# Official Transcript of Proceedings

# NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
Reliability and PRA Subcommittee Meeting

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Wednesday, May 4, 2016

Work Order No.: NRC-2347 Pages 1-192

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

# DISCLAIMER

UNITED STATES NUCLEAR REGULATORY COMMISSION'S ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, as reported herein, is a record of the discussions recorded at the meeting.

This transcript has not been reviewed, corrected, and edited, and it may contain inaccuracies.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

RELIABILITY AND PRA SUBCOMMITTEE

+ + + + +

WEDNESDAY

MAY 4, 2016

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:31 a.m., John W. Stetkar, Chairman, presiding.

COMMITTEE MEMBERS:

JOHN W. STETKAR, Chairman

DENNIS C. BLEY, Member

RONALD G. BALLINGER, Member

MICHAEL L. CORRADINI, Member

DANA A. POWERS, Member

HAROLD B. RAY , Member

JOY REMPE, Member

DESIGNATED FEDERAL OFFICIAL:

JOHN LAI

ALSO PRESENT:

HAROLD BARRETT, NRR

ERIN COLLINS, Jensen Hughes

SUSAN E. COOPER, RES

STACEY HENDRICKSON, SNL

J.S. HYSLOP, NRR

JEFF JULIUS, Scientech*

ASHLEY LINDEMAN, EPRI

MARY PRESLEY, EPRI

MARK SALLEY, RES

JEFFREY STONE, Exelon

ANDREA VALENTIN, Executive Director, ACRS

JOHN WREATHALL, John Wreathall & Co., Inc.*

*Present via telephone

A-G-E-N-D-A

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 Harold Ray, Dana Powers, Mike Corradini, Dennis Bley, Ron Ballinger and Joy Rempe.

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

The subcommittee will hear discussions of a draft report on human reliability analysis and probabilistic risk assessment on the treatment of scenarios that require main control room abandonment in response to a fire event, so-called Supplement 1 to NUREG-1921.

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

We have received no written comments or requests for time to make oral statements from members of the public regarding today's meeting, and the entire meeting will be open to public

attendance.

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.

The participants should first identify themselves and speak with sufficient clarity and volume so that they may be readily heard.

I remind everyone to check your little phones, beepy devices and other things. Turn them off, please. If they beep during the meeting I will smash them with my gavel. It says that, right here.

Before we proceed with the meeting I

understand that Dr. Powers has an introductory remark he'd like to make. So, Dr. Powers.

MEMBER POWERS: Yes, Mr. Chairman. I have an acquaintance with one of our presenters, Ms. Hendrickson. She used to share an office next door to me until I was able to drive her away with my general level of obnoxiousness.

I have no particular knowledge or involvement in this work. I will be happy to share with the members during the breaks various colorful anecdotes about Ms. Hendrickson that should reveal some of her technical qualifications.

CHAIRMAN STETKAR: And for the record, knowing your stellar personality you said before you could drive her away. That means you overlapped about 10 minutes.

MEMBER POWERS: I think it was not quite a year. It took me awhile. It was your buddy in crime that I got rid of really well.

CHAIRMAN STETKAR: I'll remind you all, for those of you who haven't been here very frequently or may have forgotten when you speak push the -- right on the base of your microphone. Turn it on. When you're not speaking leave it off. That helps the transcript because -- and also any

members of the public that may be out on the bridge line.

And with those introductory comments we will now begin the meeting. And I'll turn it over to Susan Cooper. Susan?

MS. COOPER: Good morning, everyone. Thank you for the opportunity to be here this morning with you. My name is Susan Cooper. I'm from the Office of Research and I'm here with fellow members of my team, or parts of the team that will be presenting today on Supplement 1 on NUREG-1921 which is focused on qualitative guidance for HRA, specifically for the context of main control room abandonment scenarios.

Other speakers today are up here at the table with me with one exception. My counterpart from EPRI, Ashley Lindeman here, and then Erin Collins from Jensen Hughes, a contractor to EPRI, and then Stacey Hendrickson, Sandia National Labs, contractor to NRC. Mary Presley, also from EPRI, is here at the table.

We'll introduce the rest of the team later. I know that there are a few on the line and I see one just walking into the room.

CHAIRMAN STETKAR: By the way, anybody

up front, if you need input from anybody on the line we can get it open. We just keep it muted because of pops and crackles and things.

MS. COOPER: Thank you. Excellent. We expect to have two people on the line although we didn't actually confirm that this morning. But we expect that there are two of our team members on the line.

Just as a preliminary, this presentation today is information on an ongoing research project. The report that we sent you and the associated slides represent an interim project of this research that builds on previous research projects of this team and other research, and also builds on experience in the NFP-805 fire PRA submittals and experience using 1921.

MEMBER REMPE: Susan, for context could you remind us where we are on the NFPA submittals, 805 submittals? How many have been submitted and how many are coming in.

MS. COOPER: I think my colleagues from NRR, one of them probably can answer that question better. And we've got two of them here today. It looks like J.S. Hyslop is going to handle that one.

MR. HYSLOP: Yes, my name is J.S.

Hyslop. We've issued 18 license amendments and we've got 9 under review.

MEMBER REMPE: Okay, thank you.

MS. COOPER: Yes, I guess to that point one thing that's a little bit different for this particular report from 1921 is that this is in some ways a knowledge capture as well as some research as opposed to when we were developing 1921 that was kind of alongside of the experience of developing those submittals.

CHAIRMAN STETKAR: Susan, before you start I might as well get it out on the table first because you left me an in. You said it builds on previous research and ongoing research.

Why does this report not even mention anything about ideas or the fundamental basis for ideas? Since that is a joint EPRI-NRC project on human reliability analysis methods that would seem to apply to these situations.

MS. COOPER: So, there is a reference to NUREG-2114.

CHAIRMAN STETKAR: I'm sorry, I couldn't find it.

MS. HENDRICKSON: That's primarily in the PSF section. So that's where it's referenced

is in the PSF.

CHAIRMAN STETKAR: I didn't look at the references in the PSF section.

MS. COOPER: Right.

MS. HENDRICKSON: And then it also comes up some in the Appendix B, the command and control.

CHAIRMAN STETKAR: It references a paper. I'm sorry, I looked for it there and it wasn't there.

MS. COLLINS: It should be there.

CHAIRMAN STETKAR: ATHEANA is referenced heavily there. There's a 2011 paper that is the old Ali Mosleh approach to life that's referenced there. That has been superseded.

So my question is if you don't want to acknowledge it we have a problem.

MS. COOPER: Okay.

CHAIRMAN STETKAR: If you do want to acknowledge it my recommendation -- this is subcommittee meeting -- would be to rewrite Appendix B and in Appendix B explain the mapping from ideas to what you're proposing here. And I think that might work.

MS. COOPER: Okay. I'm glad to have

that input.

The command and control appendix, Appendix A as I recall, is one of the most recent developments in this research in the sense that the team kind of came to the realization that we needed to write something about that.

I have done some recent outreach to other colleagues in my branch in the Office of Research, and that includes Jing Xing who you see here sitting in the audience.

And I've discussed with her and with others and also with some folks from Halden about this topic.

With respect to ideas specifically I would say that until yesterday I didn't have a version of the report that I knew would be reference-able.

We have -- I mean I know that as recently as last November I think I met with Jing and also Kendra Hill who I think might be -- Kendra's here.

We met to talk about some of the work that they were doing on performance shaping factors to see if it would be related. But that was a work in progress.

But I would be delighted to reference that work.

CHAIRMAN STETKAR: But it's not just the command and control, it's, as Stacey mentioned, the whole construct of how did you get to the specific set of performance shaping factors, the 10.

Now, there's a legacy from 1921, but 1921 is now old news. IDEAS references 1921 as one of the things that the IDEAS developers thought about and borrowed things from as part of the amalgamation of good practices if you will.

But that was then and we're now in an environment that has at least a framework that says, well, if you want to use a general methodology that's proposed in IDEAS for a focused application there's sort of a thought process that one goes through.

And that thought process winnows down sort of the general concepts down to, well, these are the things that we think are appropriate for this particular application.

There's already a demonstration of that in the EPRI report. Not sure yet whether it's going to be an EPRI-NRC report, but at least the

EPRI guidance for full power, whatever it is, internal events, procedure driven, at power if you can narrow yourself down into that little box application.

But I think going forward if we're going to actually -- and the reason I bring this up is that the ACRS is jointly on the hook with the NRC staff to support the development of this new methodology.

So I think anything in the HRA area if indeed that methodology is to gain any type of recognition and acceptance from this point going forward ought to at least acknowledge it.

MS. COOPER: I agree and I just this morning printed the thing out because I was -- I've been asked to be a peer reviewer for it.

MEMBER REMPE: I have a question. And I'll acknowledge up front that I did read the reports that you submitted, and I am not an expert so probably I don't understand and shouldn't be reading this report based on what it was for.

But as a person who's trying to understand, when I looked through what was in your report and when I hear John's comment about IDEAS with your familiarity of what's been proposed in

IDEAS what exactly would you use from the IDEAS methodology that would help you do what you've documented in these reports?

(Simultaneous speaking)

MS. COOPER: So, I haven't yet looked at the most up-to-date version. I looked at some tables regarding performance shaping factors sometime last fall and I've read versions of it earlier.

From my standpoint whenever I'm using guidance like that, generic guidance, and I'm looking at a particular context I want to make sure that I'm filtering and tailoring things to fit that particular context.

So, in particular when looking at the tables that Jing and I discussed some months ago my first idea was, okay, if we had events what I'd want to do would be to look at event histories and stuff like that and see how things that happened in events actually were played out or connected with performance shaping factors.

In fact, we did do something like that in ATHEANA.

We don't have events per se for main control room abandonment. We have limited history

there.

So what we do have, however, is the experience of the team members in doing analyses, in particular talking with operators and other people that are trying to prepare for these kinds of events.

It's not documented in this current version of the report, but we did conduct on the order of six different interviews of NRC staff across various offices here who have previous operating experience to discuss what they were familiar with respect to planning for main control room abandonment at the specific facilities that they were familiar with.

So that's our operating history basis. So that's what I would say is I would understand the context and the operating history, and then compare that to --

MEMBER REMPE: But didn't you already do that in this report? I mean, so what I'm looking for is what's new about IDEAS that would make this methodology you've proposed better.

MEMBER BLEY: Let me jump in a little bit. It isn't so much what's new, it's do we have an overall HRA framework within which all of the

HRAs that are going on can live and interact.

MEMBER REMPE: So if I were Susan trying to address this --

MEMBER BLEY: That fits with the last letter we wrote in this area very closely. And we talked about how that interacted between the full power, at power HRA at that time. This is another special application. So that's all I wanted to slip in there.

CHAIRMAN STETKAR: Joy and Susan, you folks need to understand, it's obvious that you've not read any of the material -- other than Stacey -- any of the material that's been developed for IDEAS.

It's obvious because when you try to answer my questions you focus to operator interviews, you talk about operating experiences.

IDEAS is a framework. For example, they talk about mental models for the way the world works. I don't see much discussion of this.

Is that important? I don't know. But that framework says you need to challenge for your particular application if that is important. And if it's not you need to justify why it isn't.

Because if it is you need to somehow

account for that. You need to set your framework, whether it's performance shaping factors, or the way you organize your thought process for modeling pre-response in that context.

And that's that funneling down from saying here's what we understand about human performance, here's a construct, a general construct that's been laid out, and now when you try to apply this generality which you can never -- it's too broad.

When you try to winnow it down to what elements of that general approach do you need to think about carefully for this particular application there's a process of doing that.

And yes, we need to account for these elements. No, in this particular situation we don't.

For example, in the full power internal events whatever the heck it is procedures are really important. Some of the other elements aren't. And there should be justification of why that is.

And there may very well be things that are important in this particular application you haven't thought about. That you haven't thought

about because you've approached it from the traditional way of thinking about this. You have.

MS. HENDRICKSON: So, let me say one thing as well.

So, Appendix B, you're absolutely right. So the language that's in there isn't inconsistent with 2114.

But what hasn't been done, so what we can go back and do, is the situational factors that are in there currently kind of jump right to the PSFs.

And so showing that linkage to the proximate causes as well as the cognitive mechanisms, that can be done.

CHAIRMAN STETKAR: I think you can make it work in Appendix B presuming that the set of PSFs actually fall out of that process in a logical manner.

I think you can work it in Appendix B without rewriting the whole report.

MS. HENDRICKSON: Right. But then I think that can feed back to the PSF chapter even.

(Simultaneous speaking)

CHAIRMAN STETKAR: I'm not writing the report, but ways of kind of getting around this

without jacking up the title and putting a new body on it.

MS. HENDRICKSON: Like some of the discussion, and we'll get into this a little later as well. Some of the discussion that's in the tables at the end of the PSF chapter which start getting at how can we help analysts in deciding what the relevant PSF is that they should be looking at.

What are some of the other qualifying factors.

That's where I think we can really show that linkage and come in strong.

CHAIRMAN STETKAR: And point them to Appendix B where there's a more --

MS. HENDRICKSON: Exactly.

CHAIRMAN STETKAR: I had to get that out somewhere, sorry.

MS. COOPER: I understand.

MEMBER BLEY: While we're on high level, a quick question. I don't remember how we and you disposed of this back on the original methodology, but I don't see, and I'm still not sure if there are anymore.

Susan, are there anymore SISBO plants

around? And if there are, there ought to at least be lip service to the fact that that could matter here.

Unless you would argue that that's already been -- if you didn't get through that part using the original methodology you wouldn't get to it for a control room event.

MS. COOPER: A good question. We have not returned to that.

I do know from some of the assistance I've given to NRR and the NFPA 805 process that some of the remaining SISBO plants are transitioning. And in some cases that's because of the kind of feedback to operations from HRA that has been possible --

MEMBER BLEY: My only thought here, and that's a self-induced --

MS. COOPER: Ashley and maybe Harry or J.S. might be able to answer that question.

MEMBER BLEY: Well, I don't think we need that. Self-induced station blackout is what that stands for.

MS. COOPER: Right.

MEMBER BLEY: At least it seems to me there ought to be a sentence that says if you're

one of those guys you need to go beyond what we've got here. Something.

MS. COOPER: Okay.

MEMBER BLEY: Just a warning.

MS. COOPER: Yes. We are constantly struggling as you might imagine with scope and variety of specific plant variations. We can certainly add something.

MEMBER BLEY: But that's a pretty significant one if that's still around.

(Simultaneous speaking)

MS. COLLINS: I think over time -- you know, originally --

MEMBER BLEY: But you're writing a methodology that people might use next week.

MS. COLLINS: Understood, understood. But I think the learning curve has been such that even when we get to a plant that we're analyzing that may have started out with SISBO all over the place they have learned.

Now that we're in the process of revising our procedures so this will no longer be an issue.

But you're right. I mean, just for --

MEMBER BLEY: That's my hope

eventually. I don't know how far along that process is.

And at this point if the others want to say how far along that is that would be great.

MS. COOPER: Apparently they don't. Wait a minute, Harry's changed his mind.

MR. BARRETT: Harry Barrett, NRR Fire Protection.

We've encountered probably five or six plants in the 805 process that have transitioned away from SISBO completely.

But there are still some deterministic plants that are doing that. And if they were to do a PRA they would end up struggling with how to deal with that for sure.

MEMBER BLEY: I think so. Thanks, Harry.

MS. COOPER: Thanks. We can certainly add something. That's a good point.

All right. I think I'm ready for the next slide.

CHAIRMAN STETKAR: Well, but just on high-level generalities. I brought up the IDEAS because obviously ACRS is heavily invested in that. Other elements of Research are heavily invested in

it.

As a general comment I thought the report was well done, by the way. I think that it hit a lot of the issues and presented them quite well in terms of trying to remind analysts what they ought to think about.

This notion of if we've got, you know, 99 operating units out there you might have 99 different philosophical approaches to how you might approach this. I'm not sure whether two units co-located at the same time would have different ones, but they might if they kind of work different.

So, and I thought reading through the whole report at a high level, I thought it was done really well.

Because I tried to read through it in terms of picking it up as an analyst giving me guidance about what I ought to think about and issues that might be a little different than what I thought about in previous applications.

So I did want to give you that kudo also up front.

MS. COOPER: Thank you. Appreciate that very much.

CHAIRMAN STETKAR: And now you can get

to slide number, what is it, 2.

MS. COOPER: Outline for the rest of this morning. Ashley's going to give a brief history of the project and some background, and identify the full team.

I'm going to then talk about the overview section in the report.

And then the selected topics that we'd like to try to address for the rest of the morning have to do with PRA modeling, the decision to abandon, feasibility assessment, timing and timelines, influencing factors, feedback to operations.

And then we'll give you a brief status and discussion of our future work.

And so now I'll turn it over to Ashley Lindeman.

MS. LINDEMAN: Sure, thanks. So, as we mentioned we're here working on research to quantify the risk from abandonment in fire scenarios.

In fire there's two different ways that we postulate the control room be abandoned.

The first one is due to habitability. So this is when smoke or fire combustion products

really challenge the environment of the main control room and the operators need to leave.

And that criteria is pretty well established in 6850.

The other way to abandon is on loss of control. That's when you may lose instrumentation or equipment and there's a decision to be made to leave and shut down from --

CHAIRMAN STETKAR: Ashley, are we -- I have to admit ignorance here because I didn't get a chance to read through your slides first.

So, are you going to get back to the loss of habitability criteria later?

MS. LINDEMAN: There is a slide a little bit later, but it's not really explained in much detail.

CHAIRMAN STETKAR: In the slides?

MS. LINDEMAN: Yes. I'd be happy to explain it now.

CHAIRMAN STETKAR: When is it better to discuss that? Later? Do you want to get through the intro now?

MS. LINDEMAN: Oh no, just ask away.

CHAIRMAN STETKAR: Okay. I had a real problem. Again, this is a high-level issue.

I for the life of me cannot understand why I should not as an analyst treat loss of habitability in precisely the same way as you lay out for loss of control.

I thought your loss of control discussion. Now I'm talking about high. You want to talk about details, we'll talk about details.

But at a high level I just don't understand why loss of habitability is fundamentally different from all of the good guidance that you have in there for things to think about and uncertainties, crew dynamics, decision-making, criteria, cues for loss of control.

So, if you could explain to me why it is fundamentally different we can get that out of the way.

MS. LINDEMAN: Sure. It was recognized early on in the project that it's very difficult to define loss of control. And there's really no guidance in any of the fire PRA reports. So that's something that we took on that we thought would be valuable to really suss out what would cause a loss of control.

So I guess our approach was what was published in 6850 and EPRI 1011989 had a pretty

rigid set of criteria. Smoke obscuration, heat flux. Also when the smoke layer descends to 6 feet, irradiates around 200 degrees. And that translates to visibility and seeing a light-emitting object.

CHAIRMAN STETKAR: Yes. That -- I probably will leave before I die, but maybe I won't.

The real question is when do people decide when it's so unbearable that they have to leave, and what do they do between the time that they get to that decision and the time when things start to get really messy in the control room.

And if I'm in a control room and it's starting to fill with smoke I'm probably going to have people trying to get the smoke out of there. In fact, I might be trying to get the smoke out of there because I know that I've got an hour to get aux feedwater back. So maybe it's more important for me to hook up a fan -- me to hook up a fan to get the smoke out of there.

How does that affect your decision on when to abandon and what to do during that interim period? And what is the time from the beginning of what you call phase 2 to the end of what you call

phase 2? Wherever you define that time window.

MS. COLLINS: Well, I would say rightly or wrongly the way it's handled currently in fire PRA --

CHAIRMAN STETKAR: And it's wrong.

MS. COLLINS: -- is saying if you meet these criteria and --

CHAIRMAN STETKAR: Yes, 200 degrees. If it's 200 degrees and my skin is starting to smoke I might leave. I probably will leave before then. Maybe I will.

In fact, maybe I might leave as soon as I see smoke coming in which is worse because in these scenarios by doing that I might extremely limit my options after I leave.

So leaving prematurely in a sense could be worse than waiting until my skin starts to smoke.

So, I honestly didn't see philosophically any difference between this notion of how do I determine that my indications, controls, so forth for loss of control have deteriorated far enough that somebody says okay, it's too late, we've lost control. We need to leave.

That's a difficult situation compared to the environment is so bad that we need to leave, or that we're so absorbed with trying to retain some barely tolerable environmental conditions that we're ignoring a whole heck of a lot of other things.

I just don't see it philosophically as any different. Because those criteria, and I'll read them so that we have them on the record. The heat flux at 6 feet above the floor exceeds 1 kilowatt per meter squared. Relative short exposure. This can be considered as the minimum heat flux for pain to skin.

Approximate radiation the smoke layer as -- I won't read the equation -- a smoke layer of around 95 degrees C, 200 degrees Fahrenheit could generate such heat flux.

Yes, if it's 200 degrees it's probably not a good day.

The smoke layer descends below 6 feet from the floor and optical density of the smoke is less than 0.3 -- it says per meter, but it's -- with such optical density light-reflecting object would not be seen if it's more than 0.4 meters away. A light-emitting object will not be seen if

it's more than 1 meter away.

So, if I can't see something more than a foot in front of my face I have to leave. It strikes me that those might be the absolute worst latest time that I might decide to leave the control room.

I might decide to leave earlier. I might also be doing other things earlier.

And I don't want to get into the details despite the fact that I've mentioned them.

MEMBER BLEY: You just did.

CHAIRMAN STETKAR: No, because I wanted to get it on record. Because everybody refers to those are very clear criteria written in NUREG/CR-6850 by folks who obviously do fire modeling.

They are not operations people. This was not written by operations people.

The other criterion, by the way, that you did not cite for loss of control which was curious is a fire inside the main control board damaging internal targets 2.13 meters (7 feet) apart.

Well, that sounds like a criterion for loss of control to me, doesn't it? You didn't cite that one.

MS. LINDEMAN: No.

CHAIRMAN STETKAR: No.

MEMBER CORRADINI: Can I ask a question? Since I'm here to learn, but you guys are -- if this is the high level I can imagine what the weeds look like.

I'm struggling with Ms. Collins' comment that currently -- I don't remember how you said it, but what I heard is currently there are certain procedures.

And then John's comment back is the current procedures or operational actions are wrong.

So my question is is his observation correct? And maybe I misheard it. I just -- you made some sort of comment currently we're doing X. And John said X is wrong.

MS. COLLINS: Well, currently what we're doing is we're basing the -- we're saying that the decision to abandon is relevant to loss of control, but the decision-making part is not modeled for loss of habitability because the presumption is once you reach these criteria that the control room is no longer habitable and the operators will go.

MEMBER CORRADINI: So, let me ask -- again, I know this is more of a research topic, but so currently if I'm an operator how am I trained relative to abandonment of control room?

(Simultaneous speaking)

MEMBER REMPE: -- more specific on page 49 out of 242 under the section Abandonment for Loss of Habitability it has here in general plant procedures and training provide specific cues to indicate an abandonment condition.

So, to be more blunt, what is -- I mean, there's been some of these submitted. What's in the procedures and training?

MS. COLLINS: Well, that's a general issue in terms of what cues are provided for abandonment in procedures whether it's on the basis of habitability or control.

And what we have found is a lack of clarity of cues. And that's why the main control room abandonment risk assessment is so key in the HRA, because we can help to provide that clarity of when a person gets to a procedure and it says the decision to abandon the control room will be made by the shift supervisor based on -- and we're not sure. That may be dot dot dot there.

That is how the main control room abandonment HRA can provide significant benefit because we speak with people. We look at their training. We look at the simulator exercises and see how much guidance is given to the shift supervisor to make that difficult decision.

MEMBER REMPE: And what are you seeing for the guidance?

MS. COLLINS: Not a lot.

MEMBER REMPE: He's saying that he's reading from 6850 or whatever.

CHAIRMAN STETKAR: But remember, 6850 is a NUREG that was written primarily by people who model fires, especially this section. It's a research fire-oriented -- it has nothing to do with real world operations in that area.

MEMBER REMPE: How do I have confidence in what's been submitted?

CHAIRMAN STETKAR: Don't refer to it as procedures. It's not.

MEMBER REMPE: It's in here as procedures.

CHAIRMAN STETKAR: No, as Erin said and Ashley said, what people are doing today is they're having fire modelers start a fire in the control

room.

And when the fire modelers say conditions get to A or B or in principle C people leave. No uncertainty. They do not leave before that and they are absolutely certain to leave at that point. That's all the PRA is doing today.

It has nothing to do even with procedures.

MEMBER REMPE: How do I have confidence in what's been submitted if you're reviewing it when there's no criteria for when they leave or not?

MEMBER CORRADINI: So, can I just ask Joy's a question a different way?

You guys are way into it better than I, but I'm missing the linkage between what is currently being trained on and what this is going to improve.

Now, you're saying it's a fire-related. Okay. But it seems to me there are -- so maybe there's 99 different ways in which the operators are trained on.

I bet you it's fleet-related. So if I look at the 25 Exelon plants there's a common training platform.

So, what is that training platform? Are they aware of the fact that it's uncertain? Do they want improvements?

For example, I'd be curious what the owners groups are saying relative to what EPRI is doing with the NRC on this.

This sort of context, maybe John gets it, but it's beyond me at this point.

MS. COOPER: So, one thing that is important to understand is that any operator today doesn't believe this is going to happen. And they've never experienced it. And the notion of leaving is bizarre.

For the most part training with respect to main control room abandonment starts with you've just decided to abandon. Exercise this procedure to show that you know how to abandon.

The guidance, whatever procedure there is for abandoning says something like it is at the discretion of the shift supervisor to decide to leave on (a) habitability, (b) loss of control, (c) security event, (d) toxic gases. I mean, there's a list. It's not just fire.

So, with respect to loss of control, and we're going to talk about this some more and

the decision to abandon and also on feedback to operators, Jensen Hughes in particular has been able to convince specific utilities that it would be operational beneficial to them to change their procedures to identify specific cues for loss of control.

You're right, we could do it for habitability. At this point in time making that argument that you need to change your procedure to say, okay, you need to -- right now we're mostly assuming that if they can't see they will leave.

But you're absolutely right. Someone could have passed out before they made the decision to leave because there are individual differences.

MEMBER BLEY: And there are two sides to this. John's been talking about the habitability one.

With these engineering kind of criteria which aren't operational.

MS. COOPER: Right.

MEMBER BLEY: By the time you hit those either you've left or you're no longer running the plant. I mean, they're really severe.

You could leave a lot earlier. He's expressed worry about that.

The opposite side is you can wait too long. I think my own inclination is this is the place that I can run the plant best of all, and I wouldn't leave it until I was driven out.

MS. COOPER: Yes, we've heard that. Everybody says that.

MEMBER BLEY: And that's kind of a wide range.

MS. COOPER: Absolutely. We've heard different philosophies altogether about what that process would be like.

CHAIRMAN STETKAR: See, my point is that in the report, as I read the report the discussion brings out both of those concepts in the loss of control.

It says well, if I leave too early I might have been able to salvage things in the control room because -- using alternate systems even. But I don't have the option to use once I leave because of my plant-specific configuration.

Or, I might wait too long such that I don't have enough time left to save the plant with what I have available out there at the remote shutdown panel.

And the whole discussion about that

loss of control concept brings out all of those. Brings out the too early, brings out the too late, brings out the ying and the yang of should I stay, should I not.

I don't see why it isn't directly analogous to the loss of habitability.

MEMBER BLEY: Well, you just have engineering criteria which are essentially the point at which you can't do it anymore from there. I'm sorry, go ahead.

MS. LINDEMAN: I just want to say loss of habitability also has many flavors. There could be a fire in the weather panel and that may not damage anything that we need for safe shutdown.

And the other extreme is it could be a fire in the main control board.

MEMBER BLEY: But that's the kind of thing that isn't there. And I agree with John on that.

And the other thing is you haven't made those engineering criteria operational, related them operationally to show that the same kind of things are going on in that area as they are in the loss of control area.

CHAIRMAN STETKAR: See, it's one of

these things where I mentioned that third bullet. You didn't rely on the third bullet about the 2.13 meter size of a fire in the main control board because that's the surrogate for loss of control in 6850. Again, not from an operational perspective at all. From a fire modeler perspective.

You didn't do that. Correctly so. Correctly so.

MS. LINDEMAN: Right, it's very difficult to model the fire spread especially within a --

CHAIRMAN STETKAR: I'm not a fire modeler. I don't want to talk about fire modeling. I'm talking now about structuring guidance for people thinking about an environment in a control room.

MEMBER BLEY: And what people will do.

CHAIRMAN STETKAR: And what people will really try to -- try to do. Let's say that.

And this kind of artificial difference that you've created between habitability and control, I think it's clear from my perspective ought not to exist.

I think you could write the guidance exactly the same way and make it make a lot more

sense by not creating that artificial difference and say look, in fact there's a range.

There's things that might affect only habitability because it's smoke coming in through a ventilation duct and it has nothing to do with a fire physically in the control room envelope all the way to a situation where, I don't know, I've got loss of control again because I have a fire completely outside of the control room with no environmental effects that is causing instrumentation to go wacko, to anything in between where I have a fire in the control room that may or may not affect the controls that I need to use to save the plant that's also causing smoke and heat.

But I don't care in some sense about guidance to an HRA analyst of which of those specific conditions I have because you're going to have -- in principle at any given plant you could have several different flavors of those conditions given the scenario.

It's important for the HRA analyst if the need to abandon the control room arises and I have cues for them to identify what those cues might be regardless of whatever combination of stuff is going on.

MS. COOPER: And I think that's what happens ultimately is if you -- you were speaking about correlating it to the criteria that would require them to go on an operational basis.

And so in a sense what you're going to be defining for loss of control may then also apply to a loss of habitability where your fire is still taking out essential equipment, and you're stipulating here is the type of equipment loss you would see, or instrumentation loss you would see that should motivate you to go.

So, perhaps you could even say that what we're stipulating for, loss of control, would also apply to those scenarios for loss of habitability where you're taking things out from an --

MEMBER BLEY: The only problem with habitability is I can no longer control the plant from the control room. It is a control issue.

CHAIRMAN STETKAR: And -- yes. It's a different way of control. I can't drive the car because my windshield has become completely black.

I was going to say some more but I don't need to right now. Let's keep going.

MS. COOPER: I think we understand what

you're saying. I think that probably -- we'll discuss the status later, but we're going to do another revision before we go to peer review.

I think we could probably develop some discussion about how that would be done, how you would develop operational cues for abandonment and loss of habitability.

CHAIRMAN STETKAR: And it may not be as -- don't necessarily think like fire modelers or engineers when you're doing this. Think like human people.

And rather than saying well, what are the specific criteria that I need to define, I do not have indicators A, B, C, D for loss of control, or I have environmental conditions X, Y, Z for habitability.

Think more about what is happening in the scenario and how do people make the decision to abandon the control room in the context of the scenario.

Because you may very well have mixtures of the two. And in the real world people aren't going to pull up their, gee, do I have A, B, C, D, or X, Y, Z.

They're going to say things are falling

apart, and I'm trying to get people in the plant to restore power to stuff, and I'm trying to get people to bring in little fans, an elephant trunk to get the smoke out of the control room.

MR. STONE: I'm Jeff Stone. I'm a senior manager for fire PRA at Exelon.

I just wanted to bring up one point, and maybe it's already understood. The loss of habitability is obviously a complete abandonment of control room.

The loss of control may not mean a complete abandonment of control room. It might mean you control some functions from the control room and other functions are controlled from other stations around the plant.

CHAIRMAN STETKAR: And the guidance for that -- and thanks, that is a difference because I abandon ship when the ship is underwater.

The guidance does handle that partial thing, the decision about what -- is command and control transferred out of the control room, leaving somebody there to control something that's controllable from there.

Does command and control remain there where somebody else goes out in the plant and

controls something out there. It does handle sort of the command and control portion of where people are doing things.

And you're right, loss of habitability means I abandon ship.

MS. COOPER: Okay.

CHAIRMAN STETKAR: All right. It'll get easier as we go along. I just, I had to ask now because LOH is the second sub-bullet and I hadn't read far enough in your slides to see whether I would rant about it later.

MS. LINDEMAN: No worries. So, continuing on.

This was an area that was somewhat looked at in 1921 but understood it was an area of future research.

And some of the 805 submittals really brought up the question about some of the legacy screening values, and whether that would be applicable in all cases.

Prior to the work by this team there was a fire -- NEI/NRC fire PRA FAQ that lived for about three years.

And after two or three years of hundreds of pages going back and forth, and lots of

discussion. Unfortunately that effort was really centered around getting a screening value. And ultimately we took the step back and tried to look at this in a more holistic approach.

So as we got into this we realized it's a really complex topic. And the plant-specific considerations. And the capabilities of the different remote shutdown panels are vast.

The safe shutdown strategies are very different. So, making any type of generic guidance is just extremely difficult.

So to do things in a practical manner, that's why we determined to really phase 1 is look at this qualitative foundation and understand the differences that exist.

And then once we have a good foundation to go onto phase 2 which is the quantification approach.

So here today we're really looking at the qualitative aspects. And you'll see what we've sussed out.

So, the project team for this. We really started with some of the foundation members from 1921. We have here today Susan and Stacey. And then Nick Melly is also in the audience and

Kendra.

And then we also have John Wreathall from the NRC side.

From the EPRI side myself and Mary Presley who are from EPRI. And then we also have Erin Collins here today, Paul Amico who is not here today, and Kaydee and Jeff Julius from Scientech.

So, those are the project team. So, a lot of experience doing these type of assessments for 805 and fire PRA from the EPRI side.

MS. COOPER: And John Wreathall and Jeff Julius should be on the phone listening in. And available as life lines.

CHAIRMAN STETKAR: We keep it muted because they're both probably screaming at the phone out there.

MS. COOPER: I'm going to be talking about the overview chapter, chapter 2 in the report.

The purpose of this chapter is to try to sensitize the readers and potential analysts that there are some things that are different about a main control room abandonment for fire events context.

And we want to try to highlight what

some of those differences are and what then the implications might be for HRA and PRA, and then more specifically talk about what the delta is between 1921 and the guidance that we provide in this report.

At this point in time we have three appendices which we've already been discussing some. We've got a background on the regulatory requirements and what historical events there are in main control room abandonment in Appendix A.

We have the discussion on command and control in Appendix B. And then some guidance sheets, forms and stuff like that, and other tips for collecting plant information for main control room abandonment.

Which you might appreciate that if this is a context that isn't practiced frequently, or in the simulator, or experienced as a real event that there's some different challenges for HRA so far as collecting information from operators and so forth.

MEMBER CORRADINI: So, I've got a question. So, how is it practiced in the simulator?

MS. COOPER: That varies. And I invite my team to add to what I'm going to say.

As I mentioned before I believe as required by Appendix R they must at least rehearse what steps are required to do in the control room before they leave it given that there's something going on that requires them to abandon.

I think most of --

CHAIRMAN STETKAR: Susan, back up a little bit.

MS. COOPER: Yes.

CHAIRMAN STETKAR: How is it really done?

MEMBER CORRADINI: I'm really struggling to figure out -- I'm sorry.

MS. COOPER: So, there are some plants that have actually done things in the simulator where they have a mockup of the remote shutdown panel in their simulator.

And they will go there and they will exercise things.

CHAIRMAN STETKAR: Back up even more.

MS. COOPER: Even more.

CHAIRMAN STETKAR: Okay. Let me ask you the question that I think will help Mike.

(Simultaneous speaking)

CHAIRMAN STETKAR: Is it practiced in

the simulator under the following conditions. Okay, crew. Today we are now going to train on control room abandonment. We had a control room abandonment situation. Now exercise the procedures. Is that how it's typically trained?

MS. COOPER: Not the first sentence. Not today we are going to do abandonment.

However, they will start a scenario and then at some point someone usually feeds them the information to say we have -- and it's easiest to say it's a security matter or something like this. We have a condition XYZ. Now what do you do?

CHAIRMAN STETKAR: Now transition.

MS. COOPER: Now transition.

CHAIRMAN STETKAR: Okay, does that help?

MS. COOPER: So they are kind of -- at this point most of the time we see let's say a force-feeding of the conditions without that decision-making.

MEMBER CORRADINI: So, here's where I'm going. I'm too empirical. Do you generate the smoke and make them worry?

MS. COOPER: No.

MEMBER CORRADINI: Why not? It seems

to me that if I'm going to get a human response I would come up with a control room situation however non-specific to a plant and put the operators in a situation where they're uncertain and watch them respond. Or am I missing something?

MR. BARRETT: This is Harry Barrett. Having been a licensed operator at Nine Mile and also worked a lot at Duke Oconee, I can tell you that there are utilities out there that practice the control room end of this where you end up having a fire in the control room and they spring it on them as a normal scenario that they don't know ahead of time.

And they go through the decision process to go -- as a matter of fact at Oconee they actually put on Scott Air-Paks and stayed in the control room even when ventilation was a problem. They couldn't see, they had to get right up next to the panel and everything.

So there are utilities that take that to very extreme levels to train at.

MEMBER CORRADINI: Okay. But it's quite widely varied.

MR. BARRETT: Yes. And it depends on whether or not they have a simulator for their

remote shutdown panel. Because at Oconee they have the SSF simulator. So they actually do that training where they transition over to the SSF which is their dedicated shutdown facility.

So there are utilities out there that do this at a fairly extensive level.

And of course there's a lot of them out there that don't do it much at all. They end up having a JPM that runs it through.

MEMBER CORRADINI: What's a JPM?

MR. BARRETT: A job performance measure which is a training tool for operators.

MEMBER CORRADINI: So the owners groups are aware of this great diversity and are happy with it? Or just don't speak about it?

I'm back to the owners groups because it strikes me, I'm looking for a connection back to those that actually have to deal with emergencies and how they -- so is that the case? There's a wide diversity and everybody's aware of it?

MR. BARRETT: I think so. And part of that I think is how utilities choose to meet Appendix R. It's mostly driven by regulatory criteria for Appendix R.

And the systematic approach to training

drives you to end up doing the job task analysis and figure out what level of training is needed on what frequency and all that.

So, they should be more consistent than they are, but I think there's a wide variety of training levels there.

MEMBER CORRADINI: So then nobody says plant X doesn't do it the way plant Y does it. But we're interested. We'll send a crew of our operators of plant X over to plant Y, different thing, and just to see how they respond. Or is that --

MR. BARRETT: Some of that's done by INPO.

MEMBER CORRADINI: Okay.

MR. BARRETT: When INPO does both the training accreditation and when they do a site visit they'll observe simulator training and they'll end up making comments that, well, you know, you might want to go talk to this plant because they do a real good job on that. But I don't know --

MEMBER CORRADINI: That's part of their accreditation process.

MR. BARRETT: Yes.

MEMBER CORRADINI: Okay, thank you.

MEMBER REMPE: So in the --

CHAIRMAN STETKAR: Joy, Dennis has been waiting.

MEMBER BLEY: Just two more points, Mike. A follow-up. And I certainly agree with what Harry said.

I've been to plants where they've told me they never put on Scott Air-Paks because it doesn't interfere with anything and nobody would ever have a problem communicating or working in one which some people disagree with.

And I've been to some plants where they send a substantial portion of their operators to actual firefighting schools so they get their head in smoke. But not many. A handful perhaps.

MR. BARRETT: Yes, I agree.

CHAIRMAN STETKAR: Joy?

MEMBER REMPE: Before Harry sits down, I'm sorry, but in the Cadillac example where they put on the self-contained breathing apparatuses, do they actually also go and practice the communication from the remote panel and the various places, and go through the whole thing?

MR. BARRETT: Yes. The people who stay

in the control room continue to end up using the Scott Air-Paks and communicate with the Scott Air-Pak on which is more difficult obviously.

But that's one of the reasons why they train on that is to actually show that they can still do the command and control with the Scott Air-Pak on.

MEMBER REMPE: Okay, thank you.

MS. COOPER: So, this discussion is actually pertinent to what the overview section of this report is about.

I mean, I guess one thing to your point, your questions, Mike, there are differences in what's required for abandoning the control room and the remote shutdown panel than what we have required -- the NRC required for main control room operations.

And that's what the overview tries to touch on. And I'll go to the next slide.

I already mentioned even within the context of PRA events this is a rare event. And so we've talked about the variations in training. So not everyone is going to have the same kind of training.

And for anything that's in the EOPs the

operators have had training frequency in the simulator at least every couple of years. That's probably not the case in many plants.

The design of the control room is -- you can't say it's standardized, but it's much more so than anything you can say about where they would go when they leave the control room, the remote shutdown panel.

The procedures that are used also are not standard. They're not requirements for that.

Staffing and where people go is also different, not standardized.

So, some of the discussion in the overview is to try to cue in the HRA analysts that some of the things that we could count on when we were doing HRA and modeling internal events, things where we were within the emergency operating procedure set, we cannot make those assumptions anymore when we're talking about a main control room abandonment scenario.

So that's kind of the point of the overview section.

And since we're running a little bit late I'm going to charge onto the next slide.

So, what we're really trying to

accomplish at a high level with this overview is to try to cue in the HRA and PRA analysts that you're going to need to shift your mindset.

While analyzing human failure events that take place in the control room you can trust that certain things are there. In abandonment you have to trust but maybe verify on, say, design things and stuff like that.

But it is a special case of a fire HRA and PRA. You can't -- this is brand new analysis that can't build on anything else that you've done before for all of those reasons that I highlighted.

So you really have to sort of start from scratch.

Command and control has kind of evolved to be something that the team has focused on. And I guess there are a lot of things that support command and control in the main control room.

We're talking about it as a meta performance shaping factor, but this is probably going to be a topic for continuing research and discussion, at least that's the way I see it. Because I haven't so far in reaching out to people found anything that really describes this and helps us understand what's really even happening right

now in the main control room, much less what happens when we start peeling the pieces away, and breaking things up, and distributing people around the plant.

So, we're going to charge onto some of the rest of the topics that the report addresses. And we'll try to get to as many of these as we can.

We're going to talk about PRA modeling, decision to abandon, feasibility assessment, timelines, influencing factors, and feedback to operations.

And first up is going to be Erin Collins to talk about PRA modeling. Or is it Ashley?

MS. LINDEMAN: So, we acknowledge the discussion we had on the loss of habitability discussion.

But early on in the project we realized that this was a good opportunity to take note of some of the findings from peer reviews, and some of the RAIs that have come out of the 805 process, and really fill some gaps or holes in some of the guidance on handling main control room abandonment from a PRA and a modeling perspective.

So, for example, in some of the early

PRAs there was not a good integration of HFEs and equipment failures in the model. So that was something that section 3 tries to provide some more complete guidance on that.

One of our foundations or starting points was when does this happen. So we need to understand when a loss of habitability or loss of control may occur.

As the first bullet, we've discussed -- we have some very rigid fire modeling criteria. Maybe we need to do a better job of understanding how that translates operationally.

But what we did try and address in this report was really hashing out in a more distinct manner defining loss of control.

So, in the report in section 4 is really where you'll find the expanded scenario description of loss of control.

So, this is a process that involves talking with operations, understanding their hesitations of possibly leaving the control room, and gaining an understanding of when you have certain instrumentation or equipment out when would they leave and either do a partial abandonment or actually fully leave the control room.

So, what we found is that this is highly plant-specific. So it's not like you can say for a certain vintage of PWR the criteria will be the same.

So what we tried to do was not provide explicit criteria, but provide a process that the plant can use to figure out their plant-specific considerations.

So, defining our scenarios is really important. We need to know what will cause abandonment and make sure that we properly model it in our PRA model.

So we want to know what are the conditions where we will reach abandonment. We can use our procedure review to help suss that out, and then include logic in the model to capture only when those conditions occur.

And as we had some discussion, our loss of habitability is really determined through fire models, our zone and our CFD models.

But the point I'm trying to make here is during a loss of habitability we talked about it's likely they'll reach a threshold and have to leave.

So we wanted to make sure that there

are certain post-trip actions that they might do. Isolate the main control room circuits. Possibly de-energize certain equipment to prevent spurious operations. And finally, energize the remote shutdown panel.

So those are likely the only things that can be done. And some of those non-essential actions that may be in other procedures, there's really no time to credit those. So that was a point that we clarified.

And then the last two bullets are really making sure that we're doing kind of what we would do for a normal scenario. We want to make sure that we have our random failures in the equipment that we're going to accredit for the remote shutdown panel. So our controls and the equipment we need for safe shutdown.

And we also want to make sure we include any type of -- well, basically the last bullet says we need to trace the remote shutdown panel.

If there's a scenario where the cable is damaged you may not or you will not be able to use the remote shutdown panel.

So we wanted to clarify that that is --

it's not only a good practice, but an essential practice.

And then finally there may be some spurious operations that may damage equipment and are non-recoverable. Similar to any other fire PRA scenario we would not take credit for that.

And the last is really just a good practice, but if these scenarios are some of your dominant contributors you should account for any type of fire protection system, suppression or detection to make sure that we're characterizing the scenario as realistic as possible.

So, in the end of section 3 there's really an approach, really kind of the Cadillac approach is to model this explicitly in your logic model.

But there's other approaches that can be taken such as binning based on certain scenario characteristics, or developing a single bounding failure that represents all the recoverable scenarios that are postulated.

CHAIRMAN STETKAR: Ashley, on that last one, I think the guidance makes it fairly clear that the authors of the report prefer the -- not so much binning approach to life.

In practice people always need to aggregate sequences because you can't do 10,000 separate human reliability analyses.

So, in any practical risk assessment there's always some conceptual binning process.

Now, given that, I had a couple of questions about the binning section.

In the section where you discuss the use of -- I'll be polite and not use the acronym that I always use -- where you use the single number for suddenly the plant gets saved.

It says if the scenarios modeled include operator actions that are time-critical defined as time required within five minutes of time available then a detailed analysis is needed.

By implication it means that if the time required is 5.1 minutes less than the time available I can get away with putting a single number in there.

I have a real problem with that because five minutes is a long time if I'm talking about milliseconds. Is not a long time if I'm talking about something on the order of, oh, an hour or so, especially given all of the uncertainties in the estimates of not only the time required to make a

decision, the time required to perform an action, but even the uncertainties in the time available because believe it or not, there's uncertainties in -- and he's left the room -- thermal hydraulics models.

(Simultaneous speaking)

CHAIRMAN STETKAR: And if you read the transcript it was one of the few things that is probably coherent in anything that I said this morning.

Now, my only concern seriously is if you put it in this guidance people will apply that on a 5.1 minutes I win, 4.9 minutes my God I've got to do this God awful analysis. So I better justify that it's 5.1.

I think that, you know, I have my own ideas about how I would do it, but some notion about relative margins might be better than an absolute criterion of 5.0 minutes. So I just offer that as a suggestion.

MS. COLLINS: That's a very good point.

CHAIRMAN STETKAR: The other thing, and it's stated when you get into the not a single number, and would even apply for a single number, but where you get into kind of a more structured

approach to some subset of bins, the guidance appropriately does say that you need to consider the conditions that would apply in the most restrictive scenario in each bin.

That's good to say. You really ought to emphasize that strongly because it implies that I have to do a lot of work going through a lot of cut sets to figure out what the most restrictive scenario is for a particular bin.

People in principle do that and have done that. PRA people know how to do that, conservative condensation and all that kind of stuff.

But it's kind of hidden in there in almost innocuous sounding words. And I think that you ought to punch up the guidance, say look, in any kind of binning process you need to make sure that whatever you're doing is from a human perspective. Because this is written for HRA. From a human perspective the most challenging scenario in that bin.

Not the most challenging because I only have one and only one pump left in the entire world that can save me. That's hardware. That may not be the most challenging human scenario in there.

And that could be a lot of work. And I think you need to punch up the guidance in that area.

MS. COLLINS: Thank you, excellent point. I kind of would like to add that to me this particular chapter, this section 3 that we're discussing about the modeling guidance is extremely important because it goes beyond just the HRA portion.

And it's the combination of the PRA and the HRA which is we always talk about how important that is, but it's really essential for main control room abandonment and understanding all the various flavors of what can happen here.

So to me this particular section is crucial guidance not only for HRA analysts, but especially we hope that PRA analysts will pay attention.

CHAIRMAN STETKAR: I wish you hadn't said that because you gave me an opening for another comment.

(Laughter)

CHAIRMAN STETKAR: General comment. The report correctly says that for these main control room abandonment scenarios situations HRA

people need to get involved deeply and broadly from time zero in the modeling.

However, the report still maintains this traditional divide between I am the PRA analyst because I draw fault trees and event trees, and you are an HRA analyst and you put numbers in little boxes that I create.

Anything that you can do to stop that notion would -- especially in this report would be good.

And that's the only reason you said, well, the PRA analyst. This is important for PRA analysts.

My comment was everybody ought to read all sections of this report. In the introduction you say well, chapter 3 is more important for PRA people. Maybe HRA people ought to read it.

The other chapters are maybe more important for HRA people, but maybe PRA people ought to read those.

No.

MS. COLLINS: It's equally important for everyone.

CHAIRMAN STETKAR: It's equally important. The guidance in chapter 3, by the way,

the examples are really good as a practitioner.

MS. COLLINS: Thanks. I'm glad. I really feel that way too. I have to give kudos to Paul Amico.

Yes, no, I understand. We still have kind of that artifice of different hats.

CHAIRMAN STETKAR: You do.

MS. COLLINS: But actually in terms of how projects are structured it happens that way as well.

And as you said, it may be happening, it may not be correct, but maybe we can do better. We're trying to do better and better as we keep going with this guidance to bridge that gap.

CHAIRMAN STETKAR: The only way that people are going to keep doing better and better and better is if they're forced to read things that tells them don't do it the way you've been doing it.

If they read things that say well yes, there's obviously -- we can keep doing it the way we've been doing it.

So that's the only way to -- some of these things that we as an HRA community or PRA community for years have been trying to say that

human reliability analysis is not like collecting pump failure data that you put in a basic event for pump fails to start, that the HRA people ought to be integrally involved in development of the model.

And that means that HRA people need to understand how plants work. And the people who understand how plants work need to understand a little bit about how people work, that you can't keep this artificial separation because you get into the problems we've had.

MS. LINDEMAN: I hesitate to talk about this slide because I feel like we've already had a lot of discussion.

CHAIRMAN STETKAR: It's why you could have put me off until this slide.

(Simultaneous speaking)

CHAIRMAN STETKAR: I don't think you need to go through it now.

MS. LINDEMAN: So, can we pass in the interest of time?

CHAIRMAN STETKAR: I think so.

MS. LINDEMAN: Okay. Thank you.

MS. COOPER: I feel like we've hit all this also.

MS. LINDEMAN: Yes, I mean, I'm not

sure if we need to really spend too much time on this.

CHAIRMAN STETKAR: The only thing that I had on some of these is I got -- as I read through the report, and this just might be because of where it is in development, the notion of -- here you're characterizing it for loss of control HRA.

The first sub-bullet under the key aspects of loss of control is cues. I get -- as I read through the whole report sometimes I get confused about where time key zero is.

When I finally got to the end of the report I think it's when the fire starts which is good.

At times in the report I get the impression that for some reason cues -- when I have a loss of control room abandonment that the cues for what you call phase 3 are indexed to the time that I -- I'm not sure when I decide to leave the control room, or after I reach the -- I'm not sure whether it's the beginning of phase 2, or the end of phase 2 in jargon.

And in one case in your examples when you talk about this time, and I'll only bring it up

here, is I think you need an example where you have cues. Let's say it's a loss of all feedwater because it's easy to talk about the pressurized water reactor where very shortly after the initiating event the operators are aware that they don't have feedwater. So that's the cue to tell them that I need to get feedwater back.

At some time later, an ill-defined time later at the moment because we need to figure that time out we need to abandon the control room.

And there's obviously a delay time. And then we need to continue restoring feedwater after we abandon.

So that now my actions to restore feedwater start in phase 1. They continue in effect through phase 2, but they're delayed by the relocation time at least which is part of phase 3 I guess. And they continue into phase 3.

Now, why is that important? It's important because it might affect my decision to leave the main control room.

Because if I know I've got to get -- if I have to get feedwater back, and I'm working on it, I'm working on it. I'm going to get it back anytime now. I've got people out there trying to

get the pumps started.

I know the smoke is getting dense. I know that the lights are going on and off. But by God I've got to get this done before I leave. That might affect the decision.

And none of the scenarios that you laid out in your timing had that. They seemed to index cues for event response on control room abandonment to something that is either the decision to leave or the start of your phase 3. And that could be important.

Because there's this implicit assumption that for some reason it's conservative to assume that everything happens at zero.

And zero might be zero when the fire starts, or zero might be zero when I get to the remote shutdown panel but everything gets indexed to those points.

And in the real world it might not work that way. It probably won't.

MS. COOPER: We considered introducing the discussion of the different time phases that we defined earlier in the report. Any sense that that might have helped you?

CHAIRMAN STETKAR: No. I didn't have a

problem with that.

MS. COOPER: Okay.

CHAIRMAN STETKAR: I just, as I went through, I was going to bring it up in chapter 2 because it's -- by the time I got to the end of the report it was pretty clear to me that as I lay out timelines they ought to begin when the fire ignites.

MS. COOPER: That is correct.

CHAIRMAN STETKAR: Thermal hydraulics analyses, everything to that, that's good. You may want to reread the report and make sure that that's crystal clear throughout the report.

I did though in the same notion of cues and timing have in the examples that you brought out, and I quite honestly am trying to look through a lot of notes here so I don't remember exactly what section it is.

But when you talk about timing of cues the one example that I didn't see was this notion where they know what they need to do sometime pretty early on, and they're working on it as conditions in the control room degrade. And that could indeed affect decisions to abandon.

MS. COLLINS: I think we had some

internal discussions on our team about that. And we do have some mention of it.

CHAIRMAN STETKAR: It --

MS. COLLINS: Some members also felt that the conditions would be so bad, and you had lost so much function during the scenarios that we're talking about that that situation is less likely.

CHAIRMAN STETKAR: But part of that, Erin, is there are statements in there that says, well, it's typically conservatively assumed that everything is lost at zero.

That's true for thermal hydraulics because pressures, temperatures and things like that. Not necessarily true for operators.

And if you've done a detailed fire analysis in areas where you do have information about fire propagation from tray to tray and some timing information those conditions that you talk about may very well degrade over time.

And you may very well have that information already in the fire modeling that you have such that we know some broad uncertainty that we won't get these degrading conditions for another 10, 15 minutes or something like that.

Whereas the operators might know because of the initial damage that something was lost closer to T-0.

MS. LINDEMAN: We tried to characterize that T equals zero was the start of the fire. But I believe we recognized that that necessarily isn't the start of the reactor trip, or fire damage. But maybe that's not well written.

CHAIRMAN STETKAR: Just a general comment. Go back and look at, make sure it's crystal clear that I as a practitioner know what is zero and how I index everything to zero.

And I don't care whether it's reactor trip, or thermal hydraulics, or whatever because what is zero.

And then, as I said, the examples I thought were pretty good. The only thing that I was missing was this notion of cues prompting operator response to restore safety functions that occur well before any conditions might degrade to a point where people start to think about perhaps leaving.

Because to me that would indicate perhaps a strong reluctance to leave until I complete the job that I was working on.

Compared to something that indeed was such a devastating conflagration at T-0 the room went away such that it became pretty clear what the conditions that I have.

MEMBER BLEY: Just to follow up on his and then two things from me. And I didn't read through all the examples with care.

I don't know if you had any cases where you begin to see symptoms before you know there's a fire. That's the one I think about sometimes. Because that could really create a tough spot for the operators.

We've seen it often in loss of air events where odd things happen that can happen with fire too. I mean, it would be really hard to model, but it's worth some thought.

The place I had a question was all throughout you talk about the remote shutdown panel and other areas. Once in awhile you say local control.

I don't know how many plants have remote shutdown panels, and how many have remote shutdown areas or whatever we call them where there's kind of distributed remote control.

My question is are there enough of

those that it's worth a little more description maybe in Appendix A about what some of the alternatives to remote shutdown panels look like, and any implications it would have with respect to control, command and control, and your last bullet here, trust in the remote shutdown panel capability.

I know the answer to that, but I -- the focus is on remote shutdown panels and I don't know if 50 percent of the plants have them, or 90 percent have them. But some of them have kind of oddly distributed systems that will be different to model and deal with. And a few have two.

MS. COOPER: That is a good point. So, was command and control your second question, or was that still the first? Was that still the first one?

CHAIRMAN STETKAR: Actually, I thought you handled --

MEMBER BLEY: There were two there, but I just wondered if something more concrete was --

CHAIRMAN STETKAR: Without getting into 77 different configurations.

When I read through it I thought that you made this notion that there's a wide variety of

things. Some plants might even have something that kind of sort of looks a little bit like a main control panel to things that have a couple of panels that may not look much like the main control panel, but has a couple of nobs and gauges on it.

And a lot of go out and tweak this valve at this motor control center or whatever. So you may want to think about it.

But I thought that you at least made the point from the perspective of guidance to an HRA person I need to go out and look at that plant.

MS. COOPER: That's exactly the message. I mean, it's not like you can just assume it looks like the last job you did.

MS. COLLINS: Right. And that, as you said, Susan, that's part of that whole up front mindset shift you have to get into, and then evaluating this versus fire HRA versus internal events is that whole progression of this is a very different beast. And you really need to evaluate the specific condition situations.

MS. COOPER: My turn. Okay, now we're shifting gears to talking about feasibility assessment.

CHAIRMAN STETKAR: Let's --

MS. COOPER: Take a break?

CHAIRMAN STETKAR: Yes. Before we shift into this gear let's take a break and let's come back at 10:15.

(Whereupon, the above-entitled matter went off the record at 9:58 a.m. and resumed at 10:15 a.m.)

CHAIRMAN STETKAR: We're back in session. Feasibility. It is feasible to finish this meeting by the time we have to. It may not be possible.

MS. COOPER: So, feasibility assessment is Supplement 1 to 1921 on main control room abandonment.

1921 established feasibility criteria for modeling human failure events and fire PRAs, and the team wanted to look at feasibility again in the context of main control room abandonment.

This was not something that we were able to do right off the bat. It took a considerable amount of time, training, experiences from doing the analyses or talking with operational staff and so on and so forth.

But in the end we developed some new guidance that's a consensus based on the team

discussion over time.

And in particular there are four new types of guidance. We talked about feasibility needing to be assessed on a scenario level in addition to on the basis of individual HFEs.

We have two new feasibility assessment criteria that are specific to main control room abandonment.

We talk about some additional issues and provide some additional guidance on the existing criteria that were already established in 1921.

And then we have a discussion about -- and this is a pretty important one due to the unusual nature of this particular type of HRA, and that is what do you do if in starting to do your analysis it looks like this scenario is not feasible, but that's not an acceptable answer.

And then we sort of begin the discussion in chapter 6. And then there's also some more in the discussion on feedback to operations which is later in the report.

CHAIRMAN STETKAR: You're going to talk about that in some other slides later?

MS. COOPER: Yes. Scenario level

feasibility basically says that you need to make certain that the collective set of actions that are required to safely shut down the plant can be performed, for example, within the overall time available.

And this is then going to be connecting to the discussion of timelines which comes in the report in the next chapter.

There's also -- we have to consider manpower across the entire scenario which you may or may not realize that you might be overlapping responsibilities for somebody, especially if maybe it's like a two-unit shutdown or whatever and there's a swing operator, and both units are perhaps counting on that one particular operator.

So, we have some discussion about scenario-level feasibility.

Then the two new criteria are related to command and control and communications. And we specifically say that for command and control there needs to be a pre-defined plan for command and control that addresses what is different when you've left the control room.

Everything from who now is staffing. In the main control room you have the shift

supervisor and the principal. He's assisted by the STA. But if your plan now when you've left the main control room is that the STA is going to go off and do something else, like he's going to be like a field operator and do things then that shift supervisor no longer has backup, or another set of hands, or someone else to communicate with people.

And then because of the nature of main control room abandonment strategies there may be many people out in the field, or more people out in the field, field operators doing different things, and their actions might need to be coordinated. There will probably be some kind of communication required. And this is all an increased workload.

So, the plan needs to address these kinds of changes. We haven't made any specific recommendations because every plant is going to be different, but those are the kinds of things that need to be addressed.

Similar kind of approach is taken in our guidance with regard to communications. Again, they have to have a clear plan for communications which addresses, again, the fact that there might be more communications.

And they also need to have equipment to

be able to perform these communications. I've seen everything from, okay, we've got to take the radios with us when we leave the control room to here's a locker with some stuff in it that's supposed to be working and so on and so forth. So that needs to be all laid out and understood ahead of time. So those are the two new criteria.

And that's all we're going to talk about. We do have some backup slides if you want to talk about some of the other aspects of feasibility assessment. But that's all I was going to talk about now unless you had any questions.

CHAIRMAN STETKAR: I think some of the comments will come up when we get into the timelines of some of those things.

MS. COOPER: Okay. All right. Well, then we'll go to timelines.

MS. COLLINS: Speaking of timelines, that's a good segue-way from feasibility because as we've learned more and more so much of the evaluation of feasibility in all our fire PRAs and especially MCRA has to do with timing.

So, 1921 for fire PRA established how crucial it is to evaluate a timeline for individual human failure events. And that guidance still

applies from the individual HFE standpoint.

But what we found with main control room abandonment, the timing is even more critical and particularly when we're talking about scenario-specific timelines.

So it's not just the individual performance anymore, it's a group of operators working together to resolve a very drastic situation.

And as you mentioned, John Stetkar, earlier it's important for us to evaluate this timing from respect of -- the same origin. That the T equals zero is the start of the fire.

So we're integrating various timing sources together into a single timeline that begin with fire progression. You know, how does the fire start and progress, and what are you accounting for suppression, and what are you accounting for damage states.

Then we're also looking at the accident progression, the thermal hydraulics in terms of how would we normally evaluate a particular accident condition, and when are you losing equipment.

And in this case we're also looking at the procedure progression for main control room

abandonment and the operator response. Who is doing what and where, and how much time did they need to do that individually and especially collectively.

I think one of the key things that this document provides is the notion and the guidance for these scenario-specific timelines, and the correlated actions that are happening amongst a group of operators.

Part of that is also the accounting for command and control. A shift supervisor may be stationed at a remote shutdown panel or wherever he would be reporting to and then coordinating the tasks between the various operators. So if there is timing related to that that needs to be addressed as well.

The next slide shows an example of -- we really feel that it's very important to do this visually. And we recommend that the analysts put together these actual visual timelines.

I know it's something we've evolved over time in HRA, but from the standpoint of main control room abandonment it really becomes important because you're not just dealing with a single operator, you're dealing with many.

And this is very simplified, but in our document we show integration of a variety of different operators. And we're even starting to work on a more complex example if we can to show how these different operators match up on a similar timeline, and how that all progresses.

CHAIRMAN STETKAR: And I think you've heard from us these are wonderful. They're great for communicating with analysts who may not -- may get too focused on what their job is rather than understanding the whole scenario.

And they're wonderful for communicating with people in plants because it allows you to place things on a scale of things that they understand.

And it's why I said earlier this notion of suppose the cue for my action pops up in the middle of that, what you've indicated is phase 1. How does that affect where those arbitrary vertical lines are on this drawing, and what decisions might be made. So these graphics are really good for communication.

MS. COLLINS: Even as an analyst developing this, you may think that everything fits well and is totally feasible, but then when you

begin to add more and more let's say especially into phase 3 when you have a lot of very complicated actions it lets you know that, oh, I'm running out of time here, and I have an issue, and it's something I need to bring back to the plant and discuss.

CHAIRMAN STETKAR: Erin, why don't you finish your discussion of these phases. Leave the graphic here though while you discuss the next slide because we can read words. Because I want to come back to this with a couple of questions.

MS. COLLINS: Okay. No, that's a very good idea because it is harder to bounce back and forth.

So, phase 1 is essentially the actions or the mindset that is involved before you make that decision to abandon. So, you're starting from T-0 is the start of the fire. And at this point the operators are getting cues, and they're getting indications or losing indications and losing systems. It's becoming clearer and clearer that they have an extremely serious situation here.

They will probably be having somebody -- - they have fire alarms going off that indicate where the fire is occurring if it's not occurring

in the control room itself.

And they may even have somebody sent down there to verify how severe the fire is. And so that's part of the whole pre-decision process.

Then you get to phase 2 where you say here is the actual timing involved in the decision to abandon. So you have all this input information but now it's the decision process on the part of whoever the person is in control then conferring with the crew as much as they can and saying we have lost a significant amount of equipment. We've lost a significant amount of instrumentation. How do we make that decision that leaving the control room where we feel comfortable is the right thing to do and going to whatever alternatives we have. So that's our phase 2.

At the end of phase 2 we presume the decision to abandon has been made, and now you're moving command and control outside the main control room to wherever the station is.

And then you're sending most likely individual operators out. Sometimes that happens with a procedure where you have individual attachments for various tasks and they're heading out into the plant to take these actions.

And at the end of phase 3 we presume that you have completed those particular actions and you're in a safe and stable condition.

This just helps us to stage the timing process more clearly so that we understand what's happening when.

But obviously the goal is you need to complete everything within this time frame. So you need to be mindful of what's taking up more or less time and might lead you into a circumstance where you have feasibility issues.

So I don't know if that goes through -- you had particular questions.

CHAIRMAN STETKAR: That was the introduction that you needed to get through before I could ask the questions.

A couple of things. Just leave the graphic up there because I don't think that any of the other slides discuss this. And tell me that they do and I'll wait.

When you talk about phase 3, and this again is more, as I read the whole report beginning to end, you talk about in phase 3 there are execution actions. It's given that term, execution actions.

MS. COLLINS: Correct.

CHAIRMAN STETKAR: And as I read through the report I sometimes get confused what you mean by that.

And in particular there are statements in the report that say -- let me find one. Execution actions that follow MCR abandonment will not include cognitive evaluations unless a procedure indicates that some diagnosis is involved, e.g., if/then statements are used in the procedure.

Well, other places you say, well yes, phase 3 can certainly include cognition.

Now, why is that important? Because other places you say I can -- it seems to say that I can do a feasibility assessment for pick up the cup. And I have how long is required to pick up the cup.

And I have a different feasibility assessment for walk to the door. And I can do that.

And now if I must pick up the cup and walk to the door I can take those bits and pieces and put them together.

I'm a little bit concerned about that.

And I got the implication from some of the discussion because you can say, well, I can take a collection of these things and then somehow fit them together in my phase 3 because they're simply execution. They're what I always talked about, the push a button, eat a banana.

And it doesn't seem to -- it seems to strongly downplay the notion that once I leave the main control room there still might be a heck of a lot of cognition left.

So, just take that as a comment. Because again, I was sensitive to it. And different places as I read in the report the kind of guidance for how to treat those phase 3 actions were more I have a box full of different things, and oh yes, well, this particular recovery -- bad term because the next comment will be on that word -- this particular response requires one of these, and one of those, and two of these other things because it's turn a crank on a valve.

And so I can put those things together as if they were completely independent and they didn't care about the whole context. So that's just a caution. Maybe I was too sensitive to it.

The other thing, this is a little bit

perhaps more important. If I now look -- and you don't have it here, but I'll point you to figure 7-3 in the report.

The report does a good job about saying the way you back out the time available for phase 2 is by running to the end to see how much total time is available, looking at how much time is required to implement phase 3 and then figure out what that little middle slot is.

And I thought that conceptually it did that very well. How do you do that in practice? That's a different thing. But conceptually it did that I thought quite well with one exception.

And well, the exception is that the report uses this term recovery actions. And it's used both in the context of phase 3. It's also used throughout the report as if they are separate things.

And to me that's a relic of Swain and Guttman about I have a basic event for the basic action to push a button, eat a banana, and then I have a different basic event that I multiply it by -- because my friend over here said that I pushed a button and I picked up a grape.

And I'm not sure that the current

construct of understanding human performance is that discrete.

And even if it is you do make the notion that, well, a particular human reliability analyst might decide to combine that in the definition of a particular HFE and another analyst might not.

Well, let's not do that. The reason I bring it up in the context of the timeline is that figure 7-3 says that at the tail end of what this graphic shows as phase 3 I somehow need to allocate a time available for recovery of phase 3 actions.

And in the figure it says 10 minutes is the time available for recovery of the phase 3 actions. That now constrains me because at the end I've thrown that arbitrary time 10 minutes in there that I'm somehow going to assign some number to that then has an implication about the whole scenario progression in real time.

And that bothers me. I mean, that bothers me more than this notion of defining a basic event for recovery.

Because now you're talking about artificially constraining a scenario timeline that you're using for communications with HRA analysts,

with people who are developing event trees and fault trees, and with operators personnel by some sort of arbitrary notion of what this recovery thing is.

So I'd recommend you get rid of that. Just make the development of the timeline the development of a timeline. If you're screaming toward the brick wall, the brick wall doesn't move back 3 inches or ahead 3 inches so that you have extra time to pump the brakes one more time, you know.

Just that's the end. Thermal hydraulics. The steam generators are dry. The core is on the floor. Whatever it is.

MS. COOPER: That is a very good point, yes.

CHAIRMAN STETKAR: And that notion of recovery actions kind of creeps in here and there throughout. So be a little sensitive to that. That's my recommendation.

MS. COOPER: We would ordinarily scrub that because we have already in 1921 five different definitions of recovery. This is not the right one anyway. This is different.

CHAIRMAN STETKAR: Yes, but I mean here

-- this is different and there's explicit guidance about how I ought to think about developing this simple graphic here that says I need to somehow put some mushy thing at the end.

MS. COOPER: Thank you. Good point.

CHAIRMAN STETKAR: You're going to switch to PSFs now, right? Any other -- because timelines and feasibility are important. If anybody else has things on timelines and feasibility. Five seconds of silence.

MS. HENDRICKSON: Okay. Let's go onto the PSFs. So with the PSFs we really tried to stay consistent with --

CHAIRMAN STETKAR: Okay, I'm the microphone police.

MS. HENDRICKSON: Thank you. So, with the performance shaping factors we really tried to stay consistent with 1921. We don't disagree with anything that really 1921 says. So that's where we started.

Now, from that though the realization that the main control room abandonment scenarios really go to a whole different level.

And one of the big things we focus on is the command and control, this meta PSF that we

define.

But the performance shaping factors you see listed there primarily came from 1921 as a starting point.

Then from that we look at the experience of the analysts on the team as well as the operator and trainer interviews that we conducted to see what are those little catches that are then going to take these performance shaping factors to a different level. What are the other issues that are going to start tripping people up.

And so on the discussion primarily in this chapter it is not just a rehash of what 1921 said. It's the what is going to be specific about leaving the control room, about being out at these local actions, about having distribution of crew that's going to be the issue.

One of the things that we really struggled with, and I think this is what really came to the consensus of talking more about the command and control meta PSFs is it's very, very difficult in these situations to try to tease apart what are these influencing factors, and what do you really call complexity versus what's workload versus what's crew dynamics. Because you see such

overlap now happening.

When they go to abandon the control room, and especially in those plants where they don't have a dedicated remote shutdown panel and they're going to many different local action locations you now have the person who is in charge or trying to lead the command have to communicate over -- not face to face, over different communication lines.

Also having to have information communicated back to him from the local plants because he may not have all the cues and indicators at his disposal at the remote shutdown panel that he's standing at. And so the communications has taken a whole new level of entanglement.

But that then also impacts crew dynamics as we've got all this additional communications going on. The different reliance on folks that have happened which then in turn impacts complexity.

So you kind of see this growing web going up.

And Susan, if you would, go to the next slide because it's start to introduce.

That growing complexity, the overlap of

all of them I think really points to the need of having that command and control as this meta PSF, this kind of overarching one.

But other issues that come up when talking about the PSFs and trying to assess what the impact is is the decision to abandon, when they're still in the control room, what's going to impact their actions there.

What are the types of motivation as well as actions they're taking, and what are they needing to do. What do they need to be sure to take with them, to grab.

Then as they distribute how are they distributing. Where are they going.

The shift supervisor who is probably going to still be the person in command, but not necessarily, is he going to have someone else with him at the remote shutdown panel.

And so what actions will they need to take. What actions would be local actions within the plant. What information needs to be fed back in that they're not going to be able to gather at the remote shutdown panel.

MS. COLLINS: And one of the other -- you know, we were talking about human-machine

interface at the various locations.

We're used to -- Susan had to remind us throughout the project we're used to a standard control room layout and this type of thing.

That changes when you go to the remote shutdown panel. It changes then again when you're going to local stations throughout the plant. So that becomes important.

CHAIRMAN STETKAR: I think -- and it is important. I caution you don't -- as I said before when you're talking about loss of habitability and 6850, that's driven by people who model fires for a living.

Don't get too focused on NUREG whatever it is, 0700 about I must have an orange indicator that is 3 inches wide and 6 inches above normal eyesight because people will focus on that and perhaps lose context of the bigger picture.

Yes, indeed, if I have something that only looks like a board and I mean a plank with no indications whatsoever that's important. It might not make too much difference whether it meets all of the criteria of NUREG-0700.

MS. COLLINS: Exactly. It might not matter --

CHAIRMAN STETKAR: You point to that a few times and you've just mentioned it, so.

MS. COLLINS: Well, you know, we used to say you need to consider it within the PRA context and what are they evaluating.

So, maybe I don't care if it's white letters on a black background versus black letters on a white background, but how that parameter is presented may have a lot to do with how well they're getting that information. So it might be that.

CHAIRMAN STETKAR: That's true, but also in the back you have a very good discussion about resource allocation for doing this stuff.

And I certainly don't want an analyst spending three hours measuring lettering and doing, you know, is the tag for a particular valve the appropriate color and the appropriate size as compared to, you know.

MS. COLLINS: No, no.

CHAIRMAN STETKAR: Evaluating perhaps instead of having two bins where they spend a lot of time doing that rather than having six bins that gives me better fidelity for the overall PRA.

MS. COOPER: That's a good point. I

guess we should probably consider adding some more discussion.

I mean, one of the --

CHAIRMAN STETKAR: It's important to look at.

MS. COOPER: -- for us --

CHAIRMAN STETKAR: Susan, is your mike on?

MS. COOPER: Sorry. One of the things that we thought was important for people to know is that a task analysis probably has been done for actions that are taken in the control room with considering the design, and the layout, and the requirements or guidance given in 0700.

That may not be the case for the remote shutdown panel. There is some discussion in 0700 about the remote shutdown panel. We followed up with one of the few people I know who did the design reviews following TMI and he said he didn't remember ever looking at one. All the focus was on the control room. So, this is the trust but verify.

But your point is well taken. We probably could write something more about what is it that we need to be concerned about for

operations in this context.

CHAIRMAN STETKAR: It's just I saw a few references to it. And again, I'm sensitized to not having analysts spend too much time on one particular issue, especially if it's as prescriptive if you will as 0700. And people like to go measure heights of characters, and colors of panels, and figure out if something makes a factor 1.7 difference.

MS. COOPER: Understood. Point taken.

MS. HENDRICKSON: So, at the end of the PSF chapter there's these two tables. So, what we wanted to do was within this qualitative guidance is give some sort of guidance to the analyst of how exactly can you start to evaluate these PSFs and what are the things that you might look for.

This is not an exclusive list and at this point we should probably consider the table still preliminary. But it at least starts them in the idea of -- the first table 8.1 tries to present scenario characteristics that might be particularly relevant. And then what would be the performance shaping factors that might degrade that.

And then it also presents what PSFs might actually help to offset it. Not to be

thought of canceling out, but to be considered as in its entirety as a whole of how it might impact if they have that scenario.

CHAIRMAN STETKAR: Just a general comment. I liked 8.2 much better than I liked 8.1.

MS. HENDRICKSON: Did you?

CHAIRMAN STETKAR: Well, if I'm an analyst I'm going to think of all of those offsetting things anyway.

And it always came down to procedures and training anyway. So why have the table. 8.2 sort of gave me different things to think about. So that's just a comment.

MS. HENDRICKSON: I would say 8.1 kind of feeds more of the researcher's soul, right? It goes from a scenario-specific analogy and then feeds into the PSF.

The 8.2 I think probably would be more useful for an analyst because it starts at the PSF level and talks about how would you actually measure it.

For example, the procedures and trainers, they do not exist. They do not match situations.

CHAIRMAN STETKAR: Again, guidance.

Bigger picture guidance. Anyway, just I liked 8.2 better than 8.1. Somebody else might have liked 8.1. And that's 8-1, 8-2 I think.

MS. HENDRICKSON: Returning to our earlier conversation about NUREG-2114 8.2 is really where you could see influences from that.

CHAIRMAN STETKAR: There were things that -- well, I mean, you know, it's good because you would hope that this is not at cross purposes to 2114.

MS. HENDRICKSON: But the language, we can pull it out definitely more. But that's where I see the biggest influence from 2114 which is showing the when would this PSF be consequential, which is similar to the -- I can't remember if it's the cognitive mechanisms, or the --

CHAIRMAN STETKAR: I always have to go back to the pictures in the appendix.

MS. HENDRICKSON: Okay, so that's the primary chapter on PSFs. And the PSFs that were listed there. Let me ask first if there's any questions before I go into the command and control appendix. Okay, let's go onto this one.

So, command and control is currently written as an appendix because we weren't trying to

offer explicit guidance. It was more to make people aware of it and really kind of start the discussion.

We call it this meta PSF because it is kind of this overarching. It's an overarching factor that's impacted by many of the other ones such as complexity, such as crew dynamics, and such as communication.

And how does that really change when we're seeing what we're used to within the control room, and they're having face-to-face conversations. They're in a relatively quiet environment. Everyone is very familiar with the jobs they need to know. That's what they're most highly trained on.

And then switching then to the abandonment situation where they're now distributed across the plant. And how does that really change the complexity as well as the dynamics between them. Let's go onto the next one.

So, understanding the command and control structure is key. The appendix first looks at guidance on how that structure might be defined and how it can be evaluated.

At this point it's mainly based on what

Emily Roth, and Ali Mosleh and others have come up with which isn't inconsistent with 2114, but the language is a little different. So we can clean that up definitely.

And then it goes through some of the situation factors for command and control which -- actually, decision to abandon and the situational awareness, the detecting, noticing, and all that are the macrocognitive phases they'd be going through.

CHAIRMAN STETKAR: That's why I say I think you can rewrite it. It doesn't require jacking up the roof and putting a new house under it.

MS. HENDRICKSON: It's making the language consistent. We can clean it up.

CHAIRMAN STETKAR: Right?

MS. HENDRICKSON: Yes. Yes. So, the detecting and noticing are the macrocognitive phases.

The situational factors drills in a little more quickly. It kind of gets right into the PIFs.

And so I think you're absolutely right here that we can show that connection more of going

through the cognitive mechanisms and all, and show how we got right to it.

But it goes through the situational factors such as decision to abandon, what are the performance shaping factors in kind of entirety and in that kind of complex web that would impact it.

Oh, and then I forgot also the reference to ATHEANA. So it's kind of that macrocognitive work that we've looked at previously as well as the ATHEANA and experience of teams and operators and all.

So that's it for command and control and then we're going to move on. So now is the time if you all had any additional questions on either PSF or command and control.

CHAIRMAN STETKAR: This is typical. Five seconds of silence interprets move.

MS. COLLINS: As we mentioned way early on in our discussions one of the wonderful things about going through all this detail is not only to provide input to the PRA analysts and the HRA analysts themselves, but to provide feedback to the operations staff so that we can have a genuine impact on the improvement of how MCRA is viewed, reviewed, trained, prepared for, et cetera.

But as part of that we need to as analysts, and we hope that in our guideline document we're providing some perspectives to operations so that we can open their minds and eyes to how you need to view this and make it a more reliable, feasible process.

So, the key areas that we need to look at are the PRA perspective that we can give to them. They have an understandable reluctance to leave the main control room even when things go quite bad.

But if we can provide them that PRA perspective and say that however rare it might be you might actually achieve a fire of a severity where that is necessary, and you're going to have significant effects to instrumentation and equipment availability and reliability such that being in the main control room is not effective anymore.

So, we often have a credibility problem when we go in and discuss these things because, as Susan said earlier, it's hard for them to visualize it can happen.

So again, even though it's a rare event from the PRA standpoint it is something we have to

imbue them with this idea of it can happen. There are these situations. So it's best to be prepared for them and how can we help you be prepared for them.

CHAIRMAN STETKAR: Let me ask you, Erin. This is -- you know, miraculously we have more than enough time to have these discussions.

As I read through this I oftentimes got confused about what we are evaluating in the PRA and when we are evaluating that. And let me elaborate a little bit more.

There's one notion that says I should do a risk assessment of the as-built as-operated plant today which means I go in and I try to understand as best as possible given the current procedures, training, culture if you want to use that term, how people would or would not respond during a particular scenario. And I develop my risk assessment based on that.

And the conclusion of that risk assessment might be it's okay. It might be that some improvement is needed. And some improvement might be anywhere from fix the paper, to fix the training, to fix the people, to fix the plant.

When I started to read some of the

discussions of the interviews which is what we're talking about here I got confused because they seem to be telling me as an analyst to tell the operators how they ought to fix it before I analyze it.

And that starts to bother me because then I'm not sure what we're analyzing.

And in particular you mention that we as PRA practitioners have to convince those stupid operators about how important these things are that they don't believe in.

And once they understand that, once they understand that if they don't know this particular set of information, well then obviously they must leave.

So now I've biased the as-built as-operated plant by educating, hey wait a minute, wait a minute, no. Don't think about that other stuff that you've been trained to think about. Think about this stuff that this little event tree, fault tree nonsense has determined is important.

Because see me as an operator, I might be more concerned about the fact that I've lost all of the indications on the secondary side of the plant, that I don't know what's happening out there

at all.

And those panels are on fire. It might even be the fire protection panel. Maybe I've got perfect displays of what the little stuff that's been modeled in my event tree/fault tree thing is that I as a PRA analyst know is the only thing in the world.

And I might decide to bail out of the control room because I don't feel comfortable with the fact that I don't know anything that's going on on that other unimportant side of the plant.

So, now you're telling me that no, no, no, you can ignore that because the PRA doesn't care about that stuff.

And look, in this other scenario when you have damage to this and only this stuff that's important so focus on this. That bothers me --

MS. COLLINS: -- that sense then I agree with you.

CHAIRMAN STETKAR: I did, in a couple of places where you discuss exactly where you were starting to discuss in the context of this slide that we've seen a reluctance on the part of the operators to believe these PRA scenarios.

So we as PRA practitioners need to

educate those operators on how important and what they should really focus on in the construct of this particular PRA scenario.

And that's not at least modeling going in the as-built as-operated plant.

We had experience in PRA where people have fixed procedures, and people, and plants, and hardware, and things, but only after we've been able to show them that we did the best job possible to model the currently as-built as-operated plant.

And look, these scenarios are risk significant. So now decision-makers, managers who have money and resources need to make a decision of do I fix the hardware, do I fix the people, do I fix the procedures.

MS. COLLINS: And maybe it is as you said at the very beginning when does this all happen.

And typically we do tend to do the main control room abandonment toward the later stages when we have gone through a lot of the fire PRA assessment. Then we're evaluating this and we do have that knowledge about what the risk significant sequences are.

But you're right. I mean, obviously --

CHAIRMAN STETKAR: You know that. I don't know that as an operator. All I know is what I'm trained about. And I understand how the plant works. And I understand critical safety functions. I understand what's been drummed into my head for the last 15 years of my life, my procedures, all of that kind of stuff.

There's just a bit of a concern that we're trying to force attention in an area where we want to have that attention from our particular PRA focus that might not necessarily be an unbiased objective assessment of the currently as-built as-operated plant.

I have experience in doing this. Not in main control room abandonment, it was for ATWS procedures. I was doing -- not in the United States again.

We did an assessment and it showed ATWS scenarios were not nearly as unimportant at a particular plant as everybody knows they are.

And it was because the operators, you know, the operator performance during ATWS came out to be important.

And the plant staff came back and said well, this is absurd. Obviously our operators will

perform.

I said gee, you know, we talked to the operators. They said they don't have procedures for ATWS. You never do any training on ATWS. They don't even believe an ATWS is going to occur. So how would you expect them to perform as 1 failure in 10,000 ATWS events?

And they -- oh yes, maybe we ought to write some ATWS procedures.

Now, had we told them that ATWS is going to be the most important thing in the PRA if the operators always fail they might have become awfully creative now in my interviews about yes, well, we have these other panels. We can shut down from over here. We can trip the motor generator sets. There's a bunch of things we could do -- would certainly bias their feedback to me.

MS. COLLINS: No, you're right. We may start out with this slide and say oh, the first thing we do is we impose a PRA perspective on them.

From my standpoint that's really not what we do. We start out saying these guys have the nuggets of gold we understand in terms of how are they going to respond.

But then once we've discussed with

them, and once we find out where the pitfalls are, if we know from a PRA perspective having gone through the analysis that main control room abandonment is risk significant then it's incumbent on us to provide that perspective and then say let's work together to find the remedy to your MCRA.

CHAIRMAN STETKAR: And that's very important. All I'm saying is as you read through the report it's something that I got sensitized to in primarily the discussions of this interviewing the operators and providing feedback.

Are we trying to inadvertently provide feedback too early such that we're biasing that interview process before we understand clearly how they would respond today.

MS. COLLINS: Yes, I see what you mean. No, that's a very good point because we do try very hard in our interview process to go in with a -- not totally clean slate. We've done our homework and understand what the procedures are.

But you're right, we shouldn't come with our hammer first before we have their information.

CHAIRMAN STETKAR: You know, my notes

on Appendix C that discusses a lot of this stuff is -- it's really good.

And the only exception is I had one paragraph that I pulled out in section C.3.1 that talks about this extensive discussion to break through the paradigm, direct focus on critical actions, yada yada yada.

MS. COLLINS: Yes.

CHAIRMAN STETKAR: And there was a section in another part of the report. But if I've sensitized you to it you can then read through the report.

MS. COLLINS: Yes. At this point I'll look at it again with that mindset.

CHAIRMAN STETKAR: Just look at it from that perspective.

MS. COLLINS: Yes.

MS. COOPER: I don't remember the specific discussion, but I do know that one of the things that we wanted to capture in our discussions of feedback to operations is that when there is a result and we see that, for example, there isn't enough time given the number of actions they have people performing, then the notion of PRA insights, and which actions are critical for the PRA versus

others, that's when the conversation with operations begins, and the working together starts, and you try to figure out if there's a way to shorten the amount of time required up front so you can meet the time available deadline.

CHAIRMAN STETKAR: I think that certainly is important. I think that's in theory why we're doing risk assessment, to improve plant response.

MS. COOPER: Absolutely.

CHAIRMAN STETKAR: The operators on the other hand, there might be perfectly good reasons why they're spending attention to things that from a PRA perspective we don't even think about.

And it's why I always in fire analyses say that when you collect the information going in, you have a good section in there about collecting information.

I want to know what's going on out in all of those panels, in the control room that we don't model in the PRA.

And people will say well, they're unimportant because they don't show up in my PRA model. They're not an aux feedwater pump. They're not a high-pressure injection. They're heater

drain pumps for crying out loud. They're turbine lube oil systems for crying out loud and it's not a fire in the turbine.

Yes, maybe I care as an operator who runs this power plant day in and day out in my life that I don't know whether or not the turbine is coasting down and I don't have any lube oil. I don't know.

Maybe I'm going to wipe out the whole freaking turbine. And that might distract me, for example. And we have actual operating experience where people have been distracted by that sort of stuff.

So that there may be certain reasons why they're focusing in a fire scenario on things that we don't put in our little fault trees and event trees at all.

MS. COLLINS: I think even, Susan, if you can go to the next slide, we talk in this second grouping about procedure and training updates.

And the final bullet talks about consolidation or reordering your procedure steps that might allow them to take certain non-risk significant actions, but not at the time when we

need them to for the PRA.

And so you're right, we need to be very sensitive to that though in terms of why are they taking those actions and what comfort does it give them.

CHAIRMAN STETKAR: You do because seizing the main turbine might not be what I want to do when it's coasting down.

If I can take care of that in 2 minutes at least give me assurance that it's not going to seize compared to having a time window of 45 minutes to take care of the other thing.

MS. COLLINS: Right.

CHAIRMAN STETKAR: Because if I focus attention always on the thing that I have 45 minutes for, and I seize the main turbine the day might get worse for me.

MS. COLLINS: So it's more of a -- we've done the evaluation and we look at it from that timeline perspective and we see that there is a feasibility issue here.

So again, we would go back and say you have a variety of steps in here. Why are you performing these? What's the goal of this? And that's the perspective.

CHAIRMAN STETKAR: That's the important part approach, not my God, you have to focus on these things because our little PRA says you have to focus on these things.

MS. COLLINS: It's more of a we need to understand why you're taking these steps because -- and we would just like to let you know that from our perspective this can compromise the amount of time you have to focus on the goal of going to safe and stable shutdown.

So if we understand better where we might make a compromise here so that you can get the ultimate goal done, but you can also have these pieces of equipment, or this information that you need that you consider to be important, how can we work that out together. So, yes.

But it is important to not have that heavy-handed approach up front.

And then similarly sometimes we find from a feasibility standpoint that you're really at a time crunch factor. And the only way to really remedy that might be to have a physical plant mod.

Now, that's never a popular thing is to say let's spend a whole lot of money on a plant mod.

CHAIRMAN STETKAR: I was going to say oh my God, a capital expenditure?

MS. COLLINS: Well, and that's usually -- but, again from the PRA, from the standpoint we can show them that we really can't achieve this goal without having something change. So, can we do it by a procedure or training mod? Perhaps we can.

But if we really can't maybe we have to recommend a plant mod and see how that flies.

These are the type of ways that we would start out by building our timeline. We see how things fit. We see how they don't fit. And then if we have difficulties in terms of that time crunch, or functional crunch, then we need to discuss with operations how we can meet together to accomplish that overall goal, and what does that take.

MS. COOPER: From my perspective I think it's not only important to discuss these kinds of things. Like you said, this is what PRA and HRA is supposed to do.

But that it has been done in this context. And remembering even back to when we were developing 1921 I can recall feedback from various

members of our team who said they were sitting around a table having these unpopular discussions with operations.

And they're all pointing to the HRA analyst and saying fix your number. And it's like what do you want me to do?

So, I think putting this down that it can be done, it has been done, can be helpful support to the HRA analyst who might find themselves in that kind of situation.

CHAIRMAN STETKAR: Again, all of this comes back though because this process of necessity is going to rely heavily on the understanding of the plant and discussions with operators. Because you by and large can't pick up a rote procedure and understand how it would be done.

The guidance -- in places it does say that the people doing the interviews have to develop an operations perspective.

You can't go in saying I'm the PRA analyst and you have to understand what I do. And this is why you need to deal with me.

You can't say I'm an HRA analyst and I understand how you will fail.

You have to say I want to understand

how the plant works and I understand a lot about plants.

MS. COOPER: Agreed.

CHAIRMAN STETKAR: So, make sure the guidance is written, you know, because practitioners are going to pick this up and you've even got a script for crying out loud in Appendix C.

Hello, my name is Ron Burgundy and I'm not wearing pants.

(Laughter)

MS. COLLINS: No, you're right, I guess from that perspective we have not emphasized well enough what a team effort we consider this to be, and how important it is for the HRA person to learn more than we're imposing.

MEMBER BLEY: Not that I don't agree with almost everything you've said, but having a script and some guidance on how to interview people is long, long, long overdue. I'm glad you took a shot at it.

CHAIRMAN STETKAR: In fact, the script isn't bad. It's just -- the point I'm trying to make is the less you talk about PRA and HRA the more credibility you will have in that interview

process.

The more you talk about how plants work, and let them tell you what they will do and why they will do it the better the whole process.

MS. COLLINS: My perspective usually is I have the script to kind of remind me while I'm going through the process of what I need to accomplish.

But I let them talk as much as possible and I write as much as possible and have some other team members there so we all capture it because I'm there to learn from them.

And the script is to keep me focused a bit to make sure I've covered all my bases. But, yes.

CHAIRMAN STETKAR: I'm going to switch gears here and get to a slide that says expected usage which starts to sound like closeout stuff.

So, before we get to closeout one area that I noted that is addressed minimally is how do you account for uncertainty in timing?

There are statements in there that say things like, well, we need to develop -- for the feasibility assessment we need to use estimates of mean values for time available and time required,

let's say.

And I think that's reasonable for a feasibility assessment because that's expected response. So on average we would expect it to be feasible.

On the other hand there are also correct statements made that there can be I would think very large uncertainties in some of these time estimates.

The guidance doesn't seem -- other than saying that maybe I ought to interview more than one operator to look for variability in their responses it doesn't seem to tell me that I need to look for uncertainties. So that when I interview an operator don't ask them how long do you think it will take to do this, or don't count the number of steps to the door under average locomotion.

That I go in as an interviewer because I'm probably only going to have one shot at doing this and ask everybody for a range. And perhaps go in asking them first for a range so that I get some sense of could it be a variability from 30 seconds to an hour and a half to get to the door, and then what's, well, the best estimate might be a minute and a half.

There's none of that sense. Because then I don't know how the uncertainty will be used.

There's discussions that says well, to account for uncertainty I can do sensitivity analyses. Well okay, the ACRS is on record I think saying that sensitivity analyses are a poor surrogate for uncertainty evaluation.

And indeed there's guidance now, I'll go back to the generic IDEAS methodology about how one can explicitly account for uncertainty at least in the sense of timing as part of the quantification such that if there's a 15 percent probability that the time required will exceed the time available based on the uncertainty in those two parameters the best I can do is 85 percent success. And there might be some small fraction of that that I don't succeed based on, performance shaping factors and all of that other stuff.

So, I think you need to think a lot better at how uncertainty will be treated in this whole process from the perspective of -- feasibility, as I say, it's okay to use mean values I think for feasibility. Others might have different opinions.

But if the purpose of the interview

process and the walkdowns, and the talkthroughs, and all of that sort of stuff is to develop a sense of not just is it feasible, but what might be the variability or the uncertainty in those estimates, make sure the analysts go in with that perspective. And that they know why they're going in with that perspective because indeed some of that measure of uncertainty will be used later in the quantification process. It's not just something as an adjunct piece of information that you might do some sort of parametric sensitivity study on.

MS. COOPER: That's a good point. We do have some discussion in 1921 about building those ranges. But for this particular context where the experience of the operator may not be such that you can -- he knows or has thought it through to be able to develop it, be able to tease that out.

CHAIRMAN STETKAR: And here again is where the generic IDEAS methodology has built on some of that guidance from 1921 and gone on further to say that indeed there's a construct of using those uncertainties in the actual quantification process which did not exist in 1921.

MS. COOPER: The DELORES fire, I think

I got that right, the incipient fire detector report that just had a public workshop last week. The HRA on that which I did, and it's been updated since the draft significantly. I know, Dennis, we talked about the draft some time ago, but it's been updated rather substantially.

That does look at a probability distribution of time available and actually uses sample points to do the HRA. And there are partially feasible cases. So that's been done in that report. Probably not the same way as it is in IDEAS, but we did do that.

CHAIRMAN STETKAR: And as I said, it's important going in because this is -- I read this, it's guidance to a practitioner. And if it's guidance to a practitioner that says, well, I need as a practitioner now to be sensitive to the notion of uncertainty in timing.

(A) I need to be sensitive to it. Why is it I as a practitioner need to be sensitive to it? Because it will be used later.

Now I don't need to telegraph that to the operators that my God, be careful to make these ranges small because if you don't they might reflect on your performance.

But I need to be able to communicate the fact that I'm looking for a range of values based on their experience.

Especially as I get into these notions where I'm trying to select something that might be representative of a bin of things.

Because when I'm selecting those bins there might be -- I might need to differentiate between bins because of broader uncertainties in usually not time available, but maybe -- time available versus response time rather than other criteria that I'm using to do that binning algorithm.

MS. COLLINS: I think we kind of felt oh, you know, when we're talking about uncertainty it tends to slide more over into the quantification aspect.

But there is this qualitative aspect obviously of saying once you're interviewing people and you're in that mode anyway you can be thinking of trying to tweak the levels of their experience and see what the range might be.

CHAIRMAN STETKAR: If you don't get it then you're not going to get it. Who are you going to leave it? You going to leave it to me as an HRA

analyst who's never operated a plant, and especially not that plant, to say well, it might be +/- 3 minutes because somebody wrote a report someplace saying that that's a standard deviation on a normal distribution. You know, push a button, eat a banana.

MS. COLLINS: Understood. Yes, in one case I was very fortunate even to have a variety of timing from several simulator exercises of the MCRA procedure which was phenomenal. Because then I could see even in the training exercise the point where they would stop and discuss.

You actually had many ranges there and I could factor that into the analysis.

But if you don't have that type of data you need to extract it carefully when you're doing the interview process. Again, not to bias, but in order to obtain some feeling for their sensitivity for the timing of those various actions.

CHAIRMAN STETKAR: Usually there's differences of opinion about how one does that. I personally usually like to go in and say well, here's the scenario. How long do you think it might take you to do this. How quickly might you be able to do it.

And then get them to think about what factors would affect both of those bounds. And then try to focus on where the middle point is rather than by saying what's your best estimate of how long it will take you.

MS. COOPER: Elicitation approach.

MS. COLLINS: Exactly. You're scoping out the upper and lower bounds first and then going to the middle. Yes. That's a point well taken.

CHAIRMAN STETKAR: Okay. Any other comments? There are others of us who were interested in uncertainty in timing.

MEMBER BLEY: Not on that particular issue.

MS. COLLINS: Okay.

MEMBER BLEY: But before you go onto the next slide, I just want to whine about two sentences at the end of the report. Section 10.2.

It's noted throughout this report MCRA is a unique case of fire HRA. The high degree of interface between PRA, HRA ... necessitate a solid qualitative analysis.

Come on. It's true here, but there's a high degree of interface everywhere between PRA and HRA. And this kind of tells people don't think

about it anywhere else. So I'm just complaining about the sentiment somebody might get from that.

MS. COLLINS: Yes, I see what you're saying. I mean, we want to try to make sure that there's that great correlation throughout in any PRA that you do.

But I will say that it's particularly critical here when you're considering -- we had that whole chapter 3 on the modeling and how that has to be an integral part, and you have to think differently and then have --

MEMBER BLEY: I've seen PRAs set up with required operator actions that they want to hand off to some poor HRA analyst that don't match the procedures. Because the way they set up their PRA model.

The interaction is important everywhere. You get some nonsense in this. It's very important here, I agree.

MS. COLLINS: Okay.

MS. COOPER: Okay. We can massage that.

MEMBER BLEY: Make it three sentences. Say as always, it's important.

CHAIRMAN STETKAR: That comes back to

my earlier whining about the distinction between the PRA analyst and the HRA analyst, and who should read what chapter, despite the fact that everybody might want to read the whole report.

MEMBER BLEY: Exactly.

MS. COLLINS: All right. So, who do we expect and why do we expect they're going to use this thing anyway?

Well, because as we go forth and do various fire PRAs it's become clear that this is a bit of a different beast, and there is the necessity to have particular guidance on main control room abandonment analyses for fire PRA and HRA.

And the coordination is crucial as it might be for every aspect of PRA and HRA, but it is quite important here to have good coordination between those two aspects, and make sure everything comes together properly in the big soup.

CHAIRMAN STETKAR: Erin, I understand why you might not answer, or why Harry might not answer.

In practice why has the staff and EPRI spent a reasonable amount of resources on developing as I said going in, in general pretty

good guidance for this particular aspect of fire scenarios.

I mean, what's the force and function? Indeed, are main control room abandonment scenarios driving the fire risk for many plants coming out of the NFPA 805 process? Or is this something that we're just trying to make better in fire PRA overall?

MS. COLLINS: I think it's a combination. There are cases where it does dominate, and then there are other cases where the explanations for how the analysis was being performed, we were finding that we were getting significant RAIs, you know, requests for additional information. Tell us more about that process. Tell us more about how have you looked at these things.

Especially when you're talking about that decision process to abandon the main control room. I think a lot of that motivated it. Ashley?

MS. LINDEMAN: No, I completely agree with what you said.

MS. COLLINS: Oh, and Harry?

CHAIRMAN STETKAR: I'll let Harry. We've not seen any of these things, that's why I'm

asking the question.

MR. BARRETT: One thing I'd like to point out that I think is somewhat applicable to your whole idea about feedback operations.

Several of the plants that have been through very detailed main control room abandonment scenarios also got rid of SISBO.

And because of that there was an iterative process to rewrite those procedures. And it was a massive effort. I know V.C. Summer went through quite a bit of effort and so did Ginna.

So, this is probably a good poster child for saying this is the right way to do it because in fact you're not going to operators and telling them no, you're not doing it right.

You're actually saying we've got to change our philosophy here and we've got a lot of work to do. Let's use the PRA to inform that, work with the operators and have them tell us how they do their job. And it's back and forth.

So I think that's key. This has been almost a test case for this, these guys going through this very detailed analysis process.

CHAIRMAN STETKAR: I'm glad to hear that people are actually doing that rather than

other things.

MR. BARRETT: But I would say as far as the across the board on the 805s we've seen main control room abandonment be like in the middle of the pack as far as fire areas.

We've seen a couple of them percolate up to very, very high importance. Typically it's cable spreading rooms and switch gear rooms that are the most important.

CHAIRMAN STETKAR: That was going to be the second half of my question. You already answered it. So it's mostly the loss of control type things.

MR. BARRETT: Yes.

CHAIRMAN STETKAR: And that's why the emphasis.

MR. BARRETT: Usually the habitability is not a big hitter. There are some that are, but you know.

CHAIRMAN STETKAR: Well, it's not a big hitter because it's got to be a pretty darn bad fire to get them out of there according to those discrete criteria in 6850.

MS. COLLINS: That's a very good point. I appreciate you mentioned how iterative the

process has been is that you may start out with a certain set of procedures. And as we learned from the PRA how important this is and what type of guidance needs to be provided, again, factoring it all in.

And so we've had to, you know, our analyses have had to keep modifying because we keep learning more, and they change the procedures, and we factor different things in.

CHAIRMAN STETKAR: I think it's -- and I hope, and it sounds like from what Harry's saying plants are actually using it productively.

I think that the more we can get away from the artificially defined Appendix R, you will not have X, and you will by definition have Y. And therefore you must do Z approach to life. And get something that's much more realistic and that people have confidence in.

And is much more flexible in a sense.

MR. BARRETT: Yes, and we've seen it the other way with modifications as well. Some plants decided to put modifications in to make some of these actions outside the control room more rapid or easier to do.

CHAIRMAN STETKAR: I will spare you.

Just imagine a stout defense of Appendix R has been elicited.

MS. COLLINS: So, this pretty much summarizes a lot of the issues that we've gone through in our whole presentation.

But we provide expanded guidance for the scenarios of loss of control and how to guide people on providing better guidance in procedures for that decision.

We're looking at an explanation of the go or no-go criteria for certain performance shaping factors from the feasibility standpoint that we didn't necessarily have in 1921.

And especially we have quite a bit on developing those timelines, and how important it is to have that integrated approach between the various type of information that you have from fire modeling and from accident sequence analysis and all this. And then the integrated communication between operators and how that all comes together in a total timeline.

That's something that wasn't really addressed as well in 1921.

Then the whole concept of whether you call it feedback to plant operations, or feedback

to analysts from operations that's recommendations for how we can all work together to make those scenarios more successful.

And then ultimately this particular document focuses on the qualitative insights, but obviously next will be porting that information over into quantification. So, what type of insights are we getting. As you said, what are we getting now from interviews and putting it all together so that we can then be prepared to come out with those numbers we so dearly want and love.

And hopefully we've made it -- in the qualitative analysis portion we have done it from the standpoint so that no matter what actual quantification method you're using later this is all valuable input information that you can port over to any particular method you choose to use.

So, from my standpoint having learned how to do this by just kind of saying oh, Houston we have a problem here, we have to roll up our sleeves and figure out with the plant how are we going to address it.

Ourselves and Scientech, we have tried to port into this document the experience that we've had, the variety of experiences so that we

can give guidance to other analysts.

And we fed back into it information from the performance shaping factors psychology side. So we have a nice well rounded basis and EPRI experience and NRC experience.

So I think altogether we put together -- I'm quite pleased with what we've been able to put together.

I'm glad though that we're getting very good feedback from you in the cases where perhaps we didn't include guidance where we should have, or our language is more stilted than it should be to give a different perspective than we intended.

MS. COOPER: All right. Just a quick status on where we are.

The report that was sent to you to look at in preparation for this meeting is the starting point for a report that we plan to prepare for peer review.

We're actually having discussions yesterday and then later today about action items. We've had a parking lot of things that came up while we were furiously developing what you were given and other things.

NRR is looking at it now. But we're

planning for the peer review and that is the next step to get a next revision ready for the peer review.

And then looking forward we're planning on having the peer review this summer. We're already working on and have identified or locked down a few peer reviewers at this point in time.

As we did with 1921 we anticipate -- we plan to include both NRC and industry reviewers. We looked back at who we had included in the 1921 peer review. Also, who we got comments from during the public comment period for 1921.

And we're trying to capture that audience within the peer review because we don't plan to have a draft for public comment.

Ashley and Mary are both working their contacts through EPRI to try to make sure we represent some of those people.

We may also be able to include some additional reviewers. Right now I have a tentative commitment from Halden, from someone there to take a look at the report.

They've had an interest in this issue of command and control and so forth. And Claire Taylor's been working on developing qualitative

guidance for HRA also. So there's some dovetailing with her work on that.

So we're working on that. And then the next step is developing quantification guidance.

Hopefully we can get that started sort of alongside the peer review.

When that work happens we intend for that to be a more formal process. We will have a draft for public comment. We will have testing along with the peer review because we feel like we need to go through all those steps for that particular piece.

CHAIRMAN STETKAR: Here too, Susan, just on the quantification we haven't seen anything, but again a caution.

Take a look at the IDEAS framework. There's not a lot in the general methodology. There are ways to think about quantification, but not in the general methodology.

But there's kind of a framework set up at least on the internal events, at power procedure driven stuff about how quantification might be done rather than relying on Swain and Guttman, or something like that.

MS. COOPER: So, not the generalized.

CHAIRMAN STETKAR: Generalized kind of gives you a way of thinking about it. Dennis may help out better here because you can speak about facts, right?

MS. COOPER: Well, we'll take a look at it because --

CHAIRMAN STETKAR: Take a look at it because you don't want the guidance on the quantification to become orthogonal, or too divergent just because it relies on things that were done in the past or other frameworks.

And as I said, I already mentioned this convolution of the time required and time available which the only place I've seen that so far is in -- it's in the general guidance and in the specialized. But that notion exists there.

MS. COOPER: Okay. We'll definitely take that into consideration.

We've had some small discussions about quantification, but I personally have been trying to say just wait, wait, we need to understand everything here before we make any decisions.

And I think it's going to be easier for us to build consensus on different approaches. But anyway, that's the plan going forward. And that's

the end of the prepared material.

I want to invite Ashley or Mary if they want to add anything here in closing also so I don't have the last words.

MS. LINDEMAN: Yes, I just wanted to thank you guys for your feedback. I think up until this point the team has obviously become intimately familiar with the draft, and it's just really valuable to get an outsider to provide constructive comments.

I think that just further enforces the need for a very solid peer review. So, thank you.

CHAIRMAN STETKAR: Mary, do you have anything or are you going to remain silent? Mary's going to remain silent. Good. Well, not good.

(Laughter)

CHAIRMAN STETKAR: Let me, before we go around the table get the phone line open. Because I know there are people out there who may or may not want to say anything.

While we're doing that, if there's anyone in the room who'd like to make any comments please come up to the microphone and do so.

Well, it's been a little quieter the last couple of times so since John is here and he

is --

MR. LAI: I've been told the line's open but nobody's on.

CHAIRMAN STETKAR: The line's open but nobody -- another scintillating meeting.

Let me just try. If there's anyone out there and you're actually on the line just please say something.

Okay, well, we did that. So, as we always do in subcommittee meetings I like to go around the table and see if any of the members have any final comments that they'd like to make. And I'll start with Joy.

MEMBER REMPE: Wow, I get to go first for a change.

Again, as I mentioned at the beginning of this I'm not a practitioner, but nevertheless I actually found the report very well written. I liked the graphics, the trees and the discussion within the text about what things to consider.

And I was interested in the topic because of it being well written.

There were a lot of suggestions from folks that are more knowledgeable in this area than me. And I actually also would like to comment that

it's good to have this interaction now.

So I believe I heard you say you were going to update it before you sent it out to peer review. And I think it's good to see that interaction with ACRS now rather than it's about ready to go out the door and we don't have time to deal with these comments.

Even though I'm not a practitioner there was a lot of discussion in here that I heard today that I did not get from reading the text. And it could be my ignorance, but I learned about the fact that -- comments and sentences in the text that talk about that there are cues to decide when to abandon.

May not be exactly honest from the discussion here today that there is a little more fuzziness about when to do it. And I hope that that's clarified.

And there were a couple of other comments about what's really at the plants versus what I read in the text that I would like to see beefed up.

Let's see. Also, I actually like the discussion toward the end here about what's motivating this work. Because that was something

when I read I was really curious about.

There's been some of these license amendment requests submitted and approved and more in the pipeline. But hearing that there's been some changes, there's been a lot of RAIs, I think the motivation section could be beefed up to really help the reader with this document too about why this is important.

And then last but not least I guess I'm more skeptical or curious about what John brought up at the beginning of the meeting about the benefits of the IDEAS methodology.

And during the discussion John actually talked about that there might be some nuggets related to quantifying uncertainties.

I don't think I just want to see references. As a person who's been listening to the IDEAS discussion I'd really like to have some -- when you go through and look at this document give us an honest assessment of how your effort has benefitted from reading that document and the framework. And be honest about it.

And if you see some things where it's not complete be honest about that too. Because I am curious.

When you're having a specific example it's easier for me to follow things than the more higher level IDEAS methodology document when I read it. And so I think that that interaction would be good both ways, to what's good about it and how it helped you but also where it's needing some improvements to cover your particular situation.

And with that I'll turn it back to you.

CHAIRMAN STETKAR: Mary?

MS. PRESLEY: We just got a text. Apparently audio is back now and John and Jeff are on the bridge line.

CHAIRMAN STETKAR: They are. Well, let's see. I was really surprised that they had just abandoned. I know somebody's paying them so they had to acknowledge the fact that they're out there getting paid.

(Laughter)

CHAIRMAN STETKAR: It's been a little quieter for some reason the last couple of times. So we'll try that again and interrupt our march around the table. I was going to skip Ron only because he made a wisecrack.

(Simultaneous speaking)

CHAIRMAN STETKAR: I heard a pop. So

first of all, somebody just please do me a favor and just say hello. Anybody out there, just say hello.

MR. WREATHALL: Hello, John.

CHAIRMAN STETKAR: Thank you very much. Hello, John.

MR. WREATHALL: Yes, this is -- I've been following along.

CHAIRMAN STETKAR: John, John?

MR. WREATHALL: Yes?

CHAIRMAN STETKAR: I know who you are, but you have to actually state your name for the record because you're going to be on the transcript.

MR. WREATHALL: Okay. This is John Wreathall.

CHAIRMAN STETKAR: Thank you.

MR. WREATHALL: I've been following all the way from the very beginning. And in the early part of the discussion, actually when you were initially talking about the role of IDEAS the line I was on was breaking up. So I actually missed quite a bit of that.

So, I'm hoping I can get updated by the presenters, or looking in the transcript.

But the issue of command and control, I'll just deal with one thing that I think is -- because it's still evolving.

The issue of what we mean by command and control, we initially call it a meta PSF because it represents the outcome of multiple types of PSFs we separate, complexity, crew interaction, workload, and so on.

But it's actually a work process that may or may not have its own failure mechanisms associated with it as well as having PSFs in some ways attached to it.

And I think we need to expand that understanding before we can say how any particular quantification framework, let alone individual tool, would be useful for that.

So, I think there will be a little bit of further development in that area. And then start looking at what kinds of quantitative frameworks might be relevant rather than picking a particular quantitative framework and then force fitting it into what our understanding of command and control is.

I've got a bunch of notes, but I think that was the only one I wanted to specifically

address in this opportunity.

CHAIRMAN STETKAR: Thank you. Anybody else on the line who'd like to make a comment?

MR. JULIUS: Yes, hi, this is Jeff Julius.

CHAIRMAN STETKAR: Hi, Jeff.

MR. JULIUS: Hi. Like John I've been on since the start and have followed along. It was a good discussion through the ideas and loss of habitability versus loss of control.

The one comment I wanted to make was on the discussion of phase 3 and the cognition.

And I think the point -- my takeaway was we need a better description on how the cognition changes from in the phase 2 where we're making the decision to abandon, and in phase 3 it's not that there isn't cognition. It changes to this coordination of control and sustaining the functions through the mission time.

And so there are -- the cognitive aspects change as you go from phase to phase.

CHAIRMAN STETKAR: And again, for the benefit of the record I think -- I agree with Jeff that as I read through the report there seemed to be not a clear sensitivity to this notion of how

cognition is treated in phase 3.

Because I get everything from statements saying there is no cognition, and I don't want to go find where that's made, but indeed it's made, to something that says well yes, you do have to account for it, but only under certain conditions.

So, I don't think it's a fundamental -- it's just a sensitivity that you have to build in the guidance.

Anyone else on the public line who'd like to make a comment?

If not, and having assurance that it's open we'll re-close the line so it stops popping. And I'll continue going around the table with Dr. Ballinger, sir. Turn your mike on.

MEMBER BALLINGER: Okay. This is of course not my area. I'm a metallurgist so that means I'm an idiot. But I find this fascinating.

I did read both reports so myself and probably Dennis were involved, I was involved with two cases where we couldn't abandon the control room unless we could swim and breathe at 300 feet. One was with a fire and the other was with flooding.

But the one with fire was a scenario which carried out over a period of half an hour. And so I'm very sensitive to that kind of thing.

So I personally believe that when it comes to these kind of very severe events that it's human reliability and human actions that really drive eventually anyway.

So thank you very much for the presentation.

CHAIRMAN STETKAR: Dennis?

MEMBER BLEY: Well, before my comments I want to mention that -- because I've heard the word you have not received ACRS comments today. You've had a discussion with members of a subcommittee and the ACRS has made no comments yet in this area, except our previous written reports.

As with the previous fire HRA I really like the depth to which you examine the things people ought to think about when they do this analysis. I appreciate that a lot.

I especially agree with Jeff's comment that came in the midst of ours and I won't say anymore about that. Nothing more to add.

CHAIRMAN STETKAR: Dr. Corradini, sir.

MEMBER CORRADINI: I'm new to all this

so I just thank the group for their explanations and indulging me in my questions. Thanks.

CHAIRMAN STETKAR: Dr. Powers, sir. You realize everybody who has a doctorate I call a sir.

MEMBER POWERS: Well, I of course feel some constraint about not commenting on this particular piece of work.

I will say that it does drive me to more sympathy for Mr. Ostendorff's opinion on this area.

And for those that caught me at the break I have not exhausted my inventory of anecdotes about Stacey.

(Laughter) CHAIRMAN STETKAR: As final closing I'd like to thank everybody. Despite the comments that I made about bits and pieces of the thing I think you've done a really good job about as I mentioned earlier to try to highlight considerations from an analyst perspective all the way through how I might construct the framework of a logic model to capture this type of process through things that people might think about when they go in and talk to operators who are justifiably skeptical of the fact that they would

ever even consider the notion of leaving the main control room.

So, and I think you've done quite a good job at doing that. And I really appreciate all the thought that's gone into it from everybody.

It's been -- with all of the logos everywhere in the report I know it's been a massive effort. So I really appreciate that.

And I wish you luck getting something out for the peer review. And I'm sure we'll be interested in hearing about it.

We'll have to talk about your schedule. I think the subcommittee would certainly be interested in hearing about it I'm going to say probably after the peer review because you're on a tight schedule and you might get additional feedback.

Just scheduling interim meetings doesn't help. So we should keep track of that process and try to get another briefing of the subcommittee after you get the peer review done and have sort of a path forward from that which obviously would be fall time, somewhere in there.

And if there are no other comments, any closing comments, I'd like to thank everyone and we

are adjourned.

(Whereupon, the above-entitled matter went off the record approximately at 11:50am)

# Supplement 1, NUREG-1921 Qualitative HRA for Main Control Room Abandonment


Susan E. Cooper (NRC/RES)
Ashley Lindeman & Mary Presley (EPRI)
Erin Collins (Jensen Hughes)
Stacey Hendrickson (Sandia National Laboratories)


ACRS PRA Subcommittee Meeting
May 4, 2016
Rockville, MD

*A Collaboration of the Electric Power Research Institute (EPRI) & U.S. NRC Office of Nuclear Regulatory Research (RES)*

# Status of Fire HRA Modeling on Main Control Room Abandonment (MCRA)

- Today's presentation:
  - Provides information on an on-going research project
  - Limited to an interim product of this research which:
    - Builds on previous research products (e.g., NUREG-1921 / EPRI 1023001)
    - Uses the experience developing NUREG-1921 & supporting NFPA 805 submittals

# Presentation Outline

- Project history and background
- Project team
- Overview
- Selected topics:
  - PRA aspects
  - Decision to abandon
  - Feasibility assessment
  - Timing and timelines
  - Influencing factors
  - Feedback to operations
- Status and future work
- Closing

# Project History and Background

- Research underway to quantify risk from abandonment of main control room due to fire generated conditions
  - Loss of habitability (LOH)
  - Loss of control (LOC)
- Identified as an area of future research in EPRI 1023001 / NUREG-1921
- Complex topic and plant specific considerations (e.g., capabilities of and procedures for remote shutdown panel [RSDP]) complicate development of generic guidance
- To provide analysts guidance as soon as practical, the project is divided into two phases
  - Phase I - qualitative guidance
  - Phase II - quantification

# Project Team

- NRC/RES
  - Susan E. Cooper, NRC
  - Stacey Hendrickson, Sandia National Laboratory
  - John Wreathall, John Wreathall & Co., Inc.
  - Nick Melly, NRC
  - Kendra Hill, NRC
- EPRI
  - Mary Presley, EPRI
  - Ashley Lindeman, EPRI
  - Erin Collins, Jensen Hughes
  - Paul Amico, Jensen Hughes
  - Kaydee Kohlhepp, Scientech
  - Jeff Julius, Scientech

# Overview

- Purpose of “Overview” (Section 2) is to help readers understand why more & different qualitative analysis activities may be necessary to address MCRA scenarios
- Topics:
  - What’s unique about MCRA contexts?
  - Implications for HRA/PRA
  - What’s different from NUREG-1921 for MCRA?
- Pointers to appendices:
  - Appendix A - background & historical events
  - Appendix B – discussion of command and control
  - Appendix C – guidance for collecting plant information for MCRA

# Overview (continued)

- What's unique about MCRA contexts?
  - MCRA is rare NPP event
  - Internal events HRA/PRA benefits from nearly standardized MCR designs, EOP content & format, staffing, etc.
  - MCRA HRA/HRA must address variations (even within NPP type and vendor) in, for example:
    - Remote shutdown panel (RSDP) design & capabilities
    - General plant design
    - Procedure(s) & associated strategy taken for safe shutdown

# Overview (continued)

- HRA/PRA, shift in “mindset” is needed
  - MCRA is a special case of fire HRA/PRA that does not build on internal events HRA/PRA
  - Without MCR environment, EOPs, etc., common HRA assumptions (e.g., all crew members working off same procedure and providing backup to other crew members) cannot be used for MCRA
  - Command-and-control (as a “meta-PSF”) can become important for MCRA due to changes in staffing, communications, etc.

# Selected Topics

- PRA aspects
- Decision to abandon
- Feasibility assessment
- Timelines
- Influencing factors
- Feedback to operations

# Qualitative Guidance: PRA Aspects

- Expanded MCRA process and guidance from EPRI 1011989 / NUREG/CR-6850
  - Fills gaps in existing methodology where additional guidance is needed
    - Integrating HFEs and equipment failures in model
- Determine plant conditions when LOH or LOC may occur
  - Entry criteria for LOH based on specific thresholds and calculated from fire modeling
  - Entry criteria for LOC not well defined in current methodology
- Expanded LOC scenario definition
  - Identified in MCRA procedure entry conditions or, more likely, through interviews with operations
    - What loss of function and instrumentation would lead to shutdown using RSDP?
    - Identification is highly plant specific

# Expanded Process and Guidance for MCRA

- Modeling guidance considerations for MCRA:
  - Define plant conditions that constitute LOC or LOH based on procedure review, then include appropriate logic in the model to capture when those conditions occur
  - Based on fire modeling, determine scenarios that would result in LOH and generally only credit abandonment for those scenarios (i.e., do not credit actions in the control room that only appear in other procedures)
  - Include random failures of equipment required for remote shutdown (including controls located at the RSDP) in the PRA model
  - Include mitigatable fire-induced failures of equipment required for remote shutdown (including controls located at the RSDP) in the model, based on circuit analysis of RSDP and control circuits to determine if any abandonment scenarios can cause failure

# Expanded Process and Guidance for MCRA (continued)

- Modeling guidance considerations (continued):
  - Include non-mitigatable fire-induced failures of equipment required for remote shutdown in the model
    - Spurious operations that can damage equipment catastrophically before it can be recovered (e.g., diesel overload, pump running with suction closed, etc.)
  - For scenarios modeled with detailed fire modeling, account for detection and suppression to the extent required to ensure realism in the dominant scenarios
- Three approaches discussed and examples provided:
  - Integration of the MCRA modeling into the plant logic model for the fire PRA
  - Other approaches: scenario bins or a single bounding MCRA failure probability for all recoverable MCRA scenarios

# Decision to Abandon

- Two situations can lead to a decision to abandon the MCR
  - Loss of habitability (LOH)
  - Loss of control (LOC)
- Abandonment on LOH
  - Applies to fires in the MCR
  - May apply to fires in adjacent rooms that “communicate” with the MCR
  - Represented by fire modeling, not HRA
    - Fire modeling determines when habitability conditions are exceeded
    - Due to threat of personnel safety, it is assumed operators leave when conditions are exceeded

# Decision to Abandon (continued)

- Abandonment on LOC
  - By procedure, applies only to certain areas of the plant containing enough cables that MCR functions could be lost. Examples include:
    - MCR
    - Cable spreading room
    - Relay room
    - Cable tunnels/chases
  - Key aspects of LOC HRA
    - Cues (symptoms) can range from very subjective to objective
    - Need to develop understanding of crew interpretation of LOC conditions
    - Decision dynamics are very important (single decision-maker or collaborative)
    - Crew “degree-of-belief/trust” in remote shutdown capability must be assessed

# Feasibility Assessment for MCRA

- NUREG-1921 established feasibility criteria for modeling HFEs in fire PRAs
- Section 6 of Supplement 1, NUREG-1921 discusses additional needs for MCRA scenarios:
  - Developed based on authors' experience (interviewing plant staff), interviews with NRC staff with operations experience, etc.
  - Developed as a consensus through team discussions
- Four new types of guidance are discussed:
  - Feasibility must be assessed on a **scenario level**, in addition to with respect to individual HFEs
  - Two new criteria have been identified
  - Some additional guidance on assessing existing criteria
  - What to do if "not feasible" is not acceptable
    - Discussed later under Feedback to Operations

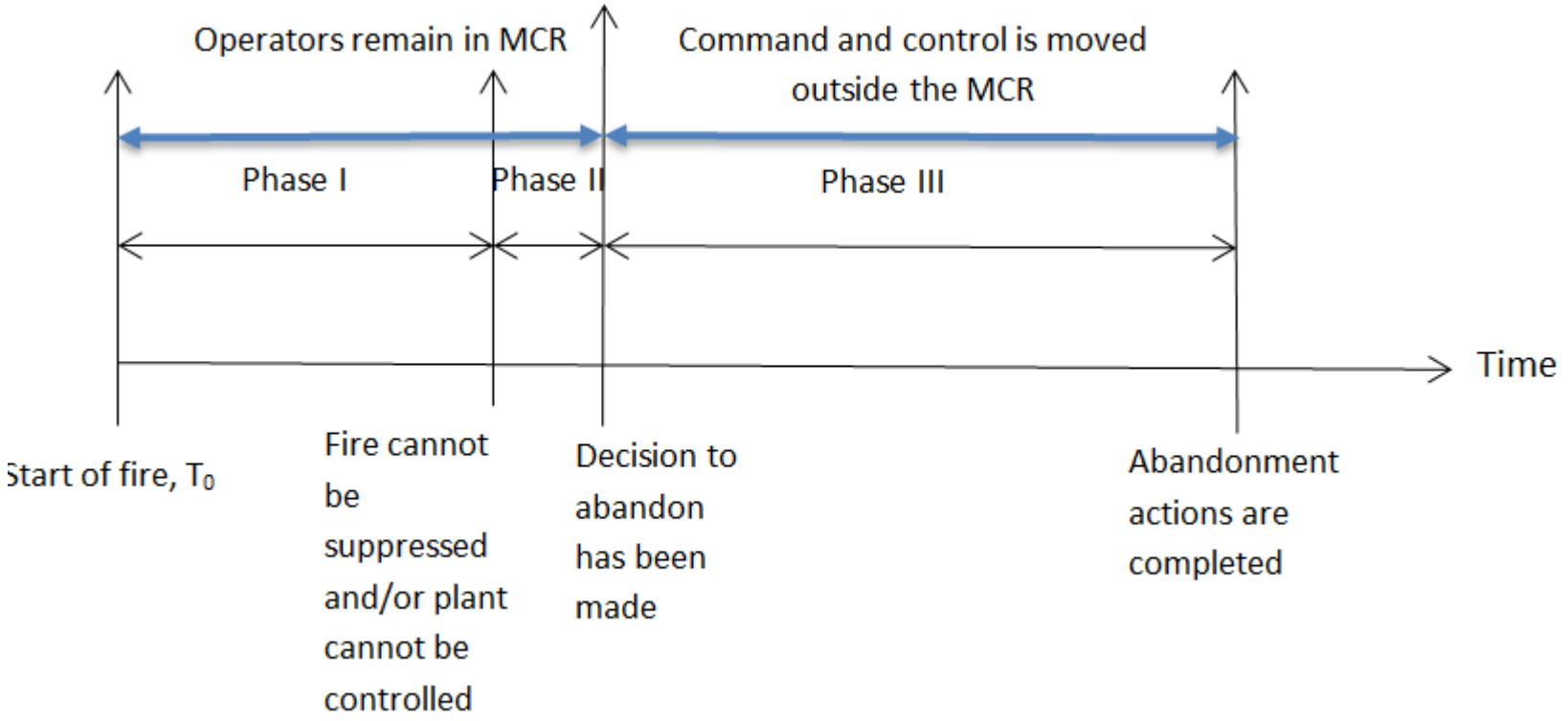
# Feasibility Assessment for MCRA (continued)

- Scenario level feasibility assessment, e.g.,
  - Can all actions, collectively, be performed within overall time available (accounting for possible coordinated actions, hold points, etc.)?
  - Is there sufficient manpower across the entire scenario?
  - Is strategy feasible with respect to procedural support, equipment availability, & RSDP capability?
- Two new criteria:
  1. Must have a pre-defined plan for command-and-control, e.g.,
     - To address changes in staffing support, increased workload (e.g., coordination of actions, increased communications)
  2. Must have a clear communications plan, e.g.,
     - To address increase in communications needed, & have necessary equipment available

# Timing and Timelines

- NUREG-1921 established a timeline for individual HFEs
  - The guidance in NUREG-1921 can be applied to MCR abandonment HFEs
- For MCRA, timing is even more critical, so the supplementary guidance recommends:
  - Developing scenario specific timelines that show who is doing what and when, all with respect to the same time origin
  - Accounting for command and control and coordination of tasks by various operators stationed at different locations
  - Integrating the various different timing sources into a single timeline with the same time origin
    - fire progression
    - accident progression
    - procedure progression and operator response

# Timing and Timelines – Three Time Phases of MCRA




Phase I – Time period before abandonment decision
Phase II – Time period for the decision to abandon
Phase III – Time period after abandon has been made

# Timing and Timelines – Three Time Phases of MCRA

- **Phase I** - associated with actions taken before the decision to abandon
  - May or may not be considered as part of Appendix R
- **Phase II** – timing for the decision to abandon is plant-specific and requires agreement between plant operations, fire PRA modeling and fire HRA
  - Typically the team will need to define conditions which require abandonment and the time at which these conditions will exist. Good example of FPRA feedback to training and/or procedures.
- **Phase III** – timeline accounts for execution time after the leaving the MCR, the same as NUREG-1921
  - Also addresses extra time required for command & control, coordination and communications

# Influencing Factors

- Performance shaping factors
- Command-and-control

# Performance Shaping Factors

- Guidance for evaluating PSFs primarily derived from:
  - List of PSFs developed in NUREG-1921
  - Experience of PRA analysts in identifying MCRA sequences modeled
- The following PSFs identified in NUREG-1921 are just as critical for MCRA (and in some cases, more so):
  - Complexity
  - Crew dynamics
  - Crew communications
  - Cues and indications
  - Procedures
  - Training
  - Timing
  - Time pressure and stress
  - Human-machine interface
  - Environment
  - Staffing and availability
  - Special equipment
  - Special fitness needs

# Performance Shaping Factors (Continued)

- In general, assessment of the PSFs for MCRA needs to consider:
  - Decision to abandon the MCR
  - Actions at the RSDP
  - Local actions in the plant
  - Command and control issues
- Guidance to the analyst in this section:
  - Provides table of examples of the PSF impacts related to distinguishing features of MCRA scenarios
  - Assists the analyst in determining which PSFs are the more significant contributors to the qualitative analysis of a particular MCRA scenario by identifying the contexts that make a PSF consequential, and why
    - Content of these tables is considered preliminary

# Command and Control (C&C)

- "Meta-PSF" that describes the need for a central body of authority to make decisions but have them carried out by a distributed group
- C&C during in-MCR operations:
  - Shift supervisor is aided by ROs and STA, who are monitoring and providing information input
  - Staff are co-located, allowing face-to-face communication and shared access to information in a relatively quiet atmosphere
- MCRA is more complex and person-in-charge must transition through a series of contexts:
  - Decision to abandon the MCR
  - Transition to the RSDP
  - Communication of instructions to staff located elsewhere, sometimes based on reports of measurements from the field

# Command and Control (continued)

- Understanding the C&C structure outside the MCR is the key to understanding the impact on the reliability
- Command and Control appendix provides:
  - Guidance on how the C&C structure can be defined and evaluated, such as:
    - Identifying where the person or people leading the response will be located
    - Identifying how procedures will be used by the person or people in charge and by the field operators
  - Situational factors (e.g., detecting/noticing or directing attention/managing workload) for C&C that could negatively impact:
    - Decision to abandon
    - Post-abandonment responses at RSDP or out in the plant
  - C&C based on macrocognition work by Roth, Mosleh, et al., with adaptation from ATHEANA

# Feedback to Operations

- Findings from the analysis can be fed back into operations, training, or even design to ensure feasibility and improve reliability of MCRA
- PRA perspective
  - Addresses (understandable) reluctance of operators to leave MCR and credibility of MCRA scenarios
  - Analysts have to assist in providing the PRA perspective regarding the severity of the fire
    - Fires large enough to result in significant effects on instrumentation availability and reliability will also be large enough to impact systems capable of providing sufficient cooling to reactor vessel – both may render MCR ineffective
    - Provide operators with list of failed equipment and indications for the most risk-significant plant-specific scenarios that would trigger MCRA – could be used as simulator exercises

# Feedback to Operations (Continued)

- Plant Modifications
  - Where time is particularly constrained and the action is essential, plant modifications may be appropriate to provide rapid response mechanism or improved human-machine interface
  - Example: installation of a (or several) MCR “disconnect switch” to address spurious operation of valves (e.g., mitigates spurious opening by causing the valve to re-close)
- Procedure and Training Updates
  - MCRA analysis can assist in clarifying or emphasizing certain steps to ensure they are performed in a sufficiently timely manner
    - Providing better guidance to the Shift Supervisor on making the decision to abandon the MCR
    - Consolidation or re-ordering of procedure step performance that might still allow non-risk significant actions to be taken in addition to the PRA critical actions

# Expected Usage

- Guidance to both fire PRA and HRA on modeling MCRA
  - Coordination is crucial for successful analysis
- Expanded guidance for LOC scenarios
  - Special attention to decision to abandon, unique to MCRA
- Expanded criteria for feasibility assessments
  - Explanation of go/no-go criteria for PSFs
- Expanded guidance on developing MCRA timelines
  - Detailed discussion of approach, inputs, and feasibility considerations
- Feedback to plant operations
  - Recommendations for increasing likelihood of MCRA success
- Inputs to feed into quantification
  - Qualitative insights, PSFs, timing information used in all HRA methods

# Current Status

- Draft report provided to ACRS PRA SC will be starting point for developing a report ready for peer review (then publication)
- Peer Review:
  - Team is reviewing “parking lot” items before finalizing report for peer review
  - Team is developing a peer review plan

# Future Work

- Supplement 1, Qualitative Analysis Guidance:
  - Peer review (Summer 2016):
    - NRC – RES and NRR reviewers planned
    - Industry – outreach for reviewers underway
  - Final publication (Summer/Fall 2016)

- Supplement 2, Quantification:
  - Begin work in Summer 2016
  - Plans include:
    - Testing
    - Publication of a draft for public comment
    - Peer review
    - Final publication (with update to Supplement 1, as needed)

# Closing

- Remarks from EPRI and NRC/RES management
- Questions?



JENSEN HUGHES

Advancing the Science of Safety

Sandia National Laboratories

# Backup Slides

# Feasibility Assessment for MCRA

- Additional guidance for MCRA scenarios:
  - Sufficient time: Time required for all tasks must be considered, including any dependencies.
  - Sufficient staffing: Staff needed to support command-and-control must be considered, in addition to other operator actions
  - Primary cues available/sufficient: Cues for all actions (in MCR, at RSDP, or at local stations) must be available & sufficient
  - Proceduralized & trained:
    1. Must be sufficient for all actions required for MCRA scenario
    2. Actions that are not needed for PRA-modeled MCRA scenario should not prevent success of strategy (e.g., do not take up more time than available)

# Feasibility Assessment for MCRA (continued)

- Additional guidance for MCRA scenarios: (continued)
  - Accessible location:
    - Each MCRA location is accessible w/r to travel path & remaining in place for duration of actions
  - Availability & accessibility of equipment & tools:
    - Ability to gather all necessary tools & equipment, demonstrate use, etc.
  - Operability of relevant components & systems:
    - Evaluate availability of required controls at RSDP & local stations, confirm functionality

# Timing Sources Used As Input to MCRA Timeline

- Fire progression – from fire modeling
- Accident progression – typically from thermal-hydraulic analyses
- Procedure progression and operator response timeline
  - Following the decision to abandon, there are typically multiple inputs (one for each operator)
- Timing model for the decision to abandon

**The key to MCRA timing is to integrate the several different timing sources into a single timeline with respect to the same time origin.**