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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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RELIABILITY AND PRA SUBCOMMITTEE

OPEN SESSION

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WEDNESDAY

OCTOBER 15, 2014

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., John W. Stetkar, Chairman, presiding.

COMMITTEE MEMBERS:

JOHN W. STETKAR, Subcommittee Chairman

RONALD G. BALLINGER, Member

DENNIS C. BLEY, Member

JOY REMPE, Member

MICHAEL T. RYAN, Member

STEPHEN P. SCHULTZ, Member

DESIGNATED FEDERAL OFFICIAL:

JOHN LAI

ALSO PRESENT:

SUSAN COOPER, RES

JAMES R. CORSON, JR., RES

KEVIN COYNE, RES

MARY DROUIN, RES

ANDERS GILBERTSON, RES

DON HELTON, RES

STACEY HENDRICKSON, SNL

CHRIS HUNTER, RES

ALAN KURITZKY, RES

STEVEN A. LAUR, NRR*

JEFFREY T. MITMAN, NRR

JOHN SCHROEDER, INL

NATHAN O. SIU, RES

JOHN STEWART, EPRI*

RANDOLPH L. SULLIVAN, NSIR

JING XING, RES

MIKE ZAVISCA, ERI

*Present via telephone

T-A-B-L-E O-F C-O-N-T-E-N-T-S

Opening Remarks.....4
J. Stetkar, ACRS

Opening Remarks.....5
Kevin Coyne, RES

Project Status Overview.....7
Alan Kurtizky, RES

HRA Approach for Level 2 PRA.....74
Stacy Hendrickson, SNL
Susan Cooper, RES

Adjourn to Closed Session.....113

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

(8:31 a.m.)

CHAIRMAN STETKAR: The meeting will now come to order. This is a meeting of the Reliability and PRA Subcommittee. I'm John Stetkar, chairman of the subcommittee meeting.

ACRS members in attendance are, Ron Ballinger, Steve Schultz, Mike Ryan and Joy Rempe, and I believe that we will be joined by Dennis Bley. He may be hung up by, I'm afraid there was a crash on the Inner Loop or something this morning.

John Lai of the ACRS staff is the designated federal official for this meeting. The subcommittee will hear staff's discussion on the progress of the Level 3 PRA project and the approach on human reliability analysis for the Level 2 PRA.

There will be a phone bridge line. To preclude interruption of the meeting, the phone will be placed in a listen-in mode during the presentations and committee discussions.

A portion of this meeting may be closed in order to discuss and protect information designated as proprietary by NRC pursuant to 5 U.S.C. 552b(c)(4).

We have received no written comments or

request for time to make oral statements from members of the public regarding to today's meeting.

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

A transcript of the meeting is being kept and will be made available as stated in the Federal Register Notice. Therefore, we request that participants in this meeting use the microphones located throughout the meeting room when addressing the subcommittee.

The participants should first identify themselves and speak with sufficient clarity and volume so that they may be readily heard. And I'd ask you all to check your little beepy devices and please turn them off.

We will now proceed with the meeting, and I call upon Kevin Coyne to start us off. Kevin?

MR. COYNE: Kevin Coyne from the Office of Nuclear Regulatory Research. Thank you very much for

the opportunity to discuss the Integrated Site Level 3 project with you today. If I haven't lost count, and I may have, I think this is the fifth subcommittee meeting we've had the opportunity to have on the project. The fifth one has probably never come, but we're very much looking forward to the discussions and the feedback we'll receive from the meeting today. We have all day planned out.

As Alan will cover in moment, we are making progress in all areas of the study, some areas more than others, but progress nonetheless in just about every aspect of the study.

We expect this fiscal year to be a significant production year for the study. FY14 was a very good year for moving forward with the study, and we expect '15 to bring several significant pieces of the study together as maybe pieces begin to complete and we're able to see a more complete picture.

But that hasn't been without some challenges, and we're looking forward to discussions this afternoon to talk about a few of the challenges that we're having on the study, such as interfacing system LOCA and getting some feedback from the committee on our approach that we're proposing and

things we can do better for the study.

With that I'll turn it over to Alan to start the meeting.

MR. KURITZKY: Thank you, Kevin. I'm Alan Kuritzky in the Office of Research and the project manager for the Full Scope Site Level 3 PRA. I'm going to echo Kevin's sentiment that I'm very delighted to be here again to discuss these projects -- I have to say that.

(Simultaneous speaking)

MR. KURITZKY: So we welcome the opportunity to get feedback on this project, particularly there's a lot of challenging areas associated with the breadth and scope of this study and so we definitely can benefit from the committee of the ACRS members.

The outline for today's meeting, we're going to have two parts. There's going to be an open session for part of the morning and then we're going to move on to a closed session to discuss some of the plant specific and project details of the Vogtle plant.

In the morning session, we'll have a project status overview that I'm going to give you,

and then Stacy Hendrickson who is our HRA team lead will go over our approach for post-core-damage HRA.

In the closed session we'll talk about a number of topics, but we'll continue the discussions that we had back in February in the closed meeting on the Level 1 and Level 2, our logic. And we'll also have a discussion about implementation of the post-core-damage HRA approach.

And we want to talk a little bit about one of the issues that has come up which is interfacing systems LOCA. We'll talk to you about our approach we're doing with that. And there's also another specific item on release termination criteria that we'll discuss in the afternoon.

Okay, for the status overview, I don't want to spend a lot of time on the background. As Kevin mentioned, we're here, I think it's the sixth subcommittee meeting that we've come to.

And so you guys are pretty aware with all the objectives and scope of the project, but just the Commission communications background to the project, SECY-11-0089, is what essentially kicked us off when the staff approached the options for pursuing Level 3 PRA activities.

The SRM directed the staff to go ahead and undertake the full scope, comprehensive site Level 3 PRA. It also requested the staff to provide details about how they intend to apply the results of the study, and those were documented in SECY-12-0123.

And lastly, I want to mention SECY-11-0172 which described the staff's plans to come up with a standard approach for expert elicitation, the SRM to that SECY directed the staff to highlight that approach in the Level 3 PRA project. And so I'll discuss that in the presentation.

The radiological sources that we're considering, it's a site level PRA so we're looking at both reactors, both spent fuel pools and dry cask storage.

It's full scope, so we're looking at all the different types of internal and external hazards. We're also looking at all the different, you know, power levels -- full power, low power and shutdown.

I also do want to mention that we have in our quality assurance program for the study, there are many layers of review that we're implementing. Those range from the standard internal type initial author, internal technical review, our management review, et

cetera.

It also includes self-assessments to the PRA standards, the applicable PRA standards. We have a technical advisory group that's been established with some of the senior level PRA in a related area, folks in the agency that also look at some of the key issues and the documents that we produce.

Our plan is to have reviews to the PRA standards at various project milestones, and of course go to the ACRS to get your input on the work that we're doing.

And once we do get to the point that we're releasing publicly available documents on the study, we will have a broader public review and comment period, and also put together an expert panel that will include the likes of people from, say, universities, national labs, other interested groups, et cetera, to get a little broader feedback from across the spectrum of stakeholders.

So the status report that I'm going to give you in this morning's session, first of all, I'll point to the bullets on the slide. We'll start off with the reactor, at-power, Level 1. The most known, the most common, people are most familiar with.

We'll go over the internal event and flood work that we've done, and then the other types of hazard, internal fires and the external hazards. We'll then move on to the Level 2 and Level 3 work, both just for internal events and internal floods right now.

Then the reactor, low power and shutdown work at Level 1, spent fuel pool, dry cask storage and the overall site risk. And lastly I'll talk a little bit about the PRA standard reviews that we're doing.

So where do we stand? The Level 1, internal event and floods for the reactor, at-power, we have completed those initial models. We based that on the licensee's model. The licensee had a one top, capped a one top model, if you convert over to a standard event tree model in SAPHIRE.

We did a number of changes to that model. One of the things we wanted to do is we wanted to make the model a little more familiar to the people, the agency that use the SPAR models, so we substituted some of the conventional SPAR modeling routines, and they're particularly the one thing with loss of offsite power, common-cause failure and ATWS modeling or RPS reliability modeling.

So we did those transitions in the model for this study. We also had run some MELCOR calculations and based on those had modified some of the system success criteria for the model.

In our review of the human reliability analysis that the licensee had done, we identified some human error probabilities that we felt we wanted to change either because we might have some disagreement with what the licensee did or we just had a different approach that we wanted to pursue and, or we couldn't reconstruct the basis the licensee had for their work so we wanted something to stand behind and so therefore we changed a number of those ATPs.

We also updated the flood frequency for more recent data. And in general, the data itself, we used a different data set than the licensee did. We had basically used the data from the 2010 update to NUREG/CR-6928 which is maintained on the INL website.

So in that regard, initiating event frequencies and some of the component failure probabilities, et cetera, are based on that data not necessarily what the licensee has in their PRA.

MEMBER BLEY: Can you tell us a little bit about what they had and why you've gone away from it?

Did they have any plant specific data?

MR. KURITZKY: Yes, we both had plant specific data. The approach we used, they definitely had plant specific data. We also, the approach we used, and when we get to the closed session and continue the discussions from last February, John Schroeder who's our lead PI for Idaho on this work can talk to you at length about our data approach.

But in general what we did is we used the data from 6928 and we used, they have plant specific data that they then did the Bayesian update on, so they had those generic SPAR data as a prior and it was updated using the Vogtle specific data, the exact time periods for when the update data was versus the CR.

MEMBER BLEY: Until we get to that, just one more question. Did you have more or less or different plant specific data than the plant had?

MR. KURITZKY: More in terms of numbers of components or years of data?

MEMBER BLEY: Both.

MR. KURITZKY: John will have to give you the specifics in the afternoon.

MEMBER BLEY: Okay, I can wait.

MR. KURITZKY: Yes. And again I don't

think the way we -- we could go up to 2010. I think the licensee's model probably stopped earlier just because the generation of when they did their study. But I'm not sure exactly what the cutoff points were. So we'll get back to that.

MEMBER BALLINGER: This won't be his part. Do you have any idea of how much using different data affected different system results?

MR. KURITZKY: It didn't have any huge impact as far as I know. And John can probably speak to more details. John, or Chris Hunter will be up there also.

There are some things we did actually use from the licensee's PRA, common cause failures which are one of the things that will tend to drive the results. And those, where there were common cause groups or components that we normally had in the SPAR models we used that data. There are some that we did not have in the SPAR models so we actually used the licensee's common cause failure data directly from what they had.

And in most of those cases I don't think there were huge differences. The ISLOCA is going to be one that we're going to touch on this afternoon

where the use of common cause failure data for the leakage of the check valves and MOVs does make a huge difference.

CHAIRMAN STETKAR: Alan, just so we get the terminology correct, when you say common cause failure data you mean estimates from a report someplace?

MR. KURITZKY: There's the data that goes into the alpha factors that we use in our common cause failure approach. I think it's also in NUREG/CR-6928 too.

CHAIRMAN STETKAR: In numbers. I'm not aware of any common cause failures of --

MR. KURITZKY: In the actual.

CHAIRMAN STETKAR: Actual, yes.

(Simultaneous speaking)

CHAIRMAN STETKAR: There are other things that you can count.

MR. KURITZKY: Right. They're actual common cause failures.

(Simultaneous speaking)

CHAIRMAN STETKAR: Diesel generators and valves and things like that, but not of BWR or PWR, RHR, check valves in the way that you've modeled them

in PRA.

MR. KURITZKY: Right. We definitely don't have any BWR check valves in this plant.

CHAIRMAN STETKAR: But they would be relevant though. There are check valves.

MR. KURITZKY: Right. Yes, for all systems in component groups you don't necessarily have actual data on, and whatever approach --

CHAIRMAN STETKAR: We'll talk more about that this afternoon in the closed session.

MR. KURITZKY: Okay, so let's see. So those are some of the changes we made to the licensee model that we pored over. We actually were able to do our peer review. The PWR Owners Group led the peer review for us against the PRA standard back in July.

That was a very productive process and it was good for us to see actually what that entailed and we got some good feedback from that. And that's something I'll touch back on later in the presentation when I discuss those reviews.

What we're doing right now with the Level 1 internal event, internal flood model as well as some of the issues that we identified even prior to the peer review that we wanted to work on but weren't able

to do it before, we had to get the peer review, the scheduled peer review completed.

So going back to look at those issues as well as some of the things that the peer review itself had identified, and we're going through all those issues to decide how we want to update the model for the next revision.

CHAIRMAN STETKAR: What's your schedule for doing that update?

MR. KURITZKY: We don't really have a schedule for the updates. It's more what the nature of the project's going to be because there's so many pieces. And unfortunately whenever something changes for, let's say, a Level 1 internal event model, has implications for the fire model and the other things like the Level 2 model and things that come down the road.

One of the other places that we're identifying things that we want to change is in the fire work we're doing right now. We've identified a number of things that affect the internal event model.

CHAIRMAN STETKAR: Yes. It's no surprise.

MR. KURITZKY: So all those are going to get folded in. So essentially our philosophy really

is to pick the point that we think that we're going to catch 90-plus percent of what we need to change in the model and say, okay, now we're going to make a redo of it.

CHAIRMAN STETKAR: But you are, sort of cast it in the schedule thing, but you are planning to do a one time only redo of the model?

MR. KURITZKY: I wouldn't say one time only. We wanted to be, again there's going to be redos throughout. It's the nature of this project. We want to limit it to one major redo which we want to wait long enough that we have very high confidence we caught most of the major things.

And then there will probably be one project wide review late in the project when any loose things that have been picked up over the ensuing year or two all get rolled back in. So I'm hoping on only one major redo.

CHAIRMAN STETKAR: Okay, thanks, Alan.

MR. KURITZKY: In any case, so the last thing I just want to mention is, I mentioned SECY-11-0172 that identified the need for a Level 3 PRA project to pilot the expert elicitation guidance. And this ISLOCA issue that we came up with, this is the

one that we've identified as one that we wanted to use that guidance for because the ISLOCA that was done for the licensee PRA shows ISLOCA has being a very small contributor which is not atypical.

However, the data that we had in the INL database for common cause failure, check valves and more of the valves for leakage, turns that into a very high contributor. And because ISLOCA or containment bypass sequences it can be a very big risk contributor.

And so since it's such a large potential risk contributor, we felt, and the data was so uncertain, so sparse and therefore uncertain, that we felt this was a good candidate to do an expert elicitation on to get a little better confidence in what we were reporting.

Moving on to the internal fire work, we're in the process of mapping the licensee's -- and again just to remind the members. Southern Nuclear had prepared, they have a peer reviewed Level 1 internal event, internal flood PRA for Vogtle. They also have a peer reviewed internal fire PRA for Vogtle.

They are just in the process of completing a seismic PRA for Vogtle, though it wasn't completed

in time for us to really take advantage of. However, we're making use of all the information they're using for that seismic PRA.

In terms of the fire PRA, we had the advantage of looking at their fire PRA which had, I think, over a thousand fire scenarios, and we were able to map them into about, somewhere between 120 and 150 standards for ourselves based on plant impact.

And in all models we have to have a separate event tree for every one of these fire scenarios.

Question?

CHAIRMAN STETKAR: I was going to ask why, but it doesn't make any difference.

MR. KURITZKY: Why we were reducing it down from --

CHAIRMAN STETKAR: No, no, no. Why do you need a separate event tree? But that's okay. That's fine. It's software.

MR. KURITZKY: In any case, so we'll have somewhere between 120 and 150 event trees for the fire model. There are very few right now, and modifying the fault tree logic, system logic based on things that might be different for fire than it would for the

internal events, for instance, putting in events for multiple spurious operation, we also did some changes based on the DC control power or some of the other things that, you know, have more implication for a fire start than might have been for the internal event, so it wasn't necessarily included in the model.

That also leads to some of the things that I mentioned before. That we're going to have to update the internal event model again in the future to account for these other changes. Actually it's being updated as we're doing the fire model.

CHAIRMAN STETKAR: This is one of the things I've talked to people for 20 years about. There should be a PRA model. You know, you're learning that you didn't have a PRA model.

MR. KURITZKY: So let me interrupt one second because I misspoke. It is a PRA model. We had updated. When they update the fire PRA model it is the PRA model.

What we'll have to go back and do, if we want to, is requantify the internal event results, so that the internal event results that we're reporting are consistent with the model that we report the fire results for.

CHAIRMAN STETKAR: You have the same fault trees.

MR. KURITZKY: It's the same. It's one model. It's all being changed. One big trunk model. I misspoke when I say --

CHAIRMAN STETKAR: Okay.

MR. KURITZKY: It's requantifying the model, not redoing the model.

CHAIRMAN STETKAR: Okay.

MR. KURITZKY: Yes, it's all one big model which is going to end up possibly being a problem later if you go into the integrated risk, but we'll get to that when that time comes.

Anyway, so we're making changes to the internal event fire system logic. I think we're pretty much done with that now. We're just doing some tests to see how it changed from the internal event results we reported before to make sure that nothing got messed up. There's things we know should change, but we just want to make sure nothing got changed that we didn't want it to change. So that's the process we're in right now.

We're hoping to have the internal fire model completed and documented. This says generally

2015. My most recent information since these slides were prepared is maybe a little later. Maybe sometime early in 2015. It could be February, it could be March. There are a number of factors involved.

One of the things that we are facing as a challenge here is the fact that because it's based on the licensee's fire PRA, and the licensee's fire PRA uses a number of modeling assumptions and techniques that are consistent with some of the NFPA 805 submittals, and those assumptions and techniques are under discussion at NRC right now, there hasn't been a broad acceptance of them necessarily.

So we'll have to decide how we want to treat those things in our model. Because right now we have those same things and now we have to decide whether we can keep them or whether we have to make some kind of a change. So that's one of the challenges we're facing in terms of the fire.

CHAIRMAN STETKAR: And we're not going to talk more about the fire, so let me ask. Do you have some examples of what those are?

MR. KURITZKY: Yes. Are you familiar with the King factor? Okay, so that's a perfect example, like the 0.25 factor for what's the probability that a

fire gets out of an electrical cabinet and damages other stuff in the plant.

CHAIRMAN STETKAR: And they had it in there?

MR. KURITZKY: They had it in there.

CHAIRMAN STETKAR: Okay.

MR. KURITZKY: Now for a point of interest, Southern is redoing their fire PRA right now and they're getting rid of those things that are under debate and are right now. So they're going to do additional modeling so they don't need to use the King factor.

Unfortunately that work isn't going to be on a time frame that allows us to actually take advantage of it. So we'll have to figure out what we need to do in that regard.

CHAIRMAN STETKAR: Okay, thanks.

MR. KURITZKY: Okay, two more seismic events. We had completed our initial seismic PRA model and documentation. That initial model is based on the seismic hazard curves that the licensee provided to NRO for Units 3 and 4 back in 2012.

And also it's based on some plant specific fragilities that we got from the licensee but which

have since been modified. Some of them have been modified. So we're waiting right now for the licensee to supply us the revised fragilities.

At the same time when we get the revised fragilities, we'll requantify our seismic model using those fragilities as well as they submitted in March and updated 2014 hazard curves. So we'll do the updated hazard curves and fragilities all at the same time.

So the Vogtle model we can still review right now, but we will not call it semi-final until we get the new fragilities and the new hazard curves. So hopefully we get that done by the end of year, again it's going to be timed by how long it's going to take us to get that information from the licensees. It's been a little bit of time getting to us.

CHAIRMAN STETKAR: Do you know what fragilities they're updating?

MR. KURITZKY: Well, there was a number of them. But there were some that, well, the fragilities we got when they provided them earlier they acknowledged right off the bat. These are in process.

CHAIRMAN STETKAR: Oh, okay. Thanks.

MR. KURITZKY: So they were just an

interim thing. So in any case, we're waiting for those new fragilities.

But now the schedule for when we'll actually get the model, we cranked, you know, cranked out the new numbers. It's going to be based on when we get that information from the licensee as well as the availability of our seismic or structural experts in Research. Because --

CHAIRMAN STETKAR: How many discrete seismic initiating event bins or frequencies or --

MR. KURITZKY: I think we're going to have around seven.

CHAIRMAN STETKAR: Seven, okay.

MR. KURITZKY: Yes. I think it's that but I can't remember exactly. I think it's around seven.

CHAIRMAN STETKAR: It's not 200.

MR. KURITZKY: No. Yes, exactly. I think it's somewhere around the seven ballpark.

MEMBER SCHULTZ: Alan, we're in the second or third portion that we're doing one thing here, and then the licensee has also got a program planned and they're updating their models, and we're hoping they were going to come together or we're not sure how they're going to come together.

I looked through, I don't see today, at least in the morning, a master, I'm not looking for a master schedule with dates on it. I'm really looking for a programmatic plan that's associated with bringing this together so that at some end point we can understand what the licensee has done and what we have done and where they are in space.

And does that exist? And the reason I'm asking is that it sounds as if you do have a good plan, I just wanted to make sure it was in the process at least of being set down somewhere so that the whole team could understand, so that both parties could understand and try to optimize, try to optimize how these things will come together. Because as you discuss these things, lots of things are changing.

And we want to, as we're making great strides in improving models here and there, it's important that this come together at some point or at least perhaps more points than one so that we can make these comparisons.

We'll talk more about that through the day, but --

MR. KURITZKY: Well, let me, I can address it right now. We'll have a formal plan that deals

with the licensee's point, their PRA versus ours. What we have is more of a schedule of how our pieces fit together.

MEMBER SCHULTZ: Good.

MR. KURITZKY: It's relatively dynamic. And so, you know, by the time we make one it's out of date. But because of different times, and there's a number of factors we'll discuss later why our schedule keeps getting whipsawed all around.

However, the comparison or the tie-in to the licensee's, we're not really focusing on that because that's not something that we're tying into. We're doing our study.

MEMBER SCHULTZ: Right.

MR. KURITZKY: We're taking advantage of the things the licensee can provide us, whether that be whole PRAs that have been peer reviewed or in part PRAs or just information they can provide us on the plant. To the extent we get that we fold that into our study.

And the more information we can get from the licensee obviously the better our study's going to be. And there's some things that were already at T-zero and we were able to take them all, and there's

things as you identified that are in a lot of time coming out and we're working with the licensee to optimize our ability to get ahold of these things.

Sometimes they might not be as eager to submit it until they've had more of a chance to rigorously go through it on their own, and that can lead to delays as well as getting through licensing, et cetera.

So this is a PRA input that we have and it's almost like a bonus, so to speak. Because I don't like just raw information. We can have some processed licensee information that we can take advantage of if it's available in our time frame.

But we don't work to that schedule. You know, we're going to work to a schedule. And in the case of the seismic. This seismic PRA analysis is going to internal review. We know that something will have to probably change there just because some of the fragilities are questionable.

But if we don't get the stuff from the licensee in time we'll put other fragilities in there that we have in-house that we're more comfortable with. So to the extent that we get information from the licensee, great, and we'll make use of it if it's

in a time frame that works with our project. But otherwise, it's just our internal project schedule that we're working towards.

So in that regard we do have a schedule. It's not, I didn't put like a chart, you know, the line, the time charting, the Microsoft project chart. But we have a schedule that we're working with and it's bearable because different pieces come at different times and we think this is going to feed into that but now this is three months away so now obviously this thing is going to get moved out too.

So it's moving pieces. And there's going to be a lot of iteration. There's so many pieces tied together, there's going to be a lot of iteration throughout this project as we head towards the part where everything merges together.

So I definitely --

MEMBER SCHULTZ: I wasn't -- yes. And I understand both the issues and the problems associated with it. I just wanted to feel that we, and that's why I called it programmatic. Because you just identified a number of assumption sets that are going along with program and project in trying to capture that. I'm interested in making sure that things are

being documented so these assumptions along the way in the places where you feel things are solid and soft can be fully identified so that when you get to the end you basically know what you've done and where things stand.

MR. KURITZKY: Right. And again something we've stressed all along in this project is the documentation and traceability of what we've done. So we're making a large effort to get that stuff down on paper and keep track of how we get everywhere, how the models change, what changes are being made and why, what assumptions we're making, why, what decisions, et cetera.

So we do have a fairly good documentation trail there that I think will serve the project well --

MEMBER SCHULTZ: Good.

MR. KURITZKY: -- as we go forward. But the schedule is, as we'll discuss later, it's fairly uncertain just because there's a lot of factors out of our control.

CHAIRMAN STETKAR: Part of the uncertainty in the schedule though, and this is the discipline of doing PRA is that you can't stop and reiterate on

parts of the model and try to make them perfect because you never finish.

MR. KURITZKY: Right.

CHAIRMAN STETKAR: And it sounds like you're doing a lot of that quite honestly.

MR. KURITZKY: No, clearly we're not.

CHAIRMAN STETKAR: Okay.

MR. KURITZKY: As I mentioned before, there are a number of things as is any PRA that we identify through the review process that we want to change. Instead of constantly changing, we actually lock them out of that.

Again the reason we're building up quite a list is because we locked them all down for the peer review and we will not change it, anything about it, until we have collected all these other things.

Like I said, I'm hoping there will be one big redo that will catch 90 percent of the stuff. And then anything else, hopefully it's not major, will all be done at the very end when we recrunch everything. So we're hoping that we just have --

CHAIRMAN STETKAR: It just doesn't necessarily come across that way when you say, well, we're waiting to get the --

(Simultaneous speaking)

CHAIRMAN STETKAR: -- updated fragilities and maybe there's changes to, you know, the licensee's fire model and we may want to consider those.

MR. KURITZKY: Right. But then that's all part, in terms of the internal events that's all part of that one redo.

CHAIRMAN STETKAR: Okay.

MR. KURITZKY: The seismic one hasn't really been completed yet so anything we can get to do on that is all part of that first cut. So I'm sorry if I left that impression, but no, we're just essentially doing, I'm hoping two major redos and then everything else hopefully will just get caught at the very end.

CHAIRMAN STETKAR: Okay, thank you.

MR. KURITZKY: In terms of the high winds, external flooding and other hazards, we have completed the high wind PRA model, the Level 1 high wind PRA model and self-assessment. We're getting ready to have a peer review on that in November.

We also have completed our other hazards evaluation and self-assessment. By other hazards, we're talking about things --

MEMBER BLEY: You mentioned that earlier, but have you called another peer review and --

MR. KURITZKY: The peer review for the high wind and other hazards is going to be November 12 through 14th.

MEMBER BLEY: Okay. And in terms of people are they --

MR. KURITZKY: Well, actually, I was going to get to this last bullet. I mentioned that this says we submitted the documentation for the peer review. Actually, we have all the documentation ready to submit. We were supposed to submit last Friday. We haven't submitted because the peer review team hasn't been completely identified yet. So we're waiting to get --

MEMBER BLEY: I didn't want names, but the kinds of people. Are they --

MR. KURITZKY: Again, I said I don't know who's on the team. They're going to obviously be people that are PRA related and know about the external hazards, but --

MEMBER BLEY: You said the external folks and internal. Yes, okay.

MR. KURITZKY: See, I think the problem is

for the internal event and internal flooding, which we did in July, there was no shortage of experts to stick on that panel. I think as we're getting into the other areas like, you know, the other hazards, the Level 2, some of the areas that had all these peer reviews done in the past, coming up with a critical mass of folks to do the peer review is becoming a little more problematic.

So again we have not heard back. There's a team lead assigned by the PWR Owners Group, but we haven't gotten the team members assigned yet. So we're just waiting for them to tell us the team members that can sign their MBAs and we can ship the stuff to them.

MEMBER BLEY: Sure.

MR. KURITZKY: So when we come back to you in, I think February is when we're going to come back next time. By that time we'll be able to tell you who was on the team because hopefully the review will have been done by then.

In any case, so the other hazards, for those who aren't familiar, there's essentially everything except for the internal events and floods, internal fire and seismic high winds. Everything else

is in that other hazards category. That includes things like external flooding, external fires, aircraft and other transportation accidents, turbine missiles or anything else besides those.

CHAIRMAN STETKAR: Have all of those screened out?

MR. KURITZKY: Everyone, in our initial look everyone else has screened out, yes.

CHAIRMAN STETKAR: Interesting.

MR. KURITZKY: After the peer review I'll let you know whether they're still screened out. Right now they're all screened out.

MEMBER BLEY: I guess what I was getting at was I know that they'll come up with people who have worked on PRAs.

What I was just thinking because I haven't done any of that wind work in quite a few years -- the folks we used to have to help on that probably all retired -- I don't know who these days are the real experts, and now applying what we know about winds to specific sites and to areas where the site itself can be affecting the wind.

And I was just wondering if you have some people who have not just done PRAs but have worked,

you know, who are real experts in wind and wind among structures.

CHAIRMAN STETKAR: What Dennis is saying is this is not just taking the ASCE, you know, contours and saying, okay, this is the Vogtle site and I'm on this contour and therefore the wind exceedance frequency is, you know, 1.27 times 10 to the minus 5. That's not the actual site specific wind hazard.

MR. KURITZKY: Right. Again --

MEMBER BLEY: And variance that affect it for other buildings, you know, that whole, that there's some fairly complicated stuff that ought to be considered.

MR. KURITZKY: Right. And there's been some work on high winds that was just done just prior to this project, some updated stuff on high winds, where some national wind experts were involved in the work. Especially those guys, they really know wind but they don't know how we use the wind information for PRA.

So it's again bridging that gap. I don't know to what extent --

MEMBER BLEY: What I was asking, are you going to have some people like that to help?

MR. KURITZKY: Yes. And I hope so, but I don't know exactly what's going to be on it. The PWR Owners Group is going to propose a team. We'll have to take a look at who they're going to propose. Hopefully they'll have sufficient, you know, credibility and experience to be able to do a good job at reviewing the PRA.

CHAIRMAN STETKAR: Well, it's kind of disconcerting that you're relying on a peer review group and they haven't identified anybody with these qualities yet. You're relying on them to essentially tell you what you should have done?

I mean typically the reverse is true. The PRA group are the experts. And you throw your expertise to the wolves in terms of the reviewers. If you don't have ultimate confidence in what you're doing for the PRA, you know, you shouldn't be relying on some one-week wonder peer review group that's cobbled together among people who may or may not be available that week to tell you what you ought to do.

MR. KURITZKY: Okay.

(Simultaneous speaking)

MR. KURITZKY: Because I was responding to Dr. Bley's question about who was on the peer review

group. You're not talking about what, you know, that was a different question what we have involved in our PRA. We stand behind our PRA and what we've done. I don't know who's going to be on the review group.

CHAIRMAN STETKAR: So have you looked at these localized site specific --

MR. KURITZKY: I don't know the details of what was in the analysis. We have another gentleman who read that report. I don't think he's in the room today.

But I know fragility wise we were shy on, I know one potential weak spot is that we didn't have building fragility information for the structures and equipment at Vogtle. And so we used it from another plant, which isn't very comforting but there was no other data that we could find that was out there.

CHAIRMAN STETKAR: Not only not very comforting, it's wrong.

MR. KURITZKY: Right. So whenever there's something better that can be done --

CHAIRMAN STETKAR: No, no, no. It's wrong. Don't do that. This is a site, the whole purpose of this is a site specific PRA.

MR. KURITZKY: So one of the reasons that

we look forward to coming here is so we can get advice on how to go about this.

CHAIRMAN STETKAR: Advice is, don't use building fragilities from another plant.

MR. KURITZKY: Yes, so don't use isn't actually very beneficial, but if you have something, an alternative that we could use we'd be certainly willing to pursue it. So if you have like, if you know --

CHAIRMAN STETKAR: Find somebody who does that work, pay them and let them do the fragility analysis.

MR. KURITZKY: Okay. So getting a straight fragility analysis for Vogtle is not within the resource constraints of our project, so we need to make use of something that's at least partway done. We may have to extend it or extrapolate in some regard, but it has to something from which we're starting from because a straight, from scratch fragility analysis for wind for the plant is not something that we can currently accommodate.

MEMBER BLEY: At least you can have people who know how to do that see where what you've borrowed makes sense and where it doesn't make sense and where

you need it some.

But, you know, whenever you guys bring the wind stuff here, we're expecting that you'll have somebody who can talk to that and that you'll have somebody who can talk to local wind effects, you know, given what=s in the general area, than how these would apply to the site given the other structures on the site and that sort of thing.

And, you know, I don't know, this event may be so solid that except for some really severe things you don't have any problems, but I --

MR. KURITZKY: I had nothing on the coast, but --

CHAIRMAN STETKAR: It's not on the coast, but it's a fairly flat site.

MR. KURITZKY: Right. Okay, so that looks good. We'll take that feedback and recommendations. When we come to you with our wind PRA we'll get into it in more detail. Do you have any comments on the wind or external hazards?

CHAIRMAN STETKAR: I'm curious that you screened out aircraft crashes, but I guess we'll see the analysis.

MR. KURITZKY: Yes, we did screen them

out.

CHAIRMAN STETKAR: Did you look pretty carefully at Augusta Airport and the air traffic control?

MR. KURITZKY: Yes, we had I think a fairly rigorous look at some of the aircraft.

(Simultaneous speaking)

MEMBER BLEY: Nearby military?

MR. KURITZKY: We looked at it all.

Okay, so onto the Level 2. We've completed the initial reactor, at-power, Level 2 PRA model. That means we went through to find the plant damage stage, we developed the containment entry, the supporting decomposition event trees that addressed the different severe acts of phenomenon, established our release categories. We quantified and documented the entire model.

One of the things that we did somewhat are novel in this Level 3 period is we directly linked the Level 1 and Level 2 models together in SAPHIRE, so the Level 1 core damage cutset information has been passed through all the way to the release categories.

Also one thing we had to do for the Level 2 is address human reliability analysis, so we came up with

an approach or a method for addressing post-core-damage HRA. That's what Stacey's going to talk to you about in the next presentation.

Most of the documentation has been completed. We're going to submit it to the peer review at the end of this month, so we'll just be tying up a few things over the next couple of weeks.

As I mentioned, the PWR Owners Group-led peer review will occur in December, the week of December 8th through 12th. Again we don't have, they have a team lead identified. We haven't yet been told who are the team members.

Once we get that peer review completed, just like the Level 1 we'll take, there's a number of items that we've already identified in the Level 2 PRA that we would like to change but we've locked it down for the time being and we're not going to keep chasing a bouncing ball.

So once we get the feedback from the peer review team, any feedback we get from the ACRS, any other comments that we get either internally or looking at other parts of the project between now and whatever that times that we're going to start the second version of the Level 2, we'll go ahead and fold

that into it at the same time.

MEMBER BLEY: I'm kind of glad to see your second bullet, and look forward to learning more about that.

MR. KURITZKY: The second --

MEMBER BLEY: On directly linking the Level 1 and Level 2. Last time we looked at early work there, the bridge or transition tree and the containment tree had a lot of linking problems that were still to be worked out.

And I take it they've been all worked out now and --

MR. KURITZKY: Yes. Yes.

MEMBER BLEY: Is there still a bridge tree or is it, it's just an all-integrated --

MR. KURITZKY: Standard level entry has some of the containment systems. The PDS, I'm not sure like a PDS tree or PDS bridge, see that was really used just for identifying PDSs and coming up with recommended sequences. Because we don't actually use the PDSs in the quantification, because we're directly linking the level and sequence directly into the containment entries.

MEMBER BLEY: So you're not calculating

PDS frequencies any longer?

MR. KURITZKY: No, we just used those for coming up with representative to identify representative sequences. So yes, so the PDS is like an interim thing for information purposes, but in the actual quantification we just directly link the Level 1 sequences into the containment entries.

Level 3. Right now we're at pretty much the Level 2 to 3 handoff that we have some initial just source term results that we've given to the Level 3 team. The MACCS input deck is essentially complete. They're doing some shakedown using the source terms that the Level 2 team has provided.

They're also finishing up the final touches on developing the multi-source modeling capability in MACCS, again because we have two different reactors and we have a spent fuel pool so we could get releases at different points in time, so they had to make some adjustments to MACCS to be able to handle that. I think that's pretty much done now.

So we're hoping to have the Level 3 or consequence analysis results done for the internal event and internal floods at-power in early 2015.

MEMBER BLEY: Are all of the sources built

into a giant tree in the computer model so that you're getting timing information to use in this kind of modeling?

MR. KURITZKY: The output in Level 2 is the release categories, so they all get binned into categories there. We didn't get into PDSs because we were able to directly link, but we do get into release categories. And then the release categories have the representative source terms in terms of all the quantities and the timings, et cetera of the release.

MEMBER BLEY: Okay, from all the sources?

MR. KURITZKY: For each of the release categories.

MEMBER BLEY: Okay.

CHAIRMAN STETKAR: So in principle you could get an early release from a containment and a late, in combination with a later release from a fuel pool, for example.

MR. KURITZKY: Only when we're doing a Level 3.

MEMBER BLEY: Yes, yes.

(Simultaneous speaking)

CHAIRMAN STETKAR: That would be a distinct source term.

MR. KURITZKY: That's what I was getting at.

CHAIRMAN STETKAR: Of a release category.

MR. KURITZKY: Right. MACCS is going to, we're going to lock it down to --

MEMBER BLEY: Looks like we're saying this right.

MR. HELTON: Well, I think to some extent you're talking about --

CHAIRMAN STETKAR: Don, identify yourself.

MR. HELTON: I'm sorry.

(Simultaneous speaking)

MR. HELTON: My name is Don Helton. I work in the Office of Research and I'm the lead for the Level 2 PRA in the spent fuel pool PRA. What you're describing is something that is ultimately the goal but it's not what's in the model right now.

So right now the internal events and floods blends into release categories. Ultimately the intent is to integrate the model and to have the types of phased releases like you're talking about, where you're considering releases from multiple sources into either a single release category or else you're merging release categories into a single offsite

consequence instant.

But the details of how that's going to be addressed are ahead of us, not behind us.

MEMBER BLEY: Okay, let me ask you. If you have people working on MACCS to handle this, are you giving them some representative timings and combinations to work on to test out what they're doing, in terms of timing of releases and character of releases from different sources at the same staggered times?

I'm just wondering how they're doing their work and how you're being able to look at it.

MR. HELTON: So right now I think the way of thinking about it is that they're in parallel working with dealing with those release categories that we've already generated from a single source standpoint, from an actually turning the crank standpoint, and then in parallel to that figuring out what needs to be done to the crank so that it can be turned when these concurrent releases are going to be modeled.

CHAIRMAN STETKAR: Not necessarily concurrent though, but also staggered. I mean I think what Dennis is alluding to is pick your standard, you

know, Level 1 PRA release. I don't care whether it's large or small, but it begins at some time X.

And in principle there will be sequences, I don't know what their frequency is, but there will be sequences where perhaps as a consequence of the initiating event and failures in the plant you've lost spent fuel pool cooling, something like maybe two or three days later, later, you get a much different characterization release from the spent fuel pool.

MR. KURITZKY: I think --

CHAIRMAN STETKAR: Or the other unit.

MR. KURITZKY: I think, John, where you said concurrent you meant multiple, I think, is what it actually meant.

CHAIRMAN STETKAR: But I mean Dennis's question, I think, is, are you telling the MACCS people, you need to be able to handle something that looks like that.

MR. KURITZKY: Yes, that's what that third bullet is supposed to address.

CHAIRMAN STETKAR: Okay.

MR. KURITZKY: It's to address different sources occurring at different times. Different releases occurring from different radiological sources

at different times. Radiological source refers to like spent fuel pool 1 or 2, or reactor 1 or 2, et cetera.

CHAIRMAN STETKAR: Okay. And now just to help me how the project's going to pull this stuff together, this is not unreasonable at all what you're telling us.

At some point not too far off you're going to have the results back from your peer reviews and you're going to hit a point where you do this first major redo. By the time you do that we'll we be at the point they'll be able to model, you'll be able to feed these time sequenced releases to MACCS and they'll be able to run it, or is that going to happen some time beyond that?

MR. KURITZKY: The multiple source releases will occur after we do the redo.

CHAIRMAN STETKAR: Okay. So the first redo won't include any of that. That will be in the big one later.

MR. SULLIVAN: Is this alive?

CHAIRMAN STETKAR: It is.

MR. SULLIVAN: Randy Sullivan. I have the joy of being involved in some of the Level 3 and what

we're talking about here. And yes, indeed, we have found that MACCS will not accommodate long delayed actions so we're making that revision right now.

And no, it's not done, but yes, we didn't expect to have to delay offsite protective actions, movements of population longer than 48 hours. Forty eight hours. And we do have some, that parameter is being adjusted now as soon as we can get the Sandia folks off of issuing of the current version of MACCS.

So in the next few weeks we'll extend, I didn't intend to extend the seven days from 48 hours because somewhere we bump against credulity, don't we? But in any case, 48 hours is not the right answer and we have to change that.

CHAIRMAN STETKAR: Thank you, Randy.

MR. KURITZKY: Okay, done with that.

All right, moving on to low power shutdown, that's an area that hasn't really moved as fast as some of the other things we've been doing, for a number of reasons. But we have started getting up an application to the study right now. We developed an initial plan which we've submitted to our technical advisory group.

We've gotten fairly positive feedback from

the TAG. They're in general agreement with the plan. They also provided us some suggestions for some of the challenges that they identified in the plan.

CHAIRMAN STETKAR: I forget. Did the plant actually have a low power and shutdown PRA?

MR. KURITZKY: I was just, the words were coming out of my mouth.

(Simultaneous speaking)

MR. KURITZKY: Thank you. Ed McMahon.

Okay, so the plant commissioned a low power shutdown phase several years back but they aborted after some of the early tasks. However, those early tasks included definition of plant operating states and identifying a set of initiating events to consider, or accident scenarios to consider.

So we were provided that information, and that was one of the main inputs that we used in developing our set of operating states and plant evolutions that we're going to consider.

The set of initiating events or accident standards to consider is based on a number of pieces of information that the initial list that we got from the licensee for their initial work on Vogtle, plus we have two versions of an EPRI report, and also the

Seabrook low power and shutdown PRA, which one of the better low power shutdown PRAs around. So we have information from them that have helped us come up with our list of events that we're going to consider in our model.

We also had the opportunity to go down to the site last month. Unit 2 was in its refueling outage, so our team went down there and was able to observe a number of things important for the modeling. It was a very successful trip.

I want to take this opportunity to again plug Southern Nuclear who has done just an outstanding job every time we've gone down to the site, and it's been many times, of really working hard to make sure we got to see what we needed to see and meet the people we need to meet, and really have just done a bang-up job helping us down there.

One of the big challenges we have with the low power shutdown period, it's a scope issue again. Trying to manage the number of plant operating states and plant evolutions and accident sequences or scenarios that we need to model and still keep the thing within some kind of manageable proportions.

And that probably doesn't even work when

we start looking at fires and other hazards. So that is one of the outstanding challenges we have with this part of the study and how successful we are with it is just going to come out in time.

CHAIRMAN STETKAR: We're going to be interested in seeing that low power and shutdown study when it gets, you know, ready for pre-prime time, basically as soon as you have something together that's somewhat coherent. Because you mentioned sources of initiating events, and in my experience those are such relevant information.

But in many cases, a systematic examination of operational testing and maintenance evolutions during that plant's, the way that that plant, not in every generic plant was something published in the '80s, but that plant manages their outage is very important to identify things like human caused initiating event.

Drain downs, where you come close, for example, because of various operational, the way they time things in the outage, for example. And I don't know how well Vogtle got to examine that whenever they kind of truncated their effort, because that tends to be one of the things that lags development of the

event models.

You develop the plant operating states, you develop the basic event model structure and you start thinking about maintenance alignments, and eventually you get around to looking at how people interact with the system at each point in the outage.

MR. KURITZKY: Right.

CHAIRMAN STETKAR: So I just caution you that there may be a lot of work that's needed there and that it's probably not available at all, not relevant from anything you can pick up generically because each plant manages their outages differently.

MR. KURITZKY: Right.

CHAIRMAN STETKAR: And it's a general flow for a PWR, but how and when they do specific types of tests, how and when they do, you know, specific types of operations can be very different --

(Simultaneous speaking)

CHAIRMAN STETKAR: Early in the outage or late in the outage, you know, and stuff like that.

MR. KURITZKY: And so that's been very, even at the same plant, outage to outage, so yes. Those are definitely limitations or considerations that we need.

MEMBER BLEY: Alan, let me just follow that up because I'm going to reemphasize some things John said.

Coordinated maintenance and operations is the place most people go wrong the first time they do low power and shutdown PRA. Because if multiple things out at the same time while they're doing operations, then you need to track that because it really changes your ability to recover.

And most people now are wiping out a whole train for a week or two or more and then wiping out another train later. But you do it all different, but you do have to look at that coordination really carefully because it makes things a lot worse.

MR. KURITZKY: Right, understand.

Jeff?

MR. MITMAN: Yes, my name is Jeff Mitman. I'm currently on rotation to Research from NRR. In NRR I'm a risk analyst in DRA and I do a lot of SDPs and a lot of those are in shutdown. In Research, I'm detailed over to Research for three months to work specifically on the Vogtle low power shutdown PRA.

We were down at Vogtle, I guess, three or four weeks ago, and the issues that you're bringing up

are, we understand those and we're dealing with those. We're looking at specific outages and how each specific outage flows.

But you're right. Every outage is unique, not only between sites and the utilities, but at a site on a particular outage. So, for example, this particular Unit 2 outage that we looked at, they have a lot of work on, I think it's called MSIP where they're squeezing the hot legs and the cold legs and that's on their critical path. It's extending the outage a little bit, and because of that they didn't do a hot mid-LOOP.

So one of the things we have to deal with is what outage do we look at, you know, we can't look at all outages and then average them. You know, we have to do one specific analysis, and so we're going to have to come up with a reasonable, generic outage for Vogtle to look at.

But it's going to be a challenge to defend what we pick and why, and we're going to have to document that very carefully and explain what we've done.

CHAIRMAN STETKAR: That's to each outage has its own nuance. But if, in my experience anyway,

especially for a relatively mature site like Vogtle, we're not talking about plants back in the '70s and '80s and we're not talking about a plant that's in its third refueling outage either.

You typically can look at what, take the timeline of a typical, you have plant operating states defined. So for some reason you've been able to look at the outage history that the plant has and define a discrete number of plant operating states.

I don't know how many you have, ten, twelve, thirteen, six, I don't know. Look at what's done operationally throughout those plant operating states in terms of varying level, varying pressure, varying, you know, what's in and out of service, and look at what type of testing is typically performed in each. So look at their test protocols. MR. KURITZKY: Testing. We haven't gone to the level yet of looking at specific testing. The tentative plan is to come up with initiating event frequencies across the POS and not trying to divide the POS into, say, okay, POS 3 on Day 4 they're going to be doing a certain test.

CHAIRMAN STETKAR: But my point is, understand that in POS 3 they typically do this type

of testing. And it's not POS 12, okay, and it's not POS, you know, whatever, 7, in the middle of the outage when the core isn't there. But understand what kind of, you know, get that map of testing and operational experience.

You aren't going to pinpoint it, you know, at 3 o'clock in the morning on this outage they did the test in POS 3 and they delayed until 9 o'clock in the morning in another outage until POS 3, that they typically do it in POS 3.

Occasionally it might get bumped back, you know, to POS, pick a number, 12, you know, when they're heating up rather than cooling down.

MR. KURITZKY: We're well aware of understanding not only the conditions of the POS, what the temperature pressure level is, what the equipment availability is, and we're also well aware of what work is going on during those POSs.

CHAIRMAN STETKAR: Okay, good.

MR. KURITZKY: But having to go down to the level of looking at individual tests, I don't know if we're going to get that much discretion, discreteness in the model to be able to go that far.

CHAIRMAN STETKAR: Okay.

MR. KURITZKY: But that's something we can take a look at.

CHAIRMAN STETKAR: I just bring it up because I'm working on a low power and shutdown study in another place and they've identified some pretty interesting things that they hadn't thought about.

And it's kind of, you know, risk management, because they said, well, there's no real reason that we need to do this, it's just expedience. We've always done it at that time and, you know, we could do it at a different time.

MR. KURITZKY: Right. Okay, feedback.

MEMBER REMPE: Alan, before you --

MR. KURITZKY: Yes?

MEMBER REMPE: -- you leave this slide, on this slide you're talking about available resources. Earlier that came up with the discussion about fragilities. I know it's coming up in another slide.

And what flexibility do you have to say, well, this is, I mean clearly you want to do a good job, and if there's not enough funding do you have the capability to go and say, look, I just have got to do a decent job to get more funding for a particular task?

And then, conversely, I know there were a lot of SRNs that told you to do a lot of different tasks associated with this study. Are there some things that are cost intensive that perhaps are adding us value and do you have that flexibility to push back in trying to devote the resources to things that might have more technical significance?

MR. KURITZKY: Kevin?

(Laughter)

CHAIRMAN STETKAR: Eventually we get there.

MR. COYNE: It's a great question, and I want to point out our management has been extremely supportive of this study. And although we've had some budget issues across the agency over the last several years, the Commission actually salvaged funding for the Level 3 project when we were in pretty tight budget times to make sure we had adequate funding to move forward.

So funding hasn't been so much of an issue. The main resource challenge has been our own staff, and particularly with a lot of this spent fuel pool issues going on that has drawn away staff who are working in other areas of study.

The impact that it really has on us is it stretches the schedule out. We're not curtailing areas that we think are risk significant to meet a schedule, we just inform our management and we move forward with a revised schedule.

So shutdown in particular has been a challenge that unfortunately has crept up to be one of our critical path items on the study. That's probably not a surprise for people who have been doing this for awhile. It came up on our radar in the last couple months just because of the various resource challenges with our own staff.

But we're managing it. We have a project management team, Alan, Mary Drouin and myself, who meet weekly to discuss these kinds of issues and see what's coming up on the study and what issues we need to pursue, what ones we can do a little less on and which ones need fuller attention to move forward.

CHAIRMAN STETKAR: That's one of the reasons that back, really, I don't know how many meetings we've had, if this is the sixth or seventh, I've lost count a long time ago.

But early on we sort of discussed the notion of what I characterized as a horizontal plan

versus a vertical plan versus an integrated plan. Horizontal, meaning push through Level 1 internal events at-power all the way out to Level 3. Get that done.

MR. COYNE: And we're doing that.

CHAIRMAN STETKAR: And, but in that notion, the shutdown study isn't critical path on that.

MR. COYNE: Right. Correct. Correct.

CHAIRMAN STETKAR: That's part of the vertical, if you will, integrated --

MR. COYNE: It's critical path in us delivering a final NUREG --

(Simultaneous speaking)

CHAIRMAN STETKAR: Of the overall project, that's true. Okay.

MR. COYNE: And as Alan pointed out, you know, we're not holding up those horizontal pieces to a level of perfection. I think that's safe to say.

We're trying to be expedient, we're trying to be practical, we're trying to capture the most important things we can, but recognize that as things dynamically move around there's things that we can't capture as we lock down the Level 1, 2 and 3 and we'll

have to go back and do an iteration.

Our big fear is it's going to be three or four iterations rather than two or three iterations. But we'll have to manage that as it evolves.

MEMBER SCHULTZ: Kevin, let me ask you. Is the technical advisory group, have they been presented with this challenge and do they take ownership in a role then looking to resolve it in terms of identifying the scope and available resources, or is their role different?

MR. COYNE: I'll try a quick answer, and I'm looking to Nathan Siu who's the chair of that group and he's moving towards the microphone.

But from our project perspective, the key thing that the technical advisory group is providing us is that expert judgment on many of the technical areas. They're not so much engaged in schedule and resource type of concerns, programmatic type concerns, but giving us expert advice on any area they feel and want to give us advice on. But there's some particular areas that we piloted to them that we would really like their opinion on.

MEMBER SCHULTZ: But as we discussed a few minutes ago that -- well, I'll let Nathan respond.

But as we discussed a few minutes ago that it becomes a technical issue and technical advice can help to address the challenge or help to identify the importance of not getting the resources when you need them for the program, for the program to be successful.

MR. SIU: Nathan Siu, Office of Research.

CHAIRMAN STETKAR: Nathan, did you identify yourself?

MR. SIU: I just did, but I don't know if --

(Simultaneous speaking)

MR. SIU: No, the technical advisory group has generally been operating at a more detailed level. We get presented certain aspects, for example, you're going to hear about the Level 2 HRA so we'll provide comments on that.

On the low power shutdown we'll provide comments. We did comment on the overall technical plan at the beginning of the project, but we haven't been monitoring and saying, oh, you should be spending more time on this aspect rather than this aspect. That hasn't been our role.

MEMBER SCHULTZ: But this is coming to

you, the initial plan for this aspect of the work, so I'd look for some comment associated with that.

MR. KURITZKY: Yes, and the TAG has given us comment, as I said, on the low power shutdown initial plan. Yes, we see the comment from them on that.

MEMBER SCHULTZ: You've got that already?

MR. KURITZKY: We have that already.

MEMBER SCHULTZ: Okay.

MR. KURITZKY: Okay.

CHAIRMAN STETKAR: To be cognizant of the time here, I wanted to -- we actually don't mind sitting here until 9 o'clock at night. That's the role we, and I'll make sure I nail the other members' feet to the floor but --

(Simultaneous speaking)

MR. KURITZKY: I'll need to be home to watch that on TV --

(Simultaneous speaking)

MR. KURITZKY: Okay, I'm just about done. Spent fuel pool PRA is one area that we haven't made that much progress in primarily because our team leader who sits beside me is also the team leader for Level 2 PRA as well as a key member of almost any

spent fuel pool related activity that the agency gets involved with.

So Don's been pulled in a lot of different directions and has not really had time to spend on the spent fuel pool PRA part of this project, so it hasn't moved nearly as far along as some of the other aspects.

Again in that horizontal view that Chairman Stetkar mentioned, it's not holding up the other parts of the project that we're doing, but in terms of the overall project schedule it's, as I say, going to get to a point where it will have an impact. In any case, we have done some initial work.

We've developed the site operating phases that encompass the different configurations dealing with the spent fuel pool. We have an initial list of hazards that we're going to consider. We've developed a simplified MELCOR model that we've used to do some initial timing calculations to help us determine what areas to put more attention on.

And we have started doing some initial accident sequence work, Level 1 accident sequence work. Right now we've worked on the very large seismic event which is, I think, 1g or higher, and

we're currently doing some work on the next step down which is a 0.5 to 1g area. But as a whole, this is one area that hasn't been moving as far along as some of the other parts of the study.

In terms of dry cask storage, this one has been moving along very well. We're in the process of completing the accident sequence development both for the loading operations and storage. We have some structural analysis that's been done for us by a contractor on the fuel and the canister.

And so we're hoping once that work gets done we can pretty much wrap up the source term characterization for, the source term frequency and characterization work for the dry cask storage PRA sometime in the spring of next year. So it's actually moving along fairly well.

Integrated site risk, that's the big piece that ties it all together. It's something that because it's such a cutting edge area that really there's not a lot of experience in it and we've been working on it ever since day one. Obviously not as intensely as we will as the project moves further along, but we have developed a plan for what we intend to do.

It's more of a high level plan. It's in our technical analysis approach plan which is the TAPP at Chapter 17. It's a publicly available document. We are planning -- while it would be great to be able to take all the single source models in SAPHIRE and then in SAPHIRE jam them all together, you know, identify certain dependencies, whatever, and jam the whole thing together, turn a crank and spit out integrated site risk results, that's just not practical.

So we have to be a little smarter in how we go about it. We're taking insights from the single source models to help us prioritize what are the key things to include in the integrated model. One of the things, we have been doing some exercises where we've been propagating sequences from one unit into another unit to see how SAPHIRE can handle that propagation. So far it's worked out fairly well.

You know, sequence by sequence, we can propagate certain numbers of sequences into whole event trees or even the whole model, but putting the whole models together would bust the bank. So our focus really is on the dependencies. That's the key item we're looking at for multiple sources

particularly between the two units.

The dependencies show up in two primary areas, human dependencies and equipment dependencies. The equipment dependencies are basically two types that we had to concern ourselves with. That's shared equipment between the two units or spent fuel pools, et cetera, which Vogtle really doesn't have much. Units 1 and 2 at Vogtle are almost completely independent. There's virtually nothing that they share between them.

The only thing is in the switchyard they have a Plant Wilson B- not the switchyard. There's some stuff in the switchyard they share, and Plant Wilson, which is an offsite source, which can be a backup emergency source to a single vital AC bus or a single 4KV safety bus at any unit with just one bus. So that obviously can impact either unit. But outside that the two units are essentially separate.

CHAIRMAN STETKAR: You do have dependencies on common initiating events though.

MR. KURITZKY: Yes. Yes, the common initiating events, clearly. I'm sorry, I didn't mean to --

CHAIRMAN STETKAR: Okay.

MR. KURITZKY: Yes. So obviously there's some 9:38:00, we envision seismic being one of the main contributors that's going to affect not only both units but both spent fuel pools.

So yes, there's what we call -- I can't remember what Marty Stutzke used, we can just say it being common cause initiators or something. He had broken down the various things that we're looking at. But from the plant response point of view it's the human actions and the equipment dependencies we're looking at.

Now the other thing besides shared equipment, which is not a big concern for us at Vogtle, is the across-unit CCF groups, common cause failure groups. And that is something of a concern to us simply because even in single units there's some important safety equipment in many of them.

In the nuclear service cooling water system there are six pumps and eight cooling tower fans in a single unit. So when you look at common cause we could have groups of 12 to 16.

It's not that you have no data to use for that, really even the common cause failure models we have aren't really designed to handle groups that

large. So we'll have to do some type of assumptions or simplifications to try and get common cause for groups of that size.

In any case, we are awaiting the single source PRA model results to be completed and to be available so that we can help tailor what we want to do in the integrated site model.

And the challenge here is similar to the spent fuel pool, also in low power shutdown, it's scope versus available resources. Again it's one of these things where you could, if you wanted to you could make this problem as big as you can throw money at it. Because there's so much you can throw at the model, so much you can address. But in reality we have to try to keep it something that's manageable and something that focuses on one of the key risk insights that we could get at doing the integrated site risk. So that's the challenge there.

The last thing I want to talk about are the PRA standard based peer reviews. Our quality plan for the project calls out PRA standard based peer reviews as one level of our review, our quality program.

The PWR Owners Group was gracious enough

to agree to fund four peer reviews for us in the calendar year 2014. The first one that was completed in July, as I mentioned, was for internal flood Level 1, but we have two more scheduled for this year.

The November one is going to be on the high winds and other hazards, and in December will be the Level 2 PRA for internal events and internal floods.

The fourth one, since we didn't have another piece of the studies readily available for peer review this year, we decided to have them help us come up with the review criteria for those aspects of the site that we don't have current standards, current even draft standards for. So that really was addressing the spent fuel pool and the dry cask storage.

So we're going to, it looks like now we'll have a PWR workshop to come up with review criteria for those two parts of the study. That's actually been pushed into the beginning of 2015 just because of schedule issues.

We also are engaging in talks right now with the PRA Owners Group to see whether they can support us for some additional peer reviews in

calendar year 2015.

CHAIRMAN STETKAR: Assuming you have the report from July review or --

MR. KURITZKY: So the July review, we have only basic information insights from it. The actual report itself is prepared already, but there's one single issue that's missing and so they've been holding off to get this last feature. CHAIRMAN STETKAR: I'm just curious why we hadn't seen it.

MR. KURITZKY: So that's one of the things we proposed for the February meeting. That's something that we were --

CHAIRMAN STETKAR: Okay, thanks.

MR. KURITZKY: -- trying to have on the list for February.

Okay, so just to wrap up. We've established a very robust infrastructure for the project. It took a lot of time in the beginning of the project to do that. However, we think it will pay off dividends as we go down the road.

Much of the work or at least a large portion of the study has been done in-house. We've had a lot of support from contractors of course, but we've done a lot of the stuff in-house. And we've

actually been able to get significant contributions from all the RES divisions as well as several of the NRC offices, so the interorganizational collaborations worked very well.

We've been very successful at using mid-career and junior staff and incorporating them into the project and getting their experience up in doing PRAs. So that has been a success while meeting one of our objectives for the study.

We are, as Kevin mentioned earlier and I described just in the few slides, making progress in all the technical areas though of course some are moving more rapidly than others.

Some areas that we've made some advancements are in the linking of the Level 1 and Level 2 models directly in SAPHIRE, also the approach for doing HRA post-core-damage which you're going to hear about momentarily.

There are some substantial challenges that remain. The biggest one again is just key staff. Getting the people focused on the work and not being pulled in other directions, that's really been the main thing we've been having to deal with. And because of that we're approximately 16 months behind

schedule right now, hoping to hold there but time will tell.

I want to take this last opportunity just to acknowledge the support we've gotten from initially on this project. First and foremost, Southern Nuclear has been, they've committed extensive resources to support us in terms of digging up and providing this information, setting up and taking care of all our trips down to the site, and also reviewing documents. They've really put a lot into this and we appreciate that.

Also the PWR Owners Group, as I mentioned, are sponsoring many of these peer reviews for us and so we greatly appreciate that. And lastly, with Westinghouse and EPRI each putting up one member on the TAG, so that's been very beneficial too because they bring some experience perspectives to our TAG that we wouldn't otherwise have if we were more insular in the agency. And that's all I have.

CHAIRMAN STETKAR: Okay. Anybody have any more questions for Alan? If not, thank you. And we'll go to Stacey on HRA.

Stacey, I hate to put you through this, but we haven't heard from you in awhile and we've

never heard from you in terms of being the lead on the human reliability analysis for a Level 3 PRA.

So for the record, could you just summarize your experience and qualifications?

DR. HENDRICKSON: Certainly. So my name is Stacey Hendrickson. I'm from Sandia National Laboratories. My PhD is actually in quantitative and cognitive psychology.

I've been at Sandia doing human reliability analysis as well as human factors for about eight years now. So that's my background a little bit.

So today we'll talk about the method we use for the post-core-damage HRA. In the closed session later we'll actually go through the application of it within the Level 2 PRA.

We also have Susan Cooper from the Office of Research in the audience, so if you have anything to add, Susan, please let me know. And Don Helton was a big part in helping with this method and approach as well.

CHAIRMAN STETKAR: Let's make sure you're -- I don't know, are you picking up everything over there? Okay, just make sure you speak loudly enough so that we pick you up.

DR. HENDRICKSON: Get closer.

CHAIRMAN STETKAR: Thank you.

DR. HENDRICKSON: So first I'll just kind of provide a background and discussion on why we took the approach we did and what informed the approach. We need to gain an understanding of what's really different in the post-core-damage, could we then apply methods that we're used to, methods that we're familiar with?

And so what we learned is really the current methods that are used for the at-power, Level 1, internal events don't really recognize and they fail to capture the full complexity and elements that are within post-core-damage.

So to help us with the understanding, we have done some plant visits. So we've interviewed the operators, interviewed some of the emergency directors. Understood how they're applying the SAMGs, the severe accident management guidelines, the EDMGs, all the different procedures. Done some walk-throughs and talk-throughs of some of the different key fire events and operations and actions.

And so from that Vogtle's been very forthcoming. They've helped us a lot with it. We've

also worked with some of the lesson learned from some of the other accidents, like Fukushima, and we also have lessons learned from, members within the group have worked on other HRA activities such as the fire HRA guidelines, NUREG-1921, the formation of the IDHEAS Level 1 method and as well as the psychology literature review.

And then they also looked at some of the efforts that were being done for post-core-damage, some international efforts that have been completed in the past and how we could learn from that. What had they applied, what were they seeing as being the most important factors, and then move on from there.

MEMBER BLEY: Let me just ask you one question, and you can hand it up later. You don't have to answer it right now. You know, no method tells you how the plant works either before it's broken or after it's broken.

They don't specifically tell you how equipment fails. They don't tell you how operators turn switches or make decisions. Well, some of them help you understand how they make decisions. Is this a methodology issue or is this an issue of the people doing the analysis learning to understand unique

situations that might be occurring post-core-damage?

DR. HENDRICKSON: It's probably a little of both, right.

MEMBER BLEY: Well, as you go forward if you can show us where --

DR. HENDRICKSON: Okay.

MEMBER BLEY: -- the methods that are out there are inadequate and what you've done to make them more adequate.

DR. HENDRICKSON: Okay.

MEMBER BLEY: We'd be interested in that.

DR. HENDRICKSON: So digging deeper into what really is different with post-core-damage operator responses, so what is it that we need to be more cognizant of, and also look at how is this different from what some of the Level 1 methods we've used. Why can't we use some of those same factors or some of the same quantifications that they've done before?

The one thing you'll hear come up again and again and as I'm talking through this, is the procedures. That really is the game changer here. It's the use of the primary reliance on SAMGs as opposed to the emergency operating procedures, the

EOPs.

CHAIRMAN STETKAR: Stacey, is that because people traditionally who have done Level 1 PRA have been obsessed with procedures, and if there are procedures it's good, and if you follow each step in the procedure you win and if you don't follow the step in the procedure you lose?

In other words, is this focus on procedure simply an aberrance of, the wrong way to do human reliability analysis in Level 1 PRA? From what you've learned looking at the way people make mistakes.

DR. HENDRICKSON: Certainly the focus on procedures here is a holdover from the focus from Level 1. However, I'll say that here it was something that we had to be able to latch onto to have any sort of prediction of what is it that the operator's going to do. So yes.

CHAIRMAN STETKAR: But on the other hand, as Dr. Bley said understanding what's happening in the plant and how people think and react to things with or without procedures and whether the procedures help you or hinder you or something that you just throw in the basket because they're useless, doesn't mean that you look at procedures first and foremost. You look at

what's happening.

DR. HENDRICKSON: And really what you see when you move into SAMGs is, I think that even becomes a bigger issue because SAMGs aren't as prescriptive as the EOPs so they're guidelines, right? They're suggestions.

Also the definition of success is now very different because we're not avoiding core damage, we're after core damage. So a lot of that comes into play now in discussing what will they decide, how will they decide it, really go through kind of that whole human processing model of the situation awareness, the diagnosis and so on.

Susan, did you have something to add?

MS. COOPER: Yes, I just wanted to add --

CHAIRMAN STETKAR: Identify --

MS. COOPER: Susan Cooper from the Office or Research.

CHAIRMAN STETKAR: Thank you.

MS. COOPER: I just wanted to add and emphasize, the approach that has been developed for Level 2 is very much imminently tied to our understanding of how post-core-damage operations will occur at Vogtle. It's very much tied to information,

accumulative amount of information, interviews and so forth that we collected at Vogtle. And, you know, really we had a very different picture, our understanding of how things might work before we made those visits.

So it's very much tied to how we think they're going to approach the use of their SAMGs and work together as teams and perform decision making, execution, all of those things. So it's, we are very cognizant of the need to make sure that we're focusing on implementation of procedures, how things are going as opposed to the procedures themselves.

CHAIRMAN STETKAR: How they say they're going to do it because they've actually never done it.

MS. COOPER: The site has had one E-Drill where they have implemented their SAMGs.

CHAIRMAN STETKAR: They probably didn't know the core to do that though.

MS. COOPER: Right. You're right. But that's the same for the EOPs and the simulator.

CHAIRMAN STETKAR: Yes, that's my point.

MS. COOPER: True. True enough. True enough.

MEMBER BLEY: John just got into something

I was interested in, but I want to back it up a little. Stacey, you were involved in the precursor to the IDHEAS, that report that looked at all the factors, includes --

DR. HENDRICKSON: Yes.

MEMBER BLEY: Because you studied this, is there anything in that approach in that first document, did you find anything that that doesn't describe at least in a general way do you need a new basis or is that basis still the same?

DR. HENDRICKSON: So when you say the first document, do you mean the first document to IDHEAS or the cognitive lit review?

MEMBER BLEY: The cognitive lit review, yes.

DR. HENDRICKSON: So when we were going through and doing the cognitive lit review we were still focused on internal, at-power, Level 1. We were trying to think more broadly, but our immediate --

MEMBER BLEY: But you looked more broadly than even nuclear plants. You looked at things that affect people under any situations and in industry that you could think of.

DR. HENDRICKSON: We did. We did.

MEMBER BLEY: So move on.

DR. HENDRICKSON: So one of the things --

CHAIRMAN STETKAR: Just let me be, just for the record because people occasionally look at these transcripts, if anybody wants to look for that it's NUREG-2114, for the reference.

MEMBER BLEY: Only in a psychological foundation for human reliability analysis.

DR. HENDRICKSON: So we did. One of the things that we really latched onto was Klein's decision making model for naturalistic decision making, and that lit review as well as some of the other lit review that we did for this project specifically.

We latched onto that because it's experts coming into a situation scenario that they don't have as much guidance behind them. They don't have these prescriptive procedures or something, and they're having to kind of chart their own path now. They're relying on previous experiences, relying on previous things they've done and then have had to chart a new path.

So that was also cited in that lit review that we were able to glom onto. That work was

primarily done with firefighters, some of the military as well.

MEMBER BLEY: And other emergency responders?

DR. HENDRICKSON: Emergency responders.

MEMBER BLEY: I think what you've just told us is that basis document is still appropriate for thinking about this problem.

DR. HENDRICKSON: Yes.

MEMBER BLEY: Okay, thanks.

DR. HENDRICKSON: Yes. Yes.

Okay, so going through some of the things that are different. Again, you=ll hear us come with the procedures that the SAMGs and how the SAMGs differ from the EOPs in a number of ways. The training, as we've mentioned that the training is much less frequent on the SAMGs than the EOPs. So operators tend to --

MEMBER BLEY: Can you give us a little history on that? I suspect it's changed in the last three years.

DR. HENDRICKSON: It has changed some.

MEMBER BLEY: Was there any training on it before Fukushima that you've run across?

DR. HENDRICKSON: There was. I'm not real comfortable in answering this.

Susan, do you have --

MS. COOPER: Susan Cooper, Office of Research. As part of our background and education before we even went to the site, we looked at a number of things across the U.S. including there's an NRC, there are NRC inspection reports for each Region that were done right after Fukushima that I looked at and got a gauge for.

By the time we, unfortunately Stacey wasn't with me, but I made a trip to Vogtle in June of 2013. They probably were already sensitized, because they'd had an E-Drill the previous August where they actually did user SAMGs and that was the first time they had done that.

They had also talked about doing some other mini E-Drills and so forth. And then we were just there in July of this year and it sounds like that's even ramping up even more now with respect to training.

MEMBER BLEY: And that means more than once a year?

MS. COOPER: I don't know that we got the

specifics. I think the base training that Westinghouse proposes for the SAMGs is the same. I think the difference is what they're doing in drills and more integrated responses for the plant site is changing.

MEMBER BLEY: Okay. Let me give you just a little background, Stacey, before your time. Back after Three Mile Island, we changed how we do procedures and we know the new procedures and what they're like. A lot of smart people worked really hard on those and got them for each plant type to be profiled pretty well, and then each plant went through them and got them pretty right.

And then they started using them in training on a simulator. And over the next quite a few years they found lots of little places in those procedures where you got into binds and double binds and you couldn't follow them through and they cleaned them up.

And now they're really good for all the things we've run the drills on, and then when we first started looking at the new procedures that were made a few years ago or something for shutdown, we went out to one plant and they walked through with the guy who

wrote them for that plant or who made them plant specific, and as soon as we went through a few exercises we found lots of places where it got in knots and couldn't get out of them.

And so they worked on those and they've gotten better. Nobody's ever used these things, and there have been a handful of exercises that exercise, I assume, just one little piece of these. They aren't quite, well, in some cases they are, but they're not intended to be quite step wise walk-through procedures.

As you begin to apply these to specific scenarios that come out of the PRA, I wonder if you're going to find places like that where they get locked up even though they're supposed to be more general and give you ways to get out of big problems. And I wonder if you've thought about that at all or if you've found anything like that.

They've really been exercised very little. I mean again a lot of smart people work hard on them, but what I'm wondering is how they'll really work in practice on things other than a handful of cases that we've tried to find.

CHAIRMAN STETKAR: Even, you know, and

we're running way over time so we'll have to be very careful here. But I was just reading something the other day. I don't want to mention the plant.

But one of the findings of an actual event that happened at that plant, even using well developed, well trained -- theoretically -- system based emergency operating procedures, the operators at that plant got hung up on a particular step in a procedure for, I believe -- I can't remember -- I think it was something like seven or eight hours, and sat there. Because their interpretation in the control room at that time among the entire group was that they could not move on to another point and another procedure until they satisfied a certain criterion. And they sat there.

Now they didn't melt the plant, which is a good thing, but indeed they could have done other things had they progressed to the procedure where they should have. So even in that context --

MEMBER BLEY: And they knew they wanted to get there, I think.

CHAIRMAN STETKAR: Well, depending on who you talk to, Monday morning quarterback you always knew that that's the thing you should do. The fact of

the matter is in the heat of battle they didn't. They sat there.

So beware. And beware of one test under one focused spotlight of one piece of one procedure.

DR. HENDRICKSON: Right.

MS. COOPER: Susan Cooper. Agree completely, John. We would like to go and observe an actual E-Drill and see what's going on so far as the decision making. But again, right, it's not a bad point.

CHAIRMAN STETKAR: It's an E-Drill, Susan, it's they didn't melt the core. These people in an E-Drill would have progressed through the procedures because they were not faced in the control room with the things that were going on in the plant during that particular event, which indeed complicated all of the cues that they were getting.

MS. COOPER: Well, yes. I mean I guess there are some, as you know probably better than I do, some limitations in the simulators so far as how you get to those post-core-damage conditions.

But the one drill that they did run did start off with the scenario that ran them through to the point of core melt and then they did make that

transition to the TSC leading decision making.

But your point is a good one. We're going to have trouble investigating the decision making process. One thing I can tell you is that we are getting more information, although still lots of uncertainty and more data points to collect, but we are getting some information about the execution side which is principally ex-control room and that probably this afternoon or whatever will be the best time to talk about that.

CHAIRMAN STETKAR: Let's see, everybody likes to have breaks in the morning. We were going to go into closed session after the break. So if I can ask the members, we're going to talk more about HRO this afternoon. If we can let Stacey get through this introductory part and so that we can take our break and then go into closed session, I'd appreciate it.

MEMBER REMPE: There's one more question that I should bring up in the open session. It's this point about cues. And again I'm sure we'll have to --

CHAIRMAN STETKAR: Sure. The instrumentation may not be qualified for severe accidents.

MEMBER REMPE: Yes. And I did look at the reports that you did in your Q&A, Don, and things like that. But it's not clear how much depth was given to if erroneous signals from the instrumentation before it's declared damaged or whatever, because water levels were an issue at Fukushima, for example.

And so I didn't see that in the discussion very much in what I read. And maybe there's more there, but I think that is an important point that needs to be considered. That it's not just the operators and beyond core damage, it's even at some point between things are going south and in core damage that they should be questioning or have some basis to say the sensor gives an erroneous signal and how do they deal with that issue. And that's a tier 3 thing coming up too.

MR. HELTON: Yes. And I guess the one thing I would like to say in the response to that is I think you're right. Your observation is correct. You've looked at most of what's there and what's there is not quantitative.

So essentially we know that we don't want to be on the end of the spectrum where we're saying they can't do anything because they don't have any

information, because we know that generically that's not the case.

By the same token, we know that there are challenges to what they have and we ended up where we could get to at this point was somewhere in the middle of a qualitative assessment. What are the challenges that they're seeing? How is that going to affect their ability to make a diagnosis and to take action?

And so we can talk about some of that this afternoon in terms of the HRA implementation and how it worked into decisions about what actions they would take and what the reliabilities of those actions are, but your statement is correct in that there is more that could be done with a lot of additional effort.

And the Q&A you mentioned tries to make the case that there's definitely more that can be done, but it's not a matter of doing a little more work and getting bang for the buck. It's really a lot of effort that's got to be put in at this point because of where the state of the practice is in that area at the moment.

And so I hope that we're going to get some feedback this afternoon as sort of are we missing something there, is there an incremental benefit to be

had? And beyond that how do our strengths and weaknesses in that area compare to our strengths and weaknesses in phenomenological assessments of, you know, ex-vessel coolability and, you know, all of these other things that also have an impact on the PRA results?

CHAIRMAN STETKAR: One of the things, and it is good for this open session, is that the PRA models tend to fail things or make things succeed in a very black and white and clean manner.

So for example that DC power is not available, you clearly know a subset of instrumentation or a complete set of instrumentation that has, quote unquote, failed. And if DC power is available you know that that set of instrumentation is available.

Now the problem is that when you look at a sequence that says DC power is available, so in the HRA you say the instrumentation is available, it might not be very reliable because it's not designed to perform under it.

So when you look now at into the Level 2 and a principal Level 3 world, those sequences that have available instrumentation don't necessarily mean

that it's doing what you thought it's going to do because it's just not failed cleanly.

And that's a bit of the problem in the PRA bimodal success and failure branches coming out. You need to think pretty clearly on those success branches what you have and how reliable information it might be providing to the operator despite the fact that the things are moving and, you know, colors are flashing or whatever.

MEMBER REMPE: And this project's in a unique situation because you have the plant willing to work with you. You have the guidance documents. So you actually are well poised to answer some questions that relate to other issues --

CHAIRMAN STETKAR: I hadn't thought about that.

MEMBER REMPE: Yes, and now because this would really be a great opportunity to address and share a few things.

MS. COOPER: Susan Cooper, Office of Research. I have spent some time and Stacey has also spent some time interviewing emergency directors and also folks who would be serving as SAMG evaluators.

And we've discussed this issue in general

and for some specific types of information as to whether or not, you know, whether or not they would believe it or whether they would wait to get accurate information, how would their decision making process go.

And based on that plant specific information and talking to those few emergency directors and other folks, operations folks, we made some simplifying assumptions about that decision making, which is what you see, which is partly coming from the plant and partly coming from the capability of trying to understand what that instrumentation is going to be doing, you know, over the range of scenarios that we might be looking at.

DR. HENDRICKSON: So a couple of the elements to point on this slide before we move on. The teamwork, the teaming, how is that different from the pre-core-damage to the post-core-damage.

You now have got a much larger group. The emergency director is located within the TSC. You have a much more distributed group, and folks that the field operators as well as the groups still in the main control room and the group out of TSC.

Decision making, we've already talked

about some, the redefining of what success is and that the better path may not be immediately obvious. And then staffing. It may be inadequate for responding to site-wide events. Later we can talk some about some of the health physics and the involvement of health physics personnel and how that's changed some of our understanding as well.

So then the model of operator response for this project, the focus has been on the SAMGs, to a lesser extent the EDMGs, the Extensive Damage Mitigation Guidelines. We'll get into some of that a little later as well.

The approach was influenced by our interactions with Vogtle, so this approach is built for application to Vogtle and that's important to keep in mind. Perhaps it could be extended to others, but that would have to be considered and each one of these things looked within the context of what other plant would be moving into.

One of the key elements that we focus on then is procedural support. The knowledge of the environment. They're going to be most familiar with the main control room environment, but now we're doing quite a bit of local actions, ex-control room actions.

The availability of the information gets to the question you were asking, so timely and accurate information to be available is going to be critical. And so you'll see how we questioned that and how we also quantify those. And then what training's received which we've already talked some about as well.

So looking, let's go to the flip side and a little bit of, well, what's the positive side of operator response in post-core-damage? Keep in mind we have experts that are composing these teams. They do have procedures available. They have the SAMGs.

Although there's not a direct link within the SAMGs back to the EDMGs and the EOPs, they are familiar with those. They are in our talks and everybody's with them. We understand they do use those, so they use these in collaboration with each other, and significant guidance available then to support the TSC response.

MEMBER BLEY: Can you just clarify who you mean by "they"?

DR. HENDRICKSON: They'd be, so we've got the emergency director leading it and so they're going to be of course the primary decision maker. But then

you also still have the senior reactor operator in the main control room and others that would be contributing to that decision making as well.

MEMBER BLEY: Okay.

DR. HENDRICKSON: And then a significant amount of time. So typically when we're talking about post-core-damage, we're talking about order of hours and versus in the Level 1 situations where they've been much more constrained.

So they would typically have more time. There's more complexity and more uncertainty to work through, but they're going to have more time to work through it.

The scope and limitations of the method. So, and I'm going to stress it again. This was developed to support this Level 3 PRA project, so it's developed in support of Vogtle. The limitations, right now it's only for the at-power, internal events. We may be able to extend that later. We're supporting the Vogtle Units 1 and 2. We assume that the HFEs have already been identified. We worked closely with Don and the Level 2 PRA team, and then we worked through the eight scenarios which we'll talk about more in the closed session.

Dependence issue. This will come up I'm sure. Dependence between pre-core-damage and post-core-damage HFEs is at this point treated as uncertainty. We'll also get into some discussions about uncertainty.

As we were going through the application of it we did not find any strong or obvious between those, between the pre- and post-core-damage, and we can talk about that a little later.

MEMBER BLEY: Have you been looking at specific scenarios?

DR. HENDRICKSON: Even with scenarios that we were quantifying for the post-core-damage, we kept in mind what dependence might be with the pre-core-damage and we didn't see any obvious links.

And then another thing to keep in mind is it's not accounting for the effects of management culture, so there may be an effect of changing from the pre-core-damage to and management culture to a post-core-damage. So let's jump into the approach. First is the screening approach which helped us in identifying those HFEs that were likely to be enacted following core damage.

The screening approach considered four

factors, primarily, was the priority of the action or the priority of the guidance of SAMG, habitability of the environment, availability of indications and of resources, and then survivability. We looked at the four prior to vessel breach, and then following vessel breach in the timings as well as the HFEs to consider.

So the very first thing to look at is what the HFE identification criteria, how did it determine which HFEs to focus on? In order to be included it had to be either a first priority, so meaning that the SAMG action, the SAG or SCG action would have been a first priority during the 12 hours following the event, and the area must be habitable.

If it's not a first priority then it must be a second priority during the 12 hours and it has to be a second priority for at least two consecutive hours. And again of course the area must be habitable.

The area being the area either where they're of course doing the diagnosis, the decision making, as well as the area they're going to have to travel to, the area they'll have to travel through, all that's considered.

It's also been identified as being an HFE

to be considered. We applied a screening methodology to it and then later we'll talk about the detailed methodology that we applied. Further categories, the first one, the 1.0.

If DC power is unavailable during the period of diagnosis or execution it's considered infeasible. It's thrown off. It's given an HEP of 1.0. So if DC power is not available we just don't credit it at all.

Next level down, the 0.9. If any of those conditions were met it would have been given a 0.9. So if it's never the highest priority during the scenario or there's more than one HFE occurring -- excuse me, more than one Level 2 PRA HFE occurring upstream, strategy is not at least the second priority for two consecutive hours, and an accident-altering event occurs during the implementation period. So if any of those would have occurred it would make it a 0.9, otherwise we go to the 0.1.

To get the 0.1, notice that's the lowest HEP available. In order to get the 0.1, it had to have met all four of these criteria which is very similar to EOP action. This then is tapping into the training they were received on the EOPs, the

familiarity they'd have received on the EOPs.

So if it's similar to an EOP and same or similar action that will also be prompted by the EDMGs. So now we're making the criteria that it not only has to be similar to an EOP action but also to an EDMG action.

Again just focusing on that, what's the familiarity with it, what's the training going to be on it, so now it's been backed up by SAMG, EOP and EDMG procedures. It's the highest priority for at least three consecutive hours, bumped up that two hour limit.

And then finally, during the time period there's no habitability or survivability concerns, meaning there's no concerns to the person environment and there's no concerns to the instrumentation within the environment. Now if that scenario is not going to meet any of the above listed criteria within the table, 0.5. So 50 percent.

For the scenarios we've gone through thus far within the quantification, all of them have been handled by the detailed analysis. There's one that they're still, that we may come back and do a detailed analysis on. Right now I believe we've given it,

we've screened it out to a 1.0.

So let's jump into the detailed analysis we've done. First the definition of HFE success. Success is defined a little differently for our post-core-damage than what we're used to for the Level 1 space.

Here, deciding to take an action to achieve a critical function as specified in the SAG or an SCG, so within a SAMG guidance, and then the operating crew completing it. Understand that no judgment was made regarding if it was the correct or incorrect action to take.

What they're doing is they're following, they're basically following the procedures. This gets to Chairman Stetkar's point of are we relying too heavily on the procedures, but in this case we needed something that we could latch on to. So defining success is deciding to take the action that's been detailed within the SAMG.

And then we also did a preliminary qualitative analysis. Let's get into that on the next slide. So the HFE definition, we're looking at what's been written in NUREG-1921, the fire HRA guideline, represents the state of practice for HRA with an HFE

definition.

Gaining the understanding of accident sequence, what procedures might be involved, what kind of training has taken place, what cues are they being presented with. So gaining understanding of the accident sequence in order to be able to understand the factors that would be used for assessment.

One of the first steps is then completing a feasibility assessment. The feasibility assessment is really the question of before we get into any kind of detailed analysis can this action actually be done?

Primarily we're going to be looking at a timing assessment. Is there enough time available in order to do diagnosis as well as execution or implementation? They did put on the criteria as well of being the priority, so of the SAG or SCG instruction must be a first or second priority.

This follows with what the screening criteria was as well, that if it's a second priority it must be second priority for two consecutive hours. The area must be habitable. Understand too that the area here does not just mean the area in which the action's taking place. We're also taking about the route in order to get to the area.

And then availability of staff, equipment and the information. So all these elements would have been evaluated just as an initial feasibility assessment. And then later on you'll see where we'll dig deeper into some of them once we've been satisfied that there's at least a ground level that allows the action to take place.

So a qualitative analysis. Break it up here into we'll go first through the diagnosis and then next we'll go through execution and implementation.

We toyed a little bit with whether to call this diagnosis. We settled on it because it's what people would be familiar with, but it's also meant to kind of include the situational assessment, the sense making as well as diagnosis and decision making.

So three areas to focus on, the type of underlying procedural support. The focus is on SAMG, but if there's underlying familiarity, a similar description of the action within the EOPs or the EDMGs we gave them credit for that. That gets back to the having training on these actions, having greater training, greater familiarity.

And so if they have familiarity from EOPs

or from the EDMGs, then they're probably going to better able to avoid the action. The information availability, the availability of the plant state and parameter information to the TSC involved in responding to the scenario. We'll go through some of it.

If we think that the information availability is lacking completely and has already been screened out through feasibility, so now we're getting to two levels of is it just adequate or is it what they'd expect? Is it good?

And then the potential negative impacts from taking the SAMG indicated action, within the SAMGs at the beginning of before describing the action it will describe potential negative consequences that might occur if this action is taken.

We know the SAMGs are not prescriptive step-by-step, this is what you need to do, it's a layout of guidelines, this is what you as the operator need to consider, when going through think about this action, also keep in mind there may be these negative consequences.

So SAMG is going to lay out if there were to be potential negative consequences after doing the

action. If there are potential negative consequences, we of course need to consider that in the decision making of the operators and of the EOB, and so that's going to take a place as well in the diagnosis.

So we can look at some decision trees for going through each of these factors and leading to then the HEP, the human error probability.

The human error probability primarily came from our expert judgment on the team. It's based on nominal values that are used within Level 1 internal event analysis that have been adjusted upwards slightly to then account for the greater complexity or what we feel would be the most reasonable estimate for a post-core-damage, nominal value.

So we started with what does SPAR-H recommend? How does ATHEANA define these terms? And that's also where we looked at for the multipliers that we're applying. So we start with that nominal value, and then based on the responses to each of these factors, procedural support, information availability, potential negative impacts, we applied a multiplier to that nominal value.

These multipliers were derived some from what we learned from NUREG-1921, the fire HRA

guidelines, as well as what other methods have applied such as like SPAR-H.

So we'll go through, let's go through each one of these branches, go through so you can understand what the distinctions we are making.

The procedural support we've talked some about. The topmost branch would be the worst case. That's where the, we call it, it's basic procedural support, meaning the action is only described within the SAMGs and that would be then their only familiarity with it.

Next would be the next level down, which is labeled as fair, would be to have a SAMG described action but there's also some support from EDMGs. So there's some familiarity or some additional discussion of it from the EDMGs.

Next would be good. And so the EDMG, there's EOP support. So we make the distinction here that the best, kind of the gold standard is going to be the EOPs. That's the one they're most familiar with. That's the one they get the most training on. So if there's other support for EOP, they're going to have either a good or even the best support.

CHAIRMAN STETKAR: Stacey, are you aware

of any EOPs that address post-core-damage situations? EOPs keep you away from core damage so you'd never have good EOP support for post-core-damage, would you?

DR. HENDRICKSON: Not for directly post-core, but it's going to talk through some actual actions they'd have to take.

CHAIRMAN STETKAR: Okay. At any rate, kind of turning switches and pushing buttons? Perhaps we --

MS. COOPER: Susan Cooper. Yes, the distinction is actually, you know, SAMGs principally provide guidance on priorities and a strategy, a general, you know, certain plant parameters or conditions that you're trying to address.

What we're trying to get to here is also then what will the TSC SAMG evaluators need to do to describe to a field operator what they're going to actually do, this individual steps that are going to need to be taken in order to implement this strategy.

So this is simply recognizing that if it's already been written out in an EOP or that something in an AOP can be used and modified to address the situation, that would have more detail and support that the folks in the TSC would not have to have more

effort. There's less effort to do that.

CHAIRMAN STETKAR: I understand that. I was just questioning why it's a mutually exclusive branch point in a logic model rather than a combinatorics in the equality of the SAMGs and the EDMGS. In other words a serial type thing.

This seems to say that despite the fact that I don't have SAMGs or EDMGs, if I have good EOPs for post-core-damage I get something. So we can talk more about this this afternoon when we get into some of the details. I just wanted to understand this logic structure here.

DR. HENDRICKSON: Some of the confusion I think is that each one of these branches assumes that there is SAMG guidance. That's not captured in the parenthetical.

CHAIRMAN STETKAR: Okay.

DR. HENDRICKSON: Each one of them assumes that we've got a base SAMG guidance and then what could be added on top of the, so is this action also discussed within EOPs and EDMGs.

Did you want to add anything to that?

MR. HELTON: I think a quick example might clarify it. So, for instance, like Stacey said, the

assumption is is that we've gotten to this point because the SAMGs are directing a particular, guiding them towards a particular action.

Here what we're asking is the question, is that action also familiar to them in an EOP or an EDMG context? So if this SAMGs are guiding them to manually open atmospheric relief valves on the steam generator, do the EOPs under pre-core-damage context also have that type of action, and in that case the answer would be yes.

Under a pre-core-damage situation, manually opening the atmospheric relief valves is something that's covered in a particular part of --

CHAIRMAN STETKAR: You can find pretty much in any procedure guidance for somebody to do anything with anything in the plant, so that's okay.

MR. HELTON: There actually are a lot of the SAMG actions that don't have a clear parallel in the EOPs --

CHAIRMAN STETKAR: Parallel, that's right.

MR. HELTON: -- and the EDMGs, and that's what we're looking for here is the sense of familiarity because it's something that they trained on in another context. And there are a lot of the

things that the SAMG actions are asking them to do that do not have that level of familiarity because there is not that parallel in the EOPs.

CHAIRMAN STETKAR: EOPs, you mean.

MR. HELTON: Or EDMGs.

DR. HENDRICKSON: Or EDMGs, yes. We can dig into an example later too, if you're interested.

CHAIRMAN STETKAR: Yes, the second one would be an appropriate time to do that.

DR. HENDRICKSON: The information availability we already talked briefly about whether it's adequate or whether it's good. Good here would be that they're able to go right to the instrument, right to the panel and see the reading.

Adequate might be something like that they can get a sense for what the reading should be, but they still have to do some calculations or still have to do some inferences to understand exactly what's going on.

And then the potential negative impacts. So if those potential negative impacts that would actually preclude them from taking the action, whereas that would have already been screened out because what we've captured here is that there's potential negative

impacts that can be mitigated or there are no potential negative impacts or specified. Whereas, there might be a third choice which is, say there are potential negative impacts which actually preclude them from taking the action that would have been screened out into the 1.0.

So if there are potential negative impacts that can be mitigated, it's still going to cause them to have time to pause, have some impact on the decision making, and there simply not being negative impacts that need to be considered.

Let's walk through the execution, quantification and qualitative analysis now. We focused on the location of action first, whether it can be done within the main control room or whether it's a local action and needs to be done ex-control room. You're going to have greater familiarity with the main control room actions, so say that a larger factor will be given to the local actions, the ex-control room actions.

Also for the complexity of response. A couple of things might speak to the complexity, whether it's the number of tasks that need to be completed. Simultaneous actions, so if there's

multiple tasks that need to be done at the same time, whether there's multiple locations that need to be visited, and where there is multiple functions then have to be addressed. All of that's going to lead to an increased complexity.

And then finally environmental concerns. We already in the feasibility assessment have looked at whether there is habitability or survivability to the point that it would completely preclude the action occurring. This is looking at is it degraded to a point that's going to hamper it? Not prevent it but it's going to hamper it.

The decision tree again, that the human error probabilities have the same essential basis as what we'd already discussed with diagnosis. Location of action. We already discussed whether it's local or a main control room.

The response execution can be either high or low, so with just a "by" here. And then environmental concerns, poor or good, that if they're so bad that they hamper the actual occurring would have already screened out. And so the maximum HEP for execution would be 0.5 delta 0.1.

So that's a real quick run-through of

actual method. And then we can dig into later how we actually applied it and some of the things we ran into and what we've learned from it too.

MEMBER BLEY: I have pages of questions for you, but in deference to our leader here I've saved them for this afternoon.

DR. HENDRICKSON: Okay.

CHAIRMAN STETKAR: Anything else for Stacey? In deference to our leader here? We've got it. There's nothing else for Stacey and I appreciate everybody's restraint this morning. We will recess until, I'll ask you back at quarter until 11:00, 10:45 please.

(Whereupon, the above-entitled matter went off the record at 10:32 a.m.)

Full-Scope Site Level 3 PRA

Advisory Committee on Reactor Safeguards
Reliability and PRA Subcommittee

October 15, 2014
(Open Session)

Outline

- Open Session
  - Project status overview
  - HRA Approach for Level 2 PRA
- Closed Session
  - Level 1 event tree logic
  - Level 1/2 interface and Level 2 containment event tree
  - HRA implementation for Level 2 PRA
  - ISLOCA
  - Release termination criteria

Level 3 PRA Project Status Overview

October 15, 2014

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Background (1 of 2)

- Commission paper (SECY-11-0089), dated 7/7/11, provided options for undertaking Level 3 probabilistic risk assessment (PRA) activities
- In a staff requirements memorandum (SRM) dated 9/21/2011 the Commission directed the staff to conduct a full-scope, comprehensive site Level-3 PRA
- SRM-SECY-11-0089 also requested Staff's plans for applying project results to the NRC's regulatory framework (SECY-12-0123)
- SRM-SECY-11-0172 directed staff to pilot draft expert elicitation guidance as part of the Level3 PRA project

Background (2 of 2)

- Radiological sources
  - Reactor cores
  - Spent fuel pools
  - Dry storage casks
- Project scope
  - All reactor modes of operation
  - All internal and external hazards
  - Integrated site risk
- Quality reviews
  - Internal (self-assessment, Technical Advisory Group)
  - ASME/ANS PRA Standard based peer reviews
  - Advisory Committee on Reactor Safeguards
  - Other external reviews:
    - Expert panel review
    - Public review and comment period

Outline

- Reactor, at-power, Level 1
  - Internal events and floods
  - Internal fires
  - Seismic events
  - High winds, external flooding, and other hazards
- Reactor, at-power, Level 2, internal events and floods
- Reactor, at-power, Level 3, internal events and floods
- Reactor, low power and shutdown, Level 1, all hazards
- Spent fuel pool (SFP)
- Dry cask storage (DCS)
- Integrated site risk
- ASME/ANS PRA standard-based peer reviews

Reactor, At-Power, Level 1, Internal Events and Floods

- Completed internal event and flood models – based on licensee's PRA models, with some modifications, e.g.,
  - Substituted SPAR methods for modeling loss of offsite power, common-cause failures (CCFs), and anticipated transients without scram (ATWS)
  - Revised some system success criteria and human error probabilities
  - Updated flood frequencies with recent generic and plant-specific data
- Completed ASME/ANS PRA standard-based peer review, led by PWR Owners Group (PWROG)
- Revising model and documentation to address peer review and other internal comments
- Piloting expert elicitation guidance (per SRM-SECY-11-0172) for interfacing systems LOCA (ISLOCA) frequency estimates
  - Large uncertainty associated with common cause valve leakage rates

Reactor, At-Power, Level 1, Internal Fires

- Mapping SNC's fire PRA sequences to SAPHIRE
- Revising Level 1 internal event model to include additional basic events needed for fire PRA model
- Anticipating completion of model and documentation by January 2015

CHALLENGE

Review and acceptance of key fire PRA inputs (e.g., fire scenario parameters and fire analysis)

Reactor, At-Power, Level 1, Seismic Events

- Completed initial seismic PRA model and documentation
- Current SPRA model based on 2012 hazard curves and preliminary plant-specific fragilities provided by SNC
  - Will update model once revised fragilities provided by SNC
  - Updated model will also incorporate 2014 hazard curves
- Anticipating completion of model and documentation by December 2014

CHALLENGE

Review and acceptance of plant-specific seismic fragilities

Reactor, At-Power, Level 1, High Winds, External Flooding, and Other Hazards

- Completed and documented Level 1, at-power, high wind PRA model and self-assessment
- Completed and documented “other hazards” evaluation and self-assessment
- Submitted documentation for PWROG-led ASME/ANS PRA standard-based peer review (scheduled for November 2014)

Reactor, At-Power, Level 2, Internal Events and Floods

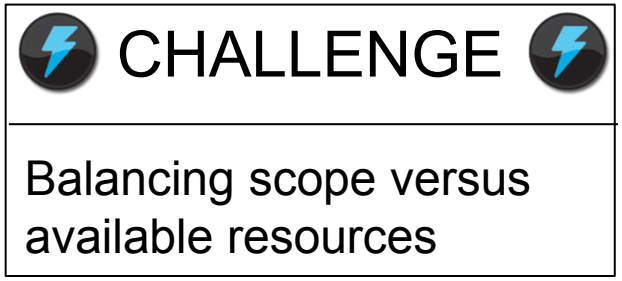
- Completed reactor, at-power Level 2 PRA model for internal events and internal floods
  - Completed release category development, model quantification, and draft documentation
  - Directly linked Level 1 and Level 2 PRA models
  - Developed and implemented a human reliability analysis approach for post-core-damage response
- Preparing for PWROG-led peer review (scheduled for December 2014)
- Will revise model and documentation to address peer review and other internal comments

Reactor, At-Power, Level 3, Internal Events and Floods

- Finalizing EP parameter sets
- Shaking down MACCS input deck
- Developing multi-source modeling capability for MACCS
- Anticipating completion of initial model and documentation in early 2015

Reactor, Low Power and Shutdown, Level 1, All Hazards

- Submitted initial plan to Technical Advisory Group
- Defined plant operating states and evolutions to be considered
- Identified initial list of events to model
- Site visit completed on 9/26/2014



Spent Fuel Pool PRA

- Developed site operating phases to encompass major SFP configurations
- Identified initial list of hazards
- Performed numerous pre-fuel damage sequence timing calculations to prioritize probabilistic model build-out
- Developing initial Level 1 accident sequences

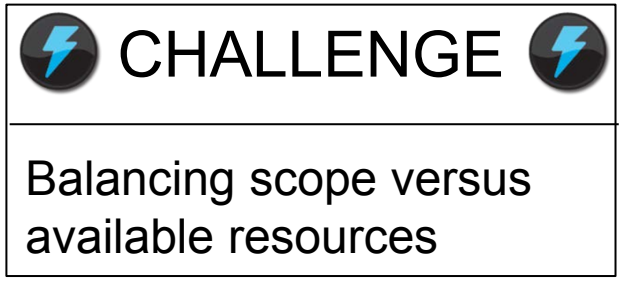
CHALLENGE
Staff availability (especially Team Leader)

Dry Cask Storage PRA

- Completing accident sequence development
- Performing structural analysis on fuel and multi-purpose canister
- Anticipating completion of model and documentation (including source term frequencies and characterization) in Spring 2015

Integrated Site Risk

- Developed Technical Analysis Approach Plan section
- Planning to use risk insights from single-source models to prioritize sequences to propagate to other source models
- Focusing on:
  - Human action dependencies (especially related to SAMGs, EDMGs, and MCR habitability conditions)
  - Equipment dependencies (especially across-unit CCF groups and shared equipment)
- Awaiting single-source PRA model results



ASME/ANS PRA Standard-Based Peer Reviews

- PWROG-led ASME/ANS PRA standard-based peer review completed on reactor, at-power, Level 1 PRA for internal events and floods (July 2014)
  - Professional team, well-structured process, very detailed review
  - Very effective means to gain feedback on process used to develop the PRA and audited selected areas of the PRA
  - Good opportunity for NRC staff to become more familiar with the peer review process
- PWROG-led peer review scheduled on reactor, at-power, Level 1 PRA for high winds and other hazards (November 2014)
- PWROG-led peer review scheduled on reactor, at-power, Level 2 PRA for internal events and floods (December 2014)
- PWROG-led workshop being planned on review criteria for spent fuel pool and dry cask storage PRAs
- Additional PWROG-led peer reviews being planned for CY 2015

Concluding Remarks

- Robust infrastructure established
- Very successful inter-organizational collaboration and significant use of mid-career and junior staff, led by senior staff
- Progress is being made in all technical areas of the study
- Advancements made in some challenging areas (e.g., integration of Level 1 and Level 2 PRA models and Level 2 PRA HRA)
- Substantial challenges remain, especially administrative (i.e., funding availability and staff diversion), as well as licensee resource challenges in responding to requests for information
  - Project schedule has slipped approximately 16 months
- Acknowledgements
  - Southern Nuclear Operating Company (SNC) – Extensive resource commitment to provide plant information, support plant visits, and review project documentation
  - PWR Owners Group – Support for ASME/ANS PRA Standard based peer reviews
  - Westinghouse and EPRI – Support for Technical Advisory Group

Method for Post-Core-Damage HRA

October 15, 2014

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Application of HRA to Post-Core-Damage Situation

- Current methods inadequate for post-core-damage analysis
  - HRA methods geared to supporting at-power, Level 1, internal events PRA fail to recognize and appropriately capture the increased complexity of post-core-damage scenarios
- Little experience to guide our understanding of operator responses in post-core-damage conditions
  - Current approach based on information collected from Vogtle Electric Generating Plant (VEGP), Units 1 and 2, plant staff and general understanding of how people in other highly reliable organizations that deal with complex technology or complicated activities respond to challenging situations
  - Human performance challenges during the Fukushima-Daiichi accident also provide insights
- Approach authors have been involved with other HRA activities (Fire HRA, IDHEAS, etc.)
- International efforts in this area reviewed (e.g., HORAAM, MERMOS)

General Understanding of Post-Core-Damage Operator Response

- Procedures
  - Severe Accident Management Guidelines (SAMGs) differ from Emergency Operating Procedures (EOPs) in a number of ways including format, level of detail, prescriptiveness, and requirements for decision-making
- Training
  - Less frequent training on SAMGs vs. EOPs
  - Most training simulators not equipped to model plant behavior after the onset of core damage
- Cues
  - May not be available or may be ambiguous
  - Less information and less accurate information on plant conditions that are important inputs to decision-making
- Teamwork
  - Pre-core-damage team = small cohesive team in the main control room
  - Post-core-damage team = larger number of people and multiple distributed locations
- Decision-making
  - Assessment responsibilities shift from control room operators to technical support center (TSC)
  - Redefine “success”; “better path” may not be obvious
- Staffing
  - May be inadequate for responding to site-wide events that involve multiple radiological sources (recall that this project does not include the ongoing emergency preparedness requirement changes related to the Japan Lessons Learned initiatives)

Modeling Operator Response

- Focus of post-core-damage HRA = SAMG and, to a lesser extent, Extensive Damage Mitigation Guideline (EDMG) actions
- Approach influenced by plant-specific information (especially how VEGP is expected to respond to post-core damage conditions)
- Key Elements for Operator's Response:
  - Procedural support – TSC has explicit procedures (even if not as straightforward as EOPs) plus team likely has significant knowledge about general plant dynamics and operations
  - Knowledge of the environment – most familiar with main control room (MCR)
  - Availability of information – response plan only as good as the information on which it's based. Timely and accurate information is critical.
  - Training received

Positive Side of Operator Response

- Experts composing the emergency response team have procedures (SAMGs, EDMGs, and related EOPs in some instances) with significant guidance available to support the TSC response
- Many of the scenarios will have a significant amount of time to develop thoughtful response strategies based on the procedures

Scope and Limitations of Method

- Scope
  - Developed to support the NRC's efforts in performing an HRA to support the Level 2 PRA for VEGP, Units 1 and 2, as part of the Level 3 PRA project
  - Introduces context unique to post-core-damage analysis and offers methods for performing a screening HRA and a more detailed HRA

- Limitations
  - Addresses at-power, internal events only (for now)
  - Supports quantification of a pressurized water reactor (PWR), specifically VEGP, Units 1 and 2
  - Assumes that the human failure events (HFEs) for the Level 2 PRA model have already been identified (as part of the screening analysis)
  - Dependence between pre-core-damage HFEs and post-core-damage HFEs treated as part of the uncertainty. Strong, obvious dependence was not observed in the representative scenarios analyzed.
  - Dependence between pre-core-damage HFEs and post-core-damage HFEs does not account for the effects of management culture

Screening Approach

- Identify those operator actions (HFEs) that are more likely to be enacted following core damage, considering:
  - Priority, habitability, availability, survivability
  - 2 time frames – prior to vessel breach; following vessel breach
- HFE identification criteria
  - It is ever the 1st priority during the 12 hours following SAMG entry and the area is habitable

    OR
  - It is ever the 2nd priority during the 12 hours following SAMG entry and is the 2nd priority for at least 2 consecutive hours and the area is habitable

Screening HEP Criteria

HEP	Criteria
1.0	If DC power is unavailable during the period of diagnosis or execution
0.9	It is never the highest priority during the scenario **OR** More than one Level 2 PRA HFE occurs upstream **OR** The strategy is not at least the 2nd priority for 2 consecutive hours **OR** An accident-altering event occurs during the implementation period
0.1	It is very similar to an EOP action in terms of the action's function **AND** The same or similar action will also be prompted by the EDMGs **AND** It is the highest priority for at least 3 consecutive hours **AND** During the above time period there is no habitability or survivability concern
0.5	If not covered by one of the categories above

Detailed Analysis

- Definition of HFE success
  - Deciding to take an action to achieve a critical function as specified in a SAG (Severe Accident Guideline) or SCG (Severe Challenge Guideline) and then the operating crew completing it
  - No judgment made regarding if it was the correct or incorrect action to take
- Preliminary Qualitative Analysis

Preliminary Qualitative Analysis

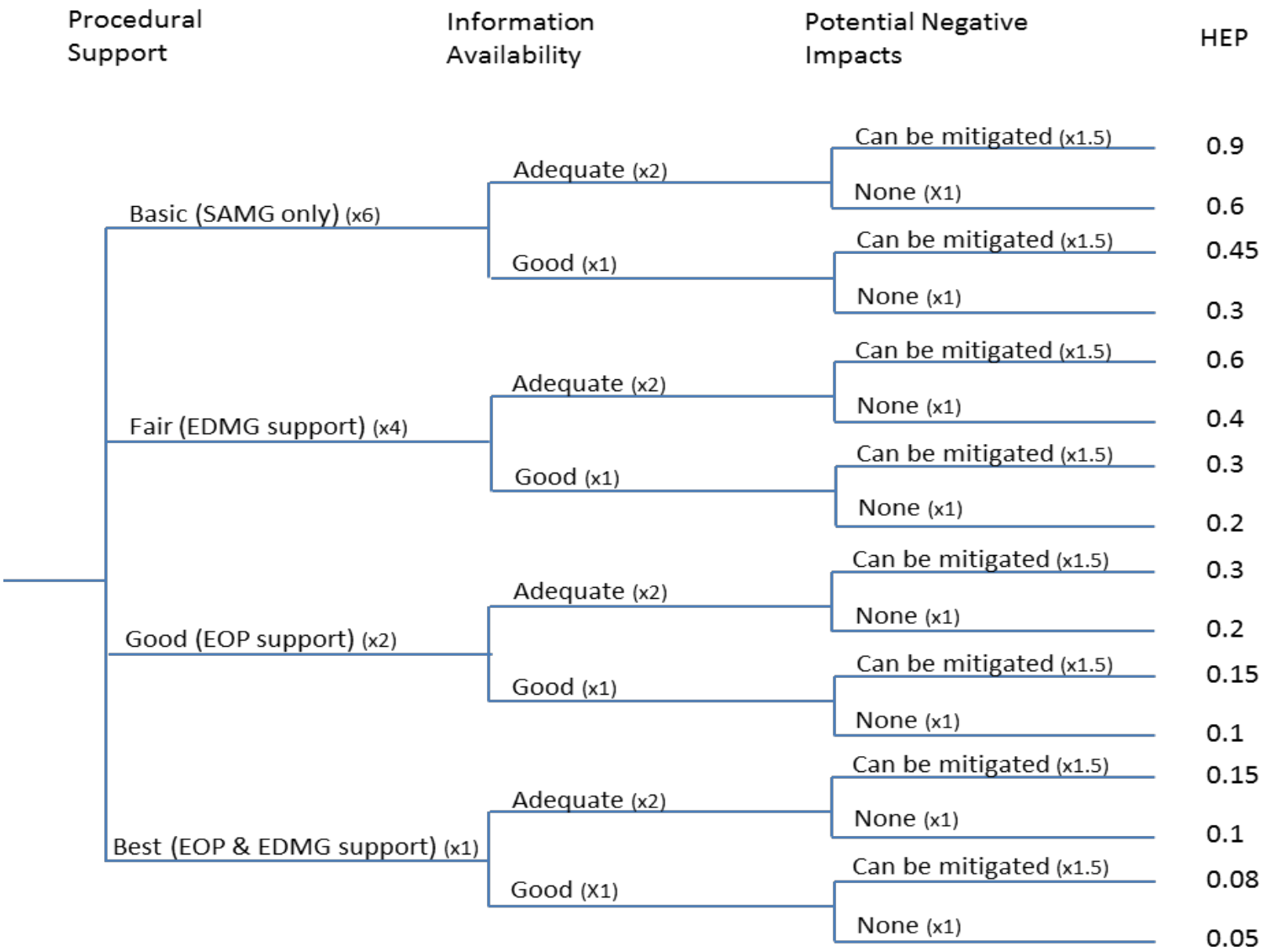
- HFE definition
  - NUREG-1921 represents state-of-practice in HRA
  - Gain understanding of accident sequence and behavior of plant in order to assess factors for assessment of diagnosis and execution

- Feasibility Assessment = can operator action be done?
  - Timing assessment: determine if enough time available to develop a strategy and perform the action
  - Priority of SAG or SCG instruction: must be a 1st or 2nd priority during the 12 hours following entrance into SAMGs, and if the 2nd priority, must be such for 2 consecutive hours
  - Habitability: area must be habitable
  - Availability of staff, equipment, and information

Qualitative Analysis for Diagnosis

- Type of underlying or supporting procedural guidance and/or knowledge
  - Focus is on SAMG based actions; however, action response may be supported by other procedural guidance
  - The better the underlying support for the procedural guidance, the more familiar and more comfortable the operators will be with the action
- Information availability
  - Availability of plant state and parameter information to the TSC or other plant personnel involved in responding to the scenario
- Potential negative impacts (trade-offs) from taking SAMG indicated actions
  - Evaluates the potential for negative consequences associated with various strategies directed in the SAMGs to lead the decision-maker away from the action

Decision Tree for Diagnosis



Qualitative Analysis for Execution

- Location of action
  - If the action is to be performed locally, additional general stressors and conditions may be a concern
- Complexity of response execution
  - Number of tasks to be completed
  - Simultaneous action sequences
  - Multiple location steps
  - Multiple functions
- Environmental concerns
  - Environment may be degraded to a point hampering (but not preventing) the action

Decision Tree for Execution