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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

FEBRUARY 18, 2015

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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 Stetkar, Chairman, presiding.

COMMITTEE MEMBERS:

JOHN W. STETKAR, Chairman

DENNIS C. BLEY, Member

JOY REMPE, Member

STEPHEN P. SCHULTZ, Member

RONALD BALLINGER, Member

DESIGNATED FEDERAL OFFICIAL:

JOHN LAI

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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 Steve Schultz, Dennis Bley, Ron Ballinger and Joy Rempe.

John Bley of the ACRS staff is the designated federal official for this meeting.

The Subcommittee will hear the staff's presentation on the progress of the Level 3 PRA project.

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 USC 552(b)(c)(4).

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

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

Participants should first identify themselves and speak with sufficient clarity and volume so that they may be readily heard. And I'll ask everybody to check all of your little electronic devices and silence them, please.

We'll now proceed with the meeting and I guess, Kevin, I'll call on Kevin Coyne to make some introductory remarks.

MR. COYNE: This is Kevin Coyne from the Office of Nuclear Regulatory Research, so I'm the Branch Chief responsible for the project.

With me is Mary Drouin who is our principle technical advisor and Alan Kurtizky, obviously, is our

Program Manager for the project. We're not overly fixated on titles, which I guess is a good thing.

Again, I try to get a number of meetings that we've had. We've had many meetings on the project and we've enjoyed good interactions with the ACRS. We'll have many more, so I guess this is one of many meetings that we've had and many meetings that are to come with the Subcommittee.

And we have enjoyed the feedback we've gotten and look forward to the feedback for today's meeting.

So, we have an open and closed portion. The open will provide the status update. Alan will provide that. And then we'll go into the consequence analysis portion of the study.

This is a key milestone for the project. We're reaching the end of at least the preliminary evaluation of the full Level 3 PRA for Internal Hazards and Flooding and Power, so in the next few months we'll be wrapping up the Level 3 portion.

We'll have to go through a second integration, Alan will get into that as we clean up some of the modeling details going forward. But this is a big milestone for the project and we're looking forward to reaching it.

We've also completed several peer reviews with the support from the PWRS group. These are big milestones for us also and it provided valuable feedback to us as we go forward.

The closed portion that will largely take the afternoon, we'll go into some detailed Level 1 modeling issues and will involve proprietary information, so that's why we've requested that portion to be closed.

I won't get into the things that Alan was going to cover but I just want to note, we continue to have strong support from Southern Nuclear for support for the project and have enjoyed fantastic support from the PWR Owners Group and with the peer review process.

So the peer reviews we're doing are very similar to what the industry would do for their PRAs and that's been a very valuable process for us from a number of perspectives.

And, with that, I'll turn it over to Alan.

MR. KURITZKY: Thank you, Kevin.

Okay, as Kevin mentioned, I'm Alan Kuritzky, also with the Office of Nuclear Regulatory Research and am Program Manager for the Level 3 PRA project.

I think Kevin touched on what's on this

slide, what we're going to discuss in the open session.

I'll give a quick overview of the project to date or particular those things that have occurred since the last briefing in October.

We also are going to present to you today some information on our Level 3 PRA of consequence analysis portion of the project. Keith Compton from the Division of Systems Analysis and Research will be providing that presentation.

Also, Randy Sullivan from NSIR will discuss our emergency preparedness modeling work that we've done so far.

As Kevin mentioned, the afternoon session is going to be closed because we'll be discussion a lot of proprietary information.

The main topics are going to be to go over some of key review findings from the PWR Owners Group led peer review of the Internal Event and Flood PRA models that we finished in the summer, finished in the late spring and had peer reviewed in the summer.

And then also, we're going to discuss some of the logic and structure behind the event trees for the Level 1 model in the afternoon session.

So, to get into the status overview, again, I'm going to try to make this kind of quick because we briefed you just a few months ago and so, there hasn't been -- there's been some things that we've definitely advanced since then, other things haven't gone quite as -- haven't moved that much further along.

But, just to kind of reorient everybody to the nature of the project, I put this Rubik's cube up there because the key to this project or to understanding the scope of this project is to recognize that while we often times talk in what I would consider to be one and two dimensions in the PRA world, that is taking the reactor at power at say Level 1 and then you're looking at the different initiators along one line or one axis.

Or you could look at reactor at power internal events and floods and then you're looking at the different levels of the PRA 1, 2 and 3 along another axis.

So, in reality, we have to -- while we focus initially on all the different axes more or less and one and two dimensions are planes, eventually we have to fill all the blocks in the middle, too.

So, there's a lot more work that we're going to have to accomplish. We've accomplished a fair amount

And some of the subsequent blocks are just variations of the initial blocks and don't take quite as much effort, but nonetheless, there are still a lot of pieces that have to be completed.

As we go over this stuff today, the way we break it down, at least initially, is talking about the reactor at power, the Level 1 model for the different initiators, then we'll also go to the reactor at power for Level 2 and 3.

Then we'll talk a little bit about the low power shutdown modeling we're doing and then we'll hit the other radiological sources, that is the dry cask storage and spent fuel pool and we'll wrap it up with integrated site risk and the path forward.

Okay, internal events and floods, reactor at power Level 1, that's the bread and butter of the model. We completed that work in the, as I mentioned, late spring and had it peer reviewed. We have since received the final peer review report from the PWR Owners Group.

We have, in general, I think the peer review was relatively positive. It identified that we had a pretty much a state of the technology PRA and, for the most part, were able to meet Capability Category II of the standard for most elements, however, our support requirements.

However, there are a number of areas where we either just met Capability Category I or, in fact, did not meet the supporting requirement. And those areas are places that are candidates for us to do more work or at least improve our documentation as to what we did and why we were only doing what we did.

So, based on the input we received from the peer review as well as from other comments, we are now in the process of updating that model. There is a fair amount of work that we have to do to bring what we call initial model we called our RA-01, Revision 1 model. We're now working on the RA-02, or Revision 2 model.

And there's a lot of things in it that we're going to be changing. Some examples are the initiating of in frequencies are going through some significant changes.

We're also trying to add in some uncertainty parameters that were not included for some events in the initial model.

We are also correcting some of our human failure event dependency analysis. There were some problems with that in the initial go round.

And we're doing some, as Kevin mentioned, some changes to the event trees, trying to make them a little more consistent across initiators, in some places simplifying some things, other places we may have to add a few things.

The last thing involving the Level 1 model is the interfacing systems LOCA. As we have mentioned previously, we have an expert elicitation that we're performing for that topic because it can be such a risk dominant issue and we have some very data that are driving our results.

We are currently in the process of putting the expert panel together. We are gathering experts in the areas of valves, pipes, common cause failure. We're also getting someone with a lot of system Vogtle plant-specific system experience on the team. And hope to have that actual panel meeting the week of April 20th.

We hope to start doing some of the preliminary reviews and work by the beginning of the April and the actual results of that will probably not be ready until the summertime.

Questions?

MEMBER BLEY: I am -- well, go ahead, John.

CHAIRMAN STETKAR: Let me ask, because I haven't read far enough ahead, are you going to talk a little bit -- no, you're not.

I've read through the peer review report and it's a proprietary report, but you touched on -- as I read it, there were a lot of comments on individual items and things like that.

You mentioned initiating event frequencies which was one element. You mentioned HRA which was another element.

There seemed to be quite a few comments on the internal flooding analyses. My takeaway in terms of three big areas from their review was data and, in particular, initiating event frequencies, HRA, both in -- some comments on individual human error probabilities but you mentioned the dependencies. And the internal flooding, there seemed to be quite a few comments on that.

Did you want to mention anything about what you're doing on internal flooding in response to that?

MR. KURITZKY: Not right now. The afternoon session, the first --

CHAIRMAN STETKAR: Okay, fine. I didn't know what you had planned.

MR. KURTIZKY: Yes, we're going to discuss that and our flooding lead will be up here, too, so we can talk to that.

CHAIRMAN STETKAR: Okay.

MEMBER BLEY: I'm just going to ask you

about the interfacing system, LOCA.

My memory, and it's not a real solid memory, was it a few years back, Idaho did an awful lot of work and convened expert panels on that very issue. What's driving you beyond where they were?

MR. KURTIZKY: Well, I'm not familiar with what Idaho did a few years back.

MEMBER BLEY: They did it for NRC for staff.

MR. KURTIZKY: Okay, John, do you want to speak to that? Just identify yourself with the microphone.

MR. SCHROEDER: John Schroeder, Idaho National Laboratory. I was involved in that study. Yes, it was many years ago.

We did not -- the result of that study was basically a recommendation to use some screening of entries and some simplified assumptions about where break locations would be in PWRs and PWRs.

We did not use that model or that test of screening models in this study. We went with what the licensee had because it was developed in some detail and was not inconsistent with what we had done to establish that screening model. So, we just left it at that.

The resulting of entries we had in place did conform to the recommendations of that screening study but we did not enable all the nodes in the way it would have been recommended.

And the things that we were missing, we disabled the operator action detection and mitigation portions of those entries and we did not make any assumptions about the break locations for the different initiators that were in that.

And there were also some pipe break probabilities that were developed, again, on a screening basis. Since we had a detailed model coming from the licensee, we didn't go to the Idaho study at all.

MEMBER BLEY: Okay. But, you're effectively going to be -- would it be correct to say you're going to be filling the gaps that you just described as well as being more specific on the break locations and frequencies through the upcoming expert elicitation? Did I get that right or wrong?

MR. KURITZKY: Do you want me to speak to that, John?

I don't think, I mean this is the first that I'd actually heard of the Idaho work. I just wasn't familiar with it. I don't know whether or not our lead for the expert elicitation who is not here right now is aware of it. So, I would want that information fed to our panel.

We have some very specific things that we're having the panel look at. The extent that Idaho or anybody else has looked at these things previously want to make use of that information and we have provided them with a substantial amount of previous study information that we were aware of that we wanted them to consider. And this is certainly something that we might want them also to take a look at, too.

But like I said, it's not intended to fill any specific gaps in any previous study. It has a very specific statement of work and items that we want them to address.

CHAIRMAN STETKAR: Alan, are you planning to address the interfacing system LOCA in more detail this afternoon or is this our opportunity to discuss that topic?

MR. KURITZKY: No, the ISLOCA will probably be up but the only thing I'll mention later is that we'll probably have a future meeting focused on expert elicitation for which ISLOCA would be a main topic. So, this is the chance for today.

CHAIRMAN STETKAR: Okay, then let's make

sure that the Subcommittee understands at least what the expert elicitation will be addressing.

MR. KURITZKY: Okay. It's primary thing is to address the frequency of ISLOCA. However, we also are having them look into, depending on, again, some of it's going to depend on resources and time, but we want them to also look at break location and break size.

CHAIRMAN STETKAR: When you say frequency of ISLOCA, can you be a little more explicit on --

MR. KURITZKY: Specifically for failure mode where we have large reverse leakage through series check valves or MOVs.

CHAIRMAN STETKAR: That's what I wanted to hear. So, that's what they're going to be primarily looking at? The problem is they're using a beta factor model for beta times, valve failure and this expert elicitation panel, I believe, is going to focus on that which is not necessarily what we just heard.

MEMBER BLEY: That's true and I guess many years ago, alternative models were laid out for the issue that was just described. And one looked at little bits of leakage and tried to extrapolate that to large leakage.

Another went back to the valve

manufacturers and had them talk about how you could get this kind of leakage.

And clearly, the mechanisms for minor leakage are very different from the mechanisms that would effectively lead to the disappearing rupturing or something like that.

And at least to me, the extrapolation from small leakage to a completely different physical phenomena didn't make sense.

The other approach makes sense to me and one of the manufacturers and people who were involved in valve design and testing said they've had such failures but almost -- no, I think not almost -- even through the petroleum industry, all of those had been in testing when they found they had bad forgings and none of those valves got out in the real world.

So, I hope you consider the physical mechanism as well as the mathematics.

MR. KURITZKY: Yes, by all means. I mean that's -- and you've made that comment in several of the meetings and we've taken that to heart. We are quite aware of that.

A few points I'll make, there is data for large leakage of reverse leaks and check valves and MOVs, so it's not that we just have to take data for small leaks and extrapolate, there is actual data out there. It's not substantial.

Even more so, when you go to common cause failure because there's virtually no data on that. I think there's one event in the database for some multiple set of components over a greater population that resulted and so that's the whole genesis for the expert elicitation is that we're basing it on a very suspect operational database.

But nonetheless, we are aware that the mechanisms are often times different and that's why the panel is being stocked with people who understand valves, understand pipes and the mechanics, the systems of it.

The comment we have I think only one person on the panel who's actually a common cause failure person who I would kind of, even that person necessarily can be just the mathematic, but it's more than mathematics because the valve and pipe people are not going to be necessarily mathematics peoples, they're going to be physical failure mechanism type people.

So, I think we have a good set of people that are going to be on the panel.

MEMBER BLEY: Well, we look forward to seeing the results.

MR. KURITZKY: Yes. But we take -- and I appreciate the identification of this Idaho work because, again, I personally wasn't familiar with it, maybe others are, but I just want to make sure that that information is passed along to the team. So, thank you.

Okay, moving to internal fires. Right now, we have an initial Level 1 internal fire model. However, we recognize already that there was a number of areas of that model needs work.

One of the principle areas is in electric cabinet fire modeling. There's a number of reasons for that. The model we have involved some of the assumptions and modeling choices that have not passed the muster with NRR in terms of NFPA 805 applications involving the severity factor for cabinet fires, heat release rates from the cabinets, propagation of fires from one cabinet to another. So, those are areas that we need to look into a little bit more.

Also, in the fire frequency area, the apportionment of cabinet fire frequency amongst the cabinets is an issue that we need to look into a little more detail.

The initial model that we have does not credit use of the remote shutdown panel because the licensee model from which it's adopted from did not feel the need to credit that. However, given that some of the changes in frequencies and other modeling, we don't know for sure whether that -- well, we might be being excessively conservative if we don't allow credit for it so we need to do another look into that.

Also, the HRA for the fire PRA, there's data adapted from the internal event HRA with various modifiers to deal with the context of the fire and the conditions of the fires.

Since our HRA -- internal HRA differs from the licensees for internal events, we can't adapt our fire HRA from their fire HRA. We have to go back and adapt it from our internal event HRA. We already know we have a lot of problems in our controlled event HRA.

So, now we're stuck with the decision to go forward with an initial fire model based on a flawed internal event HRA that is adapted to fire or put the thing semi to the side and wait for the revised internal event model to be completed or at least the HRA portion so that we can then go forward with the initial fire model using the corrected internal event HRAs. So that's something that was --

CHAIRMAN STETKAR: Do you have any sense at a global level how important the operator actions are to the fire results? You know, using the current numerical values?

MR. KURITZKY: I don't and even if I had the fire person here today, I wouldn't have them venture a guess because the numbers are so -- we have some very internally inconsistent values in the fire HRA right now because of the mixed bag.

You know, we actually have HEPs from the fire that are lower than the HEPs from internal event because the fire ones came from the licensee's model and ours which --

CHAIRMAN STETKAR: No, but I mean just given the -- if you looked at the fire results only, given the -- what's in there are the licensees HEPs, right?

MR. KURITZKY: More or less.

CHAIRMAN STETKAR: More or less?

MR. KURITZKY: Yes.

CHAIRMAN STETKAR: Do you have any sense of -- I mean --

MR. KURITZKY: Unfortunately, I don't.

CHAIRMAN STETKAR: Okay.

MR. KURITZKY: I don't. I don't get the impression that it's a tremendous contributor, but it's unlikely to be a noncontributor also.

CHAIRMAN STETKAR: I mean obviously it's got to be done consistently.

MR. KURITZKY: Right. So, anyway, that's an area that we've got to do more work.

And the scheduling package is one of the things we have to weigh in in deciding how to go forward.

The final model will be correct, it's just a question of what we want to do in the initial model.

Okay, to help resolve some of these issues, we're planning to take another trip down to the site to walk down some of the fire areas to try and come up with a resolution for some of the issues I just mentioned.

We cannot go back and do a complete fire analysis essentially by getting rid of those fire -- the simplifications of fire modeling assumptions and try and do it all more completely ourselves because they don't have the resources to do that.

So, we're actually trying to look at some way of prioritizing the key scenarios and seeing if we can come up with insights with some more walk downs that will allow us to extrapolate to some of the other scenarios and at least get, you know, a good enough answer to go forward.

Also, we'll take that opportunity to do

some interviews with operators to help resolve some of the other issues that are on the list.

CHAIRMAN STETKAR: Does your electrical cabinet fire frequency use the EPRI one-size-fits-all electrical cabinets? So, a 6kV switch gear is the same as a 24 volt DC INC cabinet?

MR. KURITZKY: I don't know and I don't -- I think the person -- we don't have a person here to answer that, but I do know one of the main issues is that -- well, there's one approach if you take all the -- count up all the cabinets and you have a cabinet failure fire frequency and you apportion it amongst all the cabinets.

But there are what I call well sealed cabinets for which --

CHAIRMAN STETKAR: Yes, but that's how much of that cabinet specific frequency gets out --

MR. KURITZKY: Right.

CHAIRMAN STETKAR: -- you know, to damage other things. I'm talking about the actual cabinet specific fire, you know, frequency per cabinet.

MR. KURITZKY: I don't know.

CHAIRMAN STETKAR: Okay.

MR. KURITZKY: I don't know what the --

CHAIRMAN STETKAR: I was just curious

whether you'd -- you don't know that you've departed from the NUREG/CR-6850 or the EPRI database?

MR. KURITZKY: No, and again, because we have leverage in the previous licensee model, you know, I'm not sure what --

CHAIRMAN STETKAR: And they probably used that approach also I would guess.

MR. KURITZKY: Right. Now, those areas that we find to be particularly -- we have a hard time defending those are the ones we're trying to look at some kind of --

CHAIRMAN STETKAR: The only reason I brought it up is this first bullet is the bullet that a lot of people are struggling with even in the FP 805 arena.

And my opinion is one of the reasons that they're struggling with it is that they're using a composite model for fire frequencies that isn't necessarily supported by actual experience. It's somebody at one time back in the early 2000s said every electrical cabinet is about the same so we'll just calculate cabinet level fire frequencies.

I've looked at a lot of plant specific data and that isn't true.

MR. KURITZKY: And you said NUREG 6850?

CHAIRMAN STETKAR: NUREG/CR-6850 has one category, it's called Electrical Cabinets. They have high energy arcing faults. But electrical cabinets is anything that ranges from high voltage switch gear down to the lowest voltage I&C cabinet. There's no distinction.

And the EPRI database, and in fact as far as I know, more recent updates to the EPRI database has kept that notion so that frequency of fires in motor control centers is apportioned among everything, the frequency of fires in I&C cabinets is equally apportioned in anything.

I think frequencies for some types of cabinets, if you want to call them that, are probably underestimated and frequencies for others are probably overestimated.

But I was just curious whether you've looked at that at all because I haven't seen -- everybody nods their heads to saying yes, people should look at that, but nobody seems to be interested in doing it.

MR. KURITZKY: Yes, without knowing for certain, I would venture that we are not -- we have not veered off from NUREG/CR-6850. So, if they're using a one-size-fits-all, it's likely that our model has that also.

CHAIRMAN STETKAR: Did Vogtle do any type of basing in updating?

The other things I've seen people do is take at least that generic frequency and say, here's my plant specific evidence. I have, you know, 10,000 cabinet years for low voltage cabinets with zero fire events and do -- at least do a basing update to distinguish among the different categories of cabinets.

MR. KURITZKY: I don't know the answer to that question.

CHAIRMAN STETKAR: That won't solve the whole problem, by the way.

MR. KURITZKY: Right.

CHAIRMAN STETKAR: But it's part of it I think.

MEMBER SCHULTZ: Alan, could you describe what is going to be done in more detail with regard to the site visit? Is the intention to come to a consensus or a joint conclusion related to how the HRA modeling and quantification should be done?

It sounds as if there are differences of approach and quantification between what Vogtle has done and what the staff has traditionally done.

And so, is the intent to come to an agreement as to how this project should move ahead?

MR. KURITZKY: Are you speaking specifically to the HRA or to the fire modeling in general?

MEMBER SCHULTZ: To the HRA.

MR. KURITZKY: To the HRA, I think HRA there is an approach in NUREG/CR-6850 about how to do the fire HRA. And I think we're going to be fairly consistent -- we would like to be fairly consistent with that approach.

However, again, we don't have the resources to go do the HRA from scratch. We're leveraging what the licensee has done. And what we're going to do is do some operator interviews.

What happens is we can -- going back to what I said before, the fire HRA is going to be based on the internal events rate, standard practice. You have some adjustment factors.

So, once we have our own HRA for internal events, it's not going to match the licensees anymore. So, therefore, we can't just take the fire HRA from the licensees PRA we have to kind of do our own.

But the information you know about in the context of the fire scenarios in order to go from the internal event to the fire HRA, we're not going to have all that information.

So we need to go back is try and find as much of that information as we can. We're never going to get all that information to do the entire thing but the idea is just consistent with actually the other fire modeling issues is to look at some of the more dominant contributors or the bigger human failure events.

Or, in the modeling case, different scenarios and see if we can understand how they're modeled, what differences there might be if we use a different type of modeling technique and see if we can use that understanding of the dominant contributors to extrapolate to some of the other ones.

If we can great, if we can't then all we can do is say here we've cleaned up this set of contributors, the rest of them, we know there's issues but there's right now that we can do about it. It's just a candidate for further work once we refine the model.

So, it's essentially going to be like that, looking at more of the bigger contributors, trying to get the information you need to improve the analysis and then see whether or not we can use that to extrapolate to the remaining contributors or whether we have to just caveat that we've only been able to fix this subset.

MEMBER SCHULTZ: And is the site visit also going to focus on the modeling associated with the control room abandonment scenarios, the use of the alternate shutdown?

MR. KURITZKY: Yes, I think some of the operator interviews and stuff is going to involve discussions of that. All these items on here I think, actually the fire figures, I don't know if that is necessarily a plant walk out issue, but the electric cabinet fire modeling, the MCR abandonment and the HRA are I think would be all the topics for that.

MEMBER SCHULTZ: And from what you said, the licensee didn't model that because they didn't feel it was going to be necessary to do so?

MR. KURITZKY: That would be my assumption. You know, if you're not going to model it, you typically figure that's just something was not a big risk contributor. And it may not be for us also, but since we were changing a lot of the other numbers around, we don't know that a priori and so we may want to take a look at that depending on what the initial results show.

MEMBER SCHULTZ: If you can, it would be

useful to incorporate that. As you said, it is part of the Rubik's cube that you described earlier.

Thank you.

CHAIRMAN STETKAR: Have you looked at -- I never look at dominant contributors because people have looked at dominant contributors and done whatever -- I look at the stuff that's not important because I typically find problems there.

So, when you look at your so-called dominant contributors for human actions during fire scenarios, if you looked at actions that have, for example, a high risk achievement worth, despite the fact that their human error probability might be minuscule, you might stumble across more problems than if just looking at the top 100 cut sets that have human errors in the fire model.

People have probably done, you know, to the extent possible using whatever method they use, as much as they can for those human actions, because they're trying to beat down those scenario frequencies.

The problems are typically down in the bowels of the models that you never see if you just look at so-called dominant contributors. And you might want to look down there.

MR. KURITZKY: Right. And it's a good

point. But when we talk about risk dominance, I mean based on the definitions from the standard, you're looking at things that either have a high raw value or a high --

CHAIRMAN STETKAR: As long as you're looking at those high raw values, that's my only point. If you're just looking at the important cut sets or sequences, you're not going to necessarily pick up things that are happening down in the bottom, you know, multiple series parallel actions treated independently or something like that.

MR. KURITZKY: Right. And it's a good point, but we are going to be looking at it from different directions.

CHAIRMAN STETKAR: And from raw values, okay, okay, good.

MR. KURITZKY: The reality though, unfortunately, is that there's only a few that we're probably going to be able to actually go in detail to look at and so we're going to have to be pretty choosey about which ones we decide to pursue.

Okay, so I think -- so, in terms of the fire PRA, like I said, we have to go back down again in the spring and then we will probably end up -- we're hoping to have the updated model and documentation ready in the summer, though that's going to be somewhat dependent on our decision as to whether we wait for the new internal model before we complete the -- at least the first pass fire model.

CHAIRMAN STETKAR: Are we going to talk anymore about the fire modeling this afternoon?

MR. KURITZKY: No.

CHAIRMAN STETKAR: No?

MR. KURITZKY: That's going to be a separate meeting.

CHAIRMAN STETKAR: We've had some discussions in the past about now I'll talk about fire modeling rather than PRA modeling, meaning models for fire heat release rates or propagation or severity or whatever you want to call that stuff.

Are you planning to use only fire models that have been verified and validated in the NFPA 805 transition sense or are you using other types of fire modeling approaches?

MR. KURITZKY: Right now, the model has -- ones that are not necessarily approved in the NFPA 805 sense. That's the whole purpose of trying to go down there and adjust some of these things to see if we can do them somewhat different.

We can't -- we're not going to be able to do it across the board using approved methods because the base model does not have them and we don't have the resources and time to do that from scratch.

So, again, like I said, we'll try to adjust some of the more important scenarios and see how much we can extrapolate that to the other scenarios.

But I think we'll have to recognize that we will probably end up having in our fire cabinet model some scenarios as a minimum that are using some, if not more or all scenarios that are using methods that are not necessarily ones that NRR would approve for NFPA 805.

CHAIRMAN STETKAR: I personally have no problem with that as long as, you know, there's some reasonable technical rationale for those other methods.

You know, just because a particular method didn't get verified and validated at some snapshot in time doesn't mean that it's irrelevant.

MR. KURITZKY: Right.

CHAIRMAN STETKAR: But you said part of what you're going down there -- what does going to the site provide in terms of confidence of which models you should use for, I call it fire physics rather than to separate PRA logic.

MR. KURITZKY: So, some of the issues with the -- let me first preface this by I'm no fire modeling expert.

CHAIRMAN STETKAR: Yes, and that's fine.

MR. KURITZKY: Nonetheless, my understanding, some of the biggest issues with the fire modeling right now, things that have not been accepted by NRR for NFPA 805 deal with the propagation of fires out of cabinets and from cabinet to cabinet and to other equipment in the room.

CHAIRMAN STETKAR: Right.

MR. KURITZKY: And so, right now, the model that we're based on uses some fire severity factors and assumptions on number of fires that get out of the cabinets and number of, you know, what's the likelihood it would impact other equipment in the room. Those are the numbers that are running -- that NRR is having a hard time accepting.

CHAIRMAN STETKAR: Sure.

MR. KURITZKY: So, what we want to do is go take -- actually do some walk downs with fire experts to look at a number of these scenarios, number of the more important fire areas and compartments and get a feel for how likely fire are to propagate from the cabinet to cabinet.

Are there, you know, susceptible cables within X feet of the cabinet? Is the equipment far across the room? You know, just to kind of get the physical feel as to likelihood of propagation of a fire.

CHAIRMAN STETKAR: Okay, thanks.

MR. KURITZKY: Okay, so moving on to seismic events. Again, we have an initial first pass model for the seismic PRA. We did not have the benefit of the licensee's PRA model at the time because they had not completed it yet, but we did have the benefit of much of the information that they used which they provided to us.

The current model we have is based on the 2012 hazard curves and also on some initial plant specific fragility information that Southern Nuclear provided us.

In December we received revised updated plant specific fragility information so we are now in the process of reviewing that and assuming that we are okay with the revised fragilities we're going to re-quantify the seismic model using these new fragilities as well as taking this opportunity to update to the 2014 hazard curves since the NRC received, you know, more recent hazard curves from Southern just last year for Vogtle.

So, we'll have another pass at the seismic qualification. We hope to have that done in the spring.

One area that we still need to address is the relay chatter. The last most recent information we have on relay chatter was from back in the IPEEE days. Vogtle's seismic hazard has changed since then.

Southern has redone the relay chatter evaluation. We are now working with them to get a copy of that so that we can use that as the basis for looking into that issue.

MEMBER BLEY: Is that still coming or do you have that?

MR. KURITZKY: We don't have that, no that's something that we still having to get a hold of.

Assuming we are able to get that information, we do hope to have the new seismic model completed around the springtime parameter.

MEMBER BLEY: Have you planned that work out? The reason I'm asking this is there was some work, it was probably 20 years ago, in the Diablo Canyon PRA and there was work at Budnitz and there's -- his name I forget -- that laid the background.

But the key thing I'm getting at is 70 to 80 percent of the effort is in understanding the control logic diagrams and it's not in the mechanics of relay chatter. It's in what circuits can lock up with momentary contact and what can they do? Which means most of your work is going through those control logics to make sure you understand what things relay chatter can affect and what things they can't affect.

So, I hope that's on your plan. If not, you ought to give it some thought and you could look back at some of those earlier studies and papers that came out of them that'll highlight those aspects.

I can point you to some of that if you don't have ready access to them.

MR. KURITZKY: Yes, I would actually appreciate it.

I think that is stuff I know because we have done some preliminary looking at some of that stuff that Budnitz had done or at least -- because we had discussed even having Bob do some of the work for us, though it didn't work out at the time.

But, like I said, the licensee has redone the relay chatter analysis, so the ideal thing is to get their analysis, go through it, be comfortable with what they've done and be able to accept that. That's our one success path. Anything off of that ends up being problematic.

MEMBER BLEY: But if they are aware of the history and they have good control engineers who've worked on this and not just guys who look at the relays themselves.

MR. KURITZKY: Right, I'm with you on that if that's the case.

But anyway, if there are documents, though, that you can point us to, I would --

MEMBER BLEY: There are.

MR. KURITZKY: You can provide it to John.

MEMBER BLEY: There is several papers and I've been clearing out all my old stuff and I ran across this stuff those guys did, too. And I hope I can find it, if not, I can track it down for you.

MR. KURITZKY: Okay.

MEMBER BLEY: I'll pass it through John.

MR. KURITZKY: Excellent, thank you.

Okay, just a quick time check here. Okay, moving a little faster now.

High winds and floods, other hazards, we completed the high wind PRA. That was the only other hazard that we actually did a PRA model for. All the rest of the hazards, we did a screening evaluation and screened them all out except for seismic, of course.

The high wind PRA and the screening hazard evaluation were subjected to a peer review back in November. We have not gotten a formal report back on that yet but we do have the exit interview so we do know a good idea of what types of things that they identified.

Again, they felt that the wind PRA and the hazard screening were essentially, you know, state of technology, well-structured and technically adequate.

And again, they've identified a number of areas where, you know, they would like to see us do some more work or at least improve the documentation.

Some of those areas are -- well, one in particular is the wind fragilities because Southern had not done a wind PRA for Vogtle. We did not have any wind -- plant specific wind fragilities, so we were forced to use fragilities from other plants.

And there are a number of things that we can -- that were pointed out during the peer review, either areas where we could go to to get a better approach for looking at the plant specific wind fragilities or at least identifying ways to justify that the ones we used were sufficient for our purposes.

So, whether there is more work or just better documentation we need to do, that's an area that we have to revisit.

Another thing that we'll be doing is going through some of the other hazard screening and trying to beef up our technical basis for why we've screened some of them out.

I think in most of those cases, it's going to be more of a documentation thing than actual analysis thing. But we can't rule out the fact there might be a little more analysis for some of the hazards that needs to be done.

We also are having that work reviewed our technical advisory group and we are waiting to get the report back from them. Once we get their report as well as the peer review report, we'll go forward and start addressing the different items that need to be improved to get the essentially R02 version of the high wind PRA and the screening analysis.

Moving on to the reactor at power Level 2 --

MEMBER BLEY: You didn't exactly tell us how you -- you did a little bit, but how you received the results of the peer review. Do you think you got a really good review or are there things that maybe they weren't as good at that you need to have other people follow-up on?

MR. KURITZKY: I think for right now --

MEMBER BLEY: What was your opinion on that?

MR. KURITZKY: -- we've had peer reviews that were, I think, three different areas right now, the Level 1 internal flood model, the Level 2 internal flood model and the high wind PRA and the screening.

In all cases, I think we've had very strong peer review teams. I think the process has worked very well. I think it does a good job of verifying that the PRA processed used was a good one. And I think they do a lot of digging in various areas and they can come up with some very good detailed comments, particularly if you have a quality team which we've always had.

So, they've come up with a lot of good insight at a more deep level. It's never going to be a complete soup to nuts deep review because that would require -- that's not five guys in a room for a week, that's a long term effort.

So, there's obviously going to be things that they might not pick up on, as any peer review team may not pick up on. But I think by far and wide, I think we did an excellent job and we've benefitted, I think, tremendously from those peer reviews.

And, like I said, I can't say that everything that's wrong with our models, they wouldn't necessarily have picked up. That's why we also have the TAG, that's why we also bring stuff to the ACRS. That's why we're going to have more broad based stakeholder reviews later.

MEMBER BLEY: Were there any places you really disagreed with them?

MR. KURITZKY: There were a few. There were a few things where they had findings that we disagreed with. And again, because we're not actually submitting our PRA for a licensing amendment, you know, we don't necessarily have to satisfy every finding or, you know, fact observation that it comes out in peer review, though for our own purposes, we'd want to document why we believe we don't need to do anything.

In some cases we may disagree technically. Other cases, we may just state --

MEMBER BLEY: So where I was really going with that is, sometime could you give us a briefing on any significant areas where you disagreed and aren't taking their advice?

MR. KURITZKY: Yes, I don't know if it would be a whole briefing on that but we could certainly --

MEMBER BLEY: Yes, put it in one.

MS. DROUIN: I just want to add that it's more than just a week long visit. The peer review team spends a considerable amount of time before they come to do the PRA, the peer review, in preparation. You know, looking at the PRA, et cetera, looking at the plant. So, it's not just five days by five people.

MEMBER BLEY: They get to go to the plant, too, before they get together?

MS. DROUIN: no.

MEMBER BLEY: I've never heard that, okay.

CHAIRMAN STETKAR: Also in this case, the peer review team had the benefit or the constraint that theoretically a peer review had -- not theoretically -- a peer review had been done for the Vogtle PRA and they acknowledged that and looked at issues that came out of that peer review but didn't necessarily go back and reexamine the PRAs if they'd started off, you know, from day one.

(Simultaneous speaking.)

CHAIRMAN STETKAR: The peer report acknowledges that.

MS. DROUIN: They do sign nondisclosure agreements so, you know, they are given quite detailed information, you know, about the plant. And you know, we brief them on the, you know, on issues on the design and operation of the plant.

I just wanted to point out that it's more than just this one week five people showing up. It's a lot more effort than that involved.

MEMBER REMPE: Remind me who the technical advisory group is, aren't they internal NRC?

MR. KURITZKY: Yes, the internal advisory -- it's primarily the SLs around the agency that are experts in PRA as well as some of the related areas like severe accidents, phenomenology, seismic and structural.

MEMBER REMPE: Okay, so are they also looking at the results of the PWROG owners group peer review in this current review they're doing?

MR. KURITZKY: No, we're specifically not having them focus on that because we want their review to be independent of the PWROG owners group. I mean it's not that we're trying to shield them from anything, it's not like a grand jury that's sequestered and they can't know anything that happened.

But we want them to use their experience and their expertise to come up with their items when they look at the information, not -- we don't want them to tailor to the standard, PRA standard per se, or to what the peer review -- the PWROG owners would like to review. We want them to be kind of a separate body.

MR. KURITZKY: Okay. So, the Level 2 model, we completed the at power Level 2 PRA model for the reactor for internal event and internal floods. That was peer reviewed in December.

I think we have received the final or at least the initial peer review report. I think we have the initial -- the draft peer review report and we're just sending back comments to them on that.

CHAIRMAN STETKAR: Here's where the fog is really starting to set in. Did Vogtle have any Level 2 PRA model or did they just take it out to plant damage states?

MR. KURITZKY: They actually -- they have -- well, what was peer reviewed, they have the Level 2 model. They have a Level 2 PRA model.

CHAIRMAN STETKAR: And that was peer reviewed?

MR. KURITZKY: No, that's the thing. See, they have a Level 2 model but only the part through LERF had been peer reviewed. That was one of the reasons that we decided not to use their Level 2 modeling, we did our own from scratch.

CHAIRMAN STETKAR: So, this peer review and the peer review of the other external hazards that you've had are literally are rev zero type peer reviews?

MR. KURITZKY: Yes, yes.

CHAIRMAN STETKAR: Thanks.

MR. KURITZKY: Yes.

CHAIRMAN STETKAR: Okay.

MR. KURITZKY: They're not a delta peer review.

CHAIRMAN STETKAR: Yes, not a delta? Okay.

MR. KURITZKY: Okay, so again, we had that peer review in December. We have the draft report in. We were just in the process of sending back comments on that and we'll get the final report hopefully in the next month or so.

Again, they found that our process was essentially consistent with state of the technology and generally consistent with the trial use standard. There is no formal approved Level 2 PRA standard yet, we're one of the guinea pigs for going through that. So I think the process was beneficial from both sides.

We got some very good feedback on our model. They also got some feedback for the trial use standard.

Again, there were a number of areas that were identified in the peer review that we are now taking into consideration and we'll use to improve our model. We did not agree, going back to Dr. Bley's statement, we did not agree 100 percent with everything that was identified but though, by far and large, we have, you know, the comments are good and we are going to take action on them.

So between the peer review results, our technical advisory group is also in the process of providing us a review of the Level 2. We'll take both sets of comments as well as some internally generated comments or things that we already knew ahead of time that we need to improve and put them all into the hopper and work on the R02 version of our Level 2 PRA model.

MEMBER SCHULTZ: And again, that's an independent review by the internal team?

MR. KURITZKY: Yes, the TAG is an internal review.

MEMBER SCHULTZ: But it's independent?

MR. KURITZKY: And it's independent.

MEMBER SCHULTZ: Thank you.

MEMBER REMPE: Could you talk a little bit more about what the potential enhancement areas are?

MR. KURITZKY: Oh, sorry, yes.

In fact, I forgot to mention, no, that's right, I mentioned for the Level 1, but yes.

For Level 2, so some of the main areas are improving our MELCOR model. There's just things that we want to change since the first version.

We have -- there was an error in the first version, too, that we need to correct as well as some other things we probably want to improve.

We are also going to include -- we did not have uncertainty just distributions for a lot of the stuff in the initial model just like we didn't have them for all the Level 1 internal event stuff. So, we weren't able to propagate uncertainty, so we'll go ahead and get all the uncertainties information for the uncertainty analysis.

We also are going to incorporate pressure induced consequential steam tube rupture. Right now, the initial model only looked thermally induced consequential steam tube ruptures. We wanted to get the pressure induced in there also.

I'm trying to remember if there was -- also, one other thing was now we're going to take advantage of some more recent structural analysis for containment failure size that has occurred since we did the initial model.

And there's actually a kind of like a laundry list of things that we're going to be looking at. Don Helton, who's our Level 2 lead is maintaining a whole document database thing of all the wonderful things he's going to change for the Rev 2 model.

If you want to pepper him with questions when he comes up for the closed sessions, by all means, feel free. I offer him up as a sacrificial lamb.

Okay. Moving on to the Level 3 analysis, I'll just pick up this one, you're going to hear mostly about -- Keith Compton is going to talk to you about our MACCS work and Randy Sullivan will talk to you about our EP modeling, so I'm not going to go into much detail.

Essentially, we've completed all the advancements to MACCS that we needed to do for this project. The most important ones were prolonged release dealing with being able to handle prolonged releases, releases from multiple radiological sources and enhancing the EP model capabilities. And again, you'll hear more about that shortly.

We also used insights from the SOARCA study as well as some site visits and information from interviews with some of the off site response organizations down in Georgia and South Carolina to come up with improved evacuation models.

We also have put together an initial draft technical basis document to support all the information that's going into the MACCS, in to the consequent analysis code. And that will help ensure the transparency and traceability of the final results.

And we hope to have the initial Level 3 results for internal events, internal floods sometime in early spring. And again, Keith will talk more about that momentarily.

For low power and shutdown, the licensee did not have -- or Southern Nuclear did not have a low power and shutdown model, though they did start one a while back and stopped it after a short period of time. But they had completed a couple of tasks in that -- for that project and they provided that information to us which was a big help to us in getting our model jump started.

We are developing a new PRA model in SAPHIRE for the low power shutdown. We had the advantage of observing a Unit 2 refueling last September. We've developed operating states for the low power shutdown model, taking in to mind the integrated nature of the project with the dry cask and spent fuel pools.

And we are currently putting together the event trees for the internal flood low power shutdown scenarios.

We hope to have the initial model for

internal events, internal floods completed in mid-2015. One of the big issues that we're dealing with is trying to control the scope because it's easy if we don't carefully manage the scope within all the different low power shutdown evolutions, in plant operating states and accident scenarios, we can -- this can explode on us rather quickly so we have to pretty much contain what we're going to be looking at.

CHAIRMAN STETKAR: Well, but this is supposed to be a stay to the practice Level 3 PRA for all operating modes and all initiating events. So, I'd really like to understand why you're trying to do a Slim Jim version of the low power and shutdown.

MR. KURITZKY: I would not use the term Slim Jim version, though I do like Slim Jim's, don't get me wrong.

CHAIRMAN STETKAR: I don't.

MR. KURITZKY: I did as a kid, I don't know, I haven't had one recently. But it's when I left one on a napkin once and I came back later and it had shriveled up and the napkin was really greasy.

CHAIRMAN STETKAR: Yes, but they last forever.

MEMBER BALLINGER: It's a double entendre, though, because another word for a Slim Jim is what they use to steal cars.

MR. KURITZKY: Oh, okay, so anyway, I have one familiarity with that.

Anyway, we're not trying to do a slimmed down version per se, we are going to do what we feel is an appropriate state to practice modeling for low power shutdown.

CHAIRMAN STETKAR: In particular, I mean you mentioned plant operating states, fine, you know, you can do that pretty easily.

You mentioned event modeling, fine, you can do that pretty easily.

How are you accounting for plant specific human induced initiating events which requires an awfully detailed understanding about what they do during the course of an outage, operational and maintenance and testing types of activities? That's one question.

And the second question is, how the heck are you accounting for something that's really important which is a plant specific matrix that lays over the course of the outage unavailabilities of equipment due to maintenance?

MEMBER BLEY: Correlated maintenance.

CHAIRMAN STETKAR: Which could be highly

correlated and typically is. And that's very plant specific, you can't do that generically.

So, for example, in plant operating state five, is there a 90 percent probability that a good chunk of the plant is not there? Just because of the way Vogtle tends to manage their outages, which might be very different from another plant.

MEMBER SCHULTZ: And/or how much or to what extent does the licensee use their knowledge of PRA and the plant operating states and the likelihood of issues in managing their outage?

MR. KURITZKY: So, I was just about to give you my answer which would have about a 70 percent likelihood of being correct, but luckily Jeff Mitman has just walked to the microphone and can give you the one that would be 99 percent accurate. So, Jeff? Identify yourself, please.

MR. MITMAN: Jeff Mitman, I'm with NRR, however, I was on a three month rotation over to research and I did work on the Vogtle Level 3 project for shutdown.

Actually, we have a quite bit of an advantage here because Vogtle did supply us with a very detailed mapping of their POSes which, for the most part, are the POSes that we've adopted.

Equipment availability, the evolutions that they're going through, a quite detailed, it's a huge spreadsheet, very, very useful. So, that's a very useful resource to help us map through that as we plow through the shutdown modeling.

CHAIRMAN STETKAR: Jeff, you mentioned equipment availability, that oftentimes might be from an outage plan when they plan to do things. Experience has shown that the plans often are not followed and, indeed, the plans are typically pretty high level.

So, what I'm asking about is actual experience from the plant showing in, as a function of time, through the course of an outage, what equipment is out of service and how that is correlated. Do you have that?

MR. MITMAN: Well, again, the spreadsheet that they've given us looks at, if I remember correctly, one specific outage that they were actually working on as their input into their model that they stopped work on.

So, you're right, we have the plan. We also have information from recent outages of what they've actually done. So, we could go back and use actual outage information to put it into the model.

But you're right, you have to think about are you going to look at plans or actual outages and how do you deal with the variation between the two and that'll have to be worked through.

CHAIRMAN STETKAR: I was going to say, in my experience doing low power and shutdown, that's the biggest resource sink. It's not identifying the plant operating states because those are fairly standard. It's not identifying the event models because those are pretty straightforward.

It's the maintenance, the testing that done, the types of operations and testing, identifying human induced initiating events from that operations and testing.

And then you haven't even thought about doing fire analysis for low power and shutdown because the fire frequencies are very different and the potential propagation might be very different and the frequencies and the relative allocation of transient combustibles and hot work actions and personnel induced fires are much different.

So you can't just take a, you know, the internal event at power fire analysis and paste it in there.

MR. KURITZKY: And actually, that goes to the challenge that's on the screen right here.

CHAIRMAN STETKAR: Right.

MR. KURITZKY: The balancing scope versus available resources, when it gets to fire and seismic becomes even more challenging.

CHAIRMAN STETKAR: Seismic is not -- earthquake doesn't know.

MR. KURITZKY: Right.

CHAIRMAN STETKAR: But fires do know what state the plant is in.

MR. KURITZKY: Right, but nonetheless, there's a lot -- to do everything right is beyond what our resources are. So, we're going to have to be -- try to be smart about what we can and cannot address.

And so, we welcome the feedback so we know what things to focus on, if we were not going to focus on them already, we maybe -- I think we are going to focus on, but it's good to get that reconfirmed or open our eyes to new things.

But we've got to recognize the fact that we have a limited amount of resources for that part of the project. We want to do a state of practice job but because we're extending this out into fire and other hazards, we recognize that we are going to be under some constraints and we'll do the best we can to get the best product we can with the resources we have available.

MEMBER BALLINGER: How are you going to make decisions on that path? In other words, a certain sequence of events or whatever yields a certain probability of something happening, but then there's an uncertainty on that. So, how are you going to -- what figures of error are you going to use to establish the balance?

MR. KURITZKY: Well, I think essentially, we're going to try to use a risk prioritization scheme. So, we're going to look at the initial modeling, try to see which things we think are more likely to be risk contributors versus less and focus the most amount of resources on those that we seem to think are going to have the greatest amount of impact on the risk profile.

MEMBER BALLINGER: So, it's just risk, not risk plus uncertainty?

MR. KURITZKY: I would say -- I don't want to pre-say what the team is going to do, but I would tend to believe it's going to be more risk. I don't think -- I think, yes, if there's something that's very uncertain that could be a driver that will probably go into the decision making process.

But I think it's more just taking a look at what the baseline numbers are to get an idea of what looks to be the most risk significant.

So, I would say that uncertainty might be involved in the decision making, but the baseline risk numbers are probably going to be more influential.

CHAIRMAN STETKAR: Dong that will be a self-fulfilling prophecy because you will say, ah, everybody knows that mid LOOP operation is important so we'll focus on mid LOOP operation. I will tell you I've looked at many plants where mid LOOP operation was not the most important. It was bizarre combinations of stuff that was out of service during fires that people hadn't thought about.

MR. KURITZKY: Right, so --

CHAIRMAN STETKAR: And you didn't know that until you built the model and looked at the risk results and said, whoa, I didn't really think about that.

So, looking at stuff that people already know is the most important thing is simply a self-fulfilling prophecy, it is not risk assessment.

MR. KURITZKY: Right, and I don't think we're intent just to look at what we already know --

CHAIRMAN STETKAR: That's what you said, though.

MR. KURITZKY: -- In the studies. It's what we think is going to be risk significant.

CHAIRMAN STETKAR: How do you know that --

MR. KURITZKY: Because the reason of what's going to be risk significant has to use judgment and looking at the models. If there's things -- judgment can tell you that if I take -- if equipment A, B and C are all going to be out at the same time, or I look at the data from the plant, or I just happened to know what the design of the plant and see that A, B and C if they all off at the same time, they were allowed to be out at the same time and if that happens, that's going to be real problem for these types of scenarios.

That's part of the judgment, too. Now, are we going to be complete on that? Not nearly as complete as if we can model every single situation, obviously. But again, we have to be as smart as we can with what we know we be 100 percent complete --

CHAIRMAN STETKAR: Alan, my point is you spend 90 percent of your effort looking at those models for internal initiating events during full power operation and now when I hear you talking about modeling low power and shutdown states, you're saying, well, we need to be smart and we need to be able to pare down those models. We need to take a simplified approach.

Why? What is the risk balance there? How do you know that you should spend 90 percent of your effort on those internal events during full power operation and pare down the low power and shutdown stuff?

MR. KURITZKY: Okay, so we have not 90 percent of our resources on internal events. That's the first cornerstone piece of any expanded PRA project and so we want to get that as right as we can.

Our intention was not to spend nearly as much as we did on it, unfortunately, it's the way things worked out. We ended up going back and changing a lot of things. We ended up spending a lot more resources on it than we had hoped.

But it was not our intention that that was going to be the lion's share. In fact, that was supposed to be the minimal share. Of all the areas in the project, that was the one that was supposed to have the least amount of resources because we were essentially just going to leverage over the licensee's PRA. It is what it is.

But our intention was not to short change all the other parts of the project in favor of the internal event Level 1 model.

But, given that situation, there's going to be obviously some limitations to all the other pieces of the model. We're not going to be able to spend $5 million on every other piece of the model. We're going to have to be smart about what we focus on.

MEMBER BLEY: If you're going to be smart in this low power and shutdown piece, coordinated maintenance is where you've really got to be -- you've got to do that. That's where the risk is hiding.

MEMBER BALLINGER: What is your sanity check on the balance? You're saying we're going to establish a balance, so that means you're going to make some decisions.

So, once you've decided on what you're going to spend your resources on, is there going to be a review process? An independent review process that says ah ha, we think you've got it right? Or maybe you ought to think a little bit more about one area or another.

What's your sanity check? Keeping in, you know, consistent --

MR. KURITZKY: I want to get Jeff to -- but I just want to mention, in terms of sanity check, maybe not specifically that, but that is -- that thought should be inherent and implicit in all the peer review. We're going to have a standard base peer review to the draft standard for low power and shutdown. We'll have our TAG looking at these very issues and we'll have other broad based reviews that will be focused on these types of issues.

So, if there are concerns, they should come up in one or more of these various reviews.

But let me just give Jeff the floor.

MR. MITMAN: Jeff Mitman with NRR.

For low power shutdown internal events, setting aside fire for the moment, there is no intent when we were working on the POSes to limit the POSes. The POSes that we're addressing, that we're recommending to move forward with are about 15 POSes which are the standard POSes that come out of the PWR Owners Group recommendations and which were adopted by the Vogtle site on their preliminary work on shutdown.

As far as initiating events and human action initiated events, you know, my experience in shutdown the probably 60 or 70 percent of shutdown events are human initiated and the databases for initiating the frequencies capture that.

Now, the weakness of that is that assumes that they're random within the outage and, of course, they're not. You're lining up for a local leak rate test which are very time specific and that's very hard to capture and model and we haven't looked at that at any point yet.

As far as fire goes and how we would build a fire model, when I left the project back in December, we hadn't progressed to that point yet. So, I'm not sure we've gotten very far on thinking about how we'll build a fire model yet.

CHAIRMAN STETKAR: The fire model, I mean the equipment doesn't move around, the cables don't move around in plant just because the plant is shutdown. Holes are open in walls, doors are open, so propagation can be different.

The fire initiating event frequencies, the equipment doesn't care if it's a running pump, whether the plant is shutdown or operating. But all of those human induced fire event frequencies, change a lot and the locations where they can occur change a lot during an outage compared to power operation.

And I'm personally not aware of anybody that's collected a lot of data on human induced fires during shutdown conditions. So, you can't just take the at power, I'll call it the human induced hot work maintenance related, you know, those categories that are published in NUREG/CR-6850 and other sources and say, well, I'll use those frequencies during shutdown or I'll use -- and I'll use the allocation because the allocation is driven by containment. It's driven by reactor control and auxiliary building is another category, turbine building is another category, for example.

The distribution of the fires is much different if you look at actual operating experience. The frequencies of the fires are much different, not the equipment related fires, but the people related, people and transient combustibles.

Once the fire gets burning, the amount of the equipment that gets affected depends on what's out of service for maintenance, what's operating in the plant model. So there, you can use the information from the full power fire analyses because, you know, you already have that information about the cable routing and the equipment locations.

MR. MITMAN: In addition, I'm worried that -- I've always been worried that fires were under reported at outages because you have typically a welder and a helper and if something gets started, they'll just put it out and keep on going.

CHAIRMAN STETKAR: You know, I think that was probably the case many years ago. I think -- I honestly believe that you get better reporting these days because there is an enhanced sensitivity to fires.

There still might be the guy who stamps out some smoldering thing, but I think the fires, in my experience, they've been better reported.

MR. MITMAN: And a clear example of that is there's, you know, there's a lot of people in containment and they're working in containment and the at-power fires are completely nonrepresentative of shutdown fires --

CHAIRMAN STETKAR: Oh, sure.

MR. MITMAN: -- in containment.

CHAIRMAN STETKAR: Well, but in many locations.

MR. MITMAN: Yes.

CHAIRMAN STETKAR: Whether it's containment, auxiliary building, even in the turbine building, there's a heck of a lot of stuff going on out there that, you know, it's -- the human caused fires from power operation have very little, if any, bearing on shutdown, both the frequencies and the locations.

MR. COYNE: Kevin Coyne from the Office of Research.

Just a couple of quick points. We're not strangling Alan for resources on this area. I think the point of his challenge is valid. We're trying to balance it and so there isn't an intention to cut this to a minimum level. We're trying to get at the appropriate focus, so that is a challenge.

I'll also offer that, although the TAG is largely comprised of our senior level advisors throughout the agency, we do have two industry representatives on the TAG and one of those is a pretty well recognized expert in shutdown risk assessment.

He actually approached us out of his concern of us not messing up this part of the study so we're relying heavily on his input to make sure that we're appropriately balancing these things. And these challenges you're bringing up are good and both Alan and I are taking active notes. We really benefitted from Jeff's participation in the project in the fall.

But I just wanted to leave you with that thought. We do have some external help on the TAG with this area and we certainly aren't trying to strangle the resources, we're trying to do this in balance with the rest of the project.

MR. SUI: Nathan Siu, Office of Research, Chair of the TAG.

I just wanted to address Ron's point briefly about, you know, how do you know what to look at.

The TAG is actually planning on providing input in those areas. I can't give you what it is right now because it has to be discussed, but certainly considering more than just risk, thinking about the four objectives of the project and how your choice of enhancements would address the specific objectives. I think it's something that we're going to comment on.

We're not going to give, I would guess, any quantitative tradeoffs, you know, at this level, you should do this or that. It's more in the way of principles and guidance.

MEMBER BLEY: After Kevin's comment about the extra competence you've added on to the TAG reminded me we've left the straight Level 1 stuff.

But the peer review there as I look through it, I didn't see any real HRA expertise on the panel. I saw one guy who's been through the training on using the calculator and the only good spot was at least one of them had been a licensed operator at one time which is a big help I think.

A little point of concern as we go forward when you get others of these constituted, it's probably a good thing to make sure you've got well represented unit performance side. Well, maybe you've beefed it up by who you have on the TAG.

CHAIRMAN STETKAR: The only reason that

I'm dwelling on this is that low power -- not so much low power -- shutdown risk may not be as low as you expect as far as a contribution to overall risk, especially when I look at releases out to the public because the containment may be open during a good fraction of an outage so you don't have the containment barrier.

You can also have interesting events depending on what's going on that involve both fuel in the core and fuel in spent fuel pool because they're coupled during some fraction of the outage. So the releases can get more interesting from that perspective.

So, there are reasons why you shouldn't necessarily cut too many corners in the low power and shutdown area in particular.

MR. KURITZKY: Yes --

CHAIRMAN STETKAR: And then we say completion of initial model in mid-2015, we're, you know, we're a sixth of the way through 2015 now.

MR. KURITZKY: Right. Yes, the -- all points well taken. I think to go back to what Kevin said, we're not -- I didn't want to give you the perception that we're doing a very slimmed down version here.

It's just that you can imagine, particularly when you start looking at fire, that there could be a tremendous number of variation combination scenarios with various equipment out for maintenance and different conditions and so, we have to be smart about how try to address the problem.

CHAIRMAN STETKAR: However, if you've already spent hundreds of hours looking at definitions of plant operating states, that is not the most efficient allocation of resources.

MR. KURITZKY: Actually, I don't think we've spent that much time.

CHAIRMAN STETKAR: I don't know how many you've spent, but my whole point is that a quick glance at refueling outage plan in a day or two will give you confidence that you've got, you know, miraculously 15, wow, plant operating states for pressurized water reactor is pretty standard. There isn't anything that they're doing that's funny.

Now, let's go take those resources and focus on things like correlated maintenance unavailabilities and when they do particular types of tests or operations throughout the course of an outage.

MEMBER BLEY: I know you guys are thinking about this stuff because you manage it, but the one thing that kind of strikes me is, the thing you thought would be smallest, you do first and it's the first thing done but as the first thing goes through a review and then you start responding to the review comments and all of a sudden more and more of the budget's focused on the thing you weren't going to spend as much time on.

Maybe you're going to get more comments on the other stuff.

MEMBER BLEY: And somehow you've got to restrain the effort on the first so that you've got room for the last.

MR. KURITZKY: We're aware of that, thank you.

But anyway, so again, I just want to make one final point that the power operating states, we did not spend a lot of that up front because we had that pretty much provided to us from Southern Nuclear.

CHAIRMAN STETKAR: I'm glad to hear that.

MR. KURITZKY: But we do take very good feedback on the idea to focus on the correlated maintenance because I don't know, maybe that was already something high on the list for my -- is the low power and shutdown team, I don't know. The lead's not here, but I'll certainly make sure that that information gets back to him.

Okay, moving on to spent fuel pool PRA, this an area that there was not too much progress since we last came in October.

Basically, we have a simplified MELCOR model that we put together for accident sequence timing. We're putting together a more detailed model right now that we'll use for the accident progression modeling and for source term characterization.

We're continuing to do some sequence development for the large seismic events but the primary thing here is that the team leader who also happens to be our team leader for the Level 2 PRA is essentially double booked on this project, although on other responsibilities with the agency so, we've just been making very minimal progress at this time.

MEMBER BLEY: Quick question. I think at some point you froze the design for analysis. But as things stretch out now and the spent fuel pool may stretch more and more, by the time you actually dig into the analysis for real, the fix is a result of the Fukushima directives are probably in place, you know.

Are you going to pick that up as you go?

MR. KURITZKY: No, we are not. We have very specific rules as far as what will be included in the model because of how long this bloody study takes. And certainly if things are in place at some point before the model is placed or shortly after, those will be candidates for additional sensitivity look or further work but it's not going to be part of the base model.

CHAIRMAN STETKAR: I think that makes sense. I mean they have to have some --

MEMBER BLEY: I want to know what they're doing.

MR. KURITZKY: It will never end.

MEMBER BALLINGER: Won't not including some of the really major things make the analysis somewhat irrelevant?

CHAIRMAN STETKAR: Right, and not thinking about things that they didn't include in the model that could make the risk worse would make it irrelevant. You have to start -- you have to have something that you can get your hands on or you'll never finish. They need to get a baseline --

MEMBER BLEY: At the same time, they have to, at the end say, here's what we analyzed, here's what's changed since then and here's what somebody needs to consider.

CHAIRMAN STETKAR: For example, if had

they taken credit for the Westinghouse zero leakage seals, they would have found that, oh my God, they shouldn't have taken credit for those things.

So, as time goes on, you learn things. You have to take a snapshot, get the baseline PRA, integrated baseline PRA in place and then say, now what do I understand given the fact that, you know, seven years has transpired since we froze that.

MR. KURITZKY: I like your optimism.

Anyway, dry cask storage --

MEMBER BLEY: How long are we actually at this point? I don't remember when this started.

MR. KURITZKY: I don't have a number but --

MEMBER BLEY: Go ahead.

MR. KURITZKY: -- we're making headway. We're making headway.

Dry cask storage PRA, here we are making good headway. We're continuing in the structural analysis at Pacific Northwest National Lab on the fuel and the multipurpose canister. We are doing a more advanced structural analysis than was done for the previous NRC dry cask storage PRA which was documented in NUREG 1864. Here, we're doing some additional analysis.

We're nearing completion of the development of the accident sequences that were shown to be big risk contributors in previous studies. We're also looking at other accident sequences right now to get back to Member Stetkar's point, you don't want to just focus on the dominants and we're looking at other sequences also.

In that same vein, we're doing a HAZOP to help identify other areas, other potential initiators and accident sequences or to at least confirm that we have all the important things accounted for.

We hope to have the combined Level 1, Level 2 PRA for the dry cask storage completed in the spring and because right now we don't -- there is no standard for dry cask storage PRA, we convened a workshop just last month, a PWR Owners Group led it, we hosted it.

And they were -- the focus of the workshop was to come up with a set of review criteria that are dry cask storage PRA and can be reviewed again. So I think that was fairly successful and I think they're well on their way to coming up with that document which should be ready in time when our dry cask storage period is completed and will be ready to move right into the peer review for that.

MEMBER BLEY: Any surprises so far?

MR. KURITZKY: For the dry cask storage PRA? There was one, but I was told I shouldn't mention it because we're re-looking at it and just in case it ends up not being true, it's like one of those things where they come up in there's something was faster than the speed of light but they don't want to report it yet because then it hasn't been reconfirmed by another lab.

MEMBER BLEY: I'll remember the next time. Well, I'll come back with the question again.

MR. KURITZKY: By the next time, we should have the answer for you by then.

Integrated site risk is another area that there's been minimal progress. The staff turnover has been a big issue here. One of the key people on the project has since transferred to the region which has slowed work there. The team lead also has been very heavily diverted to other activities, post-Fukushima activities. So, we haven't made a tremendous amount of progress there.

However, we are kind of retooling the team there and hope to start making more progress going forward.

Again, as I've mentioned before, we plan to use the risk insights from the single source models to focus -- to identify what we need to focus on because we're obviously not going to be able to take the full models for every radiological source at the site for all different hazards and jam into one SAPHIRE project.

But, we are focusing on the areas that we believe will be the bigger contributors to integrated site risk which is the dependency both from the human action point of view and the equipment point of view.

I do want to reiterate as I have before that from the equipment point of view, shared equipment is not a big issue for Vogtle Unit 2 because those units are very diverse.

However, the common cause failure group issue is something that's a bigger concern for us because there are some systems very crucial to plant response that have a lot of components in one unit.

But at Level 1 and 2 the nuclear service cooling water being an example. There are six pumps and eight cooling tower fans in each unit so we could have potential cross unit common cause failure groups of 12 or 16 components.

So, not only do we not really have data to support that type of modeling, even the methods don't not only go up to that number of components, we'll have to do some initial thinking there.

We are waiting for the single source PRA model results so that we can continue to focus -- identify what we want to focus the multi or the integrated site risk efforts.

We did have the opportunity to send a couple of people up to Canada last November. There was an international multi unit PSA workshop. We got some good information from that workshop and that has prompted us to start doing a literature review on more recent research being done primarily overseas and that information might be able to inform the approach.

We currently have the approach documented in Chapter 17 of our technical analysis approach plan, but that approach obviously can be adjusted if we find something very interesting in some of the more recent --

MEMBER BLEY: Who's doing most of that work?

MR. KURITZKY: I don't know. I don't know, unfortunately -- let's see, the person who led the -- oh, let Nathan -- you want to speak to that?

MR. SIU: Yes, I was at that workshop. This is Nathan Siu again.

The Canadians, of course, because of their plant design, they have focused a lot of attention to that. The French are also looking at it and there were a number of -- a few other countries.

There was a lot of interest in that workshop. It was almost standing room only.

MEMBER REMPE: So, what kind of insights from the workshop are prompting this literature review and what are the topics that are being focused on?

MR. KURITZKY: I thought Dan was here, he was hiding around the corner.

MR. HUDSON: Dan Hudson from the Office of Nuclear Regulatory Research.

Really what prompted the review is that when this project was initiated back in the 2011/2012 time frame, we took a look at some of the multi unit risk issues that we were anticipating.

There was some contracted work, we had an internal report that was produced by ERI and the idea now is since the overall -- the overarching philosophy of this project is to perform a state of practice PRA, we thought it would be worthwhile since while we were up at the workshop it was very clear that a lot of work has been done in the international arena addressing multi unit risk, that it would be worthwhile to take a moment and take stock of the work that's been done over the past few years and see what kinds of insights could be gained to inform our effort as we're moving forward.

So, that's really what prompted it. It was very clear that a lot of work has been done and I think we could benefit from taking a look at what kinds of insights have been coming out of that work in a systematic way.

MR. KURITZKY: Thank you, Dan.

Okay, moving forward to the path forward. So, where are we going from here?

2015 looks to be another big production year for the project. We have a number of things that we hope to complete this year.

Some of the upcoming milestones in the spring, as I mentioned in the previous slides, we hope to complete our Level 3 internal event, internal flood analysis.

We also hope to have the Level 1 seismic PRA completed in the spring.

And also, the dry cask storage combined Level 1 and Level 2 PRAs completed.

Later in the summer, we hope to complete the initial pass of the internal fire Level 1 study. Again, that's somewhat dependent on how we decide to address the fire HRA. But we do hope to have quite a few things coming to fruition this year.

We also are continuing to work with the PWR Owners Group to schedule more peer reviews. We're optimistic that we'll be able to schedule an additional four over the next 12 to 14 months.

In terms of schedule challenges, again, the big driver has been the availability of personnel. I mean we still are obviously there are certain key people on the project that we needed to make things move forward and they are obviously, their expertise is needed in other areas for the agency and so we struggle to keep them focused on our work. But we're doing the best we can to deal with that issue.

MEMBER BLEY: I know that's been hard. But one of your early goals for this project was also to train more junior people. Are you having any success in that area?

MR. KURITZKY: Yes, we don't have that on this. The previous presentation I think we had some of the clearer remarks. We actually feel very successful in doing that. We've managed to bring a lot of people in both young junior people who have gotten their hands into the PRA as well as nuclear people who have really taken a step up further in their PRA education and implementation. So I think we've done a very good job of that.

We've had people also coming in on rotations, some of the grow your own folks from NRR, NRO, whoever that program have come over to also work with the project and have immediately been helpful to our project as well as learning a lot themselves. So I think that aspect, that objective is moving in a very well way.

I also wanted to point out that we continue to benefit from the support of Southern Nuclear. I think as Kevin may have mentioned way in the beginning, they continue to give us tremendous support both in supplying information and giving us access to the plant and holding out hand down there to make sure that we get what we need and talk to who we need to talk to. So, that's been a tremendous benefit to us.

The PWR Owners Group also has put a lot of time and effort into running and doing these peer reviews for us. And so that's, again, we're very appreciative of that, it's been a big benefit.

Westinghouse and EPRI, I think also Kevin mentioned each of them have provided a member of our technical advisory group and so we're appreciative of that.

I also should take the opportunity to not just acknowledge the contributions from the external people, obviously internal to us, the staff, we've had great contributions from all three division in RES, from many of the other offices in the NRC have provided tremendous support to the project.

And our contractors have -- primarily Idaho National Lab and Energy Research, Incorporated have been tremendous contributors to the project.

Also Sandia National Laboratories and Pacific Northwest National Laboratories have contributed quite a bit as well.

So, we're appreciative of the efforts of all and only about 40 minutes, I think I'm done.

CHAIRMAN STETKAR: Anything more for Alan? If not, I'm going to intervene since we don't want to cut Randy off in mid-sentence or his first sentence.

Let's take a break, reconvene at 10:15. By the way, when you think about organizing the rest of the morning's presentation, we can come back after lunch in open session if there's some things that we need to finish up.

So, take a look at how much -- I don't want to necessarily short change your remaining morning sessions just simply because of the noontime cutoff. We can close it, you know, whenever -- at whatever time is appropriate.

But I also don't know how much you're planning to present in the afternoon, so take a look at the time management that way.

And we will recess until 10:15.

(Whereupon, the above-entitled matter went off the record at 10:02 a.m. and resumed at 10:16 a.m.)

CHAIRMAN STETKAR: We're back in session. Now Randy gets an uninterrupted opportunity to say whatever he wants.

MR. SULLIVAN: Well, I will -- actually Keith is going to be uninterrupted.

CHAIRMAN STETKAR: Oh, Keith is? Oh, I'm sorry. Never mind.

MR. COMPTON: I'm just stating being particularly uninterrupted.

Okay, good morning, my name is Keith Compton. I'm with the Accident Analysis Branch, Division of Systems Analysis Office of Research.

I did want to let you know where we are with the status of the consequence analyses and the short answer is that we're close to finishing, as Alan said, the analyses for the reactor at power internal.

And I wanted to do four things today. I

wanted to give an overview of -- a brief overview of some of the code development work that we've done that Alan alluded to.

Then I want to give a brief discussion of just kind of the environmental settings so that you have a context of what the region -- the characteristics of the region.

And then I'll step through each of the technical elements in the Level 3 analysis and just give you kind of a high level introduction of what our approach is for each of those technical elements.

And as we said, Randy is going to go into the emergency response in much more detail.

So, and then I'll close with just where we are and what our plans are.

So, as far as code development work, we've finished the code developments on the WinMACCS suite of codes to do support releases from multiple sources such as for more than one unit or, if you had simultaneous releases from a unit and it's associated spent fuel pool. This did involve changes not just to MACCS but changes to MELMACCS as well. So this code development work was spanned over a number of codes.

MELMACCS is the code, just as a reminder, that's a preprocessor code that leaves the MELCOR outputs and converts them into the form that MACCS is able to use.

We've also added some enhancements to model more prolonged releases. MACCS earlier had had some limitations on code variables that kind of didn't let you model things that were, you know, extended over the past several days and such, so we've extended some of the limits on variables to be able to model those.

We've added some abilities to more explicitly model those projections for modeling protective actions. That was necessitated because of the work on the prolonged releases. We need to make sure that we actually match the four day dose projections presentable in the early phase.

MEMBER BLEY: Let me slip in a question here. There are two things I'm -- one, I don't quite remember and the other one, I know we haven't talked about yet, at least I don't think we have.

I thought the last time that we got together there was still a little work that had to be done on moving from the Level 1 trees into the Level 2 analyses that you're talking about here. Has that been completed? Is that bridge intact or was there still work to be done there?

MR. KURITZKY: No, we have the full Level

2 output for that we used for those.

MEMBER BLEY: Okay, so that's already -- oh, okay.

MR. COMPTON: And I've got a slide coming up that I'll try to describe how we go from the Level 2 and map over to the Level 3.

MEMBER BLEY: Okay, I would appreciate that.

And the other thing I didn't see spinning through your slides real fast, are you going to talk about uncertainty in your Level 2 results anywhere in here?

MR. COMPTON: I'm not going to be doing any of the Level 2 results. I'm just going to be looking at the Level 3 results.

I'm sorry, I will talk a little bit about uncertainty on the -- I'll mention in kind of in passing. I don't have a special focus on uncertainty, but I'll mention a few of the things that we've done to have uncertainty in mind as we're doing the Level 3.

MEMBER BLEY: Okay, I would like that because I still haven't seen much in the Level 3 area that kind of uncertainty that's convincing to me.

MR. COMPTON: Okay, and yes, right now,

all I'll be able to do is maybe to point to some of the places that we've drawn to indicate that we do have places where we can get information on sources of uncertainty.

MEMBER BLEY: That'll help.

MR. COMPTON: But probably not a lot of detail, but as the questions that comes up.

And then the final thing that for code development, we've added some additional outputs with respects to get an idea of the size and scale of affected populations so that we have a better understanding because that drives a lot of results at the end. So, being able to understand how many people are affected in what phase and what areas.

So, we've added some of those capabilities to help us do better diagnostics.

MEMBER REMPE: So, on your protective actions or the longer releases, are these modeling changes that everybody's agreed to or are you -- how do you establish that what you're changing to the code is not just someone's idea? Has it been documented and people talked about it?

MR. COMPTON: You mean the changes for prolonged releases?

MEMBER REMPE: Yes, you mentioned you were considering protective actions because that you were doing longer releases you need to consider certain protective actions and I just am wondering what's the basis for making those code changes?

MR. COMPTON: I'll give a specific example. In earlier, the code was hardwired and had a seven day emergency phase. And the dose projection and the way the dose projection calculation was done is that if you exceeded your dose limit, by the end of the emergency phase, you would take whatever protective action, you know, you want to say.

Well, when you -- if you add the ability to have a much longer phase, you wouldn't do a dose projection going out and I can't remember what the limits are right now, but you wouldn't have a dose projection calculating dose over, you know, several weeks. You would still use the EPA four-day dose projection.

MEMBER REMPE: Okay.

MR. COMPTON: So, we decoupled the exposure period from the protective action exposure calculation. So does that --

MEMBER REMPE: Yes, so my concern about unbiased are unsubstantiated changes is not valid because what you're doing is just making corrections in separating the protective actions.

MR. COMPTON: We're trying to make the code a little bit more flexible to actually model what we think is actually right. We still have to defend what we end up choosing, but we're trying to basically make it a little less restrictive in terms of what we can do.

MEMBER REMPE: Okay. Thank you.

MR. COMPTON: Sure.

So, the environmental setting, just a few slides to give a background of the region.

This slide shows the population centers around the site. It's pretty sparsely populated. The closest large town is Augusta which is about 25 to 30 miles to the northwest.

The town of Waynesboro is a little bit closer, 15 miles southwest. It only has about 6,000 residents but it does have a fairly school population. It seems to be where a number of the schools are in the area.

And then just a few other kind of interesting population characteristics are the Savannah River site which is immediately across the Savannah River with 11,000 workers, 11,000 employees and the construction workers in the area of the Vogtle

Electric Plant which is a fairly large population which we placed near the site.

Land use and land cover, this is a -- the main land uses are agriculture and forestry, particularly in Georgia and then the Savannah River site across the river.

And again, this just kind of shows that the -- kind of in green are the forested areas and different colors of green. And I apologize for these very small -- I know these are not terribly readable, but it does give you a sense of kind of the general land area. The colored areas are agricultural and then up to the northwest, you see kind of the more urban areas of Augusta and Akin.

Just topography again, this is also a fairly flat area. This region is flat to low rolling hills. It is right across -- right near the Savannah River flood plain and there are some bluffs right across the -- it's separated from the Savannah River by bluffs that go down to the flood plain.

So, it's not a terribly complex terrain site. The reason for the topography is important is that if you did have some complex terrain characterizations, this doesn't seem to be a particularly complex site.

The overview of the MACCS input model, I'm just going to go over -- these are the technical elements that are based on what we have in the tap, they're based on the draft Level 3 standard. And I'm just going to go through each one of these in terms to tell you where we are.

Now, this is going -- radionuclide release, this is also the transition from the Level 2 to the Level 3 technical element.

Just a few points on this. We're using the inventory that we're using for the MACCS radiological calculations is the same radiological -- is based on the same origin runs that were used for the Level 2 analysis. So that we're using a consistent inventory that's consistent between the source term analysis and the consequence assessment.

The radionuclides that we're considering, they're the standard 69 radionuclide sets. Those have changed slightly over time. We didn't reevaluate these at this point because those are not expected to change.

Going forward in the dry cask analysis, that's something we'd have to pay a little bit more attention to, but for this analysis it's not -- we're going to use the standard approach.

With respect to the release points, one of the things that we've done is that we've just set a ten meter release height, physical release height for all the locations. And the basis for this that in the modeling in MACCS, when the material is released into the environment, it's pretty much immediately going to be caught up in the building wake in midst and there's a lot of uncertainty in the release points anyway so that rather than try to get very fine about the actual physical location of the release point, we just said take a ten meter release height for all the releases.

We do actually model plume rise that's associated with thermal or less dense gases, hydrogen, such like that. So, we do have a model for plume rise that if you do have a very hot or low density plume, you could get an elevated release from that.

Then as far as the transition from the Level 2 to the Level 3, the Level 2 team and, I think Don Helton is here if there are some questions on the Level 2 come up, but they identified a number of the -- they identified the representative sequences to represent the release categories and model them using MELCOR and then selected the MELCOR source terms that best fit within each release category and gave those to the Level 3 team.

And that's seen on this slide. Again, this is a fairly small font but I'm not going to go through all of this in detail, but just to give an idea of the mapping is that the release categories are overall on the left and their designators. So, those are the release categories that were generated by the Level 2.

Then the MELCOR analyses that were run and what you see here is the numbers on either the representative source term or candidate source terms give the designator of the actual MELCOR term. In other words, we'd get a 5D.PTF file that we'd analyze.

So, they took all their source terms and bended them and then selected one out of that group to represent the -- to actually represent the release category.

For example, a scrubbed ISLOCA with aux building failure, the representative source term is 5D, it could have used 5C and 5R1. And Don explained the logic for that and he's developed and documented the basis for that.

One of the things that we're doing in our analysis is that we are, at least in this analysis, as a sensitivity, we're going to go ahead and do a MACCS model for all the candidate source terms to verify that this is actually representative that shouldn't be broken up or that one is not more or less conservative than the other.

MEMBER BLEY: You're anticipating the output's going to look almost the same for any of those candidates source terms?

MR. COMPTON: We're anticipating that, right, because that's the basis for selecting the release categories. You do want to have things that all of which are very fairly similar. But we did want to go ahead and run these cases so that we can verify that there's not in fact something that we didn't notice from the off site consequences perspective.

This slide shows the typical annual wind rose at the site. And what it shows is the winds typically come from the southwest or the northeast.

One of the things, and this was a question we had had in an earlier ACRS meeting is the MACCS uses one year of weather data when we do our runs and the question had come up about, you know, how representative is that to do one year?

There are some good descriptions of the climatology, the regional climatology and the environmental report. The Vogtle environmental reports, there's a couple of those available.

There's also, because of the proximity of the Savannah River site, there's a lot of expertise that has gone into looking at the conditions on the Savannah River site. So, we've been able to read those documents and kind of verified the year that picked which is 1998 is pretty reasonable as a representative year.

MEMBER SCHULTZ: What's the reference to data recovery utilizing that as a feature of selection?

MR. COMPTON: Whenever we -- we're taking our data from hourly observations that were submitted in support of the early site permit. In any data record, you're going to have missing data for whatever reason, an instrument's out of service or has failed.

So, what you want to do generally is pick the one that has the least numbers and missing values so the data recovery rate is how many, you know, what percentage of observations you're missing or that compliment them on that.

MEMBER SCHULTZ: And the precipitation record was compared to what --

MR. COMPTON: The --

MEMBER SCHULTZ: -- to determine it was the best selection for this?

MR. COMPTON: What we found is that in

reading the reports for the local climatology is that this particular five year period of observations was unusually dry in the southeast.

So, you know, most of the year has had a fairly low amount of rainfall. So, we picked 1998 because it had a pretty high recovery rate and it had the highest rainfall. The logic being that's closer to the longer term average in the site.

MEMBER SCHULTZ: Thank you.

CHAIRMAN STETKAR: Back to Dr. Bley's question now. How are you accounting for uncertainty in that meteorological data?

MR. COMPTON: Right now, what we have, and this goes to right now, we're identifying sources of where we could do the uncertainty analysis.

We do have the five year period of record or the five years of data, so and we've developed a process to import that. We could run essentially all five. We could develop a met file for all five years.

CHAIRMAN STETKAR: But that's only five years?

MR. COMPTON: Yes.

CHAIRMAN STETKAR: I'm talking about the fact that the Vogtle site has existed for more than five years, so you ought to have site specific met data for longer than the five year snapshot that was used for the ESP.

And the last I checked, Augusta Airport has existed for quite a long time and it's not all that far away. So, you might have upwards of 50 or 60 or 90 years of data. I didn't bother to go back and pluck the Augusta data but --

MR. COMPTON: It's a matter of oversight.

CHAIRMAN STETKAR: I don't know how far back it goes, it's probably at least 50 years.

What I'm talking about is looking at variability. In other words you have out of the five years that you took a look at, you selected 1998 because you said you think it's pretty representative from the wind rose and, oh my God, that was a five year dry period so you picked the wettest of that particular five year snapshot.

Well, it doesn't give me a lot of confidence that that accounts for actual variability in that meteorology over a much longer period of time. Hence, Dr. Ballinger dug his way out of a cave to come down here from Boston,.

MR. COMPTON: Okay, I guess a couple of things. The, you know, right, I do understand that you can have more, especially over a longer time period, more variability.

The, I guess there's a few answers. One is that we could do --

CHAIRMAN STETKAR: It's a different sound, just keep going.

MR. COMPTON: Yes, I guess the -- I guess I would kind of go in terms of actual explicitly quantifying variability, I would say that you could kind of start with a single year and start working your way out.

The low hanging fruit would be to use the five years because that would not be a large level of effort and would give you some sense of variability. And it really, the answer is probably really going to come down to the trade-off of time and effort verses benefit.

So, going out to looking at other data sets or other years, going to the Savannah River site who may actually have some MACCS formatted data sets, we may be able to get some of those.

We could try to get hourly data from the site for a longer period of record. That takes a fair amount of time for them to get that information and put it in the format that we can use.

So, going to other sites -- so, the point is that we could do some of those things, we would have to --

CHAIRMAN STETKAR: But at least to sense of uncertainty. I mean you always talk about hourly data, so we have 8,766 on average data points per year. Maybe you don't need to look at hourly data, maybe daily data would be good enough. So you have 365 data points.

MR. COMPTON: Well, and we --

CHAIRMAN STETKAR: If you get a sense of extreme -- what I'm talking about is extremes. Have you, you know, have you captured the likelihood of extreme conditions that could affect --

MR. COMPTON: And that would be my --

CHAIRMAN STETKAR: -- those.

MR. COMPTON: Right. And that would be the next line that I would say is that generally since we tend to be looking kind of at -- since we average across the weather trials and we look across lots of weather trials, the fact that you may have a very infrequent weather condition that would -- is probably not -- it would be balanced by the low frequency. So we may not be -- the question would be how much would that weather trial change the actual results.

CHAIRMAN STETKAR: It could be important if, for example, the contributor to the release was wind damage to the site, for example.

MR. COMPTON: And that --

CHAIRMAN STETKAR: Or they're correlated.

MR. COMPTON: That issue of correlation is something that we've thought about, haven't done a lot in the reactor at for internal, but certainly by the time we come up to the high winds that that's exactly right.

Let's say in a hurricane, hurricanes happen at a particular -- generally a particular time of the year. So, a way that we might be able to get to that, I'm not promising we will, but we could get to that, it would be to do some kind of essentially biased sampling, looking at whether -- look at what the, you know, the sequences that are typical in the fall period would look like to see whether there's a change.

And I will point out that we do have -- in principle, we can go in and look and see what drives the tails of our distribution. Even with our one year data, we have enough variability within that one year to say, okay, we've got some, you know, high wind speeds, we've got some low wind speeds. We have some heavy rain, we have some light rain.

So we need to be able to get some sense of how much that would affect our results. So I think we can glean a fair amount from the one year that we have.

MR. SULLIVAN: Could I just add -- Randy Sullivan, NSIR.

Extreme weather is pretty much reduces consequences no matter what. If it's a slow wind speed, you know, you have a narrower plume and longer to evacuate. If it's a high wind speed, dispersion is good. If it's a hurricane, that's great because there's very high dispersion and heavy rain is good because you wash out many of the soluble nuclides.

So, I guess if you want -- if we do end up looking at extreme weather, the most likely outcome would be to reduce consequences which might be a good thing to do.

MEMBER SCHULTZ: But you need to be careful how you correlate that because the extreme weather event could happen on day one and the release could happen on day three. And the weather conditions could be completely different at that point in time.

MR. COMPTON: Yes, right. And that's why that actually, depending on how far and how detailed quantitatively we need to do, we need to be pretty careful because you're right, the release would happen in the aftermath of the event. So you'd have to kind of look at the weather X amount of time afterwards.

So, yes, so for right now, we're going to try just to talk to it and to talk about what the kinds of things that we could do and then see.

And then, again, given the context of all the other things, all the other variabilities and the other uncertainties, is it worth to go into this area or not.

And I guess the takeaway is that we have some resources to be able to do that if we concluded that that was necessary. It would just be the trade-off of the time that was needed.

MR. KURITZKY: And I think a general comment for the project as a whole, as the list of things that we would like to look at versus the list that we're going to get a chance to look at, this is going to be a much longer road and what we'd like to do is going to be much longer list.

So, it's going to be a lot of picking and choosing on what we think are the most things that have the biggest influence on the results using judgment.

But there's going to be a whole laundry list of things that would be good to look at if time and money --

MR. COMPTON: And we're trying to capture some of these and the issues and such like that. One of the questions that's come up is, you know, the impact of ice storms and so the idea is that, okay, maybe you can run sensitivity analysis, change certain parameters, use slower -- you can just slow the evacuation down, delay it and stuff like that.

So, we kind of capture that as yes, we could do that if we decided we need to. But for right now, for our base case analysis, I think it's be good to get a good understanding of what the base case looks like and then we can starting saying, does this look like it might be sensitive to certain characteristics.

MEMBER SCHULTZ: Given the challenge that you might have tried to develop a full evaluation of uncertainty associated with the weather, the sensitivity study approach would seem to be reasonable.

It would also would seem to be able -- you might capture a lot to do that experiment where you do a sensitivity of typical weather, different weather conditions and go ahead and run it as Randy said, if you will, you could learn a lot by doing --

MR. COMPTON: Sensitivity is --

MEMBER SCHULTZ: -- five or ten sensitivity studies and see how it impacted the result.

MR. COMPTON: Right.

MEMBER SHULTZ: The overall result.

MR. COMPTON: Right. And, again, since there are multiple overall things that we're calculating it's which of those might have -- in fact, some things may be affected significantly and other things may not be.

CHAIRMAN STETKAR: The problem is you can't do those sensitivity studies in isolation just looking at this. Because, for example, I mean Keith mentioned an ice storm. Ice storms tend to take out off site power. Loss of off site power tends to be a rather important contribution to core damage frequency from internal initiating events.

That part of the world, people don't move all that well when the roads are covered with ice and they're blocked with downed trees. So, you have this correlated effect that you can't just look at a sensitivity on delaying evacuation time because the roads are icy because the whole thing is correlated through the entire model.

MEMBER SCHULTZ: That's right, but that's why I think a sensitivity study would be the right thing to do rather than try to develop an uncertainty evaluation of weather and not correlating that with the event.

In other words, to do correlated event

evaluations, an ice storm, for example --

CHAIRMAN STETKAR: If that's what you mean by sensitivity study, I agree.

MEMBER SCHULTZ: Right, sensitivity --

CHAIRMAN STETKAR: But what I heard Keith saying is sensitivity study on changing delay times and evacuation without necessarily needing the entire analysis.

MEMBER SCHULTZ: Well, I was thinking of a practical example set.

MR. COMPTON: Yes, and I think the idea of running a sensitivity case where you kind of very carefully went in and said what parameters would I change, would I modify to reflect this particular characteristic and then how would I sample?

So, the important thing is, yes, that would be a very interesting analysis and designing it would be something that we'd have to put a fair amount of thought into data design and to make sure that we actually did -- that we could draw conclusions from it and not just kind of throwing in, you know, distributions and hoping that you get --

CHAIRMAN STETKAR: Preparation is important and the interpretation is important.

At least, even if you don't do it, Alan's taking copious notes over there, it's certainly something that you should address in the report, I would think, as, you know, whether it's nice or somewhere between ought to look at it and nice to look at it, some notion of that level of scrutiny, let's say.

MR. KURITZKY: One thing that is a focus for all parts of the project, and again, just to go back to my previous example, you know, you look at that Rubik's Cube, there's a lot of sensitivity studies that could apply to every one of those little blocks so the total for the project is going to be tremendous.

But I agree, the documentation is supposed to identify all potential sources of uncertainty, model uncertainty, et cetera. We may only be able to do a few particular studies within the scope of the project, but we want to identify all of those areas that are uncertain and which we know might benefit from it.

MEMBER BLEY: And what sensitivity studies could answer those questions I think is going to be key. What kind of correlations --

CHAIRMAN STETKAR: What kind of -- I mean, you know, things that we've learned is that correlations, whether you want to call them correlations or dependencies or whatever, tend to be interesting, let's say, in the context of risk. And that doing a sensitivity study on only a part of that integrated equation doesn't necessarily answer the type of question you might be looking for.

MEMBER BLEY: And I take Randy's point, or I certainly agree with that. But I can think of lots of cases in the past before we've done more thorough studies where we've put some arguments to convince us, of, gee, if we made these changes, here's what would happen to risk. And sometimes you get surprised.

There are things going on -- the exact phenomena you're talking about, we know that's true. But there are other things that are going on that somehow compound the situation.

And I think laying out the logic of what those might be, not every possible one, but --

MR. COMPTON: I'm just mulling over that there's some greater uncertainties in the EP model that might be more worthy of resources. But we'll get to those if we get to those.

MEMBER BLEY: Yes, I think that's --

MR. COMPTON: And then further, you would know this better than me, but if there's three days a year of ice on the roads, doesn't that lower the risk by in terms of magnitude?

MEMBER BLEY: Oh, sure.

MR. COMPTON: Well, and doesn't that put it in the realm of we don't look at it anymore somehow or not? Anyway, I would just throw that out for your consideration.

MEMBER BLEY: But one thing that caught a lot of people by surprise 30 years whenever we started doing this kind of work was maintenance.

MR. COMPTON: Yes.

MEMBER BLEY: You know, maintenance is good. You take stuff out, you're better off. And when we started saying the kind of argument you made, gee, if it's out for two days, that's a contribution unavailability that's bigger than the chance the thing just fails.

So, all of a sudden you start readjusting how you deal with it in a sense.

CHAIRMAN STETKAR: One ice storm a year of three days duration and, you know, I live in Arkansas and sort of get that, is not an insignificantly small number if it has a substantial consequences.

MR. COMPTON: And that, again, to me that's kind of the key is understanding some of these things you may think that they are very consequential, either not as consequential and you though. And there are other things that you might find that, hey, I thought this was really unimportant but it turns out that there was a cliff edge or something going on there.

MEMBER BLEY: And well considered sensitivities can help you understand that.

MR. COMPTON: Right.

Okay, just a few other things in keeping with this. We are continuing the process of sampling weather sequences. We have that comment suggesting that we shouldn't do weather sampling, that we should just run all 8.768 weather sequences so that we don't have to worry about sampling.

And computers are definitely faster than they used to be but we have -- because there's other parts of the model that end up taking longer to run, we're still a little worried that that may be computationally prohibited when you add it on to not just the dispersion part.

But again, this is the kind of thing that a targeted sensitivity analysis could be done to see what did I introduce any bias or anything in that.

Okay, transport and dispersion, we are going to be using the same dispersion curves that we used for SOARCA. Those were based on median value estimates from an expert elicitation that was conducted in the 1990s. I don't have the reg number memorized but there was a number of -- and this is going to come up in a few more slides -- back in the mid '90s there were a number of expert elicitations done on important parameters.

NUREG/CR-7161 turned those in to the ability to do parametric on certain analyses. So, we are, again, that goes back to there are sources of data uncertainty that since we're using those sources, we're using typically representative point medians. But, you know, you have those tools available.

We also looked at a number of different curves available both in NUREG 1150 in an earlier report, there's a number of parameterizations for dispersion that you can represent.

We did just a quick check on a number of different representations and saw that across a broad range of outputs, you're typically within a factor of two or so, plus or minus a factor of two. So, and the number that we're using is kind of in the middle. So, we did look at the idea of taking something that we don't think at least is an outlier.

We're also using a time based dispersion model which essentially after you get more than 30 kilometers beyond the site, it's a very simple approach and that had been recommended by Steve Hanna.

We also had to make some judgments about the estimation of surface roughness which affects both vertical dispersion and dry deposition.

Just to right here, this curve shows how deposition velocity changes the function of particle size. MACCS uses for dry deposition ten different particle size bins. But that curve will shift, depending on the surface roughness that essentially the turbulence gets generated and the wind speed.

So, and unfortunately, the correlations that we had only go up to the surface roughness of about 60 centimeters, they don't go beyond that and then a typical forested area might use something in the neighborhood of a hundred centimeters of surface roughness.

We are doing some work right now to redo those correlations so that they'll go out a little bit further. But there's still, even in that case, there's still a certain amount of judgment that needs to be used in setting these variables.

And again, we do have the benefit of a lot of work has been done at the Savannah River site which also use MACCS analyses, so we've been able to review some of those documents and where they made recommendations. They're not for the same kind of analyses, so you have to be a little bit careful, but at least they have a lot of discussion that you can glean useful information from.

For the protective action and economic factors, this technical element covers both short and long term protective actions and it also includes factors -- parameters related to defining your populations, defining exposure factors, breathing rates, things like that.

A lot this work has been developed by Sandia National Labs in support of this project. We based the population distribution around the site on Census data and then adjusted it for transient or special populations like the Savannah River site, like the Vogtle workforce, like the schools cohort.

I'm not going to talk about the emergency response because Randy's going to be talking about that, but we did look at the values for exposure factors and shielding from past studies and checked to see whether these seem reasonable to use. So, with some slight updates, we're using values past studies.

And using those values and then trying to be clear about what the technical basis for them actually was so that the reviewer can assess, you know, is this a reasonable approach to be used or not.

We are modeling the effects of food and water injection. We've updated the parameters for agricultural countermeasures to be more consistent with FDA guidance. And one of the results of that is that the MACCS model introduction to agricultural countermeasures both in the year of the accident and in subsequent years, one of the results of this is going to be probably the lowering the value that's used in the first year. It's going to result in more widespread food interdiction in the year of the accident.

CHAIRMAN STETKAR: What's the City of Augusta's water source?

MR. COMPTON: I do not know. I can find that out.

MR. SULLIVAN: I don't either, pretty far away, 25 miles away at the least.

MR. COMPTON: The water model is based on the model developed by John Helton. It's a fairly simple model of deposition on surface -- deposition to wash off into surface water bodies. But again, that's -- yes, I can check and see what that is and whether that's worth something that's worth considering.

CHAIRMAN STETKAR: I was just noticing there's a -- I don't know the Augusta area and it seems to be a big lake within the 30 mile radius of the plant northwest of Augusta.

MR. COMPTON: There are reservoirs and such in that area but I'm not sure what the actual drinking water source is. It wouldn't surprise me if the reservoirs were drinking sources.

MR. SULLIVAN: Are you thinking that's worth chasing?

CHAIRMAN STETKAR: I don't know, I was just asking. I mean I don't know how you're --

MR. SULLIVAN: It'd be disbursed and then we're going to give people microrem and we're going to chase that?

MR. COMPTON: I can look at it and get a sense of - those doses typically, food and water ingestion doses on a collective basis typically are not that high as a contributor to, you know, overall dose, but they're there. They can be essentially if you condemn an area and so that, therefore, there's no direct exposures then. So, but again, that's something we can look at and just kind of see whether --

MR. SULLIVAN: This is a topic that's dear to my heart where I am sort of a minority opinion.

I met with the South Carolina people, they told me they're going to burn anything that's contaminated. Nobody's eating contaminated food.

I'm trying to kick off a study to look at that nationally and it's taken nine months to issue the contract, so I guess we're down here with the FDA limits. But, from allegorical information, nobody's eating contaminated food.

MR. COMPTON: Okay. The modeling of protective actions considers impacts both on dose reduction as well as the costs associated with protective actions. And for the longer term protective actions, we've been leveraging some ongoing work on updating values for the effectiveness and costs of long term protective actions such as decontamination time periods and costs and effectiveness.

One of the things that we're doing in this analysis, we are explicitly including an intermediate phase in our modeling which is a period of time after the emergency phase where planning is undertaken and before the clean up begins.

Our model assumes that people would be relocated for the duration of the intermediate phase if they were to exceed the first year pack.

So, we did have to do a little work to -- or Sandia did a lot of the work to provide some recommendations on exactly what the right way to model those longer term protective actions.

CHAIRMAN STETKAR: Does Georgia and South Carolina have similar guidelines?

MR. SULLIVAN: You know, the EPZ in South Carolina is very, very small so it's mainly Savannah River we're talking about.

CHAIRMAN STETKAR: Okay, okay.

MR. SULLIVAN: And Georgia is a standout and that they don't believe in KI as a protective action and have never implemented that correctly in the opinion of many.

So, in that sense South Carolina's -- we involved South Carolina when we're talking about evacuating beyond the EPZ. We thought it was respectful to meet with them and let us know this study's going to show that sort of thing. And we had an interesting interchange with them. Quite competent bunch. You know they have other nuclear plants --

CHAIRMAN STETKAR: Yes, yes.

MR. SULLIVAN: -- than they're working on.

CHAIRMAN STETKAR: Okay.

MR. SULLIVAN: So, yes, it's similar, however, with regard to the EPZ, there's not much in South Carolina.

CHAIRMAN STETKAR: Not much of interesting data.

MR. SULLIVAN: And hence, it's not similar in that respect.

CHAIRMAN STETKAR: You're accounting for whatever -- well, I don't want to steal your thunder, you'll get it.

MS. SULLIVAN: There's little thunder. There's very little population there, but we do model beyond --

CHAIRMAN STETKAR: But there must be something in place for Savannah River.

MR. SULLIVAN: Oh, yes. We modeled Savannah River totally.

MR. COMPTON: Okay, for dosimetry and health effects, we haven't done a lot with dosimetry and health effects relative to SOARCA. We're pretty much using the dose factors developed for SOARCA and health effects parameters.

And again, those are -- there is information from the expert elicitations done in the '90s that have some, particularly for I think for some of the acute effects that have some sources of information on what you're ranges could be. So, by pointing back to that, we've got a -- it allows you the option to look at that.

CHAIRMAN STETKAR: Again, in terms of uncertainty, are you going to look at different types of dose effect models?

MR. COMPTON: We're planning to run --

CHAIRMAN STETKAR: You know, kind of like E versus different types --

MR. COMPTON: We're planning to run different dose truncations models. At least LNT and HPS probably also a Ten MR per year dose truncation.

CHAIRMAN STETKAR: You're planning to run that explicitly?

MR. COMPTON: Yes, that you can actually -- and that is an example of one of the things that really slows the computer down that When you use that particular you've got to be careful with that because those things do take a long -- can take a long time to run. So, but yes, we'd look at it.

Those provide particularly useful information in understanding what dose bands your effects are coming from. In other words, are your doses coming from only from the high doses, only from the low doses, kind of from the midrange and, again, a well designed set on those and looking at different output measures allows you to really get a sense of how do you -- what's driving the particular effect.

CHAIRMAN STETKAR: But in the sense of -- what I'm trying to get is in sense of the project, you are planning on explicitly quantifying those factors, you may call it and presenting them in the results as opposed to a qualitative discussion of well, we could look at this, you know, the previous discussion about meteorology and extreme weather events and things like that which you may not actually quantify.

MR. COMPTON: As I said, we'll have at least one -- and again, and I'll get to this in actually the next slide is that there's going to be a certain amount that we'll be computing and available as a resource and then, as you get kind of higher up in the documentation, there'll probably be less and less that you're explicitly reporting.

But part of that is based on we may do more calculations maybe using more than one truncation level but then, based on the results of that, we may say, hey, for this particular output, we're going to use this measure to report because we saw that it did make a big change.

MR. KURITZKY: The philosophy for the project, there's going to be certain things that the various teams -- there are going to be sensitivity studies that the team leader feels is intrinsic to their work that they're just going to run on their own.

So, there'll be a suggested list of all these things and as a project wide, we have to make it allocation resource and decision on late in the project.

But as these various pieces are going through, there's going to be certain things that are just so intrinsic, but say that they are felt to be so important that that team is going to do those things on their own.

CHAIRMAN STETKAR: So, what I'm hearing is Keith's team will have that information available. How that's reflected in the final report will be --

MR. COMPTON: That's one of the sensitivities that we just -- we're going to do at least that.

CHAIRMAN STETKAR: Okay.

MR. COMPTON: At least that one because it's officially --

CHAIRMAN STETKAR: Good.

MR. COMPTON: -- high level that I think very few people would argue against it.

One other thing on the dosimetry and health effects, although we're using the same essentially values, we are trying to -- we're leveraging some work on trying to explain the process used for that element better.

And, you know, it is a fairly involved process to derive the dose conversion factor file and a lot of the actual work ends up -- is done before you get to the MACCS input parameters. We're trying to describe that a little bit better. So, in this area the improvement is more in the traceability.

Output control, we did spend some time -- we put some thought into structuring the MACCS output files. Again, it's worth pointing out that the MACCS does not have a default output. You have to tell the code what outputs you want and you have to tell it what output you want at which location, how you want a report.

So, basically, you have to consciously decide, unless you use kind of the default approach, you actually have to consciously decide. We did spend some time trying to think about what outputs we want.

And this goes back, again, to this tiered ideas that we may compute more things at the lower level to help us understand and then we're not going to necessarily going to report everything, but they're essentially intermediate outputs to allow us to interpret.

And those are kind of key because, again, by looking at certain intermediate outputs you can get some sense of how things might change if you actually did a sensitivity study.

Anyway, for example, we're going to be calling atmospheric dispersion data that would give us an idea of how far, how fast the plume disperses is a function of distance and weather is how much material has been deposited by wet or dry deposition so that we can get some sense of, you know, at some distance down wind is it, you know, the concentration's low because of dispersion? Is it because all the material has been deposited and there's nothing left? So, all that information is useful to us.

We define the outputs by the radial interval. That's been defined with a pretty high degree of resolution near the site and, of course, a resolution as you go further out.

And so, looking at how the output measures change is a function of distance from the site. It can tell us -- this is also hopefully will help us in our interpretation of the uncertainties in the sense that you generally don't want to have your results dependent on your modeling grid if you're doing your calculations.

So, looking and seeing how the results are changing is a function of distance. It tells, you know, have they dropped to become -- is a particular output measure dropped to become insignificant at the boundaries or is it still, you know, fairly high?

If you have a collective measure, has it asymptoted such that, you know, any further out wouldn't change anything or is it not asymptoted.

So, that's part of the logic behind getting some of these results as to allow us to figure out whether when we get a number, what -- how to characterize the uncertainty in that number.

So, status, we're in the middle of checking our inputs and preparing our final runs. We've got a couple of iterative rounds of development where we've identified parameters that were incorrect or that needed some refinement. We've looked at some things and need to correct things or we've said really these things need to be looked at in more detail.

We do anticipate starting our final runs in the next week or so. And our documentation parameter choices are being reviewed by Nate Bixler out at Savannah River -- Sandia Nation Labs.

Our last check will be our self-assessment against the TAP and the Level 3 standard.

I should mention that we where working with Dan Hudson who's in charge of integrating the results from the individual release categories into the probabilistic treatment of risk. So, we'll be giving him the information that he needs to do that convolution, probabilistic convolution.

And at this point, our main challenges are just the volume of data that we have to check and to verify and just the amount of data that we have to post-process and extract and put into a more user friendly format.

So, that's all that I have at this point. Does anyone have some questions?

MR. KURITZKY: Thank you, Keith. All right, let's move on to Randy.

MR. SULLIVAN: I sort of didn't expect you to get to me this morning, but I guess you have.

I'd like to discuss the emergency preparedness model but before we do that, I'd like to say this is perhaps not a culmination but an evolution of about 25 percent of my professional career here.

These models have been underdeveloped since, it's got to be 12 years when we did the protective action recommendations study and revised the nationwide PAR guidance from NRC.

We've done several iterations of this. This would be the most advanced model. We even used these models to develop a quantification tool which the agency probably won't be using going forward. But much -- somewhat less developed but akin to the SPAR model that's used for the significance of findings in plant.

We built a couple of example MACCS models outside the plant and we used real plants that are unnamed to see what the changes in -- then reassigned a series of scenarios we thought were appropriate for oversight purposes, didn't present those to you out of fear of being castigated.

But, if you can assign scenarios that are appropriate for oversight purposes, you can then measure the delta of failures in the EP program in terms of population dose, giving a MACCS model specific to the site and we have three or four of those models that are specific.

MEMBER BLEY: Randy, in the way you use scenario, can you tell me what --

MR. SULLIVAN: Source term.

MEMBER BLEY: Source term? Okay.

MR. SULLIVAN: Yes, tied to an accident.

MEMBER BLEY: Fair enough.

MR. SULLIVAN: And we actually modeled hostile action because we thought that was significant in -- we didn't put a frequency on it, we just said this is appropriate for oversight purposes.

So, we modeled those for two sites and then calculated what would be the delta in terms of population dose of certain failures of elements of EP programs.

So, that's the advanced stuff we've done. I once said something about using these models in an organic sense, that's the organic sense. I'm much pleased that -- pleased, well, it doesn't matter if I'm pleased -- but I was impressed to see elements of these models being used in regulatory analyses.

Now, there's uncertainty in the EP models and we're going to discuss that. But clearly, this project has advanced the use of these models and I personally think it's kind of cool and I'm grateful to have gotten to do this work.

I think we just discussed all this.

All right, so, you know emergency plans are required. They're inspected, they're reviewed, they're approved. Off site plans get the same thing.

You may know that recently we required sites to update their evacuation time estimates on a decennial basis with the Census. We have all that data, we used that data for this project.

This happens to be not a very challenging population in terms of density or size. However, we did model it in some simplified -- we simplified some things because of the low population density.

Yes, we used in SOARCA, we developed best practices. We used the on site and off site plans. We actually collected POP data out of some Census database that Sandia can get their hands on.

We drove the EPZ. There's not much there. I have to tell you we were looking for bridges that could fail, there are none. And even if some culverts fail, there's a dozen ways around it.

The Georgia roadway standards have the trees set back rather far. I'm sure that's not every case, but just looking at memory, we didn't see a lot of roads that could even be affected by falling trees. And on top of that, there's very good local infrastructure for this small population.

Well, the regulations would have you say that what have you assumed that the population would be notified within 30 minutes of the event. We didn't use that figure, we used exercised data from the historical record. And it's typically more like 45 minutes or an hour when the message actually goes out.

So, notification, a general emergency notification takes eight minutes or something. By the time they go back and forth, it really should be automated some day.

And then they have some time to make their mind up. Then they sound sirens and put an EBS message out. So, we included that timing in a rather ungenerous manner due to the exercise record. Not extremely concerned but we used the exercise record.

And then, NSIR, my office, Office of Nuclear Security and Incident Response has funded many improvements to MACCS. We've modeled the Keyhole evacuation rather than do a kind of hand handed evacuate half the EPZ.

It doesn't make a lot of difference in this small population, but we did it so we used it and what it does is it shifts the Keyhole around as the weather changes. You know, MACCS goes and fetches the weather trial which we believed models the staff looking at weather predictions and then we move the recommendation and then we evacuate those sectors, too.

Like I say, on this small EPZ, maybe we're cracking nuts with a sledgehammer but we did it and perhaps that'll be the best practices when we're done with all this.

Next, please?

MEMBER BALLINGER: I have kind of a dumb thought. Certain times of the year in Augusta, Georgia, there's a certain sport that occurs at which time the population density changes a lot. Is that actually in this study, do you know?

MR. SULLIVAN: And if we could just get the wind to point in that direction, maybe they'd stop that nonsense, you know?

Well, you know, I think the population density might be --

MEMBER BALLINGER: Oh, no, it does change. It's big, it's big.

MR. SULLIVAN: I had to make some decisions early on in this project and we decided to model evacuations out to 20 miles.

MEMBER BALLINGER: So, you're outside that zone.

MR. SULLIVAN: So, we're outside that zone. We get a very interesting industrial complex south of Augusta, some 5,000 work there or something crazy. It's mainly a wood and such. But we didn't model Augusta. So, Augusta gets accounted for in other functions of the code and we just let those roll.

I didn't know it was 25 miles away, I just simply said, well, let's model ten to 20 and pay for that and declare victory.

MEMBER BALLINGER: I know you can't get a hotel within 50 miles.

MR. SULLIVAN: Yes.

MEMBER BALLINGER: And did you know that I'm loosely calling it a sport.

MR. SULLIVAN: Loosely, yes.

Anyway, we did model Savannah River site as a single cohort. We met with Savannah River and got their sense. They have an ETE and they have an emergency plan and they get a phone call at site area emergency. But they really don't move until general emergency.

There's a small population that's bunkered shutting down various national defense type facilities. Those people are rather well bunkered and rather small. It's 11,000 people and I think we're talking about 40 or 50 that would actually stay on sit and shut down processes.

There's no schools to speak of in the EPZ although a division director pointed out that, yes, indeed there is one school, a private school with 50 people in it at about nine and a half miles and we'd better not ignore them.

So, I haven't told Keith yet that we need to do something with -- I don't think we'll make a cohort of those people but need to address it in some ways.

There's a substantial school in Waynesboro, 5,000 or 6,000 people and we'd modeled that should the evacuate exceed the EPZ.

Well, we met them all and we had some interesting conversations. The county ORO direct, Emergency Management Director, says he has some 110 people who roll up to him in an emergency. I can't imagine how a small county like that has 110 staff members. Surely some of these folks are volunteers.

But fire, police and I don't know what else all roll up to him. He's been there a long time and he helped us a lot to understand what the evacuation would look like outside the EPZ and it is not easy. All right? And we didn't model it as easy.

Now the EPZ evacuation is pretty easy. It's a small population, it's well covered with sirens. The people -- we've done studies of -- a study of EPZ populations, they're generally pretty well informed.

We have that data from a telephone survey that we conducted some years ago. I don't have it specific to this site. There's some five million people that live in EPZs and apparently we did twice the number of phone calls that would be statistically significant and we couldn't shut it off then because everybody was so anxious to talk to us about.

Hi, this is Eve, I work for the NRC and we want to know your thoughts about emergency preparedness. Then we asked a bunch of questions that we wished we'd asked differently if we'd have seen the results of the survey. Maybe we'll do it gain some day.

But in any case, this is a pretty well educated population, surprisingly well educated and evacuation within the EPZ is pretty timely.

When we had the, I call them scenarios, but perhaps the project calls them case bins. We went -- I tried to classify those in terms of the emergency action level set and I did classify them. Then I met with a bunch of people smarter than me down at the site. It was a room full of SROs and the EP manager and we reclassified them. So, I didn't do so bad. But, there was several corrections and even some insights.

And the issue really is when does the general emergency start? Because that's when the sirens eventually get sounded and the message goes out and populations start moving.

I was interested in the alert on the site area emergency because that's when the emergency preparedness staff is assembled. However, we're not really treating mitigation -- well, maybe we're treating mitigation, but we'll see how that's done.

In most cases, we're talking about SAMG implementation being supported by the technical support staff and those are all -- we had no immediate general emergencies. Everything was preceded by a site and at sometimes days. And many were proceeded by an alert.

The most rapid general emergencies were the loss of power, but the release is very much later than the general emergency in those cases.

MEMBER BALLINGER: Does the fact that the site is near the Savannah River site make it different than say Seabrook where the -- you say in general, the population's pretty educated and knows about emergency planning and all that.

Could that be because Savannah River has been for so long and that there's probably emergency planning related to that site that the population's, some of which work there or worked there? And so, you would get a different result if you were to tried it around Seabrook or something like that.

MR. SULLIVAN: Yes, you see, the thing

about Seabrook is --

MEMBER BALLINGER: I'm not picking Seabrook, I just randomly picked Seabrook.

MR. SULLIVAN: Right, but there's a huge transient population around Seabrook. I mean it's the only beach in New Hampshire.

MEMBER BALLINGER: I think they all have motorcycles, they can get out fast.

MR. SULLIVAN: Okay. Actually, Seabrook has an odd thing where -- well, it's odd, it's happened several places where if there's a site area emergency, they close kinds of places, including the beach at Seabrook and the state parks at Oyster Creek and on and on.

I mean if you give warning, many of these sites have taken -- they planned and committed to empty those sites earlier than a general emergency.

We often worry about an immediate general emergency where that wouldn't be an opportunity. None of these cases have an immediate general emergencies as it turns out.

Next slide? Thank you.

Yes, so that's what I do. Actually, Sandia helps me a lot, Joe Jones out of Sandia and I have worked together for a decade on these kinds of models and I'm grateful for his help.

We convert this information into what the EP model parameters look like based on the declaration of the emergency, how long it takes to activate the sirens and EAS. Then we modeled the protective actions.

We use the site ETE. We paid LSU to do a ten to 20 mile, well, let's see we did or Sandia did, to do a ten to 20 mile ETE. I'm not sure how that rolled up. I think LSU, I'm not sure I can pronounce their name. It's the Center for Evacuation and Community Resilience. You know, a college professor put together directorates.

Brian Wolshon has worked with us. As a matter of fact, he took a sabbatical at Sandia to work on these models because he's an evacuation expert.

The first guy to get reverse laning correct and that's on freeways. It's very difficult to do and he managed to accomplish that in the State of Louisiana for, I forget which disaster.

So, we've used Brian Wolshon, LSU to develop and ETE from ten to 20 miles and we'll talk a little more about that.

So, we looked at each accident case, one through eight and all the subcases. It turned out to be 40 source terms.

We classified all of those and we modeled all of those. Some are similar and that simplified our work, others were not.

Why don't we go on to the next slide?

I think we just talked about this. Okay, we should talk about a couple of things.

We did a study of evacuations nationwide. I'm repeating myself, you've heard this. Some time ago, we studied some 250, 206 evacuations, 60 of them in detail. All of them were successful in saving lives.

We actually did an assessment in one NUREG that looked at the elements, the locals who did the evacuation, thought were important versus our regulations to see if we were somewhat in sync with that. We were for the most part.

We actually studied Hurricane Rita which is the evacuation that killed more people than the hazard, a very unfortunate constellation of events. The other 259 evacuations didn't kill people and were successful.

So, we believe that we have a good basis to say that ORO people knew how to do evacuations and that is beyond the EPZ.

If I can go on and on about this, the reason for all the planning within the EPZ is the potential for a rapid release. You know, our planning basis is a 30 minute release. None of these events had a 30 minute release, but nevertheless, that's the emergency preparedness planning basis.

A 30 minute release wouldn't be a good thing, but evacuations get moving about as quickly as they can in an hour or so under ideal conditions.

But beyond the EPZ, you would have more time and OROs have proved conclusively that they're able to protect their population.

So, just to go on a bit further, NUREG 0654 espouses that premise that the emergency planning zone is a substantial basis for expansion of evacuations should it be necessary.

There was a recent petition for rule making that I got to work on and it was a post-Fukushima request to expand the EPZ, why not out to 50 miles, right? And we analyzed in some detail and the Commission's position is that the EPZ provides a substantial basis for expansion of the evacuation should it be necessary.

The PRM response goes into that in great detail. I guess that's the NUREG 6864 where we looked at evacuations nationwide. There was a large evacuation every three weeks during the time period. I think it was '92 the World Trade Center.

So, we actually looked a malefic acts, six of them and technical hazards which are more akin to us than hurricanes. Of course, we looked at hurricanes and floods, too.

So, we have a substantial basis to say that they will evacuate beyond the EPZ should it be necessary. We talked about the state and county of North Carolina, South Carolina -- I'm sorry, Georgia, South Carolina. They all agreed that they could accomplish that should it be necessary.

The EMA director in Burke County, which is where the plant is, stated he could do that, it just wouldn't be as easy as in the EPZ.

The South Carolina folks said something interesting. They said well, where would you guys be? We would be looking for NRC and maybe even FRMAC guidance. And they're right, we would be activated here at NRC as would the EOF and the corporate offices and probably everybody else and they'd be looking to us to help them understand where an evacuation was necessary beyond the EPZ.

It's also interesting to note that the Savannah River site has FRMAC resources as in response resources for radiological emergencies. They have radiological assessment teams and apparently, they told me that they have the aerial assets kind of nearby in Florida. That's what they told me, thought the aerial assets were in Maryland, but apparently, they're in Florida today.

So the East Coast, DOE, FRMAC, aerial assets are in Florida and available to the Savannah River site, well to the state, should they request it.

So, they should have pretty good support in terms of radiological response and even aerial dose rate mapping should that be useful to them.

I guess DOE assets are wheels up in eight hours and the local rad team has a quicker response than that. They have two teams. But there'd be more radiological assessment teams and we'd be able to keep track of given about 12 hours. Actually, that's what FRMAC does is track data.

When we responded to Fukushima here, I was just snowed under with the amount of data we had. FRMAC's much better at handling that than apparently we are.

Next slide?

That's what we did and actually we modeled the EPZ evacuation. We modeled an expansion from ten to 15. We modeled an expansion from ten to 20 step wise and we modeled a direct ten to 20.

Are we going to show -- I don't think I have a slide as to which cases did which. But there was some particularly nasty source terms where we, in the best of our assessment, the recommendation would be just to immediately evacuate ten to 20 miles as best as you can.

Some of those sources --

MEMBER BLEY: That's the result of your analyses?

MR. SULLIVAN: Yes, that's the result of my analysis.

We optimized these templates for each of 40 source terms.

I think I'm for the next.

This is a picture of the wind shift business that we do, that we built in. We made a simplification here because the population is so small. Rather than do a two and five mile Keyhole, we did a five and ten mile Keyhole. It's just there's so few people within two miles that we just thought, you know, this simplification wouldn't change the consequences much and that's what we did.

I think we already talked about this. The model allows for forecasting of weather and, hence, moving the protective actions. It's just a more sophisticated model that we can use and it's sort of lost on a site with such small populations that we implemented maybe as test run since, you know, since this model will be used elsewhere.

These are the cohorts for the zero to 15 population. That's the kind of detail that we're into. I don't know if it's of interest --

Yes?

MEMBER BLEY: I just have -- now that I have your references, I'm going to read some of that. I've been interested in it.

Does the experience in all of these evacuations substantiate the ability to get people not to all run so that you can actually do it in stages rather than having them all get out as soon as they hear the word?

MR. SULLIVAN: Several of the evacuations are staged evacuations, several.

MEMBER BLEY: And it really works?

MR. SULLIVAN: Yes.

MEMBER BLEY: They were able to --

MR. SULLIVAN: You know, I mean --

MEMBER BLEY: I mean there will be some violations of it.

MR. SULLIVAN: Yes, sure, sure. No, there's shadow evacuation.

Just to run you through the nightmare of my life, I was castigated in public by one of the emanate emergency sociologists, Maletti, saying that you cannot a priori quantified shadow evacuations. It is based on the threat and emergency messaging.

We've got to do something. We're giving licensees direction to do evacuation time estimates. I have to tell them what kind of shadow evacuation to put in the estimate. So, I picked 20 percent for which I was criticized.

You can triple that with lousy crisis messaging. If you mess up the crisis messaging, you can get them all to leave. All right?

But generally, the problem is milling. In other words, people don't want to leave. The weather's nice, you know, so it really isn't a stampede, it's getting people to listen that turns out to be the worst thing. They'll do what their neighbors are doing and they're going to talk to their neighbors.

Now, the sirens have helped. The sirens and the annual education thing with the evacuation routes and where to go and what radiation is and what a power plant is, that helps a lot.

But when you study evacuations nationwide, actually milling is more of a problem. And panic doesn't happen. The sociologists will tell you panic -- panic happens in a movie theater when somebody shouts fire and you can't get to the exits.

When the whole population is faced by a similar hazard, hurricane parties not withstanding, the societal mask drops off. You are no longer a banker, you are no longer a baker. You're a person and the neighbor you hate will be in the back of your car because you wouldn't leave her, you know, there.

So, there's several things important for emergency preparedness and that is, do we really need buses? You know, we run them anyway. But nobody's leaving their neighbor behind. Right?

And we have all this thing for special needs groups. Do we really need that? No body's leaving the handicap person who lives two doors down behind. They're going to go get them.

And you know when this period ends? When FEMA shows. They hate that when I say that. Because the FEMA people are trying to help but they have a societal mask. They're a government man, they're not part of the population. That is the sociology of evacuations in a nutshell.

This has been studied extensive, as much as Maletti hates my idea of framing the shadow evacuation, this is based on his and other work. That's just the way evacuations go.

MEMBER REMPE: And the type of threat radiation versus nonradiation doesn't affect that database?

MR. SULLIVAN: Well, we've had chemical hazards that are even more deadly than radiation that haven't. But who know? We haven't had a lot of radiation release.

CHAIRMAN STETKAR: More deadly to you, but not to the folks in Midland, Michigan who took evacuation for chemical hazards from the Midland plant of Dow Chemical in stride. They evacuated a good fraction of that city pretty regularly but, my God, they were afraid of that nuclear plant. They didn't know what they would do with that nuclear plant.

So, it's not at all clear that someone who's familiar with good friend Dow Chemical because we've worked there for years and, yes, of course they can kill us but they'll kill us in ways that we understand.

It's not at all clear that panic would not reign in that city in you said we're going to have a release from that nuclear plant.

MR. SULLIVAN: Okay. All I can tell you is we've studied 260 evacuations without panic. They aren't radiation evacuations and --

CHAIRMAN STETKAR: And they aren't radiation evacuations?

MR. SULLIVAN: No. I would stake my opinion on that database and that if you're told to leave, people will leave. They've been -- especially within the EPZ, there are a surprising number, and I'm forgetting the number, could find their evacuation route map and know where to go and had an emergency kit. Do you guys have an emergency kit in your house? Okay, a lot of them do. Well, there you go.

So, I mean especially within the EPZ, we found a surprisingly educated population. And, you know, so what? So there's a bunch that weren't and they're a concern.

And actually, we're going to talk about -- we should go ahead and talk about Cohort 14 because that's a problem.

The non-evacuees, the agency has historically used 0.5 percent. I don't have a good basis for them.

MEMBER REMPE: Aren't there some people

still in Chernobyl that never evacuated?

MR. SULLIVAN: The area is absolutely fecund with wildlife now that the people have left.

MEMBER BALLINGER: There are probably a few people still around Mt. St. Helen's but you can't find them.

MR. SULLIVAN: Yes, well, they'd be dead and that the thing is there are folks who will refuse to evacuate. We've used 0.5 percent historically. In our evacuation studies, the locals, we actually interviewed locals about the evacuation to try to gather data. They don't spend time on the non-evacuees. They couldn't help us.

They said, yes, there was some but we looked after the people who wanted help. We didn't look after the people who wouldn't leave.

So, I can't give you a number. We haven't been able to quantify it.

MEMBER BLEY: When you looked at those 200 and some, that data wasn't there. How many stayed behind?

MR. SULLIVAN: Right, not how many that somebody did, but when we review this issue with off site response agencies, they relay the story that often the EMA director will advise the population that doesn't want to evacuate to please put your Social Security number on your body in indelible ink so we can help you because we are not going to reenter the hazard area to help you if you don't leave now because we have people we need to help for obeying it.

And you know something else? Maybe you've heard this from me and I'm sorry to repeat myself. There is no regulatory solution. There is no rule I can pass to change that.

We make them send stuff out once a year. We offer training. We offer meetings. There is no regulatory solution. There's supposed to be a regulator. Why do I care about people who won't follow direction or civil authorities?

Well, we're going to quantify that because, apparently, the project cares. I see no regulatory solution. However, this is an area of significant uncertainty and so we'll be doing sensitivity analysis.

I'm trying to kick off a study, as I mentioned, where we might be able to explore this a little better and maybe get some data or some quantification.

But still, I think we're going to run into the same thing. The people who -- the off site response organizations that handle evacuations are busy with people who want help, not busy with people who don't want help.

Hurricanes is a bad example because they happen so often and people have hurricane parties and all that sort of thing.

I'd like to get my hands on technical for malefic acts and see if there's some data there.

MEMBER BLEY: To John's point earlier, I just want to say, I was involved in some work with people who weren't dealing with very hazard chemicals, like the leftover chemical weapons.

MR. SULLIVAN: Yes, yes, CSAP.

MEMBER BLEY: And they do the same thing. So they lay out all these plans and you were involved more with the Army than the CSAP approach but they would come, too.

But the public there -- not the public, the people who showed up at meetings, some of them were adamant they wouldn't -- I mean the cloud passes. If you stay inside until it passes then it's safe to go.

They're saying I'm going to go pull my kid out of school, expose everybody at the school. So, there's a small contingent who are bound and determined of what they're going to do and don't have a real good feel for the rest. And of course, they haven't had that exercise so we don't know how it played out.

MR. SULLIVAN: You know, you've touched on a real important piece of evacuation sociology.

There is a strong urge to reunite families, a very strong urge. And it's difficult. I tried to address it in the protective action recommendation guidance Sup 3.

The OROs were adamant that I not poke that area. But, in fact, mothers are going to go to school and get their kids.

And there's several philosophies of this, but what we tried to do in our guidance was get OROs not to shelter everybody. Those who are not affected need to go to a status called monitor and prepare and that status allows reuniting families.

If you automatically shelter everybody, you know, you evacuate this and shelter everybody else, that was a popular protective action strategy mainly in Region II, I think.

You cause the people who are not in the affected area to violate your orders because they're going to go get their kids. And it's going to screw up the school because the school's not prepared for 100 mothers to show up, you know. Now hopefully they've got the kids on the bus and they're already at the center, but even there, families want to reunite. They're going to get their kids, you know. So, that's a difficult thing.

And then there's pets but we didn't model pets, so we don't need to go there. Decontaminating pets is like an amazing thing. But anyway, and horses.

CHAIRMAN STETKAR: Randy, do you have, and I don't know, do we have any data from Fukushima, you know, get of --

MR. SULLIVAN: We have the anecdote but --

CHAIRMAN STETKAR: -- the, you know, the flooding effect from the tsunami but do we have an information about what fraction of that population did not evacuate?

MR. SULLIVAN: Our program is so much different then theirs. It's like --

CHAIRMAN STETKAR: Well, but I'm sorry, Japanese are no different than Americans in terms of caring for individuals and --

MR. SULLIVAN: Of course not.

CHAIRMAN STETKAR: -- in caring for their children.

MR. SULLIVAN: Of course not. Well, I have some data on that, too, that I'd argue with you about -- there's a rather unfortunate event of loading elderly onto a bus like cordwood and killing half of them on the way out. I don't think that would ever happen here.

But in any case, my point about the difference is the oversight program. Our oversight program is vastly different than theirs in terms of emergency preparedness. So, the level of preparedness would be very different.

Now, of course, a tsunami killing all kinds of people --

CHAIRMAN STETKAR: Yes, but I was trying to get out of the wave effect area, you know, because those people obviously were dealing with much different dynamics.

MR. SULLIVAN: There are studies of the evacuation at Fukushima. It's considered to be largely successful. Of course, they had quite a bit of time and our system would have acted quicker to remove people than their system did. And they still had quite a bit of time to get people moving.

CHAIRMAN STETKAR: I was just thinking in terms of your Cohort 14 down there. What faction of those folks actually, you know, given the fact they had time, given the fact that --

MR. SULLIVAN: Yes, maybe you're right.

CHAIRMAN STETKAR: How many folks did stay behind there?

MR. SULLIVAN: Maybe you're right, maybe that would be a data point.

MEMBER BALLINGER: Now this Cohort 14, does that automatically place a floor on the number of fatalities that you have to assume?

MR. SULLIVAN: Well, you can maximize fatalities by maximizing that, you know, if that's what you want to do.

MEMBER BALLINGER: I don't know what you want to do, but I mean it's unavoidable that you have to make an assumption about what happens to those people.

MR. SULLIVAN: Well, if they're close enough and the wind blows in that direction, we can kill some of them. I mean most of the risk is within a few miles of one of these accidents, right? The risk of fatality certainly is there.

Now, there's not many people there and the wind only blows where it blows, but, you know, if you increase the non-evacuating cohort, you can probably get up, you know, as high a dose as you want.

MEMBER BALLINGER: But when the rest of

the public hears numbers -- of numbers of fatalities related to accidents, if it's dominated by this group then is there a problem with that?

MR. SULLIVAN: Yes, I think so. Yes, of course I do.

MEMBER BALLINGER: But you don't know what it is but you have to come up with something.

MR. COMPTON: Just for what it's worth, you have to make an assumption about the number of -- about the fraction of the population that is assumed to do that. What you can do is MACCS puts out results by individual cohorts so that you can see whether these are being -- these results are being driven by the non-evacuees, but slow, you know, by a tail.

MEMBER BALLINGER: But does this information get transmitted to the general public other than just giving them a number that says this is the number of fatalities?

MR. SULLIVAN: Not in a way that anybody -- I mean that's important.

All this data can be misused. I mean you know this better than me, right? This data can be misused, yes. Of course, it will be qualified, of course we'll explain it in a professional manner and we'll talk about it being a sensitivity and we'll do all the right things.

MEMBER BALLINGER: But you can influence this group if you publish the numbers to the general public and you say, look it, here's the calculated number of fatalities but it's dominated by the bozos that don't want to leave, not by you. You're not going to get affected.

MR. SULLIVAN: I think that's a good thing to do.

MR. COMPTON: That would be part of, again, this goes into when you're describing your results, you would want to say what are the things that are driving it?

Certain measures, for example, early fatalities might, and depending on your release, might be driven by that. Other things, for example, latent fatalities or latent fatality risk might actually be driven by the long term phase and not, you know, not by it.

So, again, this is the devil all gets in the details and that's why you'd have to look at it and see whether this is particularly sensitive -- you know, whether this one thing is driving -- if this one assumption, if this one parameter was driving you results, that would be the kind of thing we'd want to flag and identify and say, this is what is and this uncertain and --

MEMBER BALLINGER: But the numbers I've seen from say, Pilgrim or Seabrook, are only one number. They don't break them out like this, at least When, you know, when they're published, you know, in the Boston Globe or whatever the heck it is.

MR. SULLIVAN: Yes, that's for sure.

You know, another area of uncertainty is the shadow evacuation. In general, we found that a shadow evacuation really doesn't inhibit the evacuation much.

There's been studies I thought I saw a KLD study where they actually did some sensitivities on this and, you know, the further out you go, the more roadways there are, et cetera, et cetera. I mean there could be city or something, you know, so that could be a problem.

But, once again, some of these accidents, some of these cases that we're going to study are pretty much in a site area emergency for 60 hours and then they go bad.

I would think that the shadow evacuation could be pretty big under a situation like that. Oh, there's a problem at the plant, there's a problem at the plant for three days and all of a sudden now they're evacuating? I don't even know how you'd make the crisis messaging work for that.

So, I suppose we could -- there's certainly -- we use 20 percent because we used 20 percent, but it could easily be bigger than that.

CHAIRMAN STETKAR: You know, obviously, it depends on the site and local highways. I mean if you look at this particular site, there's no compelling reason for people to go toward the accident.

MR. SULLIVAN: No, no there isn't, no.

CHAIRMAN STETKAR: In some places, depending on the topography and the road system, the people wanting to get out early could compound the problem.

MR. SULLIVAN: Yes. Well, no, sure, not at this site.

CHAIRMAN STETKAR: Not at this site?

MR. SULLIVAN: Yes, not at this site.

And the KLD study looked at a lot of site. I mean, you know, a lot of sites are low population. I mean this happens to be very low. But what else?

MR. COMPTON: Just one other thing just to go into this discussion.

We should point out that like Randy said, we developed an evacuation model out to 20 miles and let those folks move out. After that point, that population is also part of the non-evacuating cohort, it's not 0.5 but it's all of them.

And those, there is -- we do model a protective action for those populations and the relocations. So there is a -- and we make some estimates about how long it would take to relocate people.

So, there is a provision in the model for taking protective actions for those populations, both populations close in who don't evacuate even though their told to or the populations that we haven't explicitly modeled in the, you know, in the evacuation model where we've set them off out there.

MR. SULLIVAN: Why don't we go to the next slide and see what's there. I don't remember now.

Yes, this is more ETE stuff. I guess the important thing here is that in studying this for a decade, we figured out there's a tail and so most of the population gets moving reasonably quick.

We've been splitting that into three cohorts because we're not smart enough to load a curve into MACCS so we use these three chunks, boom, boom, boom and then there's a tail which is a fourth chunk.

And the tail are people who have to shutdown farms or didn't get the message or whatever and they take, oddly longer. Actually, we actually used 90 percent in our protective action recommendation strategies because to the best of our ability, we calculated that that saves population dose.

If you make your decisions based on the tail, you end up sheltering a huge part of the population that you would have evacuated and, hence, you increase those. So, we've actually gotten to that, you know, through out studies that we recognize a tail.

I thought I invented it but now it's cited by Brian Wolshon as the person who invented the tail. I thought that was my idea.

But anyway, next slide, please?

Yet we do stuff like this, we slow down roadways then they get congested. So this is that, if you've ever been out there from Augusta, I guess, down the river, there's 56. LSU actually modeled that and how it would load with population and how the speed would go down.

So we do that sort of thing to an extent. Why don't we got to the next slide?

This is my favorite slide because I know none of you could read this. But what this is doing is we actually, you know, we have 64 grid elements and we can actually model the roadway system.

We say to people MACCS moves people in each grid in accordance with our direction. That's what's so cool about it.

So, it's not a static dose model, it's a dose model with people moving. And we've worked with this for a decade, we're getting better at it.

Actually, one of the outcomes of this program is Keith's staff has become way competent in running this thing. We used to be dependent on the National Lab and Keith has become very knowledge in this program, much more so than I am.

But we modeled the roadway system and those onesies and twosies in there are speed up or slow down numbers. So, where there's congestion, we can slow down the flow through that grid element.

MEMBER BLEY: And you have people moving across the lines?

MR. SULLIVAN: Yes, because that's the way roads go.

MEMBER BLEY: This is a little interesting. You know, back many years ago, 20, 30 years ago some folks we used to work with came up with crack, they acme up with crack it including trajectories.

And then there were a bunch of benchmark studies and it turned out that movement it overwhelmed the roads went and the way people were going, ended up with about the same answer in the end as the radio evacuation.

Have we changed our minds about that? It always made sense to me to track the way people would really move.

MR. SULLIVAN: You know, in our early studies, we did that. We just reduced the speed, so rather than say they were on 20 mile an hour road, we'd just say, well, they're only going to move at ten miles radial out.

Then we went to this more sophisticated model, I'm going to address that in just a second in my final slide.

MEMBER BLEY: Okay. I mean this is much more believable to me but all the benchmarks seem to say it made no difference.

MR. SULLIVAN: Well, we're struggling with that. While all this is cool and I'm grateful to be able to this and have championed this effort, sooner or later we have to figure out are we spending more money than we're getting for results?

You know, we haven't -- why don't you go to the next slide? I think we're almost there. Anyway, maybe we're not there. Could you go back, please?

I'm struggling with that because we do this 64 sector complicated model and really, one of these days when we're not busy -- uh oh.

CHAIRMAN STETKAR: It's just another sound.

MR. SULLIVAN: I hope it's not my supervisor figuring out when I'm not busy.

But, you know, we ought to do some sensitivity analyses to see if these detailed models are really changing consequences. You know, are we doing too much modeling? And that we haven't done.

Okay, I think we can go to the next one.

This is what Keith was talking about. We do this relocation estimates and we have two variables. We're assuming, actually, it's a legacy of the program, but we think it reflects reality, that areas that were going to get five rem over the next few days would likely get more attention than areas getting one rem.

And how we believe we have this data is the aerial assets that, in this case, are only four or eight hours out. We even had our aerial assets in Japan after a day or so, I think, let alone here where it's wheels up in eight hours.

So, that and the FRMAC can land in about a day. They can get their teams out a few hours later and if you've ever seen a FRMAC exercise, they can field 40 teams, radio -- it's a vast amount of data.

In addition to the licensee's teams and the state's team and the -- there'll be plenty of data on a radiological levels. So, we believe that they'll know hot spots, you know, relatively soon.

Now, we have to model this, so we make a judgment as to is the evacuation over? Has there been time to activate all the organizations? Is FRMAC on the ground? On and on, and then we make a judgment as to how long it would take for the local resources to be available and find these hot spots and tell people to move. And that's sequence specific and we struggled through that.

I think I'm getting near the end. Yes, these are the challenges.

We just talked about model complexity. You know, when does the effort exceed the benefit? I just don't know. Right now, we're doing very detailed models. I guess we should do a sensitivity analysis sometime to figure out, you know, what's too much?

The non-evacuating cohort, we've talked about that.

MEMBER BLEY: You know, there's another side to that, I'll throw it in.

Even if the bottom line answer doesn't change very much, you're also dealing with people, locals and people in the counties and the states, they can understand a model that says I'm following the roads rather than some abstract thing that shoots them off, well, you can't go that way. There's a canyon there.

MR. SULLIVAN: Right, you're right. Well, that's --

MEMBER BLEY: So, there is that other side to it.

MR. SULLIVAN: That's true.

I've modeled the ORO decision making based on their plans. You know, we assume they're going to follow their plans. They've been drilled for 30 years at this site, I think it's 30 years. They know their stuff, they're competent professionals. They're not going to run and hide, they're going to do their job. The local police are going to do their job.

You know, we've modeled it not optimistically, but we modeled what we believe would be a professional response under very challenging conditions. But that's a challenge, you know, we're assuming they'd make these decisions.

Like I said, South Carolina looked me in the face and said, well, where would you guys be? We'd be looking to the NRC for advice and we would be here, you know, we would be here to give advice. I would be here to give advice although not for much longer.

I had to model the operational awareness of the staff.

MEMBER BLEY: Our staff here?

MR. SULLIVAN: Of the operator staff of the licensees --

MEMBER BLEY: At the plant? Okay.

MR. SULLIVAN: -- in order to properly assess the protective action recommendations they'd be making.

So, for instance, if I have no power, I don't have in containment monitors that I'd be able to use for dose projections to say holy cow, there's a really big source term in containment and I think since the EPZ is done, we ought to expand out. I don't have that.

However, I would have handheld instrumentation and in some of these cases, the levels would be unprecedented in the plant and could be used to assess what's going on.

Now, many of the cases have electricity and so they would have good operational awareness. Some of the cases have lost one bus and not the other, so they have some operational awareness.

But we had to do that assessment and it was quite a challenge from my point of view. I got help from Don Helton when I had mischaracterized safety relieve valve releases, you know, in containment, out of containment and things like that.

But some of this stuff is elf-revealing, the radiation levels would be self-revealing. If you lose the vessel, you've got some pretty serious radiation levels in plant, even outside containment and so, we needed to assess operational awareness in order to drive our model of the emergency response to say, what kind of off site protective actions --

MEMBER BLEY: I have a question for Alan.

Would it be fair to ask you if there will be some correlation between operational awareness as Randy's talking about it and operational awareness in the fire part of the PRA when they lose all instrumentation or power?

MR. KURITZKY: I can't give you an exact answer. It's part of the integrated site risk aspects where we're trying to integrate all the various parts of the study. That's certainly an area that maybe something we should be looking at.

MEMBER BLEY: I mean they might not be aware of the work done over here, so I'm just saying that.

MR. KURITZKY: Right, so but it's of the integrated site risk. Ideally, we should be thinking about those types of things. Practically, will every dot get connected? I don't know, but, you know, that one's been brought up so now we can make sure that one is thought about.

MEMBER SCHULTZ: Well, it certainly weighs in to accident management as well as the overall off site operational response.

MR. KURITZKY: Yes.

MR. SULLIVAN: So, for instance, some of the cases, AFW fails, I don't know why it fails, it just fails. That's a big event. So, if you're in ELAP, which we are, and that AFW fails, we know where the -- I mean the operators would know where the plant is heading.

Now, they're going to do everything they can to mitigate the accident. They're going to bring out their pumps and, you know, lawyers, guns and money, you know, or jacks and hammers, whatever. But they know that they're on a core melt sequence now that AFW has failed even if they have no instrumentation.

So, we made those kinds of judgments and recognizing that mitigative actions would continue. We assumed they're unsuccessful or we wouldn't have lost the vessel. Right?

So, you know, we need to judge operational awareness and, clearly, there's some uncertainty there, but we took our best shot.

I think I'm done. Oh, I'm not done. Oh, there we go.

Well, you've heard all this. We've done a serious EP model. We've advanced the models we've done previously in SOARCA and the PAR study and some of the research I've done.

I appreciate your time and, like I said, I'm honored to be able to do this work.

MR. KURITZKY: If you have questions, here he is.

CHAIRMAN STETKAR: Anybody have any other questions for Randy?

MEMBER SCHULTZ: Just a comment. I really appreciate the level of detail that's going into this and it just strikes me that this is an area where, in comparison to other areas that we've discussed, the communication aspect is really important.

And so, if you go into an evaluation that would suggest that the modeling of this complexity or going into this level of detail isn't important because it doesn't really affect the bottom line result, you could send the wrong message to the external community about what is being done or how they should take or interpret the results.

Because we want the evacuation to happen and we don't want people thinking, well, you know, I mean the sensitivity study, it really didn't make a difference. And so the communication here is very important in terms of communicating the results of that final product and how these aspects may make a difference because you need to separate that from the effort and the intent of emergency planning evacuation and all the rest.

MR. SULLIVAN: Yes.

MEMBER SCHULTZ: But I think you're doing a good job of that, I really do.

MR. SULLIVAN: Thank you.

MEMBER BALLINGER: Back on slide 45, have these models been verified? I mean now a days you can take out and put your GPS on the dashboard of your car and it'll automatically will tell you where there's congestion. So, there's got to be data.

Now a days, there's cameras everywhere where you can find out when the cliff occurs, when all of a sudden everything stops, when the traffic gets so bad, all of a sudden everything just stopped.

As somebody from Boston, I can tell you the time of the day during which that happens, but not the number of cars on the road because I can walk on the hoods.

MR. SULLIVAN: Right. The computer models used to develop ETEs have been verified.

MEMBER BALLINGER: Okay.

MR. SULLIVAN: This study, we didn't do a peer evaluation of the ten to 20 mile EPZ, he ten to 20 mile ETE. So, in that sense, no.

But the IDENEV computer code that's used is used rather extensively and I hope I'm quoting the code that LSU used because that is the most popular code and it's been D&V'd in things like that.

CHAIRMAN STETKAR: But those ETEs, though, if I recall, are also for a handful of five to ten stylized scenarios, right? They're not intended to --

MR. SULLIVAN: More like 16, but yes.

Night, day, winter, summer, school, weekend, they do one for MACCS transient events.

CHAIRMAN STETKAR: Yes, something like -- yes.

MR. SULLIVAN: And I think they do one for -- we've been criticized because we haven't done severe weather.

CHAIRMAN STETKAR: Right, that's what I was getting to.

MR. SULLIVAN: And so, I've got a study working, I hope, if it ever gets out of the building to update the data -- the guidance that'll be used in 2020 for the next Census.

You know, we have a NUREG that tells the licensees how to do this. So, I think we're going to emphasize severe weather events more in the next round.

CHAIRMAN STETKAR: I seem to recall, I mean ACRS was briefed on this a couple of years ago, if I recall, and we had some comments about that.

MR. SULLIVAN: Sure. You've got to keep in mind where we came from.

CHAIRMAN STETKAR: Yes, no, that's --

MR. SULLIVAN: We had 30-year-old ETEs done on paper.

CHAIRMAN STETKAR: Right.

MR. SULLIVAN: So, when we put out our guidance and passed the regulation, we at least standardized what we want to see in ETE and that it be updated and criteria for updating in the interim.

Next go round, we're about to study the actual parameters used and so, we're going to use LSU, I hope, and we've got a set of parameters we want examined in more detail.

We want to know what are the most sensitive parameters because we don't know that now. We want to know why all the ETEs are shorter than they used to be. You know, things like that.

So, the next go round, we'll do better but that's not until 2020, so I'm not sure --

CHAIRMAN STETKAR: Is that true? All the ETEs are shorter than they used to be?

MR. SULLIVAN: No, they aren't actually. I made that statement and one of my associates actually looked at it and no, they're not.

CHAIRMAN STETKAR: Okay.

MR. SULLIVAN: And also, we're reporting 90 percent levels, not 100 percent levels all the time because of the tail. So, yes, sure, the 90 percent's different than the 100 percent. So, there's those kinds of conflating things and we're sort of on it and we're better than we used to be.

CHAIRMAN STETKAR: Anything else for Randy or Keith or Alan? If not, our afternoon session will be closed. So, what I'd like to now is ask if there's anyone in the room, members of the public or anyone who'd like to make a comment, please come up and do so.

And I believe that we have the bridge line open. If someone's out there, could you do me a favor and just say hello so that I can confirm that it's open? Anyone?

PARTICIPANT: Yes, it's open.

CHAIRMAN STETKAR: Thank you. This is the high tech world that we live in here.

Now, if there's anyone on the bridge line who would like to make a comment, please do so, identify yourself.

Hearing none, we will close the bridge line. We will recess for lunch and I'm going to be stingy here, let's reconvene at 1:00.

(Whereupon, the above-entitled matter went off the record at 12:06 p.m.)

Full-Scope Site Level 3 PRA

Advisory Committee on Reactor Safeguards
Reliability and PRA Subcommittee

February 18, 2015
(Open Session)

Outline

- Open Session
  - Project status overview
  - MACCS analysis overview
  - EP modeling
- Closed Session
  - Level 1 internal event and flood peer review
  - Level 1 event tree philosophy and logic
  - LOOP/SBO and consequential LOOP modeling
  - “Safe-and-stable” end-state

Level 3 PRA Project Status Overview

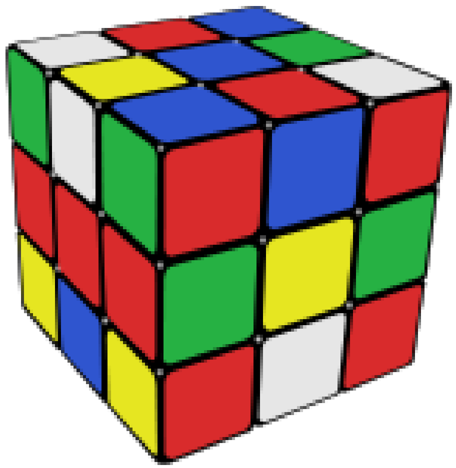
February 18, 2015

Alan Kuritzky
Division of Risk Analysis
Office of Nuclear Regulatory Research
(301-251-7587, Alan.Kuritzky@nrc.gov)

Mary Drouin
Division of Risk Analysis
Office of Nuclear Regulatory Research
(301-251-7574, Mary.Drouin@nrc.gov)

Outline of Project Status

- 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
- Reactor, at-power, Level 3
- Reactor, low power and shutdown
- Spent fuel pool (SFP)
- Dry cask storage (DCS)
- Integrated site risk
- Path Forward



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

- Completed ASME/ANS PRA standard-based peer review, led by PWR Owners Group (PWROG)
  - Final review report received in October 2014 (recently provided to ACRS)
  - Model is comprehensive with extensive level of detail
  - PRA process is at the state of the technology and generally consistent with Capability Category II
  - Some areas of potential enhancement identified
- Revising model and documentation to address peer review and other comments
- Piloting expert elicitation guidance (per SRM-SECY-11-0172) for interfacing systems LOCA (ISLOCA) frequency estimates
  - Currently assembling expert panel
  - Elicitation meeting tentatively scheduled for week of 4/20/2015

Internal Fires (Reactor, At-Power, Level 1)

- Internally reviewing initial Level 1 fire PRA model and documentation
- Additional evaluation or work needed in a number of areas, for example:
  - Electric cabinet fire modeling and screening
  - Fire frequencies (including transient fire screening)
  - Main control room abandonment scenarios
  - Human reliability analysis (HRA) modeling and quantification
- Planning to conduct another site visit in the Spring to address some of these issues
- Anticipating completion of updated model and documentation in Summer 2015

Seismic Events (Reactor, At-Power, Level 1)

- Completed initial seismic PRA (SPRA) model and documentation, without benefit of licensee SPRA model
- Current SPRA model based on 2012 hazard curves and preliminary plant-specific fragilities provided by Southern Nuclear Operating Company (SNC)
  - Recently received revised fragilities from SNC
  - After reviewing and accepting revised fragilities, will update model with new fragilities and 2014 hazard curves
- Still need to evaluate relay chatter
- Anticipating completion of revised model and documentation in Spring 2015

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

- Completed Level 1, at-power, high wind PRA and "other hazards" evaluation
- Completed ASME/ANS PRA standard-based peer review, led by PWROG
  - High wind PRA and other hazard screening generally well-structured and technically adequate
  - A number of improvements identified
- Currently undergoing Technical Advisory Group (TAG) review
- Will revise model and documentation to address peer review, TAG, and other comments

Reactor, At-Power, Level 2

- Completed reactor, at-power Level 2 PRA model for internal events and internal floods
- Completed ASME/ANS PRA standard-based peer review, led by PWROG
  - PRA process is at the state of the technology
  - Analysis was generally consistent with the trial use Level 2 PRA Standard
  - Some areas of potential enhancement identified
- Will revise model and documentation to address peer review and other internal comments

Reactor, At-Power, Level 3

- Completed accident consequence analysis code (MACCS) development work necessary to support Level 3 PRA reactor, at-power source terms
- Developed new evacuation models based on the NRC's State-of-the-Art Reactor Consequence Analyses (SOARCA) study experience and site visits
- Developed initial draft of technical basis for MACCS input parameters and datasets and initial draft of MACCS input files
- Anticipating completion of initial model for internal events and internal floods in early Spring 2015

Reactor, Low Power and Shutdown

- Developing new PRA model in SAPHIRE
  - Some information provided by SNC from an earlier effort
- Observed Unit 2 refueling outage (September 2014)
- Developed plant operating states with integrated consideration of reactors, spent fuel pools, and dry cask storage
- Currently performing accident sequence development for internal events and floods
- Anticipating completion of initial model in mid-2015

CHALLENGE
Balancing scope versus available resources

Spent Fuel Pool PRA

- Minimal progress since October 2014
- Developing detailed MELCOR model for accident progression and source term characterization
- Continuing development of initial Level 1 accident sequences, focusing on large seismic events

CHALLENGE
Staff availability (especially Team Leader)

Dry Cask Storage (DCS) PRA

- Continuing structural analysis on fuel and multi-purpose canister
- Nearing completion of development of accident sequences that were shown to be risk contributors in previous studies
- Continuing study of other accident sequences
- Performing a Hazard and Operability Study (HAZOP), a formal process for identify initiating events
- Anticipating completion of DCS Level 1/Level 2 PRA in Spring 2015
- Hosted PWROG-led public workshop on DCS PRA review criteria (January 2015)

Integrated Site Risk

- Minimal progress since October 2014
  - Staff turn-over
- 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
- Participated in international multi-unit PSA workshop (Ottawa, Canada – November 2014)
  - Insights from workshop prompted on-going literature review of current state-of-practice

Path Forward

- Continue work in all technical areas of the study
  - Completion of reactor, at-power, Level 3, internal event and flood PRA (Spring 2015)
  - Completion of initial reactor, at-power, Level 1, seismic event PRA (Spring 2015)
  - Completion of dry cask storage, Level 1 and Level 2 PRA (Spring 2015)
  - Completion of initial reactor, at-power, Level 1, internal fire PRA (Summer 2015)
- Continue with PWROG-led, PRA standard-based peer reviews
- Schedule challenges
- Acknowledgements
  - SNC
  - PWR Owners Group
  - Westinghouse and EPRI

Status of Offsite Consequence Analyses Supporting Level 3 PRA

February 18, 2015

Keith Compton
Division of Systems Analysis
Office of Nuclear Regulatory Research
(301-251-7483, Keith.Compton@nrc.gov)

Outline

- Recent MACCS development work supporting the Level 3 PRA project
- Environmental setting for MACCS analyses
- Development of MACCS input model for Vogtle
- Current status

Code Development Work

- MELMACCS (1.7.6/2.0.0)
  - Multi-source releases (multiple units, spent fuel pools, and combinations of both)
- WinMACCS (3.9.7/3.10)
  - Multisource term
  - Modeling of prolonged releases
  - Dose projection enhancements
  - Population evacuation and relocation results
  - Custom reporting enhancements

Environmental Setting

Population

<u>Population centers within 50 miles</u>

(*adapted from VEGP ESP ER Figure 2.1-2*)

General Public

Radial Area	Population
10 mile	3,472
15 mile	11,921
20 mile	33,968
25 mile	126,243
50 mile	741,114

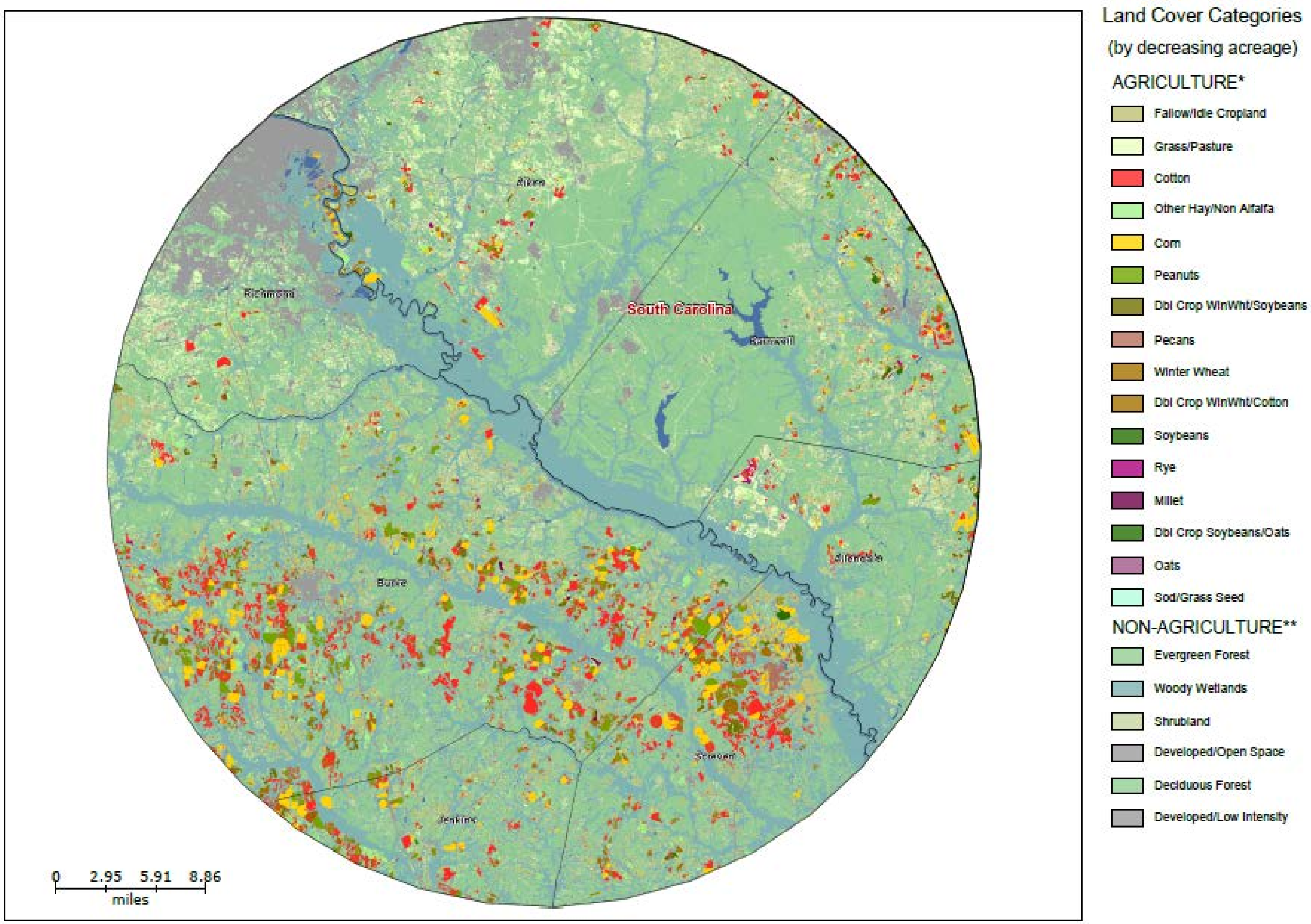
SRS: 11,000

VEGP: 2,990

Waynesboro area schools: 6,000

Environmental Setting

Land Use and Land Cover

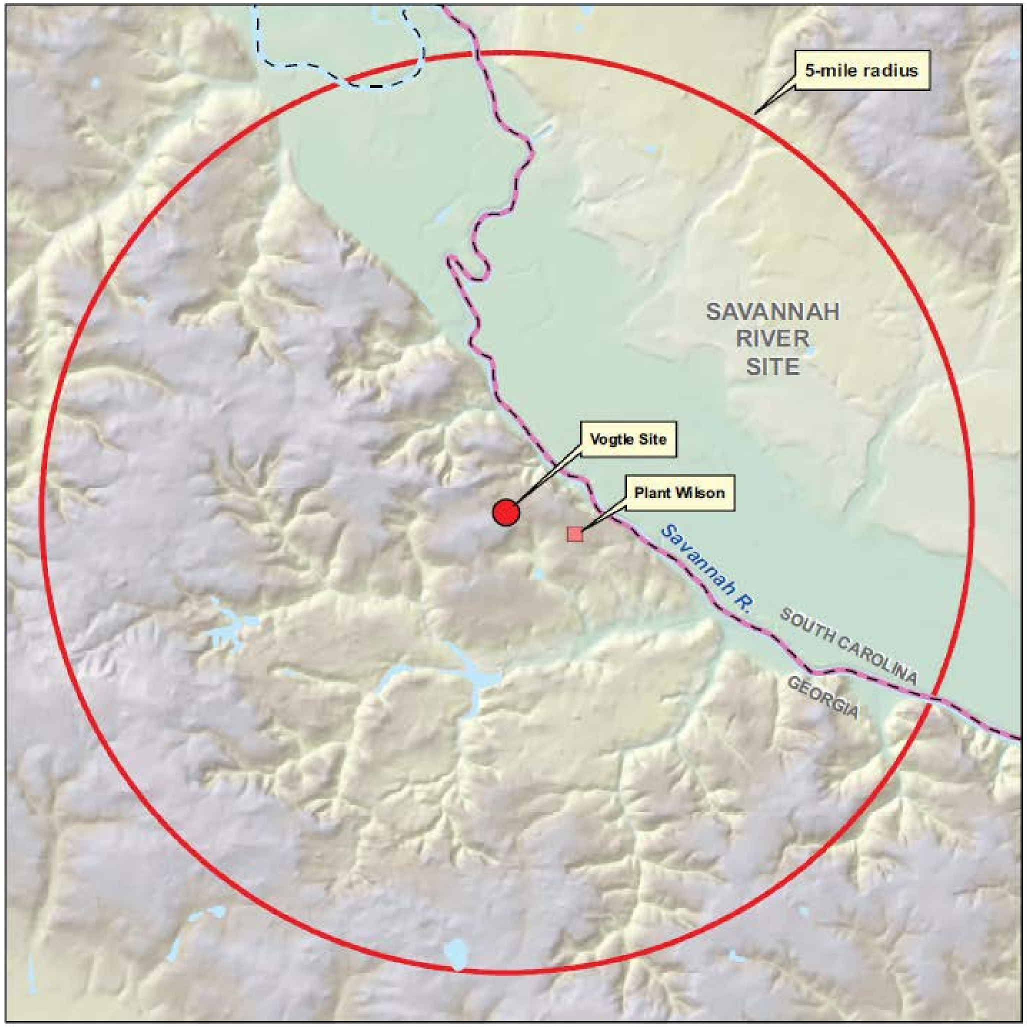


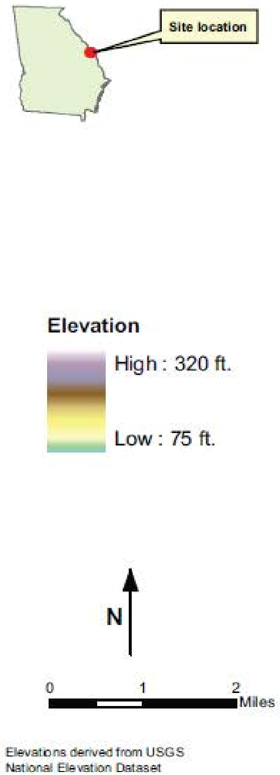
2013 land cover categories within 25 mi of VEGP

(*Produced by CropScape - http://nassgeodata.gmu.edu/CropScape*)

Environmental Setting

Topography





<u>Topographic features within five miles of the VEGP</u>

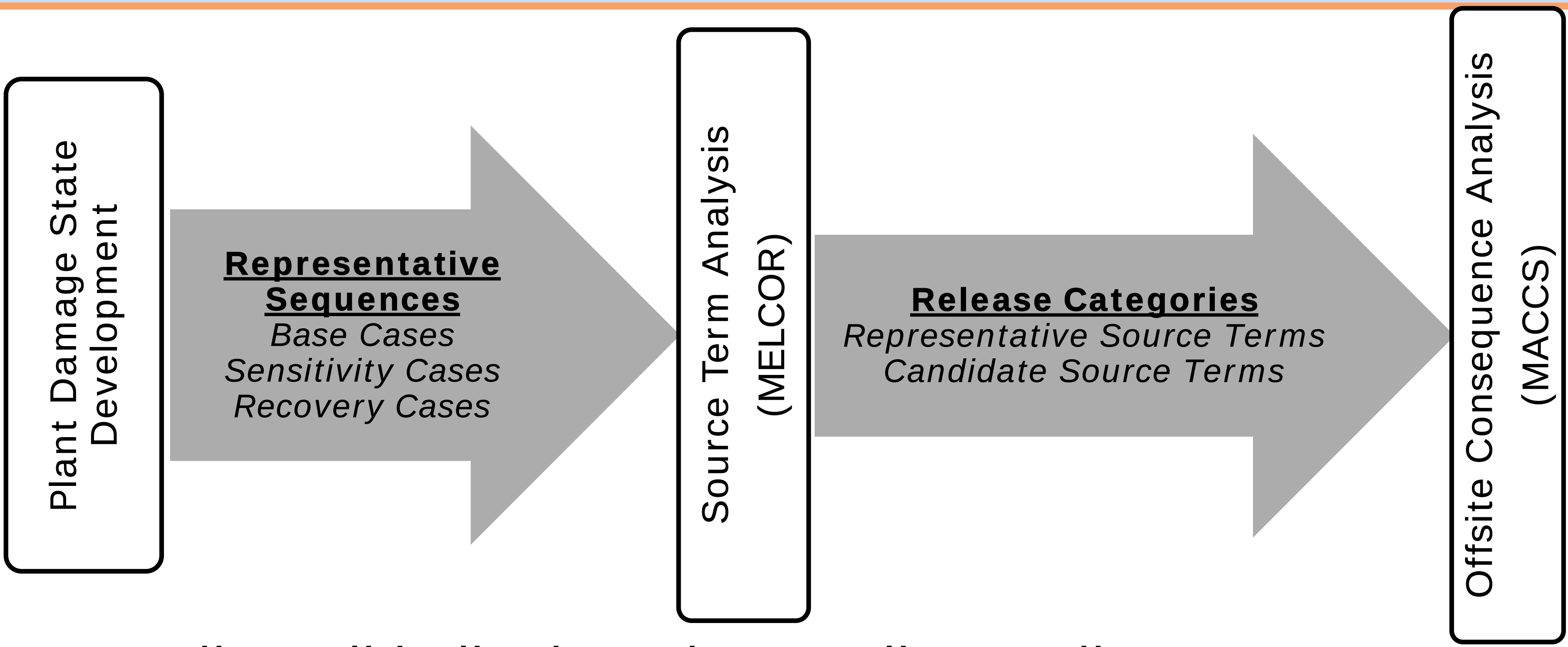
(adapted from ESP ER Figure 2.7-14)

Overview of MACCS Input Model

- Radionuclide Release (RE)
- Meteorology (ME)
- Atmospheric Transport and Deposition (AT)
- Protective Actions, Site Data, and Economic Factors (PA/EC)
- Dosimetry (DO) and Heath Effects (HE)
- Output Control

MACCS Input Model

Radionuclide Release (RE)



- Radionuclide list based on earlier studies
- Core inventory based on same ORIGEN runs used for Level 2 analyses
- 10 m release height used for most releases

MACCS Input Model
Radionuclide Release (RE)

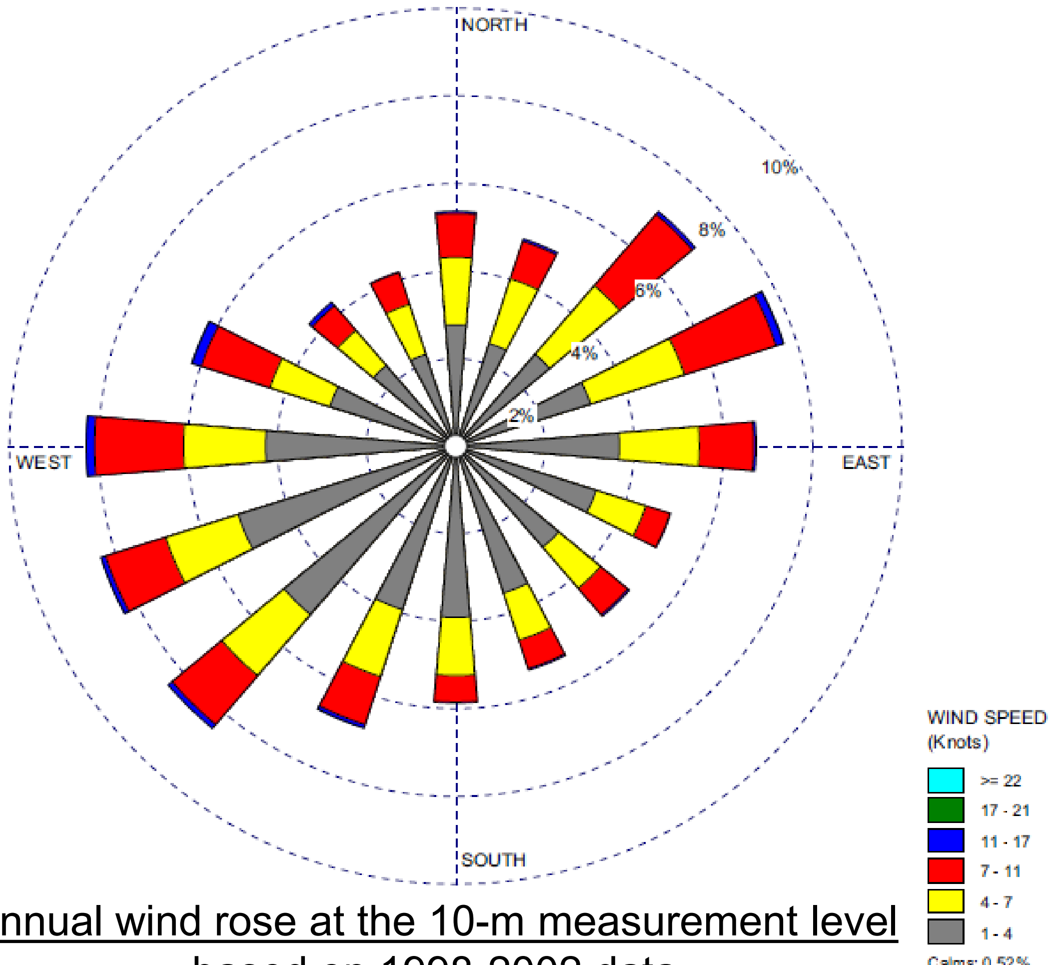
Mapping of Sequences to Release Categories

Release Category Description	Designator*	Rep. Source Term	Candidate Source Terms
Containment Bypass - ISLOCA with auxiliary building failure	V-F	5D	-
	V-F-SC	5B	5C, 5R1
Containment Bypass - ISLOCA without auxiliary building failure	V	5A	-
	V-SC	5	-
Containment Bypass - SGTR with open ARVs and MSRVs	SGTR-O	8B_154	-
	SGTR-O-SC	8BR1	-
Containment Bypass - SGTR with normal cycling of ARVs and MSRVs	SGTR-C	8_149	8A, 8R2
	SGTR-C-SC	8R1	-
Induced SGTR	ISGTR	3A3	3A2
Containment isolation failure	CIF	7	-
	CIF-SC	7A	-
Early Containment Failure (at or before vessel breach)	ECF	2A	-
	ECF-SC	6C	-
Late Containment Failure (due to overpressure)	LCF	1A	1B, 1B1, 1B2, 2, 3, 3A1, 4
	LCF-SC	2R2	3R2
Late Containment Failure (due to basemat melt-through)	BMT	2_87.9	1A1_82.5, 1B_55.5, 2R1_97, 3R1_76, 4_88.9
	BMT-SC	2R2_90	3R2_76
Containment Intact	NOCF	6A	-
	NOCF-SC	6	6R1

* -SC represents a scrubbed release

MACCS Input Model

Meteorology (ME)

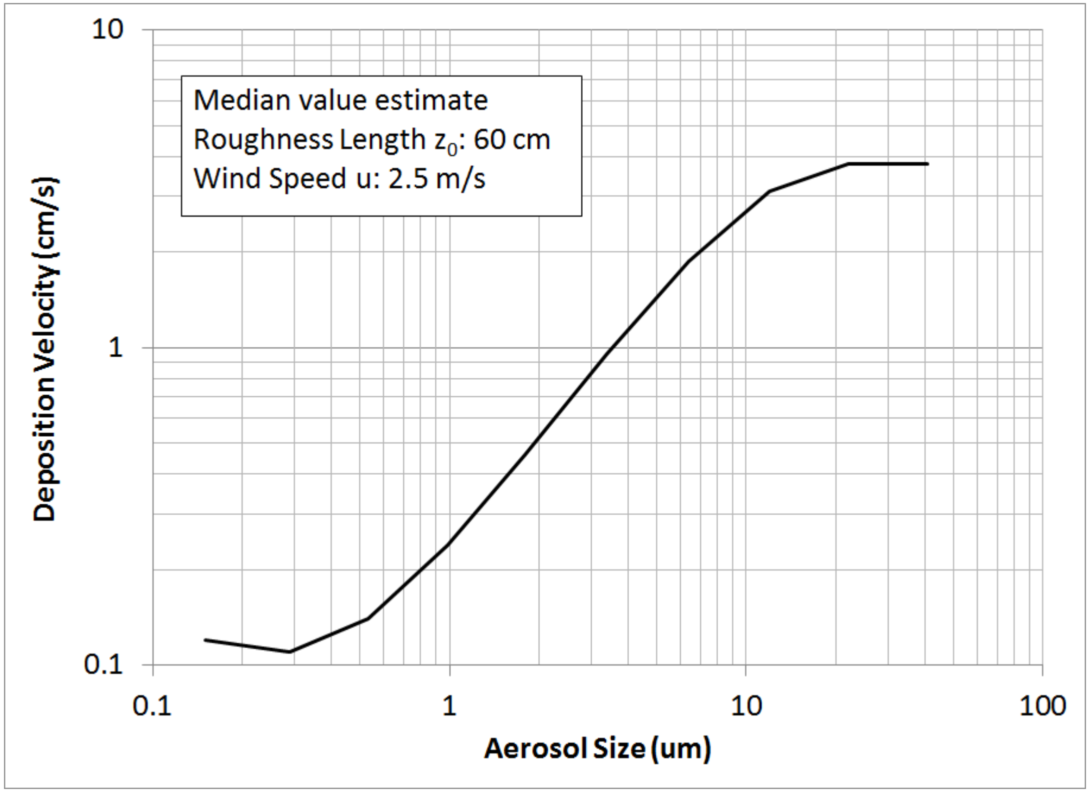


Annual wind rose at the 10-m measurement level based on 1998-2002 data
(*adapted from ESP ER Figure 2.7-2*)

- 1998 data selected as representative based on data recovery and precipitation record
- Boundary weather based on typical meteorology
- Weather sampling scheme

MACCS Input Model

Atmospheric Transport and Deposition (AT)



Dry deposition velocities based on NUREG/CR-7161 median value interpolation

- Examined alternate dispersion parameterizations
- Implementing time-based dispersion model per Hanna (2002)
- Surface roughness and dry deposition modeling

MACCS Input Model
(Protective Actions and Economic Factors (PA/EC))

- Discrete Populations
  - General public (0-10 mi, 10-15 mi, 15-20 mi), VEGP construction workers, SRS workers, shadow evacuees, Waynesboro area schools, non-evacuees
- Exposure and Shielding Parameters
  - Based on updated NUREG-1150 values for Grand Gulf
- Food and Water Ingestion
  - COMIDA food model coupled with agricultural countermeasures based on FDA recommendations for adults and infants

MACCS Input Model

(Protective Actions and Economic Factors (PA/EC))

- Protective Actions Considered
  - Sheltering and Evacuation
  - Early phase relocation based on EPA emergency phase PAGs of 1-5 rem over four days
  - Intermediate Phase Relocation - based on 2 rem EPA intermediate phase PAG for the year of the accident
  - Recovery Phase Interdiction – based on 500 mrem EPA intermediate phase PAG for years following the accident
  - Decontamination – reoccupancy based on 500 mrem EPA intermediate phase PAG
- Leveraging ongoing work to update parameters for decontamination plan and economic factors

MACCS Input Model

Dosimetry and Health Effects (DO/HE)

- Dosimetry and health effects models same as SOARCA
  - Dosimetry based on models from FGR-13
  - Deterministic health effects based on expert elicitation data (NUREG/CR-6545, NUREG/CR-7161)
  - Stochastic health effects based on FGR-13/BEIR V
- Updated documentation

Output Control

- Atmospheric Dispersion Data
- Health Effects Cases
- Early Fatality Radius
- Population exceeding dose (EARLY only)
- Population-Weighted Risk
- Population Dose
- Peak Dose on Grid
- Land Area Exceeding Concentration
- Population Dose by Pathway (CHRONC only)
- Economic Costs (CHRONC only)
- Affected Populations

Spatial Intervals for Output Control*

Radial Interval	End of Radial Interval (mi)
4	1
15	10
23	20
26	30
28	50
29	70
30	100
31	150
32	200
34	500

*Shaded areas represent tabulated intervals

Status and Challenges

- Status
  - Source terms from Level 2 analyses for Reactor At-Power, Internal Events and Floods received and imported
  - All MACCS input decks developed and undergoing review
  - Computational runs underway
- Path Forward
  - Complete internal technical review and self assessment
  - Finalize production runs
  - Coordinate output format with risk integration lead
- Challenges
  - Input data verification and checking
  - Input and output data management

Level 3 PRA Emergency Preparedness Model

ACRS

February 18, 2015

Randy Sullivan

Office of Nuclear Security and Incident Response

Objective

- Develop a detailed model of onsite and offsite emergency response for the Vogtle site
- Using the MELCOR Accident Consequence Code System (MACCS) translate emergency response model parameters into code input
- Support estimate of public health consequences

Emergency Preparedness

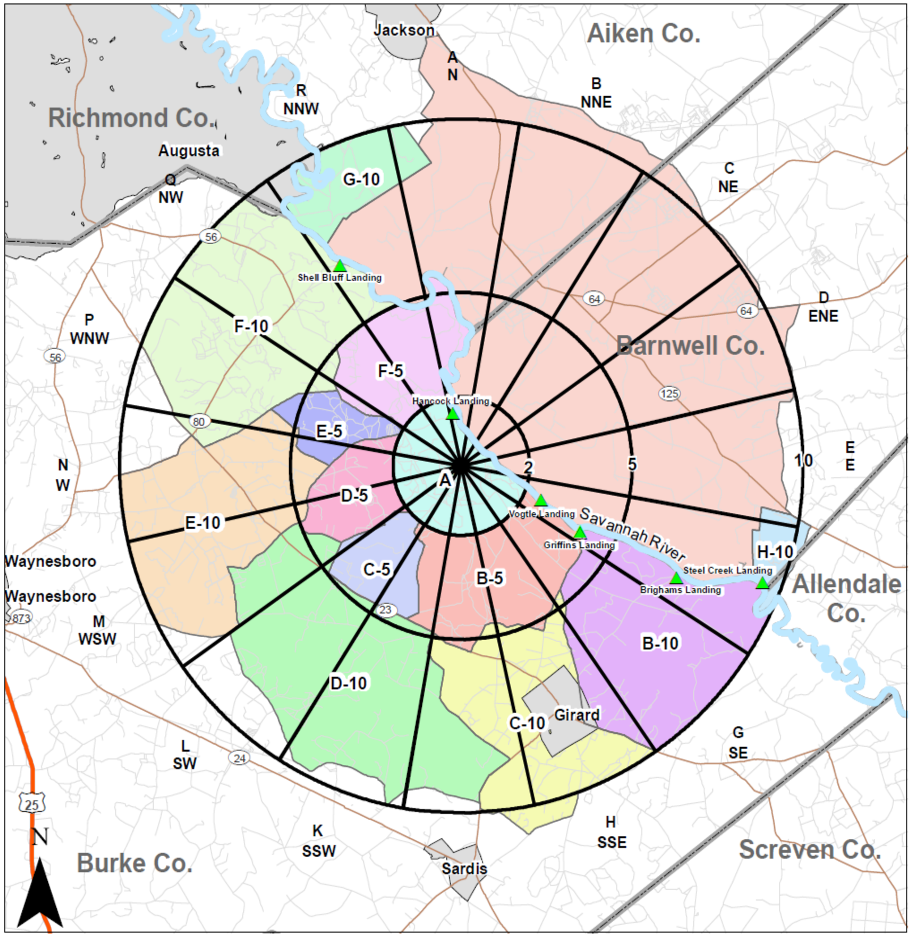
- Emergency Preparedness (EP) encompasses the plans and procedures implemented before, during, and after an incident
  - Onsite and offsite response procedures are approved, exercised and inspected
  - Emergency plans include an Evacuation Time Estimate (ETE)

Modelling

- Develop EP model consistent with MACCS Best Practices (NUREG/CR-7009)
- Review onsite and offsite emergency plans and response procedures
- Collect population data
- Review local infrastructure
- Obtain implementation timing history
  - Exercise after action reports and performance indicator data provide insight
- Recent MACCS EP model improvements:
  - Keyhole evacuation
  - Wind shifts
  - Predictive weather
  - Multiple cohorts

Overview of EPZ Characteristics

- EPZ encompasses parts of Georgia and South Carolina
- Savannah River Site (SRS) is largely located within the EPZ ~ 11,000 employees
- Small population in EPZ (~3500 residents)
- No schools or special facilities within EPZ
- Substantial roadway network



Vogtle EPZ

Information Gathering

- Met with licensee, state and county response organizations (OROs) to discuss planned response activities
- Met with SRS staff for cohort and evacuation data
- Drove the EPZ evacuation routes, bridge crossings and potential impediments and compared to ETE
- Used MELCOR accident parameters for timing of emergency classification declarations
- Met with licensee senior reactor operators to review classification timing

EP Model Input

- Convert EPZ information into EP model parameters
- Onsite and offsite response organization timing
  - Declaration of emergency
  - ORO notification
  - Activation of sirens
  - EAS messages
- Protective actions (shelter, evacuation, relocation)
- Site ETE provides demographics, response timing and travel speed

Sequence Specific Input

- Each accident sequence (Cases 1 through 8) was reviewed with the licensee to develop emergency declaration timing
  - EALs are classification criteria for declaring an emergency
  - Declaration provides timing of response
  - Declarations established for Cases 1 through 8 (and subcases)
  - 40 source terms were modeled

Evacuation Model Input

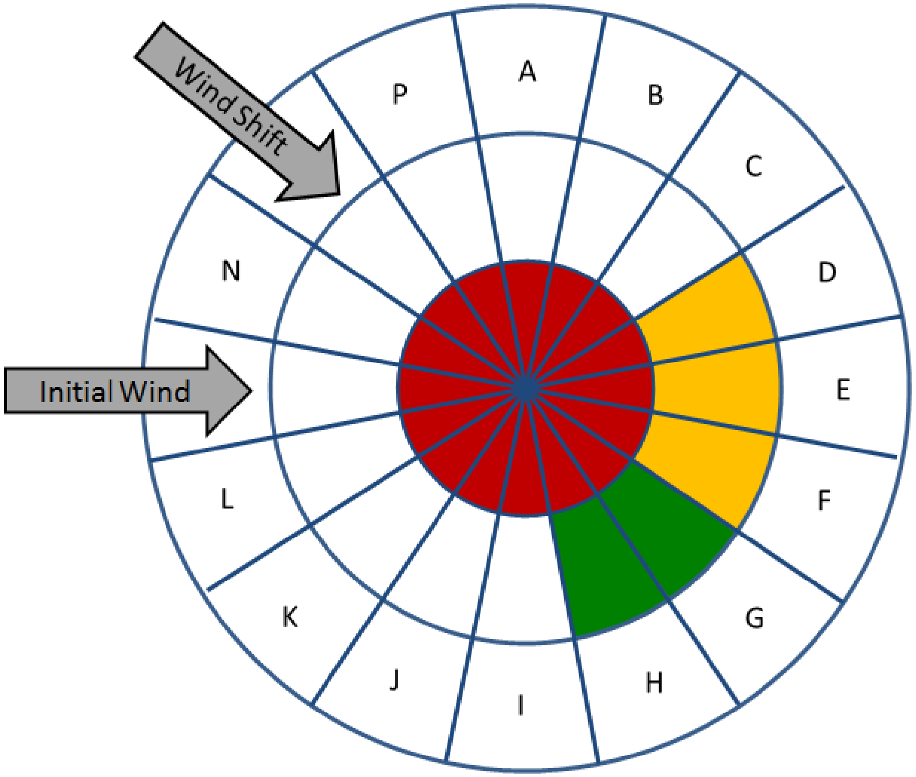
- ETE data for EPZ public response
- SRS data for cohort characteristics
- Developed ETE for areas beyond the EPZ (LSU – Dr. Wolshon)
  - NRC position that protective actions be taken beyond the EPZ if necessary (NUREG-0654, PRM 50-105 response)
  - Accomplished by county/state all hazard plans (NUREG/CR-6864)
  - Discussed with ORO personnel to gather timing information
  - Plant conditions or source terms examined for timing of expansion decision

EP Model Template

- MACCS templates were built to support:
  - 0-10 mile EPZ Evacuation
  - 10-15 mile Expanded Evacuation
    - EPZ evacuation, followed by 10 - 15 mile evacuation
  - 10-20 Expanded Step-Evacuation Model
    - EPZ evacuation, followed by 10 - 15 mile evacuation, followed by 15 - 20 mile evacuation
  - 10-20 mile Expanded Evacuation Model
    - EPZ evacuation, followed by 10 - 20 mile evacuation
- The templates optimized the input of parameters for each of the 40 source terms

Keyhole Evacuation

- Response plans use keyhole evacuation
  - Initial protective action 5 miles and 5 to 10 miles downwind
  - Expanded evacuation based on plant conditions and/or source term
- MACCS shifts keyhole when wind shifts occur
- Model allows forecasting of weather
  - Licensee and OROs use weather forecasts for expansion



Keyhole evacuation with wind shift Illustration

Cohort Descriptions

- Response of the public is modelled as cohorts (e.g., 0-15 mile model)

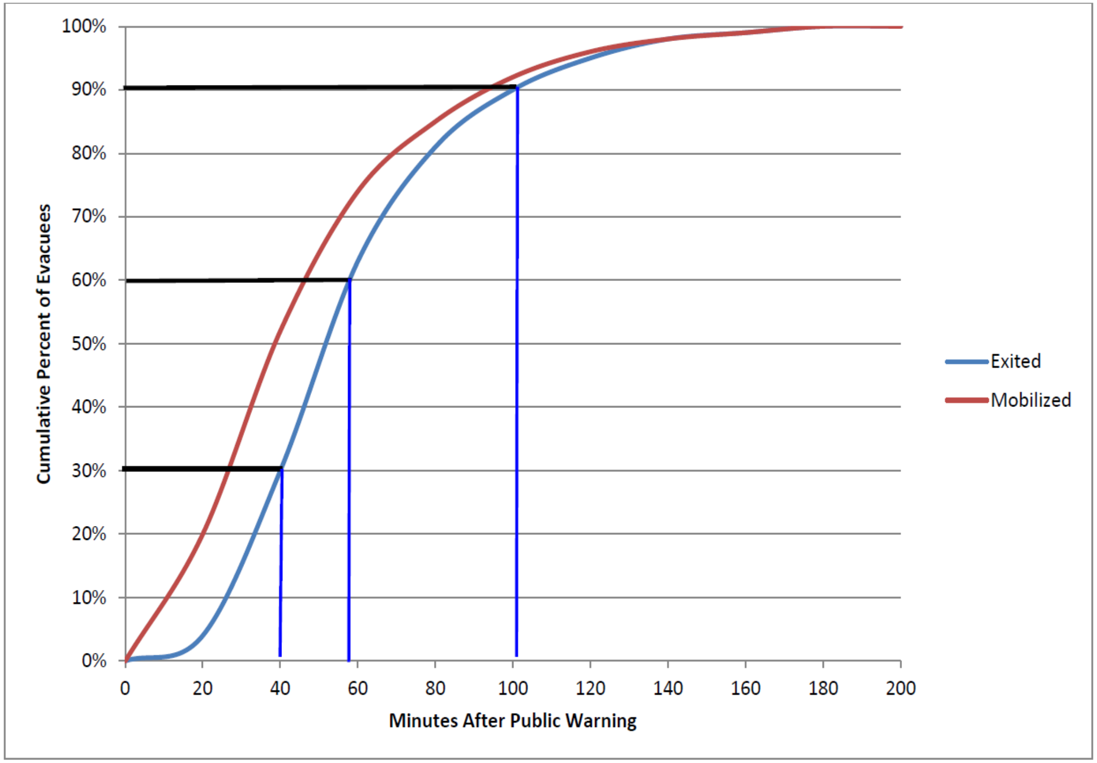
Cohort		Description
1	0-10 Public 1st group	The first group of the public to mobilize and evacuate.
2	0-10 Public 2nd group	The second group of the public to mobilize and evacuate.
3	0-10 Public 3rd group	Third group of the public to mobilize and evacuate.
4	EPZ Evacuation Tail	The tail makes up the last 10 percent of the general public in this area.
5	Savannah River Site	This includes the SRS employees located within the EPZ.
6	VEGP Construction	Construction workers are included in this group.
7	10-15 Shadow	A shadow population of 20% of the public within this area evacuates.
8	10-15 Public 1st group	This cohort represents the first group of the 10-15 public to mobilize and evacuate.
9	10-15 Public 2nd group	This cohort represents the second group of the 10-15 public to mobilize and evacuate.
10	10-15 Public 3rd group	This cohort represents the third group of the 10-15 public to mobilize and evacuate.
11	10-15 Evacuation Tail	The tail makes up the last 10 percent of the general public in this area.
12	10-15 Schools	Approximately 6,000 students attend schools in the Waynesboro area. For sequences where schools close normally and are not evacuated, the student response aligns with cohort 9 to reflect evacuation with parents.
13	15-20 Shadow	A shadow population of 20% of the public within this area evacuates.
14	Non Evacuees	This cohort represents those who may refuse to evacuate and is assumed to be 0.5 percent of the population.

Mobilization Curve

- Mobilization is the time required for the public to become aware of the incident and prepare to evacuate

Mobilization Curve from Vogtle ETE

- General public distributed among 4 cohorts
- Approximates mobilization curve

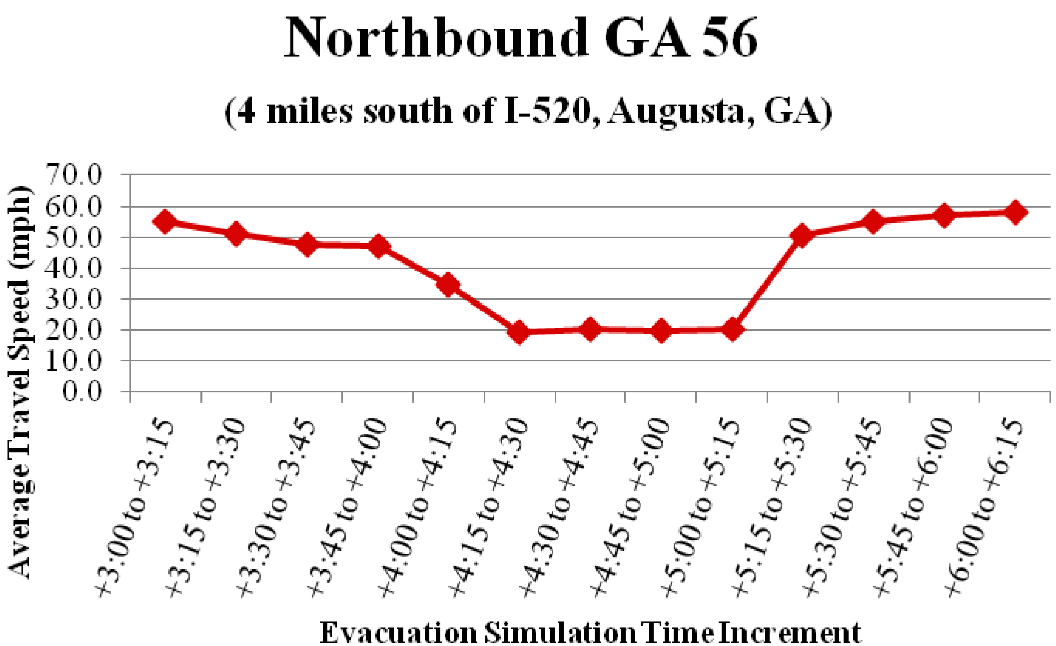


Mobilization and evacuation curve illustrating time to mobilize and time to exit the area

ETE Results in EP Model

- ETE identifies location and timing of congestion
- Speeds can be adjusted in MACCS to reflect congestion

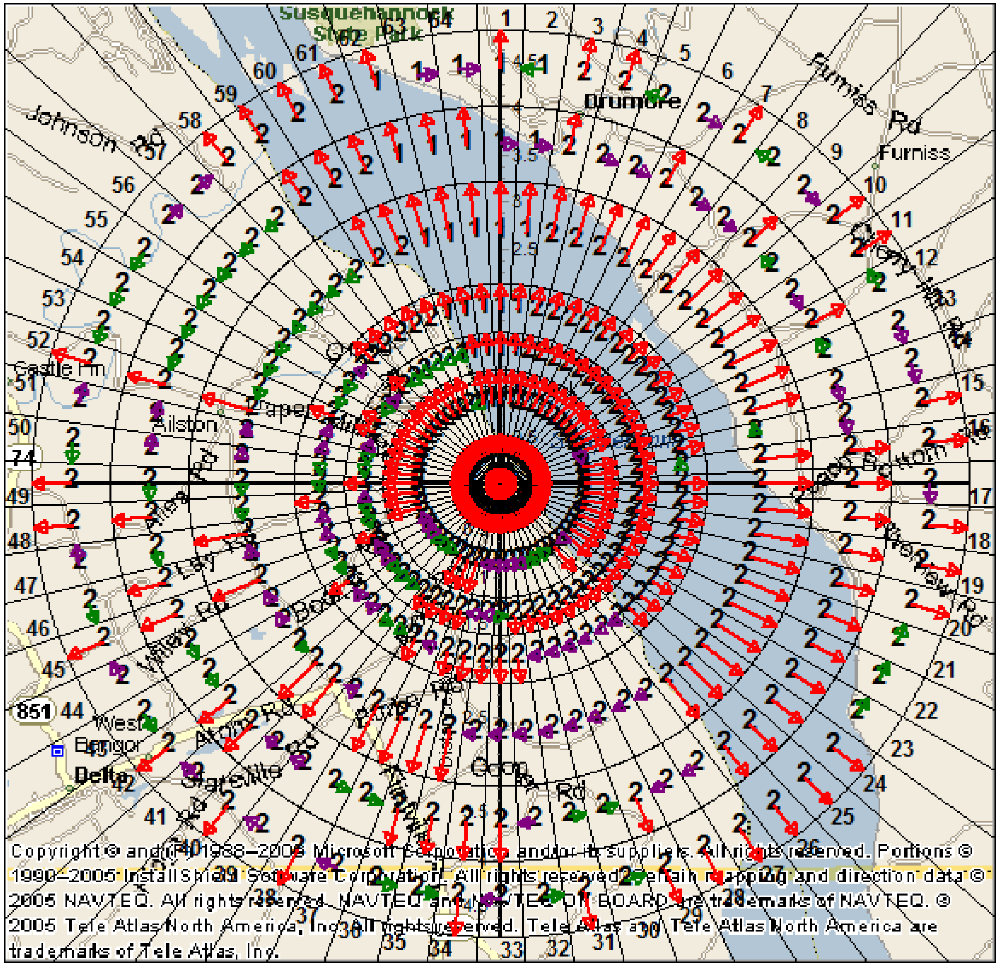
- On GA 56, evacuation beyond the EPZ congestion starts 3 hours after EPZ evacuation
- Speed is reduced during heavy travel
- Model in MACCS



Example of roadway congestion

Network Evacuation Model

- 64 sectors are used
- Cohort travel direction by grid element along evacuation routes
- Travel speed estimated from ETEs
- Speed multipliers modify estimated speed to account for congestion and free flow



64 Sector Network Evacuation Structure

“Hotspot” and “Normal” Relocation After Evacuation

Variable	Description	Vogtle
DOSHOT	Hotspot Relocation Dose Threshold	5 rem
DOSNRM	Normal Relocation Dose Threshold	1 rem
TIMHOT	Hotspot Relocation Time	Sequence specific
TIMNRM	Normal Relocation Time	Sequence specific

Challenges

- Model complexity
  - Effort exceeds benefit, e.g. travel speeds, cohorts
- Parameter value
  - Non-evacuating cohort
- ORO decision making
- Operational awareness after loss of instrumentation

Summary

- A detailed EP model was developed to represent realistic response actions
- The model implements latest MACCS features
  - Keyhole evacuation
  - Windshifts
  - Weather forecast
  - Multiple cohorts (19 cohorts used for the 0 to 20 mile expanded evacuation)
- A template structure facilitates modeling for L3 PRA

Questions?

Randy Sullivan

(301) 287-3716

randy.sullivan@nrc.gov