CHAIRMAN APOSTOLAKIS: These are 1150?

MR. MITMAN: Pardon me?

CHAIRMAN APOSTOLAKIS: These are from 1150? Oh, later. They came later, yeah.

MR. MITMAN: These studies were published in '94, I believe.

Decay heat levels are typically binned in four time windows. Typical binning is, as I've shown here, a little bit different for both BWRs and PWRs.

We use weighted average fractions for time spent in each POS. And the end state that is evaluated is core damage.

The next series of slides, and I've given you the handouts, are the - I want to go through a little bit on the event trees, kind of step you through the overall layout of the model and how things

are described.

The first event tree is really an event tree which selects which POS you're in. You come in initially with a shutdown question. This is a BWR model, so we're asking which of the two modes we evaluate, Mode 4 or Mode 5.

We're asking a question about timeframe, and the timeframe is there to determine if it's before you've removed spent fuel or after, because the decay heat levels are different between before and after reloading fresh fuel.

The next question is a question about pressure. Now we're in cold shutdown, so you might ask why we're worried about pressure. Well, there is one state down here where we have high pressure, here, which is after you've done the reloading of the new fuel, you've buttoned up and you're doing the vessel hydro, so there is one point in there where you're at high pressure.

And then you ask a question about what your water level is in the reactor. Is it normal? Is it immediately below the main steam lines? Or is the cavity flooded, the cavity connected to the spent fuel pool.

That is the last question.

Over here we end up with the POS's that we come out at, and their frequencies in the final column.

Now the example that I'm going to use is, we're going to come out through the first POS here, which is cold shutdown. Before refueling we've got low pressure and water level is normal.

CHAIRMAN APOSTOLAKIS: Would you explain to me the frequencies?

MR. MITMAN: The frequencies are inputs into the model.

CHAIRMAN APOSTOLAKIS: I mean this is -- look at the second one, it's 1.125 ten to the minus one. This is a frequency of what?

MR. MITMAN: This is the frequency that the plant is in that POS during the outage. So if you sum these, they will add up to approximately one, and they are the fractions - you can think of them as split fractions --

CHAIRMAN APOSTOLAKIS: Ah, okay, so they're conditional. Are they conditional?

MR. MITMAN: They are the fraction of time that you are in the POS during the outage.

CHAIRMAN APOSTOLAKIS: So you are in an outage, and this is the fraction of time that you will

be in this POS?

MR. MITMAN: Yes.

MR. CHEOK: It's the conditional probability that the plant is in that POS, given that they are shut down.

CHAIRMAN APOSTOLAKIS: Yes.

MR. MITMAN: Let me qualify that just a little bit, that they're shut down and in a refueling outage, because there are other models for other outage types.

We go on to refine the POS a little bit. As I said --

CHAIRMAN APOSTOLAKIS: Would you remind me what Mode 4 is and Mode 5.

MR. MITMAN: Mode 4 is cold shutdown, and Mode 5 in a BWR is refueling. So the distinction between the two is that the head is off.

We come in with the initial question asking which POS we're in, and the previous event tree selected this one. Now we have a selection just on time window. And again, there are four time windows that were used. They're just basic cut times in the model, and they're used to take into consideration things such as decay heat levels, time for operator response, and success criteria.

And then the final question that's asked is the traditional initiating event. And as I discussed earlier, they are the five initiators that we're looking at.

And then we come opt of here and we come into a more traditional event tree.

CHAIRMAN APOSTOLAKIS: So what you have defined so far with the previous event tree, and part of this one, is the initial conditions of the accident?

MR. MITMAN: The initial condition of the plant.

CHAIRMAN APOSTOLAKIS: Okay.

MR. MITMAN: And then this one looks at what initiators you can have in this particular condition.

CHAIRMAN APOSTOLAKIS: Okay.

MR. MITMAN: I want to use as an illustration a loss of offsite power.

So we come in again with the initiator. We ask a question about the availability of onsite emergency backup power, and then a question about recovery of the offsite power during the event.

There are essentially two endstates that come out of here: shutdown cooling system recovery;

and if we can't recovery shutdown cooling, then we have to go to a second-tier defense, which are ECCS systems.

CHAIRMAN APOSTOLAKIS: What do you mean by "AC Power Recovery During Shutdown"?

MR. MITMAN: Well, the initiator is a loss of offsite power. So the first response that you are going to have is to start the diesels, and power the four Kv buses from the diesels.

But you also have the possibility of recovering the lost offsite power, and that's what the second question is asking about.

CHAIRMAN APOSTOLAKIS: But the "during shutdown" part I don't understand. Why does it have to be during shutdown? It has to be before something bad happens. Isn't that what we're doing the event tree for the power operation?

MR. MITMAN: No, this is a lower power shutdown.

CHAIRMAN APOSTOLAKIS: I understand what it is.

MEMBER DENNING: But it's redundant. The term, during shutdown, is redundant. It doesn't add anything to this, because we know we're shutdown.

MR. MITMAN: You are correct. The whole

model is based on low power shutdown.

CHAIRMAN APOSTOLAKIS: Shouldn't it be AC power recovery before --

MR. MITMAN: Field damage?

CHAIRMAN APOSTOLAKIS: -- field damage or core recovery or something like that?

MR. MITMAN: Something like that.

CHAIRMAN APOSTOLAKIS: Before something bad happens.

MR. MITMAN: Agreed, it should be. The nomenclature should be clearer.

The next event tree we're looking at is a recovery of RHR in traditional shutdown cooling.

So the first question we evaluate is, can we recovery the faulted shutdown cooling previously running RHR train? If that is not available, then we can go to the second train, see if we can recover it.

Then the third question is to evaluate any alternate shutdown cooling systems that might be available.

MEMBER DENNING: Including exotic things like fire?

MR. MITMAN: No, those will be evaluated down here in the ECC tree.

Things that you might have here, a couple

of BWRs have an alternate decay heat removal systems. More traditional systems that are closer in design to a decay heat removal system versus an injection system.

And if we can't recover RHR, then we go to the ECCS tree. And here we get into more traditional things that you are used to seeing in a out power event.

Again we come in on the initiator. There is a question about depressurizing the reactor. If you're in a hydro, you have to depressurize before any low pressure systems can inject.

CHAIRMAN APOSTOLAKIS: And you are going to use SPAR-H for that?

MR. MITMAN: We're going to use SPAR-H throughout, yes.

MR. CHEOK: We have actually tested SPAR-H out for low power shutdown. As a matter of fact, the latest update to SPAR-H was to update it for lower power shutdown conditions.

MR. MITMAN: The next question is about suppression pool level, and adequacy of that for source of injection.

Then we go ask a question about the availability of low pressure core spray. Low pressure

core injection. High pressure core spray. And finally a question about availability of fire water.

Essentially if you have one or more of those systems available, you are going to come out okay if you go through this whole sequence, and you can't establish anything, you are going to end up here at core damage.

MEMBER BONACA: Try to walk through it when it would be a success, in both cases.

MR. MITMAN: Yes. Let me qualify that, as long as you depressurize.

MEMBER BONACA: Yes.

MR. MITMAN: I want to talk a little bit about future plans. Our plans are to complete an additional four models during 2006. We will do our internal reviews on all the models that we develop this year, and we'll do some onsite comparisons as we can.

There are some issues with that. One is that availability of the PRA staff of licensees, and also, availability in the low power shutdown area we're running into issues, problems, with plants not having detailed low power shutdown models. So in some cases there is not a lot to compare it against.

Other thing we'll be doing this year is to

develop low power shutdown internal events guideline.

That's all I had. Any additional questions?

CHAIRMAN APOSTOLAKIS: Okay, thank you.

MR. CHEOK: We'll have Selim no come up and give you the demonstration.

I guess we will have to go find him first.

Let me summarize while you are waiting the takeaways that I heard this morning.

I think what I heard was, in the external events models, that we should consider more what Sandia slash research are documents, guidance, as saying, and how we can incorporate that better into our SPAR models, or how we can consider those guidance in helping us to define better plant damage states, which would then become our initiating event frequencies in our SPAR models.

Right now what we are doing is using frequencies that we obtain from the licensees and damaged state definitions from the licensees. We can refine that a little better by looking at the Sandia documents.

Second takeaway I think I got from this is from the low power shutdown models is that perhaps we should consider things like external events and LERFs

to tack on to the end of the low power shutdown models. And we will definitely consider that. Whether we will come up with models to tack onto the end or not, I guess we will have to study and see if there is a reason why we should or should not have those models.

MEMBER DENNING: I don't think we really need to do anything in the LERF area yet at this point.

MEMBER KRESS: I think that can wait awhile yet.

I wondered about the use of the average shutdown state. You have an average for different plant types? Or you have just one average?

MR. MITMAN: The only way we've split it so far is to distinguish between a PWR and a BWR.

MEMBER KRESS: I think that is going to be highly plant specific, and you might want to think about refining that some way. I don't know how you get an average for an plant, because you don't have enough - you'd have to go back to all their past shutdowns, and then maybe extrapolate into the future.

MR. CHEOK: It's not easy. And you are right, it is so plant specific, and it's so shutdown specific for the same plant, they could have the same

--

MEMBER KRESS: Yes, each shutdown is different from the previous one.

MR. CHEOK: Absolutely.

MEMBER KRESS: And so I don't know another way to deal with that yet.

MR. CHEOK: It's not easy. I think if you look at the two objectives of the low power shutdown models, one was to help evaluate events during low power shutdown. And that we can do.

MEMBER KRESS: That we can do because we know what the condition is.

MR. CHEOK: That is correct. We can define what it is. On the other hand if you are trying to use those models to do - to evaluate if something is more risky at power versus shutdown, then you have to make very well known what your assumptions are in terms of what you are talking about in terms of shutdown, because there is no such thing as a typical shutdown.

MR. STANCAKTAR: How much time do you have? How many minutes?

CHAIRMAN APOSTOLAKIS: You said five minutes.

MR. STANCAKTAR: Okay, what would you like

to see specifically?

CHAIRMAN APOSTOLAKIS: Walk us through it. I don't know.

MR. STANCAKTAR: Okay, I have the models here, and documents.

MEMBER BONACA: You can spend more than five minutes.

MR. STANCAKTAR: Do you want to look at them all, or do you want to look at the documents?

CHAIRMAN APOSTOLAKIS: Why do we want to look at the documents?

MR. STANCAKTAR: Because it will give you an immediate access to some output. The other one will start from the beginning. It doesn't matter. It will all come to the same thing.

Okay, this is the Indian Point 3, based on Version 3.12 of SPAR. These versions keep changing. So one of our challenges is to quickly --

CHAIRMAN APOSTOLAKIS: 3.12?

MR. STANCAKTAR: 3.12. Not 312. So one of our challenges is to make sure that when we make a model and the font is changed, we don't keep forever changing two sets of models. So we want to quickly convert, and have only one set of models.

This is, as you can see here, three

external events based on 3.12 of SPAR. It's the same software. And the starting point is here.

If you look at the corresponding SPAR model - these are event trees - all you will see are these event trees minus these two tornado sequences.

So these are internal initiating event trees, except these two tornadoes. The rest of them up here are all new scenarios as for external events. So each one is like an initiating event. It has its own event tree. And so on.

We are using a convention, like EQK refers to an earthquake. And FLI refers to internal flooding. FRI refers to internal fire. And TOR is tornado. High wind is here, HWD.

These are the scenarios I resurrected from Indian Point 3, even if some of them were attempted to be screened out. But I kept them, because their CCDP's were not really that small. I mean they were seriously close to one.

So in the future if we have an event where initiating our frequency is affected, the same area is affected, it might have a considerable shift in plant risk. So I include it.

So we don't throw out things because they are screened out necessarily.

Here are main control room scenarios. Like this one is the evacuation. This one is main control room fire.

CHAIRMAN APOSTOLAKIS: So can you show us what you did there?

MR. STANCAKTAR: Oh, sure. For example, I'll show you - we'll start with that little one here, okay? Now here we call this stub event trees. They take you out from this initiating event as defined to an event tree that is already defined in the internal events.

So this one fire in the main control room fails nonsafety equipment. We are sending it to loss of main feedwater transient event tree with certain failures of course, additional failures and so on.

Originally we were copying event trees and just sticking them in here. But that really was a problem when you update in the future, and you have to come here and update a zillion event trees.

This way we are saving some effort, because if somebody updates the loss of main feedwater event tree, we don't have to go into 30 different places and update it.

MEMBER DENNING: Now there is a fault tree at this branch here?

MR. STANCAKTAR: This one?

MEMBER DENNING: Yes.

MR. STANCAKTAR: This one really is in this particular place, this is nothing but a flag that sends you here, and it doesn't even show in the code sets, because it's a flag that's set to true. So it goes down this way.

But yes, the answer is, there is a fault here. It is nothing but a flag.

CHAIRMAN APOSTOLAKIS: Under what conditions would you go to okay?

MR. STANCAKTAR: Never. This is zero. This is just a way to transfer to the design point without bringing the whole event tree in here.

So this is just a model convenience, but explicit. You can just see it here. So it goes here.

MEMBER BONACA: Can you get back to the one on the control room evacuation?

MR. STANCAKTAR: Sure, the control room evacuation in this case goes to its own event tree which is a new one. So let's go there and look.

It could have been developed here too. This does not necessarily need a stub tree, because it's a new event tree. But we did it in this case to be symmetric so people will recognize a pattern.

So if you go - okay in this case, it goes to transient, and then things are taken care of in the transient event tree, with switches.

But I want to show you, this one doesn't have its own. Let me show you one that does have its own main control room scenario. That's why I brought different ones.

Go back here, go to for example Wolf Creek. Here's the event tree, control room is here, go here. Okay.

This one is more representative. So this one is based on the Appendix R kind of response with fueling equipment available. So this plan cannot really handle a small LOCA or a LOCA from a shutdown panel. That is the assumption.

Whether this assumption is conservative or not will be further discussed. But in general the examples we saw, people are retaining their Appendix R assumptions.

So you come out of the control room, and you can cannot handle if there are LOCAs. Otherwise, you can survive.

So anytime you RCP LOCA or LCOA, this says you won't be able to survive.

This would be an interesting actually

point in assessing the plant risk, when Appendix assumptions are really too conservative, whether it's a good strategy or not.

CHAIRMAN APOSTOLAKIS: Do you have an example where you have a fire that fails a number of equipment?

MR. STANCAKTAR: Sure.

CHAIRMAN APOSTOLAKIS: When you go to the event tree and input that as a common cause failure.

MR. STANCAKTAR: Here. All of them have these flat files.

CHAIRMAN APOSTOLAKIS: Well, let's look at one. Do you have fires spreading in the control room? It sounds too simple to me. Something is missing.

MR. STANCAKTAR: Not yet, because you will see the details.

Okay, like in this scenario, loss of service water event has occurred.

CHAIRMAN APOSTOLAKIS: How come? Why did it occur?

MR. STANCAKTAR: Because of the initiating event. So the scenario says that if this happens on this occasion --

CHAIRMAN APOSTOLAKIS: This is a Level 1 event tree?

MR. STANCAKTAR: No, no, these are flags that failed equipment. So this is a place where you put your failures.

CHAIRMAN APOSTOLAKIS: What I got in mind is this, you have a fire say in a location, in the spreading room or somewhere else. It causes an initiating event, and at the same time it affects the performance of the safety systems.

Okay, let's walk through this.

MR. STANCAKTAR: In this one, in this event, the loss of offsite power is caused by the process ACP-NB02 and NG02 are failed.

CHAIRMAN APOSTOLAKIS: So where is the fire?

MR. STANCAKTAR: The fire is the initiating event. It's in the event tree.

CHAIRMAN APOSTOLAKIS: But where did it occur to do this?

MR. STANCAKTAR: It occurred in Area C10.

CHAIRMAN APOSTOLAKIS: Which is --

MR. STANCAKTAR: Wherever it is. I don't have it written out here.

CHAIRMAN APOSTOLAKIS: Fine, so let's go back to the tree.

MR. STANCAKTAR: Back to here?

CHAIRMAN APOSTOLAKIS: Yes. Here.

MR. STANCAKTAR: These are the properties of the scenario are captured here.

CHAIRMAN APOSTOLAKIS: But again, the fire is an initiator. I want to see a fire that does both, creates an initiating event, and disables part of the safety systems that are there to contain that initiator.

MR. CHEOK: I think that is what Selim is trying to show you. The fire is initiating in C10. Now it causes all these, the first two processes to fail in that event. And so he is setting those events to true in this particular event tree so that they are failed.

CHAIRMAN APOSTOLAKIS: What he's saying is that the fire causes the loss of the buses. It leads to the loss of offsite power. Right?

MR. STANCAKTAR: That isn't necessarily exactly the interpretation.

CHAIRMAN APOSTOLAKIS: The third entry there is looped, right?

MR. STANCAKTAR: Looped.

CHAIRMAN APOSTOLAKIS: So the fire has caused the loss of offsite power. Everything you have there has nothing to do with fire.

MR. STANCAKTAR: It does, because recoveries are not possible in this event. You cannot recover.

CHAIRMAN APOSTOLAKIS: Are not possible?

MR. STANCAKTAR: Yes, all these recoveries are also turned off. Normally, in a route you have recovery possibilities. Here, due to the event, you cannot recover.

CHAIRMAN APOSTOLAKIS: So why can't you recover offsite power in four power?

MR. STANCAKTAR: Because they burnt the buses.

CHAIRMAN APOSTOLAKIS: The buses?

MR. STANCAKTAR: Actually, it is not a true loop. It is - even if you have power at the yard, you bring it in, and you cannot bring it to these two buses.

CHAIRMAN APOSTOLAKIS: Okay, so this is an impact. That is true.

MR. STANCAKTAR: This is an example of something you were trying to envision.

CHAIRMAN APOSTOLAKIS: Because I remember when we were doing Indian Point and Zion, that was the major effort, you know. If you have a fire in your location, in the cable spreading room, where redundant

trains come the closest. As I recall I was four feet.

And then you try to figure out, what is the initiating that would be caused by this, and which bumps or bottles and so on would be disabled.

So you see to have done this?

MR. STANCAKTAR: Yes, absolutely. That's why I was trying to show you, asking you initially whether you wanted to see the --

CHAIRMAN APOSTOLAKIS: Let's see.

MR. STANCAKTAR: -- if you wanted to see the report.

CHAIRMAN APOSTOLAKIS: Well, let's look at the report.

MR. STANCAKTAR: Because in the report, there is a crucial file there. Like if somebody said, show me only one thing in the report, this is what I would show them.

CHAIRMAN APOSTOLAKIS: Okay.

MR. STANCAKTAR: Okay, this is the summary matrix of the scenarios. And in fact one of the ideas we are having now is, have the code read this kind of information, and make the scenario event trees and the logic, just read it off here as though somebody was actually trying to make trees and so on.

So here is the type of information. The

rupture of normal ASW header. Here is a name, here is the initiating event frequency. This information is just for additional information; it has nothing to do with our model.

Equipment losses are HR pumps and normal emergency service water. Normal emergency service water is lost because of the event. RHR pumps are lost because of the consequence of the event. They are wet.

And initiating event caused with an ascendant transient with these conditions.

CHAIRMAN APOSTOLAKIS: So what is the external event in this scenario?

MR. STANCAKTAR: It's internal flooding, FLI, at the AB55a. This is a name given by the plant so we can go find and read about it.

So IPEEE says, here is a scenario. They studied it. They gave down. And they said, finally, here is the scenario frequency. Here is the equipment lost. And here is the initiating event that is generated.

Now, so the thing is to represent this information in terms of the existing model. Tell the model this information.

CHAIRMAN APOSTOLAKIS: All you are doing

here, Selim, is copying scenarios you have found in the sources you have looked at?

MR. STANCAKTAR: Yes. Right.

CHAIRMAN APOSTOLAKIS: Doing it is not easy. This is a shock.

MR. STANCAKTAR: Once you get in this and this, is the place where you spent an enormous amount of energy.

CHAIRMAN APOSTOLAKIS: Now in Level 1 SPAR models you developed your own, and then you compared them to regular utilities. Here you don't seem to be doing that. And maybe we ought to think about it a little bit.

I appreciate it how difficult it would be to do your own. But on the other hand relying blindly on what the licensee has done may not be such a good idea either.

MR. CHEOK: I think that's why I mentioned earlier that the next stage would be to study the Sandia report a little better.

CHAIRMAN APOSTOLAKIS: Which Sandia report is this?

MR. CHEOK: This is the most recent one? What's the number, Selim?

MR. STANCAKTAR: On what?

MR. CHEOK: On phenomenology of fire, and how you define the different fire damage states, how you define hot shots and things like that.

CHAIRMAN APOSTOLAKIS: So this is just an enumeration of what other people have found?

MR. STANCAKTAR: Yes.

CHAIRMAN APOSTOLAKIS: Oh, it's a very good thing to do, no question about it.

MR. STANCAKTAR: Think about this when you go home.

CHAIRMAN APOSTOLAKIS: Right, that's what I'm going to do, Selim.

MR. STANCAKTAR: If I sit in my room with five people from the NRC for two months I will have figured out this scenario without a lock down or some other information.

Tornado strikes, auxiliary boiler feed pump building. I mean that is an important thing that they have figured out, and they have studied it.

CHAIRMAN APOSTOLAKIS: This is really very informative, very informative. I'm glad you did this.

My question is whether we should have a separate subcommittee meeting on this stuff. Because this is extremely - or maybe a part of a subcommittee meeting.

MEMBER DENNING: On which? Do you mean the --

CHAIRMAN APOSTOLAKIS: Just on the external events.

MEMBER DENNING: Yes. I think that we have to give them a little more time to work on that. But I think we absolutely do.

CHAIRMAN APOSTOLAKIS: I don't mean next week, sure.

MEMBER DENNING: My impression is that it isn't really practical, that this clearly limits what they can do with that external event, in the external event area. And it certainly makes their reliance on what we get from the plants that much higher.

MEMBER KRESS: And I think we ought to have an extra subcommittee on low power shutdown, and make sure Dana is here.

CHAIRMAN APOSTOLAKIS: Okay, thank you very much, Selim.

MR. STANCAKTAR: Can I just say one thing more?

CHAIRMAN APOSTOLAKIS: Sure, sure.

MR. STANCAKTAR: If a plant doesn't have a main control room fire, they screen it off, we give them one, there is some minimum standard that has to

exist. So we give them one.

MEMBER KRESS: You take one you had for a similar plant?

MR. STANCAKTAR: This is what they have. And the ability to know should be there regardless of what their argument was to drop it.

CHAIRMAN APOSTOLAKIS: There are many, many issues here. As you know a lot of the licensees, as part of the IPEEE program use the FIE methodology, which is similar to the seismic screening methodology.

And there are so many assumptions there. But also, if you want to do a more rigorous analysis, I will be the first one to admit that there are many assumptions there as well.

And I don't know, something bothers me. I think what you have done is very useful, but knowing what it takes to actually do the analysis for fire, I see a big gap.

So maybe after you guys have a chance to think about it, and start finding out how to attack it, we can get together again and see if we can agree.

MEMBER DENNING: One possibility, George, is that there is this structure they provide that relies heavily on the applicant. But then when they are going to use this to do an independent evaluation

of some specific thing, then of course they could go into the depth and do the tweaking on the model and then it fits in within the structure that they put together.

CHAIRMAN APOSTOLAKIS: That might be one possible way to go. But I certainly agree with Mike that they need some time to study whatever literature there is.

Very good. Thank you very much.

Nilesh and Mike, you want to make some closing comments?

MR. CHEOK: Yes, I guess we'd like to thank the committee members for spending the time with us. I think it was very useful.

I think we found out, like you said yesterday, George, that during the 1.174 process we engaged the committee early, and we got a lot of good feedback, and I think that is one reason why we got such great documents for this.

And we think the SPAR models are important tools for the Agency. And we think that getting committee feedback at an early stage is important for this process also.

Thank you.

CHAIRMAN APOSTOLAKIS: I think you will go

far, Mike.

Any comments from the members? Well, we will plan on having a full committee meeting. The earliest can be now February, because the December meeting has been seconded.

MR. CHOKSHI: And you are going to let us know what you think at this stage what we want to present to the full committee?

CHAIRMAN APOSTOLAKIS: Yes, we'll discuss that.

So I don't know, Eric, February or March?

MR. THORNSBURY: February is already fairly full. But it's not set yet. Things shift around.

CHAIRMAN APOSTOLAKIS: All right, so maybe we can go around the table and see how people feel about this. Rich, you want to start?

MEMBER DENNING: You know, I already said so many things that I don't have anything else.

CHAIRMAN APOSTOLAKIS: Could you remind me of a few important ones?

MEMBER DENNING: A reminder of the important things? I think that - well, general impression is very favorable. I think that this is all very important.

I think that I understand better what some of the limitations of SPAR are now as to what its objectives are and ought to be. And I think that those could probably be written down, at least for the internal events, relative to what the utility does with its own PRA models.

I think particularly in the area of external events that the objectives are going to be limited, still well worth doing but limited. I guess that's about it.

CHAIRMAN APOSTOLAKIS: Okay. Tom?

MEMBER KRESS: Well, I too think this is really good stuff, and I'm glad to see it going out. And I was awfully glad to see that there is a potential later on to go to Level 2-like things that are not just LERF but are conditional containment failure probability.

Eventually, I know this is a dream for the long run, I'd like to see Level 3 in the SPAR models too. But you know, that is down the road I'm sure.

I particularly like their QA procedures on the Level 1, and I hope they can figure out someway to do a Level 2 - do Level 2 stuff too.

That was good stuff. I just - you know, congratulate the guys on doing a good job, and look

forward to reviewing more of the stuff.

I'm a little concerned about the low power shutdown risk average. I think it is more plant specific. But I think just what they needed to do at this stage for that.

CHAIRMAN APOSTOLAKIS: Mario?

MEMBER BONACA: Well, first of all I voiced the opinion already heard from the other members. This is a great project. I've always been supportive of the SPAR project from the beginning, but now we have a demonstration of the importance of it to really inspection and to the people in the field.

There are cross comparisons here that are as valuable as they can be. Even for the external events, though I see the limitation that Richard was pointing out.

You know there are some similarities among some sites, from which, with time, there will be lessons learned about certain configurations, certain phrases that have been assumed in certain places and not in others, and they should have been - so again, it's a tool where there is a unique opportunity to share information that nobody else has. I mean that is the only one that has this way of using the same data to look at at the same time.

I am still a little concerned about what you do with the dates. I mean plants oftentimes change significantly from one outage to the next outage, and it may take many years of manpower to update in detail. There has to be a way maybe in the future that some of these critical changes can be retrieved without having to go begging around the licensees for the information. If there are substantive changes, maybe, you are proposing another 5059 for reporting those changes, is certainly something that would allow staff to maintain this basic capability and insight into the individual plants.

In general, I think that this is a great project. I think the committee has to learn more about it.

CHAIRMAN APOSTOLAKIS: And I think second that view. I think it's really a great program. And in addition to the content, I also want to congratulate both leadership of the project and the presenters, who are really being concise and giving good presentations.

This was very good, and we will follow up.

And now if we meet with - if the full committee takes up this issue say, February or March

- oh, before I go on, I really thought that the QA process you guys established for Level 1 was excellent.

And one thought that occurred to me was that that process contributes to improving, enhancing the safety culture and knowledge of both the licensees and NRC staff. And usually when we talk about safety culture, which as you know is a sensitive issue -- there are a lot of people who tend to think in terms of psychology and people's attitudes and so on - I mean here is a good practical way of raising safety culture, I think.

Now you might ask me, prove it. I can't prove it. But it seems to me that the details of the give and take that is taking place when you guys argue with licensees is just great. It's just great.

Now in terms of presentation to the full committee, I would certainly emphasize the - well, of course you give an overview first. But I would emphasize this quality assurance process with the licensees for Level 1, and then perhaps give a short - you will not have more than an hour, right? And as usual you have to really be prepared to use only 45 minutes. So and then the external events and low power shutdown, maybe you shouldn't emphasize them

that much at that meeting, and say that it's a work in process, and that the committee will review individual pieces of it later.

I thought you know both - I mean all three, John Leonard and Jeff Mitman and Selim, they should be given the chance to give the committee the flavor of what they are doing, because it is very good. Even though it is preliminary, I think it's very good.

Now, the major risk with that is that you may start an interminable debate on various issues.

MEMBER BONACA: That's why I think it may be worthwhile if we communicate to the committee to have half a day before the full committee.

CHAIRMAN APOSTOLAKIS: To have a subcommittee meeting with the full committee? Subcommittee with the whole committee, that's what you're saying? Well, we did that doing the 1.174 development.

MEMBER BONACA: Because I think we're really going to need more than four hours.

CHAIRMAN APOSTOLAKIS: Maybe we can do that.

MEMBER BONACA: Two hours doesn't do it justice.

CHAIRMAN APOSTOLAKIS: Well, let's think about it. We will talk with the planning and procedures committee members, and see. But that would be another good way.

This is of such central importance to the Agency that we may very well do that.

Fareed, did you want to say something?

MEMBER DENNING: No.

MR. CHOKSHI: And we will coordinate with Eric.

CHAIRMAN APOSTOLAKIS: Absolutely. Or maybe we will decide to surprise you.

So are there any other comments from the members? Chuck, you had something?

MR. THADANI: Yes, George, I think as you said, this is really outstanding work, and very important to the Agency.

And I'm just wondering if for some modest resources can the staff use SPAR models to understand - for some selected, one or more plants, the impact of increasing power level by 20 percent?

Is that - it may be something that might be very useful to the Agency, it seems to me, to pick one or two plants, and see what does it really mean in terms of increase in risk.

And I would include the source term part certainly in that. This is a thought.

CHAIRMAN APOSTOLAKIS: In other words have pilot plants.

DR. THADANI: Something like a pilot, where the staff actually does the work to understand what it means.

CHAIRMAN APOSTOLAKIS: But then they interact with the licensee?

DR. THADANI: Yes, they will have to.

CHAIRMAN APOSTOLAKIS: That is a good idea.

MEMBER DENNING: I don't see this as a SPAR-centered - I think it would be a good idea. Because I don't think we really have a good appreciation of that, and it challenges the capabilities of PRA, which SPAR is at the edges of challenging the PRA. But even these things like - I won't get into all of it.

So it would be worthwhile, and maybe it would start with SPAR mobiles. I don't know. It's not a SPAR extension activity.

MEMBER KRESS: Unfortunately, the real impacts of power outage is a Level 3 issue.

DR. THADANI: You will need to satisfy

your criteria obviously. But it seems to me that some interaction with licensee information, this might be not a task - a task that might not be so resource intensive.

MEMBER KRESS: One other comment. You know we don't often do this, but I thought the support from INL and Brookhaven was very good also. You know we just talked about how good the staff is.

CHAIRMAN APOSTOLAKIS: Now if we have a four-hour subcommittee meeting with all the members present, we still need one hour and a half for a full committee before we write a letter, right?

MR. THORNSBURY: Yes.

CHAIRMAN APOSTOLAKIS: We can't just write a letter. Because even then, even if everybody is here, we are still gathering information.

MR. THORNSBURY: Right, you're still just being a subcommittee. But it can be - we can schedule it for an hour and a half, and if it takes less that's okay, just to kind of formally put everything out for the record.

CHAIRMAN APOSTOLAKIS: Yes, if we have a four-hour subcommittee meeting, then maybe we have only an hour.

It's going to be hard to schedule, though,

I really think it is going to be hard.

Anyway, this was very good. Any other parting remarks?

Thank you very much. That is all, and this meeting is adjourned.

(Whereupon at 11:22 a.m. the meeting of the above entitled Commission was adjourned)

CERTIFICATE

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

Name of Proceeding: Advisory Committee on Reactor Safeguards Reliability and Probabilistic Risk Assessment Subcommittee

Docket Number: n/a

Location: Rockville, MD

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

William Click

William Click
Official Reporter
Neal R. Gross & Co., Inc.

STANDARDIZED PLANT ANALYSIS RISK (SPAR) MODEL DEVELOPMENT PROGRAM

Presentation to the Advisory Committee on Reactor Safeguards

November 18, 2005

Nilesh Chokshi, Branch Chief
Michael Cheok, Assistant Branch Chief
Operating Experience Risk Analysis Branch
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research

OUTLINE OF PRESENTATION

- Overview – Nilesh Chockshi & Mike Cheok (RES)
- External Events Models – Selim Sancaktar (RES)
- LERF Models – John Lehner (BNL) & Eli Goldfeiz (RES)
- Low power & Shutdown Models – Jeff Mitman (RES)
- Wrap-up – Mike Cheok (RES)

2

SPAR Models for External Events, LERF and LP/SD

- Objective of expanding the scope of SPAR models is to provide Agency staff with PRA tools consistent with guidance provided in RG 1.174 and RG 1.200
- Models are still in development stage
  - QA process will be similar to Rev 3 models to the extent possible.
  - Process/method for "Standardization" being defined.
  - Model specifications (e.g., scope, level of detail, etc.), limitations, etc, will be better defined following use of models in applications
  - Availability of licensee models has to be considered

Summary

- The SPAR Model Development Program continues to provide tools that are used in many Agency programs
  - Evaluate risk significance of inspection findings as part of the ROP
  - Evaluate risk associated with operating events as part of the ASP program
  - Perform analyses in support of generic/safety issue resolution
  - Perform analyses in support of the staff's risk-informed review of license amendments
  - Independently verify performance indicators as part of MSPI.
- Some advantages of using SPAR Models
  - "Standardized" models reduce variability in results due to use of different models, inputs, and assumptions
  - Use of a single software package increases efficiency and reduces potential for analyst errors
  - Provides an independent verification of licensee risk evaluations and findings

Path Forward

- Complete Revision 3 enhancements by addressing the risk-important issues.
- Complete additional LP/SD, LERF, and external events models to increase the scope of risk assessments and thus to enhance Agency risk-informed decision making.
- Continue to enhance user-friendliness of software and models; continue interactions with Regional and NRR analysts through the SPAR Model Users Group (SMUG); and continue training of Regional and NRR analysts.
- Perform a peer review of models against consensus PRA Standards, keeping in mind the intended uses of the models.

STANDARDIZED PLANT ANALYSIS RISK (SPAR) MODEL DEVELOPMENT PROGRAM

EXTERNAL EVENTS

Selim Sancaktar
Operating Experience Risk Analysis Branch
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research

1

Overview

- **SDP and ASP currently perform external event analyses on a case-by-case basis.**
- **Need external events models to**
  - **Support Risk Significance of Inspection Findings in SDP Phase 3 Analyses**
  - **Evaluate Risk Associated with Operational Events/ Conditions in ASP Program.**

2

Scope / Methodology

- Incorporate internal flooding, internal fire, seismic event, other external events scenarios into SPAR models
- Use scenarios available from
  - Latest licensee PRAs
  - IPEEEs
  - SDP external events worksheets
- Use existing SPAR model event trees, fault trees, etc.

3

Methodology (continued)

- External event scenarios are defined and added to existing SPAR model to obtain SPAR-EE
- A scenario is defined in terms of its
  - Frequency
  - Type of reactor trip caused
  - SSCs, recovery actions, HEPs affected

4

Product

- A SPAR-EE model may have
  - 15-20 internal event categories
  - 5-10 internal flooding scenarios
  - 20-30 internal fire scenarios
  - 3-6 seismic event bins
  - 0-5 other external event scenarios
- New event/fault trees, basic events, operator actions may be introduced for special scenarios (seismic, MCR-evacuation, ..)
- Model running time comparable to SPAR
- Runs identical to SPAR; no additional user software training required

5

Status

- External events (fires, floods, seismic, etc.) feasibility and demonstration study completed
- Demonstrated that external events can be readily incorporated into the SPAR models
- Currently, six preliminary SPAR-EE models completed
  - Limerick
  - Salem
  - Kewaunee
  - Callaway
  - Wolf Creek
  - Indian Point 3

6

Related Activities

- SAPHIRE software enhancements specifically for SPAR-EE
- External event handbooks for analysts
- Coordination with ongoing NRR site visits for SDP external event workbook validation
- Discussions with WOG to seek data

7

Future Plans

- Complete SPAR-EE models for all plants
- Use SPAR-EE models on two ASP events in FY 2006
- Validate SPAR-EE models to the same level as SPAR models

8

Challenges

- Obtain the latest possible licensee external events models
- Achieve standardization
  - Among different plant models
  - Compliance with industry standards
- Define modeling scope and detail
- Define scope of application of models

9

LERF SPAR Model Development

John R. Lehner (BNL), Eli Goldfeiz (NRC)

Presented to
Advisory Committee on Reactor Safeguards

November 18, 2005

LERF SPAR Model Development

- Objective
  - In response to the needs of the SPAR Model Users Group (SMUG), develop thorough but relatively simple, user-friendly analysis tools for the NRC staff to use in performing Large Early Release Frequency (LERF) assessments (seamless with Level 1 SPAR models)
- Program consists of three phases:
  - Phase 1, evaluating previous Level 2/LERF models, and Phase 2, preparing a detailed program plan, were completed in 2001
  - Phase 3, implement the program plan, is ongoing

LERF SPAR Model Development

- Approach to Model Development:
  - Include current technical information on Level 2 phenomena relevant for LERF
  - Use less detail than NUREG-1150 models, but more detail than NUREG/CR-6595 models, to achieve better run times, scrutability.
  - Directly link Level 1 and Level 2 information to allow analysis of LERF contributors, precursor, etc.
  - Provide easy adaptation to other plants in a group
  - Allow possible later update to include late failures

Plant Groups

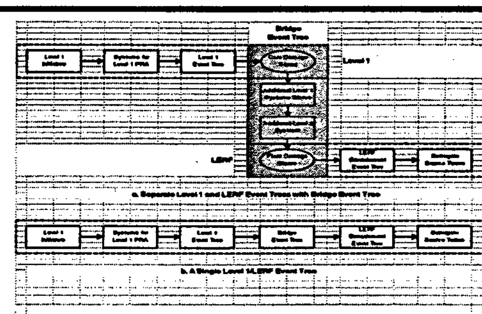
- Unlike Level 1 SPAR models, there will not be a separate LERF model for every plant. Instead use the following LERF SPAR model groups: (may be modified)
  - 5 PWR large dry models
    - Westinghouse 4 loop
    - Westinghouse 3 loop
    - Westinghouse 2 loop
    - Combustion Engineering 2 loop
    - Babcock & Wilcox 2 loop
  - 1 PWR ice condenser model
  - 2 BWR Mark I models
  - 1BWR Mark II model
  - 1BWR Mark III model

LERF SPAR Models Completed

- PWR, large dry, Westinghouse 4 loop
- BWR, Mark I, BWR/4 with RCIC
- PWR, ice condenser, Westinghouse 4 loop

- Models have undergone internal and NRC review, but have not yet been benchmarked against utility models

Logic Diagram for the LERF Methodology



Plant Damage State Characteristics

The Six-Character PDS Designator Used in the SAPHIRE Model

6-character PDS Designator	Identifier
1. Reactor Coolant System (RCS) Pressure	H - high M - medium L - low X - don't know or irrelevant
2. Secondary System Pressure	P - at normal pressure D - depressurized E - early depressurization L - late depressurization X - don't know or irrelevant
3. Station Blackout (SBO) Status	N - no SBO F - fast SBO S - slow SBO X - don't know or irrelevant
4. Auxiliary Feedwater/Main Feedwater Status	N - successful A - failed X - don't know or irrelevant
5. Reactor Coolant Pump (RCP) Seal Status	N - successful R - failed X - don't know or irrelevant
6. Containment Bypass Status	Y - containment bypassed N - containment not bypassed X - don't know or irrelevant

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Trace-ability of Results

Can group/trace results by:

- containment failure modes
- plant damage state designators
- any initiating event
- any Level 1 traceable parameter

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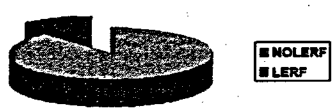
PWR Ice-Condenser

CDF = 3. 2E-5/yr with 11% of end states going to LERF (3.6E-6/yr)



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for PWR Ice-Condenser

LERF contributions by containment failure mode

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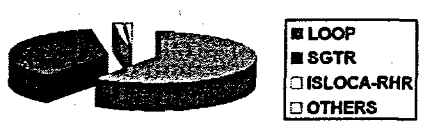
PWR Ice-Condenser

LERF contributions by initiating event



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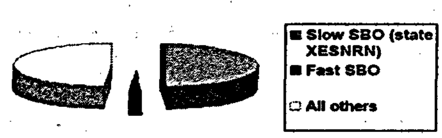
Example: Draft LERF SPAR Results for PWR Ice-Condenser

SBO contributions to LERF



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PWR Ice-Condenser

Fussel-Vesely importance measures of the ten most dominant events

Event Description	F-V importance For LERF
LOOP initiating event	0.52
Failure of igniter alternate power	0.52
Failure of prior hydrogen benign burn	0.52
Failure to recover emergency power in 4 hours	0.48
Failure to recover offsite power	0.48
Containment failure probability due to H2 DDT burn	0.47
SGTR initiator	0.41
Common cause failure of EDGs 1 and 2 to run	0.31
LER fraction of medium pressure SGTR release	0.24
Operator fails to diagnose SGTR to start procedure	0.18

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Current Status

- Three models completed
  - All need to be benchmarked against utility models
- Current models under development are
  - BWR Mark III model (almost completed),
  - BWR Mark II model

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Current Status

- Issue to be resolved:
  - SPAR LERF models are directly linked to the SPAR Level 1 models
  - Level 1 models are still changing
  - Want to develop automated Level 1/LERF interface to address this issue

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STANDARDIZED PLANT ANALYSIS RISK (SPAR) MODEL DEVELOPMENT PROGRAM

LOW POWER & SHUTDOWN

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Operating Experience Risk Analysis Branch
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
November 17, 2005

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Overview

- Objective: Develop LP/SD models to use in:
  - Event assessment
  - Support reviews of risk-informed applications
- Goal: Develop set of plant models covering all plant classes
- Approach: Use existing SPAR Rev. 3 models with LP/SD templates to develop
  - Event trees
  - Fault trees
  - Plant operating states (POS)
  - Initiating event frequencies
  - Reliability/unavailability data,
  - HRA/operator actions

2

Status

- 11 models completed
- Onsite QA of 4 models completed

Plant Class	Plant
Templates	BWR
	PWR
GE BWR 6	River Bend
	Grand Gulf
GE BWR 4 Mark I	Peach Bottom 2 & 3
W 3 Loop	Surry 1 & 2
W 4 Loop	Byron 1 & 2
	Diablo Canyon 1 & 2
	Millstone 3
CE	Millstone 2
	Palo Verde 1, 2 & 3
B&W	Oconee 1, 2 & 3
	Davis-Besse

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Scope

- PWR modes:
  - Hot shutdown
  - Cold shutdown
  - Refueling
- BWR modes:
  - Cold shutdown
  - Refueling

4

Initiating Events

Internal events only:

- LOCA - pipe break: Loss of Inventory impacting normal decay heat removal (DHR)
- HLOCA - drain down: Loss of Inventory impacting normal DHR
- LOOP
- LOSDC – diversion or loss of DHR cooling
- ISOL – isolation of shutdown cooling loop

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Scope Excluded

- LTOP: vessel or piping failures are very low probability events
- Reactivity: low probability event
- Spent fuel pool: not in current scope
- External events
- LERF/Level 2

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Major Inputs & Assumptions

- Models build on BWR and PWR templates which are based Grand Gulf (NUREG/CR-6143) and Surry (NUREG/CR-6144) studies
- Decay heat levels are binned into 4 time windows.
  - BWRs: <24 hours, 1 to 5 days, 5 days to 15 days, >15 days
  - PWRs: <75 hours, 3 to 10 days, 10 to 32 days, >32 days
- "Weighted-average" fractions for time spent in each POS
- Core damage end state is evaluated

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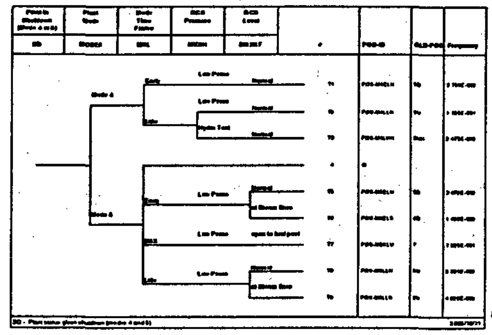
Example BWR Event Trees: POS



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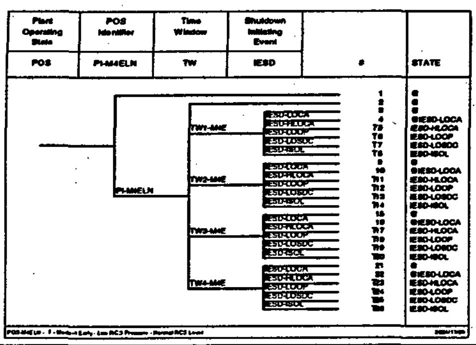
POS Selection



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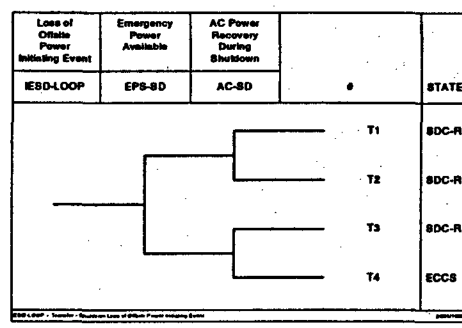
AC Power



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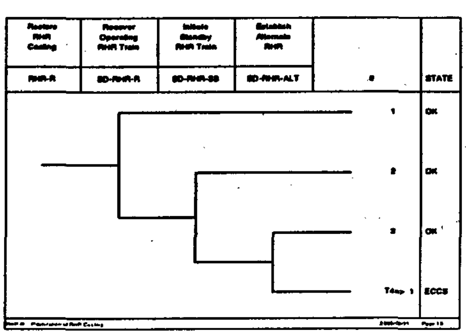
Recovery



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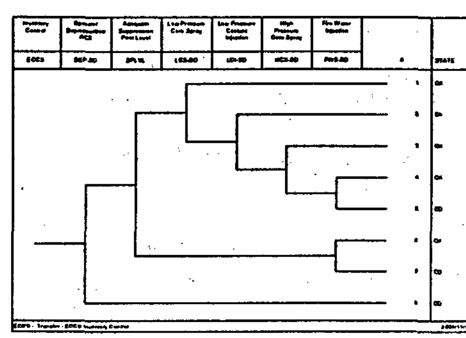
ECCS



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Future Plans

- Complete additional 4 LP/SD SPAR Models by 12/31/2006
- QA contingent on availability of PRA staff of licensees
- Develop analysis guidelines for LP/SD internal events

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