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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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RELIABILITY AND PRA SUBCOMMITTEE

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THURSDAY, JULY 26, 2012

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ROCKVILLE, MARYLAND

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

COMMITTEE MEMBERS:

JOHN W. STETKAR, Chairman

J. SAM ARMIJO, Member

DENNIS C. BLEY, Member

HAROLD B. RAY, Member

JOY REMPE, Member

MICHAEL T. RYAN, Member

STEPHEN P. SCHULTZ, Member

WILLIAM J. SHACK, Member

NRC STAFF PRESENT:

JOHN LAI, Designated Federal Official
HARRY BARRETT, NRR
BENJAMIN BEASLEY, NRR
STEPHEN DINSMORE, NRR
JOSEPH GLITTER, NRR
ALEX KLEIN, NRR
PAUL LAIN, NRR

ALSO PRESENT:

PAUL AMICO, SAIC
FRANCISCO JOGLAR, Hughes Associates*
JEFF JULIUS, Scientech
ANIL JULKA, NextEra Energy
BOB KALANTARI, EPM*
MICHAEL KAMMER, SCANA
TED KULCZYCKY, NextEra Energy
GERALD A. LOIGNON, JR., SCANA
DAN MacDOUGALL, DC Cook
BIJAN NAJAFI, SAIC
VINNY RUBANO, NextEra Energy
MARK SCHAIRER, EPM
LAURA SWENZINSKI, NextEra Energy
KIANG ZEE, ERIN Engineering

*Present via telephone

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P R O C E E D I N G S

8:29 a.m.

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

ACRS members in attendance are Sam Armijo, Steve Schultz, Harold Ray, Mike Rayn, Bill Shack, Joy Rempe. And we will be joined by Dennis Bley later in the morning. Jon Lai of the ACRS staff is the Designated Federal Official for this meeting.

The purpose of the meeting is for the Subcommittee to hear the technical findings of licensees' fire protection program transition to NFPA 805. We'll hear presentations from three licensees, the nuclear industry and the NRC staff.

There will be a phone bridge line. To preclude interruption in the meeting, the phone will be placed in listen-in mode during presentations and committee discussions. We have received no written comments or request for time to make oral statements from members of the public regarding today's meeting. The entire meeting will be open to public attendance.

The Subcommittee will gather information, analyze relevant issues and facts to 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.

Before we start, I have a few administrative things to take care of. First of all, I'd like to really express our appreciation to the staff, the industry and the licensees for supporting this meeting.

We know that everybody is really, really busy with this whole NFPA 805 transition process and we really appreciate your taking your time out. We know how much, they have not issued an SER. They will not issue an SER until their review is complete.

They have issued RAIs. They're working through the RAI resolution process. So, please keep that in mind when you ask questions, because this is not - we are not reviewing a formal staff product here. And in that sense, I suspect we will have several technical questions that will come up during the meeting.

I'd like to emphasize the fact that those questions are intended for us to improve our understanding of specific technical issues and how they're being addressed both in the staff's review and in terms of the, perhaps, licensees' responses to RAIs or particular methods that they're using to address specific issues that come up.

It's certainly not our intent for any of our questions to precipitate further staff RAIs, and let me just leave it that way. This is for a briefing of our subcommittee, and I don't know how else to put it.

And if the members would kind of, you know, keep that in mind a little bit, because it is a bit - we don't normally get involved at this stage in the process. So, it's a bit dangerous in that nature that things that we say may be misinterpreted.

One other thing, the meeting is completely open. There may be questions that tread upon areas of proprietary information, either data, perhaps proprietary methods that may be used by some of the licensees. I don't know if that's the case.

And certainly some of the information in the License Amendment Requests is classified as sensitive information from the point of details of plant layouts and things like that.

So, if we delve into any of those areas, I'd ask either the staff, and in particular any of the licensees, to alert us to the fact that we're going over the borderline between publically-available information and something that may be proprietary or sensitive.

We can close the meeting if necessary if the Subcommittee members feel that it's necessary to go into details in those areas. It's a little bit difficult, but we can do it. Let's just keep that in mind.

So, I'd ask for help again from the licensees. If you think we're getting into particularly sensitive areas or details that you don't want on the public record, please alert us to that.

And as a final comment, at the moment, we have no intent at least at the current stage of the process, to have a full committee briefing on this topic.

I suspect at the end of the meeting depending on how the discussions go, we'll discuss among ourselves whether we feel that it's necessary to bring it to the full committee.

I personally don't particularly want to do that. It's again another exercise in bringing everybody, you know, to the full committee meeting and an interruption in everybody's normal workday, but we'll see how the discussions go.

And with that, we'll now proceed with the meeting. And I call upon Joe Glitter to begin.

Joe.

MR. GLITTER: Okay. Thank you, Dr. Stetkar.

Good morning. My name is Joe Glitter. I'm the Director of the Division of Risk Assessment at NRR.

Here with me to my right is Alex Klein. And behind me - and Alex is the Chief of the Fire Protection Branch. And behind me is Ben Beasley who is the Acting Chief of the PRA Licensing Branch.

Presenting at the head of the table are

Steve Dinsmore, Paul Lain and Harry Barrett. Steve, Paul and Harry are some of the senior technical reviewers that are working on this project. We have other technical reviewers and contractors in the audience today as well.

Over the next couple of days you're going to be hearing from the staff and industry about the successes and the challenges associated with the NFPA 805 reviews.

And while the complexity and sheer volume of these reviews may seem daunting, I personally am encouraged by the professionalism, teamwork and dedication that the NRC NFP 805 team has demonstrated knowing that their efforts are tied to meaningful and prudence in fire safety.

So, that's all I had to say for an opening comment. And with that, I'll turn it over to the presenters.

MR. LAIN: Okay, I'll kick us off then.

My name is Paul Lain. I've been working with NFPA 805 for over ten years through the rulemaking and through the pilots.

I would like to - this is what we're going to go over today. I would like to spend 30 seconds on a quick look on program status. Mr. Stetkar said he didn't want to have too much programmatic-type information.

Then, we're going to walk through sort of our process, the acceptance review, some audits and RAIs on some of our observations. Then, a few -- then a short summary at the end. So, let's go ahead and get started.

Here's a - we'll do a 30-second snapshot. We've got ten License Amendment Requests under review. Four of them right now are into their second rounds of RAIs. Two of them are in their first rounds.

We've done our audits on six, the first six. The seventh and eighth are - right now they've given us supplemental information for the acceptance reviews.

And then the last two have come in recently and they're under their initial acceptance review.

And then we have another one at the end of this month, ANO1, and then four more at the end of September.

Then we'll start with Steve talking about PRA.

(Laughter.)

MR. LAIN: Unless there are any questions.

MEMBER SHACK: Somewhere there was a slide or something with a comment on it about we didn't want to repeat the ANO experience.

Is there something particularly difficult about that acceptance review or - it seemed a little late in the game to have fundamental difficulties.

MR. LAIN: We're not sure which slide that is.

MEMBER SHACK: Oh, okay. I think it was from the June 27th public meeting.

MR. LAIN: Okay, Alex was going to -

MR. KLEIN: Yes, if I could, this is Alex Klein. I think this mic is on.

If I could respond to that, we go through and I think we'll talk about that maybe a little bit more. We have a process in place where we go determine whether or not the licensee submittal is complete and sufficient for our technical review.

And in the case of ANO Unit 2 submittal, there were some deficiencies that we've identified in the License Amendment Request. We did have two public meetings with the licensee to discuss the need for additional supplementary information in order to make their License Amendment Request more complete for the staff to actually start their review.

So, I think that's what you might be referring to.

MEMBER SHACK: Thank you.

MR. DINSMORE: Well, I see that brings me right into my slide. My name is Steve Dinsmore. I'm a Senior Risk and Reliability Analyst in the PRA licensing branch. I've been there for about 16 or 17 years.

I'm actually not a real fire PRA guy. I'm more of a general PRA guy. The real fire PRA engineers are Ray Gallucci and J.S. Hyslop, who are both here. So, if you get into really detailed, technical questions, I'm going to wave around and try to get them up here. And our contractor is Garill. I see Garill is back there from PNNL.

I'm going to give you an overview of how this stuff works and some medium level of detail about what we're coming up with.

So, the first slide here talks about acceptance reviews. As Alex said when a submittal comes in, the first thing we do is a real quick review to see if it contains sufficient information to complete our review, which really means to start it, but that's the way the wording is.

So, we do that and we do it fairly

quickly. And we come back to the licensee and we either say we accept the thing for review, or we don't accept the way it is, but you can supplement, or we don't accept it, period, and you have to resubmit, which is unpleasant for everybody.

So, in the six or seven - I think we accepted six so far. And what I've got on this slide is just a little bit of information of the original or the initial acceptance review results that we've come up with in order to try to get these things to be more complete.

The first one is Reg 1.200 compliance paths. I guess you all know that we require the PRA to have been reviewed against Reg Guide 1.200. And if it has not been, then we actually will not accept the thing for review.

If a PRA comes in or if one of these submittals comes in and says we've got an internal events peer review in 2010 and we've got another fire peer review in 2011, that pretty much is very simple and straightforward.

Unfortunately, there's also a path since these peer reviews have been going on for 10 or 12 years and the guidance or the detail guidance has changed, we developed a path to keep them consistent without having to redo the peer reviews. And a number of them have been following those paths and they can be fairly complicated to understand exactly how the path that they chose makes them consistent with the current Reg Guide 1.200.

So, we've been going back in a couple cases and saying, can you explain a little more about your gap assessments, your self-assessments and how you got there? So, that's one of the first things that we've been looking at.

The second one, incomplete total risk and change in risk information as I guess most of you also - if I say something you don't recall, please let me know.

But most of you probably know if your increase in CDF is between 10 to the minus six and 10 to the minus five, we need to know your total CDF.

The LAR template had a statement in there, well, our total CDF is less than 10 to the minus five and LERF is less than 10 to the minus six. Some licensees interpret that literally, and so they came in with their submittal and they gave us that statement.

And we said, no, no, we need your estimate mostly because it convinces us that you have actually done all this work to the extent that you come up with an estimate.

That's actually been a fairly simple one to deal with. Everybody realizes what's going on. So, that's kind of passed.

This next one is probably the source of much discussion over the next couple days. We sometimes go back and ask them, can you complete, identify relevant sources and model uncertainty?

Model uncertainty, I've got two bullets here. Unreviewed methods, which are methods that the staff has not yet seen that they've reviewed.

Now, the key - I'll keep going. Key assumptions are alternate reasonable assumptions which could impact the results being used, and the consequence of using these different assumptions may affect the decision.

And for both of those types of things that the licensee have done in their analysis, we request a sensitivity study. So, they can do unreviewed methods, they can do key assumptions that maybe we wouldn't agree with, but they need to provide us with a sensitivity study before we start our review.

That's also caused some consternation because the sensitivity studies can be difficult to do. And the acceptance review is a pretty short time fuses, but we're working through that.

I guess ANO2 actually we asked them to do some sensitivity studies that were very time-consuming. So, that's one of the difficulties that we've been running across.

CHAIRMAN STETKAR: Steve, on those sensitivity studies, and I see you have a slide coming up a little bit more on fire modeling, so I wasn't going to ask, but are those sensitivity studies done by varying parametric values within the constraints of the model that they use, or are they sensitivity studies that compare - if it's a modeling issue, is it a sensitivity study that compares a set of fixed parameters from the model they use by comparison to another model, for example, that might have full V&V?

MR. DINSMORE: Thank you for that question.

CHAIRMAN STETKAR: You're welcome.

MR. DINSMORE: If the model - if we've already accepted the model, then the sensitivity study is a parametric study on how you applied it to your plant.

If we haven't accepted the model, we've been requesting that they - the sensitivity study use an accepted model.

CHAIRMAN STETKAR: Okay.

MR. DINSMORE: And we were doing that because it makes the reviews much more effective and quick since we really didn't want to review these new methods in the LAR reviews. And we try to avoid that as much as possible. Unfortunately, there's a lot of them coming up in these reviews.

So, if we can compare - if we can start off by knowing what the effect of using their new model is compared to an old one, we can move along much quicker. So, those are the two different types.

CHAIRMAN STETKAR: Okay, and that helps.

In the - and tell me to be quiet if we're going to address it later. I'm trying to look ahead, but particularly interested in applications that have used models, you know, correlations, whatever you want to call them, that are not part of the V&V suite that has been accepted in NUREG-1824 anyway.

Have you seen - and I know you're early in the review process. So, you haven't seen a lot of submittals. And at least from the three that I've looked at, I've noted that there are, let me just say, deviations among those three in terms of approaches that are taken.

You mentioned that you don't want to get into a process of essentially reviewing specific models that have been used.

Have you seen any type of tendency for a large number of applicants to use a specific model or a suite of models that are outside of the set of five from NUREG-1824 such that it may be worthwhile to actually take a focused look at those, or are they sort of scattered?

As I said, it might be not a fair question because you -

MR. DINSMORE: I think I'll give an answer and somebody else might want to chime in. I think that there is a tendency to group so that there are - it's not like there's 30 different methods.

There's five different methods that are being applied in different places. So, it is kind of grouped.

CHAIRMAN STETKAR: It's probably grouped according to contractors, I suspect. Okay.

MR. BARRETT: Yes, one thing I'd like to point out is - this is Harry Barrett, senior fire protection engineer.

I'd like to point out that in the vast majority of cases, they're all using five V&V fire models. What they're changing is the assumptions that go into the front end of that.

For instance, electrical cabinet heat release rates, 6850 has certain 75th percentile, 98th percentile numbers. They're varying the numbers that they're using in their model somewhat based on their assumptions, and that's getting different results than you would get if you used 6850, but they are using a verified model when they do it.

CHAIRMAN STETKAR: So, they're using the fundamental correlation. They're just varying the input parameter accordingly, okay.

Thanks, that helps a lot because that's different than taking the -

MR. BARRETT: I think there's a few - I think detector activation is one that I didn't think it got V&V'd and they're using that. And they end up having to come up with some other justifications for that, but the vast majority of them are all V&V codes or correlations.

CHAIRMAN STETKAR: You're not seeing somebody come in with here's Joe's Corner Grocery Store plume --

MR. BARRETT: Yes, we haven't --

CHAIRMAN STETKAR: -- correlation or something like that.

MR. BARRETT: No.

CHAIRMAN STETKAR: Okay.

MR. BEASLEY: This is Ben Beasley, acting branch chief of PRA licensing.

So, just the way you asked the question, I want to make the point that we are willing to review the methods.

CHAIRMAN STETKAR: Sure.

MR. BEASLEY: Our preference is to not do it through the LAR process, but to do it in a separate -

CHAIRMAN STETKAR: No, I understand. I was just trying to get a sense that if out of the, you know, eight or so that you're sort of in process so far, plus the two pilot plants, if you saw a large number of them all using some, you know, I'll call it Joe's Corner Grocery Store, you know, correlation or something like that, it might be more efficient to actually take a little time and look at that. That's the sense that I was trying to get.

And that's from what Harry said, I don't get that sense. So, that's good. Thanks.

MR. LAIN: As I mentioned, you're reviewing both the internal events and the fire PRA. So, this is not just with the fire PRA.

MR. DINSMORE: Yes, that was on my RAI slide.

MR. LAIN: Oh, I'm sorry. I'm taking away your thunder. We'll let Harry talk for a little bit.

MR. BARRETT: Okay. In the middle of the acceptance review, what we basically do is look at the details in the LAR and make sure that we have enough information to start the review and essentially the information we would need to write the safety evaluation from an amount of information.

If we find holes in this application where we don't have enough information, then we would end up asking for supplemental information submitted to us on the docket.

So, we get into some fairly detailed information when we end up doing this. Things like whether or not they've identified all the variations from deterministic requirements.

We had one licensee that ended up doing a control room analysis where they didn't actually tell us all of the VFDRs in the control room, which are variations from deterministic requirements.

It's kind of hard for us to end up judging whether or not they did the job right if we don't even know that they have identified all of the components that were damaged in the control room, you know.

They gave us the statement that, well, we don't have a shutdown panel. So, we have one VFDR for the control room.

That's kind of a problem. One of the ANO issues was the fact that they did their control room analysis, and what they submitted to us was so simplistic that we couldn't make sense out of exactly what they did.

In that case, it's kind of hard for us to accept the license amendment if what they've given us on the docket doesn't give us enough information to actually explain how the analysis was done.

A second issue that we get into when we look at these is if they're doing modifications, if they don't explain what those modifications are or they say, we may do this or we may do that or we may do something else that will bring the risk down equivalently, they haven't actually decided what they're going to do. So, they're not telling us what they're asking our approval on.

So, we can't end up doing an acceptable review if we don't know exactly what they're asking for.

So, the acceptance review is basically to look at in total the license amendment and decide whether or not they've given us sufficient information for us to actually do the review.

So, we can get to a very high level of detail in the acceptance review, but typically we don't.

CHAIRMAN STETKAR: Harry, in those details, I mean, I've actually read now through three of these things, generally there is summary information in the LAR supported by, I guess, you know, stacks of more detailed technical reports.

MR. BARRETT: Yes, absolutely.

CHAIRMAN STETKAR: Are those technical reports submitted to you, or are they just available for audit?

MR. BARRETT: Well, we've been doing -

CHAIRMAN STETKAR: So, for example -

MR. BARRETT: We started a policy with the pilots and we've been following it through with all of the licensees so far, is they give us a SharePoint site once we accept their license amendment.

CHAIRMAN STETKAR: Okay.

MR. BARRETT: On that SharePoint site will be the PRA calculations, the nuclear safety capability assessment, the non-power ops review, you know, the monitoring program.

All of the detailed procedures and calculations and stuff that we would need to look at as backup information to understand exactly how they did that, is on the SharePoint site.

And then when we do the audit, we also go in and we actually look at hard copies and talk to them.

CHAIRMAN STETKAR: Okay.

MR. BARRETT: When I go on to the next slide, we'll talk about that a little bit.

CHAIRMAN STETKAR: But you do have at your fingertips then their -

MR. BARRETT: Not at the acceptance review stage.

CHAIRMAN STETKAR: Not at the - okay.

MR. BARRETT: Acceptance review is -

CHAIRMAN STETKAR: Not at the acceptance.

MR. BARRETT: -- just looking at what -

CHAIRMAN STETKAR: Sure, okay.

MR. BARRETT: -- they put on the docket.

CHAIRMAN STETKAR: I'm sorry, okay.

MR. BARRETT: And it's very important because it has to be the stuff that's on the docket, because that's what we have to refer to in the safety evaluation.

There may be many tiers of information that are below that, that we wouldn't necessarily refer to directly in the safety evaluation to understand how they did it, but we're actually looking at whether or not it's on the docket and we have sufficient information to write the SE from.

CHAIRMAN STETKAR: So, at the acceptance review, for example, for the modifications, you'd be limited to only the information that's in Attachment S. And if that doesn't -

MR. BARRETT Well, yeah, in many cases it's Attachment S. And it's also Attachment C, which defines what the actual problem is.

CHAIRMAN STETKAR: Yes, yes.

MR. BARRETT: Then you look at Attachment C and you look at Attachment S, and then possibly Attachment G to see whether or not recovery actions fit into that.

CHAIRMAN STETKAR: I was just thinking in terms of details of proposed modifications, you know.

MR. BARRETT: Right.

CHAIRMAN STETKAR: That's one of the items that you mentioned.

MR. LAIN: That's something else we would also do is take a look at some of the things don't rise to the level of acceptance review, some of the things we can take care of during the RAI.

So, a lot of RAIs kind of get identified and they're filling the smaller holes versus the larger ones we can fit in.

MR. BARRETT: Yes, and some of the acceptance reviews actually get into things like programmatic issues.

The first couple of non-pilots said that they made a promissory thing that they would finish their monitoring program during implementation and the details were kind of fuzzy.

So, there was a FAQ that was in process. And once that FAQ got approved, then everybody just used that FAQ as the structure of what they were asking for. So, we kind of solved that problem.

But the acceptance review gets into a lot of different things. And for such a short review, it is very intense, obviously. It's supposed to be a tenth of the overall License Amendment Review.

And when you're talking about hundreds of hours, even an acceptance review can get to be pretty intense.

Next slide.

MEMBER SHACK: Just on that SharePoint thing, there was some comment about the SharePoint that you could use that's subject to some sort of limitations.

Those limitations are that you can't use that information as part of the conclusion that -

MR. BARRETT: Well, there's several different limitations that we place on the SharePoint.

One, we can't download or print the information. In other words, we can view it, but we don't take it in-house. That's so that we don't end up having a large volume of material that we would be FOIA-able with, you know.

It's licensee's information. We're looking at it as if we were at an audit. We don't bring it back with us. It's their information. Review it. It's just like being on an audit.

The information that's on the SharePoint is also background information, but it's not to be referenced in the SE.

If there's something that we see there that we actually need for our conclusion, we would have to ask an RAI and ask them to submit it on the docket.

Next slide. When we go in for an audit,

it's quite a process, actually. We bring a pretty good size team in anywhere from, I'd say, six to 12 people. And many of them have actually had more than that because they had observers that were trying to learn the process.

It's a multi-disciplinary team kind of similar to a peer review that reviews a typical PRA. We've got fire protection people, fire modeling people, PRAs, safe shutdown people. And we end up looking at the whole scope of what the licensee has done.

We typically ask them to give us a presentation on how they've done various aspects of it, because all the contractors have a slightly different process that they use.

So, we typically end up having maybe a day, full day of presentations so that they can show us exactly how they did it, how their software works, you know. And we'll talk a little bit about the details of that because there's some concerns with the level of; one, contractor us, and; two, the sophistication of some of the databases and the information that they're using.

But anyway, we end up, you know, having a very intense one-week visit with the licensee. We do walkdowns and we actually get into detailed one-on-one discussions with their experts to find out all the details of what they're doing.

And we actually in the walkdown, sometimes see some things that we wouldn't have expected, you know.

One walkdown we ended up seeing that the fire modeling had not addressed some of the combustible insulation on the pipes, you know. That's the kind of thing when you're on the walkdown you'll say, well, geez, that's polyurethane.

(Laughter.)

MR. BARRETT: So, you know, it's quite a process. And we end up, for instance, many of the licensees have integrated databases for their safe shutdown cable and routing programs, the safe shutdown analysis, and then that links up to the PRA.

Typically we want to end up knowing how are you going to control this now and in the future as far as configuration management? Because now any time anybody comes in that does a design change, you got a potential challenge to your whole analysis because you're now rerouting cables and changing whether or not something is in the zone of influence for ignition source.

So, we end up getting into fairly good detail talking about those kinds of things in the audit to understand that.

That's typically not something you're going to see in the LAR, but it is important from an understanding of the process standpoint.

We typically end up going into great detail talking about fire modeling, how they're dealing with V&V, which models they're using, what assumptions they are using.

In the walkdowns, typically the fire modelers will end up taking notes and looking at specific issues that they might want to ask about, ventilation concerns, that type of thing, how suppression is addressed.

And so, all of this ends up forming the basis of where the RAIs come from. We do these walkdowns and discussions with the licensees and then we have questions. And then from those questions we end up writing the RAIs, which are then submitted to the licensee and asked to respond to.

It's a very intense week. A lot of discussions back and forth. And in many cases, the staff actually does a good job of explaining why we need information. And the licensee actually understands better after the audit when we come in and say, well, we need to know this because. And that ends up being a benefit to both sides. We got a lot of positive feedback from people saying that the audits are beneficial.

They also talk about program quality. Things like were people fully qualified to do the analysis that they were doing and did they follow the limitations of use, were they within the range of the V&V models and those kinds of things. A lot of discussion about all those topics.

So, the audit ends up being a very beneficial thing overall for the whole thing.

Next page.

MR. LAIN: We'll let Steve jump in on PRA RAIs.

MR. DINSMORE: Okay. As Paul mentioned earlier, we're doing reviews of internal events and external events.

The fire PRAs, they're done mostly by imposing the fire failed components onto the internal events PRA. They don't usually go on start a fire and try to figure out the whole scenario. They look at a fire, they see what failed, they go to their PRA and they failed it.

And so, there is a lot of dependence on that internal events PRA which we hadn't really expected, but which we're dealing with.

CHAIRMAN STETKAR: Steve, why didn't you expect that?

(Laughter.)

MR. DINSMORE: Well, I guess personally we did risk-informed ISI and that one you go and you actually fail your pipe and you come up with all your scenarios.

So, the internal events PRA is used more as a source of information whereas in this case you go in the - you don't really figure out the whole scenario. You figure out what failed and you impose it on your internal events PRA.

CHAIRMAN STETKAR: Right.

MR. DINSMORE: Well, okay.

CHAIRMAN STETKAR: I guess I would be surprised if - are people actually developing different fire PRA models? I mean, have you seen any of those?

MR. DINSMORE: You might - they're probably better off answering that.

CHAIRMAN STETKAR: Okay.

MR. DINSMORE: I know that they -

CHAIRMAN STETKAR: I'll wait.

MR. DINSMORE: Okay.

(Laughter.)

MR. DINSMORE: This makes the quality of the internal events model equally important to the fires.

And the internal events as I mentioned earlier, that the peer review started in the late 1990s. And they've gone through this complicated process.

And we've eventually decided that the only way you can delete a finding or F&O from the consideration is if you have a new peer review that doesn't include it. So, they can't delete themselves.

So, we always request as I said during this NUREG review, at this point we're requesting the whole set of F&Os and findings that you had to date, and how you resolved them.

So, a number of the RAIs are actually - they submit this stuff and then a lot of times the resolution will be essentially we fix this. And they'll immediately get an RAI, please tell us how you fixed it.

So, there's a fair number of RAIs that are coming out that are dealing with the quality of the

PRAs.

CHAIRMAN STETKAR: Let me ask you because I kind of waded through some of that stuff, but only in the LARs, let me take a hypothetical case that I built an internal events PRA model sometime late `90s and I had some sort of peer review done on that in 2002, let's say.

And that peer review raised some F&Os and, you know, maybe I addressed them, maybe I didn't, because I haven't had any risk-informed licensing applications in my particular site. So, I had no real incentive to do that.

And now I'm going to use the PRA to risk-inform my NFPA 805 transition. And I have another peer review done of that model enhanced to take the fire PRA input, the fire damage input or however you want to characterize it. And that's done in, let's say, 2010.

Are you telling me that the second peer review doesn't subsume the quality of the internal events PRA as it existed in 2010 so that you have to look at that 2002 peer review separately from the 2010 peer review?

MR. DINSMORE: Well, the question illustrates -

CHAIRMAN STETKAR: Or is it not that simple?

MR. DINSMORE: Well, the question illustrates the difficulty we're having following this complicated task. I guess I got a little lost.

CHAIRMAN STETKAR: Well -

MR. DINSMORE: They could do something called a focused-scope peer review. If they did a peer review in 1995 and then they fix some models to do their fire PRA, they could do a focused-scope peer review on those elements that they fixed.

It's kind of similarly defined in the ASME standard. And if they do that, then they - and that focused-scope peer review reviews against that piece of the standard, then the old F&Os can -

CHAIRMAN STETKAR: Can still be open.

MR. DINSMORE: No, no, they go away.

CHAIRMAN STETKAR: Oh, okay, okay.

MR. DINSMORE: But if they just come in and review and say, did we fix those right, that's not a focused-scope peer review. That would just be a self-assessment and the old F&Os would not go away.

But then when they came in and told us, well, we fixed these, then they would have a good description of why they were fixed.

Did I answer - I wasn't quite sure that was the question.

CHAIRMAN STETKAR: I'm not sure it was either, but we're going to hear about peer reviews tomorrow. So - I think we're going to hear about peer reviews tomorrow. At least it's on the agenda. So, maybe we'll be able to understand it a little bit better.

MR. DINSMORE: Okay. So, there are a fair amount of RAIs that deal with peer review results, and some of those are difficult to deal with as well.

This detailed documentation on the SharePoint in the subsequent audits, it actually allows us to look - take a much closer look at significant scenarios in great detail that we usually don't - haven't been doing that. But in this case, we do because of the effect of the submittals.

So, then we end up with a fair number of RAIs talking about, well, you know, you had recovery action for fires which failed bus 1A, well, couldn't fine them for 1B. What's the difference?

And so, there are quite a number of RAIs dealing with the details of the - the scenarios that they're coming up with.

There's another one about, well, there was no transient combustibles postulated in this corner of the control spreading room, and there are two trains in that corner. Why aren't they transient combustibles in that corner?

And actually a lot of those real detailed RAIs have kind of worked their way into some questions about the methods. So, we've started in the last couple of submittals, we've started issuing generic RAIs and this one about the transient combustibles is a good example.

So, now we're starting to ask, well, how do you place transient combustibles within a fire area? Because, again, we noticed from the detailed analyses that there was - I think that NUREG-6850 says you need to identify pinch points and put the fire in there.

And so, this is one of those examples of where there's a method that they don't exactly - they're not following 6850. And so, we'll ask them to do a sensitivity study to - and of course that's difficult because they have to go back in the room and redo. So, the sensitivity studies are not that simple, but we effectively need them to be able to continue quickly.

So, there's a fair amount of generic RAIs asking directly how did you do something.

CHAIRMAN STETKAR: Steve, in those areas - I know the staff has a continuing dialogue, or I assume there's a continuing dialogue between the staff and the industry.

In those types of generic areas where - transient combustibles you just mentioned, for example, are you getting the message out to the other applicants that there might be ways that they can structure the models to make the process more efficient? I mean, their process and your process more efficient.

In many cases, you know, trying to make the model perfect might not necessarily be - it might not be necessary to try to make the model perfect, you know.

If you put the transient combustible in the worst place in the beginning, it can still show, you know, have a problem. That makes everybody's life easier, but my question is more what type of dialogue do you have if you are finding kind of generic issues in several submittals like the one you just raised.

MR. LAIN: There is a number of dialogues. I'm kind of looking at Alex to see -

MR. KLEIN: I was going to cover that in

the last slide.

CHAIRMAN STETKAR: Were you? Okay.

MR. KLEIN: Well, I think at a high level, to answer your questions, is that the staff, yes. We hold very frequent - actually, almost on a - well, we do on a monthly basis, we do a little communication with the licensees.

I'm stealing some of the thunder from Paul, but they do keep track of the RAIs. In fact, I think not at the last monthly FAQ meeting, but I think the one before that we did go over a matrix of RAIs that the licensees had been keeping track of.

And in addition to that, we periodically hold public meetings. For example, Dr. Shack mentioned I think the June meeting. That was a fairly largely attended meeting between the staff and the industry to go over some of our observations that we've noted thus far with both the acceptance reviews, our audits and so forth.

So, yes, I mean, that communication continues, and it will continue in the future. There are other meetings that we hold. Our division director, Joe Glitter, holds monthly NEI-NRC management - senior management interface meetings that are public.

Joe also contacts on a bimonthly basis, each of the licensees that have an accepted License Amendment Request in house for review. So, there's that constant communication going on there.

CHAIRMAN STETKAR: That helps. You know, the FAQ process has become pretty well formalized, but that's generally initiated from the industry.

So, I'm assuming the industry -

MR. BARRETT: Not always. One of the things I was going to point out was -

CHAIRMAN STETKAR: Have you guys actually initiated some?

MR. BARRETT: In this particular instance talking about the combustibles, transient combustibles, we initiated a FAQ -

CHAIRMAN STETKAR: Okay.

MR. BARRETT: - to show a method that we agree with -

CHAIRMAN STETKAR: Oh, okay. Good.

MR. BARRETT: - that we're proposing for the industry to look at. So, sometimes we end up looking at one of the methods that licensees use and we try to put that out for everybody to use.

And so in that particular instance, we have a FAQ that's currently in front of the task force that we had initiated.

CHAIRMAN STETKAR: Okay, good. Thanks.

MR. DINSMORE: Well, I was finished with the PRA RAIs.

MR. BARRETT: Okay, fire modeling RAIs. For the first review of a given consultant group, let's say, we typically will end up asking for input files for the models that they've done and do confirmatory analysis.

We've done that for several of the licensees. We did it for Cook. We did it for Duane Arnold just to get an idea of what results we would see and exactly what assumptions that they made.

We get into discussions about uncertainty, how they deal with uncertainty. There's RAIs that says, you know, identify what uncertainty you have in your fire models and exactly how did you address that in your decision making. That's a typical RAI.

We end up having quality issues with V&V. How do you deal with a V&V? Some of the aspects of their calculations are maybe either outside the range that was validated.

A good example would be that I think one of the licensees used CFAST. And the dimensions of the room that were qualified, they had one that was just slightly out of that and said, all right, how can you tell us that this is now V&V when you're outside the V&V dimensions of what the software is meant to be.

Those are the typical kinds of questions that the fire modeling guys will end up asking the licensees from an RAI standpoint.

Nuclear safety capability assessment, all kinds of different questions, you know. We end up getting into looking at from a deterministic standpoint, we try to understand exactly how they're complying with the regulations.

And in many cases based on what's in the LAR, we either can't make sense out of that or it's inconsistent between either one attachment or another.

You end up really having to look at the Attachment C which is the fire area review, Attachment G which is the recovery action review, Attachment S which is your modifications, and then Attachment W which kind of sums it altogether.

And if you look at all of those and between them it doesn't make sense, then RAIs come out of that and say, all right, guys, what are you doing? We don't understand how you got this answer. A lot of RAIs come out of that.

One of the things that when we get into the baseline program, 0402 has gotten several different avenues for you to end up showing that you meet the deterministic - or I should say the fundamental program attributes.

You can either comply directly with 805, you can comply with clarification which would mean - or should mean that you're really meeting the requirement, but let's say it's a different type of document that it's in, different type of paper.

What we're finding is some licensees are using compliance and clarification to actually ask for approval for deviation, which is not proper. And so, we found a few of those and sent back RAIs that says, you know, if you want to do this, you really have to do a performance-based request and give us all the information that is required for that under C27 of 50.48©.

Some licensees end up referring to their Appendix R program in their comparison to the nuclear safety performance criteria, which is not proper anymore.

Now that they're no longer an Appendix R plant, they shouldn't be using that as any part of their justification for meeting the nuclear safety performance criteria. So, that's been kind of a generic RAI.

Based on comments from the ACRS when we ended up doing the Reg Guide, we ended up endorsing Rev 2 of NEI 0001. There were some minor nuances with Rev 2.

Licensees - first couple of licensees that came in did not have any kind of gap assessment or addressing any of the technical concerns in Rev 2. So, that ended up becoming a generic RAI.

There have been some of these that came up in the first couple of non-pilots that we're working through with template changes with 0402, which is good. The process if working. We're identifying concerns. They're making changes in the template and now we're seeing that they're being resolved.

The last licensee that we ended up receiving in, Nine Mile, ended up catching a lot of that and they're fixing it in their amendment. So, the process is actually working pretty good that way.

One thing that is kind of a concern is that we're seeing a general trend of putting less information in the B3 Table or actually Attachment C.

In the pilots, for example, the Harris plant gave us very detailed information on a VFDR level and says this VFDR has a cable and that cable is not in a zone of influence of a risk-significant ignition source.

What we're getting from the non-pilots now is the risk is acceptable for the room. There's no details as to why, okay. We have to go down in the lower tier documents and actually understand how that happened versus having it in the LAR and laid out for us on a VFDR basis.

Well, this one is within a zone of influence. So, we're either protecting it or doing a modification, you know.

The level of information as provided in the Harris submittal is much higher than what we're seeing in these non-pilots, which is making us have to go to a much lower level in their SharePoint information.

And in many cases, causes us to ask more RAIs. Because once you get to that level of detail, you have more questions.

So, that's kind of a difference in philosophy in what the licensees have given us. And I think you're seeing the results of that and we're generating more RAIs because we're having to look at more detailed information.

Some fire brigade issues. For instance, I think one of the licensees ended up wanting to - well, almost all licensees have an administrative requirement that if you're down a man, you have two hours to get somebody in.

That's pretty much a standard tech spec thing and that was one of the issues that we ended up putting into a FAQ to try to get that so that everybody would do it the same way. First couple we didn't have that.

So, just give you an idea of the kinds of things that we're seeing and what we're asking.

MEMBER SCHULTZ: Harry, it seems like there's some pretty fundamental lessons learned that you've described as you've gone through that slide.

And you indicated that as the submittals have gone forward, then it doesn't sound like those lessons in fact have been learned if what the reaction has been is less information in submittals, requirements by the staff to do more digging.

And I'm a little concerned about the solution being asking more RAIs as a result of this less information that's being presented.

Alex, you talked about the meetings that are being held. These upper level lessons learned, are they being covered, driven home by the staff to help to assure that the submittals coming in are -

MR. KLEIN: Yes.

MEMBER SCHULTZ: -- going to be addressing these issues?

MR. KLEIN: Yes, I think that over the last few public communications we've had with licensees, the examples I think that Harry has brought forward - maybe not all of them, Harry can correct me if I'm wrong, but many of these issues we've discussed with licensees.

Now, I think what is important to recognize is - and what we're seeing is because of the submittal dates the way we've got them staggered right now, is that the last few that have gotten in-house may not have caught up yet with these lessons learned because of the timing of it.

As Harry mentioned, we're still in the middle of the LIC-109 acceptance review for Nine Mile, but our initial observations are that they seem to be addressing a lot of the lessons that we brought forward in past communications.

But that's only one data point at this point. So, we're hopefully - we're cautiously optimistic that future licensees will note what has occurred already, will have enough time to address these lessons learned going forward.

We'll have more knowledge by the end of September when additional licensees have come in. I think there were four that are due by the end of September.

MEMBER SCHULTZ: Thank you.

MR. RAY: Let me interject a question here that has been on my mind over the last few discussions.

There's a tremendous amount of detail. You've been going into it and how you have to dig down to find the information sometimes.

How is that handled from a standpoint of, I'll call it, compliance stability or five, 10 years down the road? Who knows what went into these assessments later so that a change would trigger a reassessment or -

MR. BARRETT: Well, actually that's one of the questions that we've had from a quality standpoint is that the vast majority of these analysis are done by contractors and the transfer of knowledge is a question.

Because once the contractors leave, the licensee needs to do modifications and pull new cables. They've got to have somebody that understands the databases and the software that's used to end up doing this analysis. And they need to maintain the analysis up to date.

We don't want to have another Appendix R where people spend $10 million doing an Appendix R study and then put it on the shelf and ignore it for ten years, and then find that their plant is no longer, you know, even close to what the analysis shows, you know.

805 has a very rigid requirement that this has got to be a living analysis and they need to end up having qualified people to maintain the analysis, you know, real time.

So, we've had numerous questions about that and there's RAIs out there. It's just tell us how you're going to end up maintaining this going forward and make sure that the right people with the right qualifications are available to make sure, you know, your analysis is valid.

MEMBER RAY: Well, you know, we get into sometimes really religious debates over applying 50.59 to changes in the licensing basis, for example.

Well, this is another world that is very similar to that, but I don't know what the rules are or how they've ever expected to be -

MR. BARRETT: Well, from -

MEMBER RAY: -- implemented.

MR. BARRETT: From a process standpoint, I think there is - I won't say it's rigid guidance, but there's some fairly good guidance in 0402 and in the Reg Guide as to exactly how that's supposed to be carried forward.

Plant change evaluations are the vehicle that you use to assess whether or not a change to the fire protection program ends up being allowable or not.

MEMBER RAY: Well, is it a part of 50.59, or is it -

MR. BARRETT: No, no.

MEMBER RAY: It's parallel to it though, right?

MR. BARRETT: It's --

MEMBER RAY: Functionally it's the same.

MR. BARRETT: --parallel only in the fact that it's self-approval. It's actually done through a license condition and is similar to the current fire protection license condition in that licensees can make changes so long as it's within the bounds of the license condition.

And the license condition for fire protection allows them various different avenues that they can end up assessing whether or not their change adversely impacts the fire protection program.

MR. KLEIN: I think your question is an important one. And I think that we recognize it as important. I think that's why, you know, you've heard Harry's response. And even at the senior management level we've had conversations with the individual licensees. I've mentioned the bimonthly phone calls that we hold.

We reemphasize the need for having qualified folks on their staffs so that this stays a very viable program moving forward.

When we're at the audits, we do sit down with their senior management to emphasize that same point. And I think in terms of communication, you know, the staff here is trying very hard to make sure that that message gets across to the licensees.

MEMBER RAY: Well, I'm sure you are and it probably is being done effectively. But, you know, five, ten years go by and it's hard for these things to stay in place unless there's something that causes that to happen.

Okay, that's enough. I won't pursue it

further at this point.

MR. LAIN: Okay, we'll move on to the summary slide. I think so there's two sort of distinct processes going on here. We're staying within our process to review License Amendment Reviews. It's our LIC-101 process and we pretty much have discussed all the ins and outs with that.

But also, Alex discussed a little bit about our continued work with the stakeholders. Just a few other things besides our monthly FAQ meetings and our monthly management meetings is that we do hold periodic workshops.

There is straining that Research puts on, on NUREG/CR-6850 that we - is in our user's need with research. We also do attend the NEI Fire Protection Forum and give plenty of presentations there. So, we're continuing to try to work on these issues.

We are, I think, reviewing right now the LAR template for industry and looking at revisions to NEI-0402, which is the implementation guidance that our reg guide endorses.

And then also the EPRI unreviewed analysis method, also we're working with that.

MR. KLEIN: Can I just clarify something that Paul just said?

MR. LAIN: Yes.

MR. KLEIN: Paul, in terms of the license amendment template with the licensees -

MR. LAIN: The LAR template?

MR. KLEIN: The LAR template. We have not received a submittal yet from the industry on that.

MR. LAIN: Oh, okay.

MR. KLEIN: But we're certainly aware that they're working on it and that the staff is ready and prepared to work with the industry on that.

MR. LAIN: Any other questions? I think we've got 30 seconds left.

CHAIRMAN STETKAR: Actually, you have five minutes and 30 seconds.

(Laughter.)

CHAIRMAN STETKAR: Anything from the staff? Anyone?

(No response.)

CHAIRMAN STETKAR: Thank you very much. Summarized a lot of information in a good amount of time. So, we really appreciate that.

According to the agenda, we're scheduled for a break. Even as an old guy, it's a little bit early for a break for me.

So, I think what I'll do with DC Cook's

agreement is ask DC Cook to come up and start their presentation. And unfortunately, we'll break in the middle of it to keep the continuity going here, because it's just a little early, I think.

(Pause.)

(Discussion off the record.)

MR. MacDOUGALL: Before we get started just for information purposes, we do have handouts over on the table over there. And one of them is the full slides, and there was a second set where we had some examples of some transient fire modeling that we did and some fixed fire modeling. So, make sure you get both.

CHAIRMAN STETKAR: The fire modeling slides are public?

MR. MacDOUGALL: Yes.

CHAIRMAN STETKAR: Okay, just to make sure, because they will be put on the record and included with the meeting records.

MR. MacDOUGALL: Good morning. My name is Dan MacDougall and I'm the NFPA 805 project manager for DC Cook nuclear plant.

First, we'd like to express our appreciation on behalf of AEP and DC Cook for the opportunity to speak with ACRS, the staff once again and our industry peers and work with them on these presentations. It's an opportunity for you to see our challenges and an overview of our project and where we're at. And I can't emphasize enough what a complex, iterative, intrusive process this is.

It's been a lot of work for everybody and it's taken enormous amount administry participation and rhetoric with the staff and our peers and I appreciate the opportunity.

That being said, the complexity behind this, I have some guests with me today representing DC Cook.

Our vice president of site support services, Mike Carlson is with us. Our regulatory affairs manager is sitting up here today.

With respect to the presentation itself, I will be doing the first eight slides on an overview of the station, how we're set up. Give you an idea how we safely shut down the plant in a fire event, alternate shutdown, some pinch points with risk.

Mark Schairer will be discussing about six slides, eight slides on fire modeling. Detailed fire modeling. We'll have a couple examples of challenges we're having with transient ignition sources and some fixed sources to walk through. And then Jeff Julius with Scientech will be presenting about nine slides on PRA.

Just for information purposes, it's a total of 29 slides. Last night we did a dry run again and we did some questioning attitude-type things and we ran like an hour and a half, roughly.

So, just for time I don't -

CHAIRMAN STETKAR: You can't control this group. So, just plunge on and we'll finish.

MR. MacDOUGALL: First time evolution for me with ACRS, this information.

CHAIRMAN STETKAR: yes.

MR. MacDOUGALL: Presentation overview. I'm going to give you some background about DC Cook and the features of the station itself that impacted the PRA.

We will give you a quick summary of our transition of 805. Originally where we were headed with it, why we transitioned, what our original intent, our goals were.

Then our development of the PRA and the challenges of hitting the regulatory guidance initially.

And then RAIs as they came through, our LAR submittal challenges with that. Our LAR submittal challenges with RAIs. Review of uncertainty, the challenges in that area.

And then kind of cover what Harry talked about later in his slides on the implementation challenges we're seeing at the station as we get closer to getting our SE. Like I said, probably about an hour and a half is what we've seen, but it's up to you.

DC Cook plant features, we are located in Bridgeman, Michigan. Beautiful southwest Michigan. Wine country. If anybody likes to visit that area this time of year, it's great.

We have two units. Total of 2150 megawatts, approximately. We're a four-loop Westinghouse PWR with ice condenser containments, which kind of presented some challenges in our PRA.

The ultimate heat sink is Lake Michigan. All plant cooling is direct lake water heat exchange. Alternate shutdown relies on other unit systems for pump fluid services. For example, full alternate shutdown we cross-tie CVCS, CCW, ESW aux feedwater and ESW needed.

We do have a dedicated fire brigade that is independent from the operations staff. So, in our time feasibility validation, our fire brigade and fire fighting activities are separate from our ability to safely shut down our independent staffing from the control room. The fire brigade does not credit any safe shutdown strategies.

We do not have a dedicated remote shutdown panel. So, we didn't meet the guidance for a primary control station on that. So, that impacted risk. We do have local indication panels, LSI panels that provide indication only.

CHAIRMAN STETKAR: Dan, you said the fire brigade is not credited in any of the safe shutdown strategies. That's deterministically.

Does the risk-informed part of the transition account for fire brigade suppression?

MR. MacDOUGALL: And response time.

CHAIRMAN STETKAR: It does, okay.

MR. MacDOUGALL: You are correct, yes.

CHAIRMAN STETKAR: Thanks.

MR. MacDOUGALL: Picked up in the monitoring program also.

Originally in 2005, we established goals for the transition. The objective adopting NFPA 805 was to adopt a risk-informed fire protection program. Specifically, we were looking for a little more realism and full burnout in Appendix R. Full area burnout. And notably we have multiple hot standby manual actions close to five, 600. And 2200 cold shutdown actions.

So, we were looking to get more realistic and basically quantify our margin and our risk and become safer.

Other part of that was we were trying to be responsive to the NRC industry request for people to transition. For stations to adopt NFPA 805 and our executive management team decided to do that. So, that was another big driver. Obviously, it takes their support from business case.

And we want to provide a more understandable licensing basis. The intent of that is a lot of our documentation and our exemptions, SERs, go way back into the early '80s, late '70s.

And to be perfectly honest, it's hard to go back and find a lot of that paper and make sure it's even valid for today's standards.

And we just - there were multiple SERs, multiple exemptions and it was a difficult maintenance issue for us as far as a licensing basis to maintain.

So, we were hoping to go back and reconstitute all that, which we have. We have been successful in that arena.

There were some business case issues we were hoping for or looking at, actually. Reduced fire protection test and maintenance cost. We've seen a huge paradigm shift with respect to suppression systems. On what used to be TRM-related is now no longer with significant.

And our non-TRM systems have become risk significant for us. For example, turbine building suppression and detection. Where before really availability and reliability wasn't tracked formally because we were focused on our PRM regulatory systems and compliance.

A big discussion there is we've got close to 40 CO2 systems, automatic CO2 systems. And in the risk-informed performance-based arena, I think we're down to eight is that number that are really risk significant. And 36 of those 40 are currently in our TRM. And all eight of them are in our TRM.

We've got close to almost 600 emergency light, fixed emergency light battery packs. Three to four heads on each one. Over 2200 heads that we maintain.

Not all of those are Appendix R related. Roughly a third, but almost, I'd say, in head space as far as not just pack heads, close to a thousand lamps that we're maintaining. And eight-hour discharge testing. And we'd hoped with the -- no longer the requirement for fixed lighting, that we could use the hands-free lighting to gain some margin there.

And then reducing fire barriers through consolidation of analysis areas and fire domes whereas the old BTP three-hour-rated barriers now even into our new fire analysis area is different -- only one different, actually, but the fire zones we had hoped to reduce are our barrier maintenance.

One significant achievement was our reduction in manual operator - OMAs and our new recovery actions. Our feasibility study right now shows 157 recovery actions that are both time critical and defense in depth that we've evaluated and done feasibility on that our - in our RAI response plus the 600 hot standby actions we had on our Appendix R. And of course no cold shutdown actions in 805 space.

Background on the station and where we're at in our LAR submittal, we did follow the 0402 template in our submittal. We did have to issue one supplement because we did not include our aggregate CDF and delta LERF from our base PRA in our LAR submittal. So, we did issue a supplement September 2nd to forward that to the staff.

We did have some questions come up during the LIC review, but no showstoppers. And it was acceptable.

We did use our base PRA applied during the development of the FREs, which are included in Attachment W of the LAR, which we'll discuss in the next two slides just to give you background on the FREs and the FSAs purely from the perspective of both the maintenance and implementation, and then the rigor that we had to put in our analysis.

To date, we've received a total of 39 RAIs. Multiple subparts. So, roughly that comes to 78. 60 percent of those are PRA related. Of that 60 percent, ten percent are fire modeling V&V-type questions.

FYI. Subsequent to 39 RAIs, we got six separate RAIs on radioactive release that we responded to. And those had multiple subparts primarily concerned with more detailed analysis and quantification of capacity of sumps, suppression system, manual suppression, that type of thing. Those turned to be somewhat of a challenge, which we'll discuss later.

And we did have a site visit in December of 2011 that proved to be very productive to discuss fire modeling where the staff came down, Mr. Lain, Alex and several of the contractors. And we literally did a hand-over-fist walkdown of the station and spent a solid week going through both our main control room fire modeling calculations, our main control room ventilation equipment room fire modeling calculations and four kV switchgear rooms.

And it was very intrusive and we have responded to those and there was learnings for both sides out of that. And we found issues we did enter into our corrective action program and fixed them to respond to them.

And actually just informally I'll say that process worked very well. We were able to write the CR, get - or the corrective action document, get it in process, get the calc revived, fix our inputs and keep moving forward.

The next two slides are just a quick overview of our FREs and our fire safety analysis because they provide a lot of the basis for our program and where PRA fits in, and later on some of our challenges.

The fire risk evaluations were used to determine delta risk between the complaint plant and NFP 805 post-transition plant. We documented delta and core damage frequency and LERF.

We had over 260 VFDR risk evaluations using 500 and 900 - or using 900 fire PRA scenarios. 157 of those required either defense in depth or - required recovery actions to resolve.

CHAIRMAN STETKAR: Dan - Jeff, are you going to talk a little bit - explain a little bit more about how those 260 VFDRs map into what are characterized as 900 PRA scenarios?

MR. JULIUS: No, we -

CHAIRMAN STETKAR: The reason I ask is we're going to be hearing from three different licensees. And I at least as I went through the different applications, had a sense that the use of the PRA models might be - there may be different uses of the PRA models. Let me just put it that way.

I might be wrong, but I want to make sure that I understand, you know, how each of the licensees have used the models to drive those scenarios.

MR. JULIUS: No, we don't have a further slide or evaluation. So, this will be -

CHAIRMAN STETKAR: Well, I'll wait until you come up then and ask you this.

MR. JULIUS: Okay.

CHAIRMAN STETKAR: We're going to take a

break so you can think a little bit about it, but thanks.

MR. MacDOUGALL: In the end, it was based on Reg Guide 1.205 and 1.174 requirements. And then at the end we did meet the 1.174 risk assessment guidelines and we'll present the specific numbers to you later and show you we're on CDF for delta risk on Unit 1. We're close. We're on the bubble there and we'll discuss that in detail. Challenge, that specific challenge.

Our FSA is more of the old fire hazard analysis portion. We had a total of 57 fire areas that we did FSAs on both deterministically and then document some of the performance-based criteria.

The FSA is described by fire protection systems and features. Our NSCA compliance strategies discusses the VFDRs and what recovery actions are associated with them.

Our fire PRA FRE risk results, and then expands on some programs that are implementation items right now, radioactive release review, NPO Monitoring and defense in depth. That's just an FYI for later for when we get to a later slide.

In our License Amendment Request we have several implementation items. As far as hardware modifications go, we've got approximately MOVs. We have to do 92-18 modifications too.

We've got fuse replacements that we've identified as a result of our coordination study. We do have four systems - two systems that we have to - to get the risk down, there are currently manual CO2 systems that we have to change to automatic.

CHAIRMAN STETKAR: Can you tell us what areas -

MR. MacDOUGALL: Switchgear area.

CHAIRMAN STETKAR: Switchgear?

MR. MacDOUGALL: Yes.

Early on in the transition, 2009 I believe it was, we took enforcement discretion because we found a 250 full DC cable running in one of the other four K units and we had to change that to automatic. And this is the area right outside the MCC room. So, the same complex, basically.

We do have some procedural implementation items. And that's - well, we've got multiple transient combustible control and combustible free zone -- hot work free zones that we've got to get proceduralized and marked in the station and roll that out.

And then of course our monitoring and NPO programs we've got to get our expert panel together, prioritize our monitoring process. And then our NOP identify, which we're working on these now is we've got a table that identifies the pinch points. And we've got to get with operations and the outage management group and see what compensatory actions we're going to institute in outage periods as a result of NPO.

And that's a real paradigm shift for them for us to step in the outage management schedule.

CHAIRMAN STETKAR: Let me ask Jeff again, are you going to talk a little bit about whether or not you used any risk insights for NPO modes?

MR. JULIUS: No, we hadn't planned to.

CHAIRMAN STETKAR: Okay.

MR. MacDOUGALL: That completes my portion of the presentation, and now we'll continue with -

CHAIRMAN STETKAR: Actually, now as an old guy, this is, I think, an appropriate time to take a break.

So, let's take a 15-minute break and we'll reconvene at 10:05.

(Whereupon, the above-entitled matter went off the record at 9:49 a.m. and resumed at 11:04 a.m.)

CHAIRMAN STETKAR: Okay. Let's reconvene. I hope you all had an enjoyable hour. I know it was good for me.

In terms of time and schedule here, I think what we'll do is we'll let DC Cook finish up. I'm assuming that will happen - let's shoot for no later than 12:30.

We'll then break for lunch and I'll be generous. I'll give you 45 minutes for lunch. We'll reconvene at 1:15.

And then we'll plan to go until no later than 6:00. I want to make sure we get enough time allocated for the two presentations this afternoon.

Since VC Summer is last up on the agenda, I don't know - do we have people from Summer here? Is that going to cause any problems with flight schedules for you?

(Off-record discussion.)

CHAIRMAN STETKAR: Okay, good. Okay. So, let's do that. And with that, we're back in session. And, Dan, pick up wherever you were.

MR. MacDOUGALL: Okay. Looking at the slides, we were on Slide Number 9, fire PRA Peer Review. On the agenda, it puts us about a third of the way through.

CHAIRMAN STETKAR: That's okay. We'll be okay.

MR. MacDOUGALL: And Jeff Julius from Scientech will pick up that portion of it.

MR. JULIUS: Good morning. So, we're going to start with the overview of the fire PRA peer review, and then the fire PRA results followed by the discussion of the technical challenges.

We conducted our peer review in October 2009. It was done by the PWR Owners Group. As Steve Dinsmore had mentioned, the fire PRA was built from the internal events PRA.

There's no significant or showstopper type of findings. We had 61 F&Os, 36 suggestions and 25 findings. And all the impacts were resolved and documented as part of the LAR attachment V.

The PRA Owners Group indicated that overall the fire PRA quality was found to be very good and many of the elements being performed at that state-of-the-art level.

The peer review process provided a good independent look at the model and basis and the findings and comments were - gave us some good insights of things that we needed to address before applying the model to the fire risk evaluations.

The summary. So, this is kind of an overview of where I'm going with this was that the fire PRA results for Cook reflect and complement the deterministic defense in depth approach. And in that respect, the insights aren't surprising.

The fire PRA results are in many cases, influenced significantly by conservative data and modeling. And you'll see in the upcoming slides, we do account for the uncertainty in the analysis and in the transition, including the conservatism.

The insight or the thing I want to emphasize here is that we looked at the different pieces and including the uncertainty, and we're trying to make sure that the plant changes we make whether they're procedure changes or hardware changes, are not based solely on the calculated CDF. It's what's the drivers behind there.

So, we've got an additional slide where we'll further talk about that, but overall it's a success story. And based on the efforts of many, the plant, the industry and the NRC, we've come a long way, but we've still got a critical evaluation of the results is essential to ensure the PRA results are properly understood and characterized.

This is somewhat akin to the IPE era where we got to the end of the IPEs and then we, you know, worked to further refine and reduce and make the models more robust.

So, in that respect, there are efforts underway for the NFPA 805 fire PRAs to be enhanced for future use in risk in management and risk-informed activities. And continued data and methods enhancements are needed, and EPRI is supporting those types of activities.

CHAIRMAN STETKAR: Jeff, you'll have to excuse my ignorance because, unfortunately, the ACRS was not involved in either of the pilot plant SERs or the review. So, we're not as familiar, perhaps, as we should be with some of the technical details or how the process works.

I tried to look through your slides and I didn't see anything on it, but I thought I'd ask you and perhaps somebody else can help. There are a large number of - and I always forget what they're called. The four Es, existing engineering equivalency evaluations that are cited in the application.

And in many cases, their evaluations to justify equivalency of a fire barrier or separation for an equivalent time or something like that.

How do those interface with the PRA, or do they? Because in some fire areas, they're used for justification for deterministic resolution of a fire area because you have an equivalent fire barrier or adequate separation or coverage on suppression systems and that sort of thing.

But I noticed in many cases for fire areas that you have used the PRA, if you go to Appendix C they're interleaved for different VFDRs. Also account for the engineering -- whatever they're called. The four Es.

So, I was curious do they affect the PRA modeling? How do you use them when you develop the PRA models for those fire areas?

MR. JULIUS: That's a good question. One we hadn't really talked about. Mark, would you -

MR. SCHAIRER: Yes, I mean, I guess we can in general terms, those quad Es, you know, engineering equivalency evaluations are generally applied to the deterministic requirements for fire barriers. And they kind of fall into two categories adequate for the hazard or functional equivalent. And they apply really to Chapter 3 of NFP 805 for the most part.

The one that you kind of zeroed in on is the fire barriers if there's a fire barrier that may have, you know, less than adequate seal or a door that may not be rated to the barrier, you know.

That may come into play partially in maybe plant partitioning where we evaluate the adequacy of the plant partitioning elements.

CHAIRMAN STETKAR: Okay. Let's follow up on that.

Do you then in the PRA when you define your fire area boundaries, account, you know, essentially take credit for that quad E conclusion?

MR. SCHAIRER: Yes.

CHAIRMAN STETKAR: You do.

MR. SCHAIRER: Right.

CHAIRMAN STETKAR: Okay.

MR. SCHAIRER: It's part of our assessment of the fire barrier -

CHAIRMAN STETKAR: It becomes a rated fire barrier in the sense of -

MR. SCHAIRER: Right.

CHAIRMAN STETKAR: -- defining your fire areas.

MR. SCHAIRER: It may not be three-hour rated, but it's shown to be adequate for the -

CHAIRMAN STETKAR: What about the - and I'm trying to skim through things here because unfortunately I get confused among the three things that I've read.

What about things like equivalent protection of cables, one-hour fire ratings and things like that? Do you also account for that in the PRA as -

MR. JULIUS: Generally, I think they were counted for when we looked at the development of the VFDR because most of ours were cable separation issues and we didn't have any of the -

CHAIRMAN STETKAR: So, you didn't have any of the equivalent wrap or something?

MR. JULIUS: None that I can recall.

CHAIRMAN STETKAR: I'll ask somebody else. As I said, I'm trying to skim through things.

MR. JULIUS: Yes.

CHAIRMAN STETKAR: But the message is you do account for them if necessary to either define a boundary for a fire area or adequate separation.

MR. JULIUS: That's right. And I'm sure it would have come up during - in the development of the FRE, we had a multi-disciplinary or team approach.

So, when we talk about an area, we had the fire safety evaluation and we start with the area characteristics and the fire protection features of the area.

And we discuss all the, you know, any of the factors like that that were associated with the area and the VFDRs and then how we were going to capture those in risk assessments.

CHAIRMAN STETKAR: Have you used fire modeling to justify any of the engineering equivalents?

MR. JULIUS: No, no.

CHAIRMAN STETKAR: You haven't.

MR. JULIUS: No.

CHAIRMAN STETKAR: They're all based -

MR. SCHAIRER: And I'll just touch upon one other example. The fire barrier being one example, and another one is there are some engineering evals for, say, lack of full area suppression.

Those would not get rolled into the PRA as an assumption. Because when we do fire modeling, we're doing field walkdowns to really assess where the suppression is. So, we will - that's an example where it would not be included in the PRA.

CHAIRMAN STETKAR: Okay, okay. Thanks.

Dan, have you had many questions from the staff on the engineering equivalency evaluations?

MR. MacDOUGALL: As far as RAIs, yes, we have.

CHAIRMAN STETKAR: You have, okay.

MR. MacDOUGALL: Not several. We have had some.

CHAIRMAN STETKAR: Thanks, that helps. Because I wasn't quite sure how those two efforts dovetailed. And I would - I quite honestly didn't appreciate the number of those engineering evaluations that were performed to support, you know, the entire License Amendment Request until we dug into it.

Because as I said, we've not really addressed one of these before. So, thanks, that helps.

MEMBER SCHULTZ: Jeff, are you going to get into more detail related to the uncertainty analysis and the comment that's in that slide that --

MR. JULIUS: Yes.

MEMBER SCHULTZ: -- the results can be reduced? Is that an example you say they can be reduced, or is this an activity that's been applied in this case, the result of which is a reduction of a factor of five to ten?

MR. JULIUS: We've done a fair effort in this case and in several sensitivities, as well as parametric data on certainty. I've got a separate slide that speaks to that. So, I'm sure that will be an interesting topic.

MEMBER SCHULTZ: Thank you.

MR. JULIUS: In general, the fire PRA model attributes, the model, success criteria, the random failure probabilities come from the foundation PRA, which is the internal events PRA.

We followed NUREG-6850 and Supplement 1. And all the approved NEI frequently asked questions have been incorporated.

There is a separate PRA model for each unit, and the overall plant site has 57 analysis areas. And one of the interesting parts, some of the analysis area had cables for both units. So, when we got to those areas, we calculated impact to both Unit 1 and to Unit 2.

Then we sum the CDF and LERF and the delta CDF and delta LERF was calculated in for each analysis area.

The ice condenser containment was more limited for LERF than other PWR containment designs and it did contribute - we added a couple of recovery actions specifically to address LERF and to make sure our overall LERF numbers were down.

But typically, the core damage frequency was the determining factor for the - or the limiting factor for the risk metrics in an individual area.

MEMBER SCHULTZ: I'm sorry, you're talking about the absolute value of LERF, or the delta?

MR. JULIUS: I'm talking in general both. We use these recovery actions in general to bring the absolute value down.

The delta LERF, an interesting piece is that because the former licensing basis, the LERF wasn't part of - there's not a variance for deterministic requirements associated with LERF. And so, the delta LERF was not affected then by those actions.

MEMBER SCHULTZ: Okay, thanks.

CHAIRMAN STETKAR: One way of thinking of it.

MR. JULIUS: Well, we did make sure we captured that insight. We were taking care of LERF and not just saying there's no variance, no problem.

In terms of the risk metrics, the table on the top shows the fire CDF and the delta CDF, and the LERF and delta LERF for each unit as presented in the LAR. And then the follow-on question about how does that fire relate - fire contributions relate to the overall CDF and internal events and seismic.

And so, you can see the 3.55E-5 from Unit

1. That's a factor of three or four higher than the internal events CDF. And the total core damage frequency from all hazards at Unit 1 is 5.2E-5.

And you see where the four-and-a-half to 5E-5 CDF for Unit 1 and Unit 2 from all hazards and LERF 7E-6 in Unit 1 and 6E-6 at Unit 2.

The interesting thing of note as Dan mentioned earlier, the delta CDF were below the 1E-5 limit, but not a whole lot below.

So, we've got in terms of the margin or to the limits anyway, the CDF and LERF we have a fair margin. And then we're fairly tight on the delta CDF.

In terms of the contributors to these, it's interesting on the two slides, one on the top areas and one on the top scenarios.

The top 16 areas for Unit 1 contribute to greater than 95 percent of the risk. And it's roughly the same number also for Unit 2.

Out of the slide, you can see the different contributions in the - after the first three areas, it drops off and to the - each area is less than 10 percent.

Of note, the turbine building and the yard there while they contribute 20 percent and 11 percent, so almost a third of the total fire CDF, there are no variances from deterministic requirements in there.

And so, there we stop the quantification at the whole fire zone burnout and we don't have detailed fire scenarios. That's an area where in the future we'll probably look to do some further refinement of the model. That's an example where there's different levels of detail in different pieces of the model.

CHAIRMAN STETKAR: That was just your own choice. You didn't want to spend any more time.

MR. JULIUS: We were at 4E-5 total fire -

CHAIRMAN STETKAR: Some of the conservatism in your results is just you didn't want to spend any more time.

MR. JULIUS: Well, because we were focusing our time on the -

CHAIRMAN STETKAR: I understand.

MR. JULIUS: But you're right. We stopped, yes.

CHAIRMAN STETKAR: And that's - anybody who's done these things knows how they're done. That's how they're done.

I'm assuming that's from loss of - fire-induced loss of offsite power, is it?

MR. JULIUS: That's correct.

CHAIRMAN STETKAR: Are you going to talk a little bit about some of these areas, or were you planning to do that, or no?

MR. JULIUS: We have some other areas that come up when we get to the specific examples on some of the -

CHAIRMAN STETKAR: Okay.

MR. JULIUS: -- technical challenges.

CHAIRMAN STETKAR: Going to talk about the control room, or not?

MR. JULIUS: No, we had not planned - we're showing the cable spreading room and that's got some analogies because it invokes some of the same actions.

But, you know, are you talking about the fire modeling on the control room?

CHAIRMAN STETKAR: It was just a little surprising because you don't - we'll hear later that some licensees have invoked the primary control station notion, and you've not done that in this PRA, right? I mean, other than the main control room.

But fires that affect the main control room, you don't relocate to a primary control station where the operators are perfect.

MR. JULIUS: That's correct.

CHAIRMAN STETKAR: And that's why I was a little bit surprised that the control room with the relatively large number of recovery actions that you have is a relatively small percentage of the total.

It must mean that you did a heck of a lot of work on it.

MR. JULIUS: We did a heck of a lot of work on it. We do have some other areas that are leading to this similar type of actions that have a higher frequency.

CHAIRMAN STETKAR: Okay. Then I'll wait. Okay.

MEMBER SCHULTZ: Jeff, these results - I'm just going to keep coming back to the conservatisms in the models.

MR. JULIUS: Yes.

MEMBER SCHULTZ: So, this set of results, does it reflect what was obtained with conservative fire modeling, or after you've gone through and done the sensitivity analyses and made changes to provide more, whatever you want to call it, better estimate models.

MR. JULIUS: Generally, it's with the conservatism in the modeling and that we'll see in later slides, I mean, we did -- the first pass we did full zone whole room burn-up. And then when we started developing the areas where we did the fire modeling, did individual scenarios, we first quantified them at the 98th percentile heat release rates and reasoned it the T square growth model.

And then as you get to the top risk significant areas, the standard has you go and develop at least a two point model. But even the two point model that we use is typically the 98th percentile and the 75th percentile.

So, part of the concern is capturing the whole range of fires, you know, from the small fires to the bigger fires.

And so, as John mentioned when we got to the point where we had developed the model sufficiently to meet the risk acceptance criteria, you know, we stopped and did the submittal.

And so, then we're getting questions from the NRC and from internal we are still learning and looking at this model in terms of what's the sensitivity to the ignition frequencies, what's the sensitivity to the spurious actuation probabilities associated with the control power transformers, what's the sensitivity maybe to some of your limitations in your internal events PRA that you hadn't addressed?

So, we've done a series of five

sensitivity analyses and the parametric data on certainty to further probe and look at these, as well as the integrated results. You're looking at the importance of the areas and the importance of the actions.

CHAIRMAN STETKAR: Are you going to talk more about uncertainty?

MR. JULIUS: I have one slide that -

CHAIRMAN STETKAR: Okay. I'll wait.

MR. JULIUS: It's towards the end here.

So, let's go through the results and then we'll hit each of the technical challenges and then try to build this cumulative picture because we're trying to identify where - that's one of our challenges related to the conservatisms.

As the top scenarios, so on an area basis the turbine building and the yard weren't at the top on the scenario basis. They saw loss of offsite power in the yard and the turbine buildings that are two of the top four. Electrical cabinet fires contribute to a lot. And that's the 4kV bux 1B and the T11A and T11D again failing offsite power.

The interesting point here, so we have these losses of offsite power electrical challenges that would like to RCP seal LOCA.

We have a CVCS cross-tie and originally the internal events PRA hadn't done success criteria to use the cross-tie to mitigate a LOCA.

So, they expanded and redid additional success criteria analyses with amp and said that, you know, the more likely RCP scenarios are the smaller break sizes. But the really big break, the CVCS cross-tie doesn't provide sufficient flow. But for the smaller break sizes, we were able to use the CVCS cross-tie to mitigate the RCP seal LOCA.

CHAIRMAN STETKAR: Did you partition them in the - use the Westinghouse model for the range of break sizes or -

MR. JULIUS: Yes, it was the Westinghouse model for the break sizes.

CHAIRMAN STETKAR: It partitioned the break sizes in your model?

MR. JULIUS: It's based on functional impact.

CHAIRMAN STETKAR: Okay. And you said you didn't - did you go back and do that in the internal events also?

MR. JULIUS: We haven't fed that back into the internal events model yet.

MEMBER BLEY: Is the use of the cross-tie procedure wholly supported?

MR. JULIUS: Oh, yes. That's part of the plant safe shutdown strategies.

The risk significant contributors come from the cable vaults and rooms with the electrical cabinets that are impacting both trains at the same unit.

So, this plant is a little different than some in terms of the - many plants have within a unit a Train A and Train B with separation here.

We've had several areas where both trains at the same unit are affected and the other unit works as the safe shutdown path so that these inter-system cross-ties effectively reduce risk and require refinement of success criteria. But they also required -- it's based on some feedback from the peer review.

The peer review commented, hey, wait a minute. Your Unit 2 modeling impact on Unit 1 was maybe a F&O Level C from the internal events. But since it's become so important in your fire PRA, you need to address this.

So, that was one of the findings in the things that we fixed before doing the fire risk evaluation.

In terms of looking at the recovery actions, we were following closely NUREG-1921 and the fire HRA approach there. And we followed that in our development of our recovery actions.

We followed 6850 and we have no unapproved methods. We had some discussion with the NRC about the data that was used or the data limitations. And so, we've had questions on how much credit we can give to the combustible free zones and the hot work restrictions especially on those transient fires in the critical areas.

We basically put transient fires everywhere and it's just the size of the fire and the impact.

So, this is one where Harry had mentioned there's a FAQ 12-0064, and we've provided comments and feedback back to the staff on that.

CHAIRMAN STETKAR: Your fire allocation report just to demonstrate, I mean, I'm assuming you had a rationale about how you distributed transient fires.

MR. JULIUS: Yes. Yeah, we have, I mean, we follow the weighting process and then we - we did pick one of the - between the hot -- maintenance occupancy and storage, we had a value less than one, but the sum of all of them was at least one.

CHAIRMAN STETKAR: That would be good.

MR. JULIUS: I guess I want to distinguish one slide to capture the fire development tasks. So, these were the first tasks to develop the base fire PRA model and the data and to get ready for quantification.

And mostly these were straightforward tasks. And as you'll see in the next slide, really the challenges started to come during the quantification or the roll-up of all this input.

So, the 6850 tasks are listed there by their 6850 task number. And the first five there weren't many challenges.

The ignition frequency wasn't technically challenging from actually conducting the work or following 6850. It was more then the overall numbers that we were seeing at the end.

I've got two separate slides. One on ignition frequencies and one on the circuit failure likelihoods. I'll further explain those.

And the reason why the numbering doesn't follow sequentially with the 6850 is because all the quantification then is lumped onto the next slide.

So, our primary fire PRA technical

challenges can be really summarized into these three areas.

One, the first technical challenge - and these were somewhat chronologically introduced. So, in 2009 we're getting ready for the fire PRA peer review.

We had trouble or we had extra effort or it wasn't intuitively obvious that the plant total fire PRA CDF was below 1E-4.

And so, we came into this thinking, well, maybe we had maybe ten areas and maybe ten scenario are within an area. So, maybe a hundred total scenarios we were going to have to do to get reasonable results.

And as you saw from the earlier slide, we wound up modeling almost a thousand. So, we went from a hundred to a thousand.

We did additional fire modeling. We took the ignition frequencies from 6850 and we went to the FAQ-48 ignition frequencies.

CHAIRMAN STETKAR: Jeff, only because I haven't looked at FAQ-48 in a long time and I didn't have time to -

MR. JULIUS: 6850 Supplement 1.

CHAIRMAN STETKAR: Those are mostly high-energy arcing faults and buses, weren't they?

MR. JULIUS: No, they -

CHAIRMAN STETKAR: Were there -

MR. JULIUS: Some of them went down, but some of them went up.

CHAIRMAN STETKAR: Yes, okay.

MR. JULIUS: They didn't all just go down.

CHAIRMAN STETKAR: Okay, okay.

MR. JULIUS: From a primary effort there was additional fire modeling, and then focusing on getting more than one train for good risk results in terms of the mitigation. Just one train alone or one train with a diesel, lots of offsite power scenarios that you had.

If you have the random failures, the diesel failed to run for 24 hours, it makes that relatively unreliable.

And so to get good, overall numbers, we had to get some additional either non-safety equipment, or to, you know, further refine the scenario.

CHAIRMAN STETKAR: Are there power cross-ties from the other unit and things like that?

MR. JULIUS: No, no, we don't have -

CHAIRMAN STETKAR: So, for example, in the diesel, let's follow up on it. What do you mean by one train plus for -

MR. JULIUS: Well, we have relatively - we expanded the offsite power modeling because initially from the internal events PRA you have pretty much as the point estimate initiator.

And then through the component selection process we went back to certain breakers and we expanded the impact so that if the fire was coming in and we knew there are certain cables, but still it was a relatively crude model.

Okay, if this cable gets hit, it's going to be a guaranteed loss of offsite power to one unit or both units.

And then we had - as we further got into it we'd say, well, you know, that's a control power and it really goes over to this function. Is that really going to have that impact, or is it - well, we still have that as one of the conservatisms.

So, fire-induced failure we don't recover offsite power. It's gone for the mission time.

CHAIRMAN STETKAR: I mean, that's not - I've seen burned cables. That's not necessarily what I would consider conservative.

MR. JULIUS: Well, that's right. But in

terms of the - if you look at the - is this the main power cable, the control power cable or could you go out and do something given this particular cable failure.

CHAIRMAN STETKAR: Okay.

MR. JULIUS: We started out with the first cut if that cable is touched, you know, all offsite power is lost.

CHAIRMAN STETKAR: Okay.

MR. JULIUS: So, we got the - in 2009 for the peer review, we got the fire CDF - total fire CDF below 1E-4.

CHAIRMAN STETKAR: That's a big drop, as you know, as you start getting to smaller numbers. A decade difference is a huge difference -

MR. JULIUS: That's right.

CHAIRMAN STETKAR: -- in those small numbers.

Between the first and second bullets, what helped you the most in that decade?

MR. JULIUS: Well, the difference there between the two, the 1E-4 and the 1E-5, the second one is a delta CDF. So, the first one was a total CDF.

CHAIRMAN STETKAR: Oh, I'm sorry. Never mind. I didn't see that delta. I'm sorry.

MR. JULIUS: But you're right. I mean, essentially you're right because we were even in the first one, we start out above 1E-4 and we got it down to the 1E-5. So, there was that decade drop.

And the primary emphasis there was on the additional fire modeling. That's where -

CHAIRMAN STETKAR: Additional - the fire modeling.

MR. JULIUS: We started out with maybe expecting hundreds of scenarios, and we had to go to a thousand.

CHAIRMAN STETKAR: Okay. But that's fire modeling in terms of - I want to try to be clear. People use the term "fire modeling" quite loosely. And we just had quite a bit of discussion with the staff on the NUREG on fire modeling.

When I think of fire modeling, I think of FIVE, FDT, CFAST. Is that the type of fire modeling that you're talking about, or are you talking about more finely subdividing the fire scenarios in the fault trees or event trees or whatever you -

MR. JULIUS: Really, all the above.

CHAIRMAN STETKAR: All the above.

MR. DINSMORE: Yes, you're right. Using the fire modeling tools like FDS, CFAST, is a specific part of fire modeling to define your -

CHAIRMAN STETKAR: It's something like, you know, going from the 6850 sort of recommended values, to something you might get out of FIVE, to something that you might get out of CFAST or progressive, typically refinements in that notion of fire modeling.

Another notion of fire modeling is something that Jeff was talking about, or I'd call it modeling, subdividing different sizes of reactor coolant pump seal LOCAs, which had nothing to do with the fire and assigning different success criteria so that you can wring out a little bit more frequency.

MR. JULIUS: Well, we want -

CHAIRMAN STETKAR: And that's not fire - I don't consider the second fire modeling. That's more realistic and -

MR. JULIUS: That was like fire PRA modeling.

So, within the activity here we did both the fire PRA modeling requirements, but we did extensive real fire modeling where you see in this later slide the fire modeling is going from a more crude or a broader impact to individual sources and targets.

CHAIRMAN STETKAR: Okay, okay. Thanks.

MR. JULIUS: So, then our next quantification hurdle was on the delta CDF and getting the deal CDF below 1E-5.

We addressed the peer review findings and the idea here was that the plant had a pretty good program, it was a good plant going in, and we were trying to do the transition without doing extensive plant modifications.

And the third area as was brought up, is the challenge with some of the uncertainty considerations. So, each of the next couple slides then develop further each of these three technical challenges.

MEMBER SCHULTZ: In terms of results, the PRA peer review F&Os, did they seem to drive the results up or down?

In other words, did the peer review identify as many improvements to the models that would benefit the result or -

MR. JULIUS: It was a mixed bag. I mean, there was - many of them were documentation. There weren't as many modeling changes. There were some on the fire modeling where - or some places where we had the unknown cable types, for example, where we -- the treatment of whether -- the thermoplastic or thermoset we further went in and did some refinements, but it was a mixed bag.

MEMBER SCHULTZ: And some were neutral in proving the documentation and supporting requirements associated with the analysis.

MR. JULIUS: That's right.

MEMBER SCHULTZ: Okay, thank you.

MALE PARTICIPANT: We didn't see any significant impacts.

MR. JULIUS: Now, there was a good one - there was one - a couple we were concerned about. There was one from Kiang Zee where we had, you know, if a component has multiple cables and it was the mapping of the multiple cables to the component.

And when we first had done the mapping, we had looked at the spurious impact that fire damage on each of these cables. But when to the PRA code, it didn't do any sorting or check. It just picked, you know, whatever the top failure mode is.

And so, the top failure mode could be a 0.03 and then the third one down could be a 0.3. And so, we did - we said, hey, we were worried about that one. And it turned out either the numbers or the cables, that didn't have as big an impact as we thought.

We had to go back in and map to make sure that the multiple cables were treated properly in their mapping to the components.

In terms of ignition frequencies, I think this one is fairly straightforward. So, we started with the first set of ignition frequencies from NUREG-6850. And then we took the results from FAQ-48.

And in addition to FAQ-48 besides it says you can use these lower numbers, but in your application you need to do sensitivities for ones that have a high alpha factor.

So, we had done that as part of our License Amendment Request and the required sensitivities showed that they didn't change our decision making. We still were within the risk limits and within the delta risk limits.

There's work still being done on the initiating vent frequency. And the ones we're wrestling with and you hear the discussion on more recently is the transients.

And the size of the fire and what kind of credit can be taken for the precautions and the worth of eliminating hot-work free or transient combustible free zones. So, that's the interchange with the NRC staff on FAQ-1264.

Another example of the effect of the fire - or transient fire suppression of personnel in the area who may have caused the fire in the first place.

Well, effectively that's rolled into the data. But if the plant was doing some practice or procedure, you know, add some additional people, would that further change it or not. And right now we haven't reflected anything in change.

And the last bullet there is there's no distinction in the data between running and standby components. One of the first areas we quantified, Analysis Area 1, that's the RHR and the containment spray pump room. And the initiating event frequencies for those pumps were the same as an operating component cooling water pump or a zirc water pump.

Okay. The next couple of slides I'm going to let Mark Schairer introduce and this is the development of the fire modeling.

And so, we did this full zone burn-up, but then we further developed the fire growth trees and the fire damage states.

So, Mark.

MR. SCHAIRER: Right, thanks, Jeff.

Yes, so this task here is really the beginning here of fire modeling. And the first step is to start to break down the whole-room burn-up assumption into individual fire scenarios.

And our goal going into it was to try to keep it simple, because we understood the long-term configuration control that the plant would have to face as we, you know, got into a more complex method.

So, initially we set out with a fire growth tree which kind of mapped out the different fire damage states.

CHAIRMAN STETKAR: Mark, can I interrupt you for just a second?

MR. SCHAIRER: Sure.

CHAIRMAN STETKAR: Because Jeff mentioned something that I wanted to ask him about. It's one of those things where you give me an example and then I'll come back at you.

Fire area AA-1 was screened out based on the deterministic approach. So, you didn't model that area in the PRA. So, I'm not sure what you're talking about in terms of fire frequencies.

What I wanted to ask you - and I understand why it screens out for a full power model, because there's nothing in there that basically affects your full power model.

How did you treat it for low-power and

shutdown modes, non-power operation modes, since it does have both RHR pumps in it?

Did you quantify it?

MR. JULIUS: Well, it wasn't quantified with the fire PRA, but it did go into the pinch point analysis for the cables.

CHAIRMAN STETKAR: Okay.

MR. MacDOUGALL: We kind of basically identified the key safety functions required in -

CHAIRMAN STETKAR: Yes, I understand. I know how you treated that. I was just curious because it -

MR. JULIUS: And actually back to that, in terms of the quantification for the PRA even though it made the transition deterministically, initially that first challenge to get the areas below the 1E-4, it was - again, because of some of the relative conservative factors, we assumed the fire in there would lead to reactor trip and then we had a wider influence before we did - we wound end up doing some fire modeling to just reduce the overall fire CDF in that area.

CHAIRMAN STETKAR: Because of a reactor trip - well, probably would lead to a manual reactor trip since you're losing both of your trains of safety systems. So, the tech specs would require you to shut down anyway.

MR. JULIUS: At the whole zone burn-up level, right, right.

CHAIRMAN STETKAR: But that's - okay. I'm sorry, Mark. Thanks.

MR. SCHAIRER: No problem.

CHAIRMAN STETKAR: It was a question as I was skimming through Attachment C, originally wanted to ask you about the shutdown notion of it. Because as I said, I can understand - I don't know the whole history of how you got to why it was, you know, disposed or dispositioned as a deterministic criteria. And then when you mentioned the quantified things, I was curious.

Thank you.

MR. SCHAIRER: Okay. So, on the fire growth trees depending on the complexity of the scenario, we could dive into these different aspects of fire modeling.

Of course their initial frequency being the initiating event. And then as necessary, roll in different heat release rates.

As Jeff mentioned, we began with looking at the 98th percentile. And if we could live with that, that was where we stopped. If we had to dig deeper into the next group of heat release rates, we would do that to try to refine the zone of influence.

So, that would be the severity factor application of 6850. Then of course all this was captured with fire modeling tools and we basically documented this in various other workbooks or Excel, basically tools that could capture some of this information that wasn't provided by the FDS or CFAST or one of those other -

CHAIRMAN STETKAR: Well, I'll let you finish this slide and then -

MR. SCHAIRER: Yes, I'll just cover detection/suppression is also, you know, on the onset of the fire scenario we may have looked as a sensitivity, can we live without detection/suppression.

And then, again, trying to keep it simple, but ultimately we rolled in quite a bit of suppression where we had to gain some CDF margin.

CHAIRMAN STETKAR: In Attachment J, did you use FDS?

MR. SCHAIRER: Yes.

CHAIRMAN STETKAR: You did?

MR. SCHAIRER: We used it -

CHAIRMAN STETKAR: Why? Okay, tell me why and where did you have to use it? How much did it buy you, if anything?

MR. SCHAIRER: Yes, we used it in six compartments for specific reasons to analyze hot gas layer timing. We wanted to get a better handle on exactly how we could roll in, say, ventilation aspects.

There were some unique - there was a damper - one of the barriers has a series of fire dampers that we wanted to roll that into the model.

The FDTs don't allow you to analyze things over time and then bring into these ventilation aspects. So, that was one part of it.

The other reason is we did a generic study across all the areas that could have a hot gas layer/plume interaction. And that's one of the limitations of the NUREG-1805 hot gas air models is they don't have the ability to roll that in.

You can make a gross assumption that you can add the hot gas layer temperature to, say, a plume, but we felt that was overly conservative. So, we used FDS to look at that interaction.

CHAIRMAN STETKAR: And CFAST didn't buy you enough?

MR. SCHAIRER: The CFAST does not provide a plume temperature that we can - that was V&V'd anyway.

CHAIRMAN STETKAR: Oh, okay, that was V&V'd.

MR. SCHAIRER: Yes. So, we used FDS for that purpose.

CHAIRMAN STETKAR: Okay. Because my - of the three we looked at, I think you're the only ones who used FDS. And it's - I've never used it, but I've heard it's - it will take some time.

MR. SCHAIRER: Yeah, it takes a little more energy and time to set it up. And just to run it on the computer can take days to weeks.

CHAIRMAN STETKAR: Just out of curiosity from your experience, was it worth the effort, I mean, in terms of the benefit?

MR. SCHAIRER: Yes, absolutely.

CHAIRMAN STETKAR: It was?

MR. SCHAIRER: I mean, we had no other way to look at those unique kind of challenges with the fire modeling without making gross conservative assumptions that, okay, we have -

CHAIRMAN STETKAR: No, but I mean the delta in terms of delta damage or however you want to measure it from the gross assumptions that you'd have to make compared to the more refined assumptions was worth that modeling effort?

MR. SCHAIRER: Yes, we believe so. It got us to where we needed to be, I think.

CHAIRMAN STETKAR: Well, that's worth the effort then, I guess.

MR. SCHAIRER: Yes, main control room was done with CFAST for -

CHAIRMAN STETKAR: Oh, it was?

MR. SCHAIRER: -- control room abandonment analysis.

CHAIRMAN STETKAR: That was CFAST though.

MR. SCHAIRER: Yes.

CHAIRMAN STETKAR: CFAST.

MR. SCHAIRER: So -

CHAIRMAN STETKAR: That's probably okay then. Just out of curiosity, you said you met six areas you looked at using FDS or -

MR. SCHAIRER: Right. So, the control room, HVAC rooms, both the 600-volt MCC rooms and then I think two of the 4kV switchgear rooms.

CHAIRMAN STETKAR: Okay. Thanks.

MR. SCHAIRER: So, our focus was to use primarily the V&V'd models. And these were within

NUREG-1824 for the most part. However, there are some in NUREG-6850, which I would call empirical correlations maybe that aren't part of that suite of models that were V&V'd.

So, this has been kind of - part of the subject of the RAIs is to demonstrate that they are used within their validation ranges.

I heard you kind of label it as, I think, Joe's Grocery Store. They're not that type of model. We're using still, you know, models that are published in the Society of Fire Protection Engineering Handbook. And they've got other studies outside of the 1824 experimental series that we're pointing to there.

So, I think Harry mentioned one of them which is the detection correlation not V&V'd.

CHAIRMAN STETKAR: Are you pretty well on track with the staff in terms of getting, you know, recognizing where you are in the exchange process here, getting resolution of the use of those models?

MR. SCHAIRER: Well, we've responded to their questions and I don't think we've received full feedback yet.

CHAIRMAN STETKAR: Okay.

MR. SCHAIRER: I can't -

CHAIRMAN STETKAR: Have you received - again, part of this I'm trying to understand technical issues, but also areas where there might be impediments on both sides.

Have you received any just blatant feedback that, no, you absolutely cannot use that model?

MR. SCHAIRER: No, we have not gotten that level of feedback. It's really provided additional justification for using this particular model.

We felt that at the time when we used it, we understood all the models required, you know, 805 required V&V, but not necessarily limited to what was in 1824.

CHAIRMAN STETKAR: Sure.

MR. SCHAIRER: So, I mean, quite a few of the models within 1805 are not in 1824.

CHAIRMAN STETKAR: Yes.

MR. SCHAIRER: So, it was a challenge, no question, to make sure we were comfortable with using those models.

CHAIRMAN STETKAR: What types of applications did you find that you needed to use the other models for?

Can you generalize? I mean, you know, is it cables? Is it cabinet fires? Is it -

MR. SCHAIRER: Yeah, some of them are like the 6850, you know, fire propagation empirical rule set where we, you know, you often hear the five, four, three, two, one method.

That, to me, is a - kind of a fire model that we definitely used across many of the scenarios, but CHRISTIFIRE and FLASHCAT ended up being what we thought was the verification or validation of that model.

So, again, that's not in 1824, but it did have a testing complete for that.

CHAIRMAN STETKAR: Okay.

MR. SCHAIRER: So, that's one of them. Yeah, we listed them all in Attachment J as you have there.

CHAIRMAN STETKAR: Yes.

MR. SCHAIRER: And they're not always pointed to 1824.

CHAIRMAN STETKAR: No, that's right. That's why I was asking. You have a good list there.

MR. SCHAIRER: Okay.

MR. MacDOUGALL: Just to respond to one question on feedback from the staff was during our fire modeling investigation we did, in our CFAST model there was an issue identified where - a partitioning issue.

It wasn't against using CFAST itself, but it was an error we had in the calculation. We had to go back and revise the calculation and clean it up because it was a showstopper.

Although it was insignificant to the results, we submitted incorrect information. We made a mistake.

CHAIRMAN STETKAR: Yes, that happens.

MR. SCHAIRER: So, the 57 fire areas across both units, 18 of those ended up transitioning deterministically. So, basically whole room burn-up. 39 of those were performance based. And in all cases we followed the 4242 methodology.

CHAIRMAN STETKAR: That's what I was going to ask, because we're going to hear from another applicant who distinguishes 4241 from 4242. And they call it, you know, they're both sort of performance-based. One is risk-informed performance-based. The other one is just using fire models.

And you did not - you always use the PRA model when you talk performance.

MR. SCHAIRER: 4242, correct.

CHAIRMAN STETKAR: Okay.

MR. SCHAIRER: 4241 would be the maximum expected fire -

CHAIRMAN STETKAR: Right.

MR. SCHAIRER: We did not do that.

CHAIRMAN STETKAR: You did not do that.

MR. SCHAIRER: Right.

CHAIRMAN STETKAR: Just out of curiosity, was it more expedient to use the PRA model? I mean, you know, because you're using the fire - what I call fire model, CFAST or FDS or whatever, in both kinds of applications to get a zone of influence in one or something like that.

MR. SCHAIRER: Yes, 4241 we just learned early on it wasn't going to work because you basically have to show the fire, you know, the VFDR cable survives the fire. That's to the maximum expected fire. And then the limiting fire scenario has to show margin.

CHAIRMAN STETKAR: Yes.

MR. SCHAIRER: And we were not going to be able to succeed in all the fire areas using that methodology.

CHAIRMAN STETKAR: Okay.

MR. SCHAIRER: So, that's why we went to 4242.

CHAIRMAN STETKAR: Okay. Thanks.

MR. SCHAIRER: We did follow 6850 methodology. Task 11 is the really - Chapter 11 is on fire modeling and then various, you know, appendices within 6850 and the FAQs that related to the PRA that have since rolled into Supplement 1. And then we did follow the fire PRA standard. Jeff touched upon the peer review results.

Our fire models were developed for scenarios specific to ignition sources. So, we didn't do generic fire modeling across many scenarios. We walked down each individual fire source, looked at the specific cables that were impacted. Fire growth was done for any scenario where it needed to be, and that was also specific.

So, we ended up with about 900 individual fire scenarios.

CHAIRMAN STETKAR: This is an area I asked Jeff earlier. How did this exchange work? You said you developed scenarios for input to the fire PRA.

MR. SCHAIRER: Right.

CHAIRMAN STETKAR: In fire PRAs that I've done in the past. they use the PRA and say, look, you fire modelers go tweak this thing and subdivide this because I need to get something over here.

It sounds like you took a different approach that you - did you go into an area and say this is a problem area from the first cut in the PRA and I'm now going to do a complete fire modeling of this area and then feed back into the PRA?

MR. SCHAIRER: Essentially, yes. We went into any fire area that didn't screen out in the first phase.

Now, we're going to - again, we're trying to use a tiered approach where, you know, we're not going to do multi heat release rates. I'm not saying we need to, but we do a 98th percentile heat release rate, identify - everything is done at a cable level. We need to use raceways to identify them out in the field. So, cables and conduit.

We would load that into our cable raceway software and we'd have a unique scenario, unique scenario ID. The logics within the software would translate the cables into what equipment where it could be logically failed based on that cable.

CHAIRMAN STETKAR: Okay.

MR. SCHAIRER: That would then be generated into what we call a Level 1 failure report, which would be transmitted over to Jeff's group. And then he would - he would basically take the equipment from there and map that to his basic event.

MEMBER BLEY: Let me ask John's question a little differently.

If you had it to do all over again, would you do it the same way, or would you see ways to get nearly to the same place with less effort?

MR. SCHAIRER: Interesting question.

Yes, I think given the approach we've taken and the lessons learned, you know, we'd still follow a similar approach.

MEMBER BLEY: Okay.

MR. JULIUS: The only additional comment I have, and this is kind of spread across a couple plants, is that typically the scoping or the general severity may be applied like in a Task 8 in terms of a 6850 task.

We had tried that a couple times and we were getting maybe a 20 percent or 40 percent reduction. And as you commented on the earlier slide, we were looking for an order of magnitude reduction.

So, we kind of skipped that, but where we are seeing that coming back into play at the end or current stage is - and we had a list of a hundred different areas and then we did the detailed fire modeling on these and they went down to the various levels. Some of them went down, way down. And others were - and the ones that are now in the middle are coming across and you've got a stairwell that has a steam generator blowdown cable in it and, you know, you're saying that's right in between two areas where you did detailed fire modeling on it.

And we're looking back at those now and doing some refinement.

CHAIRMAN STETKAR: Well, that's what a little bit, you know, when you were talking about the overall results you said, well, the turbine building and the yard are excessively conservative because we treated them all as a single area, burned them all up and, gee, they contribute 20 percent as the turbine building.

And yet, it sounds like in many other areas you did extensive fire modeling where you said, you know, you looked at some of the results and they went way, way down. Well, maybe they didn't need to go that far down.

And I think, you know, what Dennis and I are asking, is there a more balanced exchange possible between the PRA modeling process and the fire modeling, if I'll call it that, process that would more, you know, give you a more balanced evaluation across the whole plant, you know, rather than getting very, very detailed in some locations that initially show up very high. And then discovering after you've really find tuned those that other things that you haven't looked at are still really, really conservative, but you decide to stop because you met your numerical targets.

MR. JULIUS: In general as Mark said -- that's a good question. We generally haven't been because we've been responding to the questions about the different contributors and an opportunity to go back and do the review or the mining to say what would be a more balanced approach, I think.

CHAIRMAN STETKAR: Yes, I mean, I think part of the reason for this subcommittee meeting is that we've heard a lot of concerns both from the staff and from industry about conservatisms and a tremendous amount of effort to do these analyses.

And I think we're trying to understand from a technical perspective, what are the sources of those concerns?

Are they numerical? Is it counting cables? Is it doing FDS-type, you know, 500 FDS-type calculations? You know, where are they?

MEMBER BLEY: Is it fully inherent in the problem, or is there some way around some of that?

MR. JULIUS: Some of those we did know ahead of time and it's like, well, these are the top ones and we're going to - well, we need to get, you know, there's this time schedule. We're going to do all these and not do - just chip away at it.

Because we were concerned early on in the process that some of these like the sculpting approach. Okay, you go in there and you're just kind of chipping away at the results.

And it's just like, you know, that's not getting us there. So, okay, let's bring out a bigger tool.

CHAIRMAN STETKAR: Okay. Thanks.

MR. SCHAIRER: All right. We've already touched on some of this. This is really again mentioning the tiered approach where the first cut was conservative. And as we needed to, we drilled down. Time to damage calculation was coming too late.

The first set of scenarios would assume damage virtually at time zero. So, we didn't credit fire brigade response or anything like that.

But as we got more complex, we would take detailed measurements in the field of the cables and figure out the exact time to damage and roll in suppression timing.

But a challenge with that was, you know, the cable damage was often limited by the spatial knowledge of those cables. So, we had drawings - raceway drawings that we could work with.

However, as is common, you know, conduit is field routed. So, we couldn't rely on the drawings extensively for that purpose. The trays were pretty good.

But out in the field, too, you were challenged with being able to visually put your eyes on everything. So, again, that led to conservative.

If we can prove that it was outside the zone of influence, we had to, you know, include it in our damage set.

So, what we ended up doing was focusing the effort on really the risk drivers in the scenarios. And that required coordination between the fire modeling and PRA group to take a look at, all right, we're not going to, you know, some zones may have had 400 cables. We're only going to look at these maybe 50 that are really driving the risk. So, we're going to take a hit and basically assume all the other are failed each time.

And then the engineering effort of going in to figuring out where those cables are help to focus that scope. So, that was one of the things that helped us work around that issue.

CHAIRMAN STETKAR: Dan or Mark, this obviously is a very resource-intensive effort, the whole process, as you've learned.

Do you have any estimate what fraction of those resources were required for basic cable tracing? Because that's necessary for both the deterministic and the risk-informed approach.

MR. SCHAIRER: Yes, I mean, I can't possibly maybe give it on a fraction, but a good portion of the fire modeling effort is not, like you say, working with FDS and tools. It's taking the results of the fire models and then going out and applying that to what cables are affected, and that is a huge effort.

CHAIRMAN STETKAR: Did you have a pretty good cable routing database going in, or did you have to develop that?

MR. MacDOUGALL: We did.

CHAIRMAN STETKAR: You did.

MR. MacDOUGALL: And actually we had a good - we rolled into EdisonSAFE. We had had our Appendix R database, and then we rolled it over to EdisonSAFE and then kept it. And so, we were fortunate in that respect.

MR. JULIUS: But anyway, it supplemented with the PRA insights in Task 2. So, the additional LERF components are -

CHAIRMAN STETKAR: You had those in.

MR. JULIUS: Right.

MR. SCHAIRER: Yes, cable to raceway was good, cable to fire zone. But once we got down to like unique scenarios in the room, that's where we had - that was a challenge.

CHAIRMAN STETKAR: Okay.

MR. SCHAIRER: So, as we found that we needed to basically do a lot of complex fire modeling because of the number of areas where we had to do it to get the - we did a lot, you know, we did 39 areas, basically.

And kind of touching upon your point once you leave the arena of whole room damage and you're going into fire scenarios, you need to do them all, in may opinion. Because unless you can show that a certain part of the room does not have any cables you need to worry about, you know, you're stepping through and trying to put geometrical spatial relationships.

You don't know what scenarios to focus on until you do that effort. So, even some of the areas that were lower down on the list once they broke into that fire modeling list, that was quite a bit of effort.

MR. JULIUS: You can do that a little bit with the transients where the, you know, move those areas around more than, I mean, the fixed sources.

CHAIRMAN STETKAR: Fixed sources are fixed sources.

MR. SCHAIRER: So, the level of detail in the fire modeling also varied by location depending on the VFDRs.

So, initially we set out supporting the fire PRA and getting the CDF down. But as we got into fire risk evaluations, then the new focus turned to some of the VFDR cables and that resulted in additional fire modeling to go back and look at those.

Because the first cut may have, you know, grouped targets into scenarios where now we had to go back and look at individual cables, maybe, and pick those out.

So, again, the cable routing detail was an issue, but ultimately we were able to get that done. It probably took us almost 12 months to get through the VFDR for a review process with multiple, you know, we'd meet, decide which cables to go after, come back and there might be a new group to go after because, you know, the fire modeling results don't always come back with, hey, everything is fine.

MR. JULIUS: And just to expand upon that as to your first question, you asked about the 260 VFDRs and the 900 scenarios. So, I mean, we developed the set of fire scenarios as far as getting the overall fire PRA CDF. And as Mark said, we went in and took each VFDR and you went in and did an evaluation. And, you know, was that sufficient level of detail and information to disposition that VFDR, or do we have to do some additional fire modeling?

It was that maybe we'd lump that VFDR, maybe we had to revise the min set or protect it so we can get some, you know, walk down the particular cables associated with that VFDR.

So, there were additional model refinements that were done and actually that FRE process of looking at those areas was insightful because the initial fire PRA kind of did things globally, and then you're looking at specific areas and specific issues.

CHAIRMAN STETKAR: Thanks.

MR. SCHAIRER: The last bullet here really touches upon the fire PRA quantification of the scenarios. And we talked a little bit about that, but it's relatively automated straightforward process of once we identify the cables to going back on these iterative approaches.

Ultimately, the result is a refined damage set and now the PRA model would re-quantify the CCDP for that.

Okay. So, some of you have the second handout. And that's really I just wanted to - we wanted to share a couple kind of unique challenges we face with the fire modeling that didn't necessarily fall into the regular fire modeling toolbox that we had.

The first example is a transient fire in the main control room cable vault. And that is a normally locked hatch. You can see the picture there. To gain entry there, it's actually in the control room corridor and requires operations approval. And a fire brigade member actually stand there while you're in the room.

But using the 6850 methodology we used, you know, assigned maintenance storage, so we had a transient fire. The challenge was if you see the top right photograph, unscheduled raceways.

So, we did that -

CHAIRMAN STETKAR: Or for those of us who done this, the typical rat's nest.

MR. SCHAIRER: Yes, rat's nest.

CHAIRMAN STETKAR: That's a good one.

MR. SCHAIRER: So, the bottom right corner photo, there are a few trays in there which we could break out and basically use to assign it a different scenario.

But when we did that, we realized quickly that CCP was driven by the unscheduled cable. So, we didn't - we weren't able to use our typical transient methodology which was to break up the room, because there was no difference between one side of the room and the other.

The second page kind of shows you the whole room. What we ended up doing was just - there's just one big transient scenario.

CHAIRMAN STETKAR: On the handout.

MR. SCHAIRER: On the handout, yeah. The second page there.

MR. MacDOUGALL: On the back side of the handout.

MR. SCHAIRER: So, typically you'd see a room. This would be chopped up into maybe 10 to 20 scenarios where we could focus on pinch points. Not be able to do that in this case.

There is suppression in the room.

CHAIRMAN STETKAR: Ah, there you go. Thanks.

MR. SCHAIRER: I think there's a couple suppression systems. We ended up modeling the Halon suppression system. And what we ended up doing there was calculating the time to detection, time to suppression. And then crediting the trays that were covered with the delay. According to 6850, you had some delay rules there.

But again, that provided minimal benefit. The end state was really driven by the unscheduled raceways.

So, just as an example on Page 3, you know, again this is the kind of Excel spreadsheet we use to apportion transient scenarios across a floor area.

And if there were 20 scenarios, we could break up the frequency by that weighting factor. Again, we've got one line in this room.

The next page is really the quantification summary. And then the fire event tree is a typical fire event tree for a transient where we do credit suppression if possible and even manual fire brigade response for 20 minutes.

So, we were not able to really exercise all the fire modeling tools that we had generally applied to other areas. And the ultimate solution was to provide these fractional occupancy storage and maintenance factors which Jeff touched upon earlier.

And that, in our opinion, got the risk down to more realistic where, you know, we could then quantify that CDF based on that.

CHAIRMAN STETKAR: And ultimately all your fractions do finally add up to one depending on how you move things around.

MR. JULIUS: That's right. We didn't make any 0.01 or 0.1 percent.

CHAIRMAN STETKAR: Okay.

MR. SCHAIRER: Yeah, we didn't do any - I mean, we preserved the plant-wide frequency for all the -

CHAIRMAN STETKAR: yeah, I mean, that's good.

MR. SCHAIRER: Second scenario here is a fixed source scenario. And this is a 250-volt DC lighting distribution panels on the wall of the - this is a 600-volt MCC room.

And what you see here is something that looks close to what might be well sealed and robustly secured, but it doesn't quite meet the FAQ-42 discussion.

So, there are some, you know, minor gaps in the walls. So, there's possibility for the fire to get out.

So, that basically rendered us to do a fully developed fire for that. Each of these panels has a riser coming into the top of it with exposed cable.

So, we could not apply a severity factor to secondary combustibles which we normally do, because there is no distance between the source and the combustible.

All these panels are up against the wall. We're required to multiply the heat release rate by two for the wall corner effects.

And essentially what happens is each of these panels will spread up into the riser and there's trays above it that you can't see in this picture. And the resulting heat release rate leads to whole hot gas layer temperatures for thermoplastic cable, which essentially meant whole room damage at the time of that analysis.

So, that was the challenge with each of these seemingly harmless cabinets, which they all led to whole room damage.

You can see on the fire growth tree here, they're right around 20 minutes. So, we could apply fire brigade response using the fire brigade methodology.

But ultimately the solution was, all right, we had to differentiate between what was thermoplastic and what was thermoset so that we could gain - we didn't quite reach 300 - and I'm talking degrees Celsius here. We didn't quite reach the thermoset temperature.

So, that was an extensive cable material impact review.

CHAIRMAN STETKAR: Is that with the 98th percentile heat release rates from those cabinet fires?

MR. SCHAIRER: It didn't make a difference because any of the fires would lead to the riser, and then in the cable trays.

CHAIRMAN STETKAR: Oh.

MR. SCHAIRER: And that dominated the heat release rate. Combustible you have, but the cable trays, you can see there's about six trays involved.

And they quickly dominate the fire.

CHAIRMAN STETKAR: Okay.

MR. SCHAIRER: And there's no severity factor on --

(Simultaneous speaking.)

CHAIRMAN STETKAR: Yes.

MR. SCHAIRER: So, that was, as I mentioned, extensive. We went through each cable, figured out what the jacketing and insulation were classified as thermoset, thermoplastic. I think the report ended up being about 6,000 pages.

And for each fire area we had by tray, by conduit, what we could apply. We did a multi-zone of influence here. So, you've got thermoset zone of influence, thermoplastic zone of influence.

So, that was a challenge we met. That's how we ultimately, you know, we were able to gain at least some CDF reduction with that methodology.

CHAIRMAN STETKAR: Did you get enough for 6,000 pages?

MR. SCHAIRER: That remains to be seen.

CHAIRMAN STETKAR: Some of the sense of the questioning here is have you - in conclusion, do you feel that you did in some sense way too much in some areas for the purpose of this particular licensing application?

In that sense, you know, 6,000 pages of records for every cable jacketing material insulation is a heck of a lot of information. And if you, you know, if you needed to generate that to get 9.0 whatever the heck it is times 10 to the minus six delta CDF, that's fine. It was worth the effort.

If you didn't need to do that, that's also information, you know, in terms of lessons to be learned going forward about - it's too late for you guys, but other folks coming into the mill over the next year or so might - maybe they've done it already, maybe they haven't.

MR. JULIUS: The experience, as Mark expressed earlier, most of these requirements were needed to make the numbers.

MR. SCHAIRER: Yes.

MR. JULIUS: We didn't have many -

MR. SCHAIRER: I mean, the alternate is to assume everything is thermoplastic. And I don't have any, you know, sure answer for what the CDF would be, but it would not be -

CHAIRMAN STETKAR: It would be higher.

MR. SCHAIRER: Yeah, definitely be higher and, you know, using thermoplastic affects everything.

It affects the heat release rate, the spread rates, as well as the damage time.

MR. JULIUS: Well, the other option he's asking about is say it's a lower voltage and we treated them as ventilated, but to do some things that get them into the non-ventilated lower voltage -

CHAIRMAN STETKAR: I think might be a different way to skin the cat.

MR. JULIUS: Yes.

Well, the next slide then transitions back to the fire PRA. So, we have these fire damage states and you can see between the selection of the heat release rates and the T-square, the growth model and the fire damage state frequency accounts for suppression. And so, the ignition frequency is developing to the point to being a large damaging fire.

And then they're coming in and we found that some of the - even the deterministically compliant areas can't have a higher than anticipated CDF due to the conservative fire damage state frequency combined with the unreliability.

The example being the bottom line there where you were limited to a safety train powered by a diesel generator for 24 hours getting a good PRA result was a challenge.

And you can see for the lower ones, sometimes we look into maybe non-safety train equipment supplementing them.

CHAIRMAN STETKAR: It's not necessarily - I have to be real careful about time here, but, you know, just saying an area is deterministically compliant, doesn't mean that its risk is zero.

In fact, it's not surprising that deterministically compliant areas have higher risk than other areas.

Deterministically compliant is just an artifice. So, you know, saying that it's excessively conservative because it had a relatively high risk because it was deterministically compliant, isn't necessarily surprising.

MR. JULIUS: No, no, we're not saying it's excessively conservative in that case. We're saying again we had to take some of the conservatisms and the damage state frequency was leading into that.

Many of these fire damage state scenarios that we have are fires progressing so fast that we're not getting much credit, if any, for suppressions. So, you go to additional things.

So, you're coming into that and some of

your fire protection features aren't being recognized or reflected in the damage state frequency. And because of that, then it's not surprising that -

CHAIRMAN STETKAR: That part as well.

MR. JULIUS: Right.

The circuit fire likelihood was an interesting challenge in that we followed the 6850 process and developed the cables. And we got to the point of the highest single spurious cable likelihood probability was used following the FAQ-47.

We assigned - both the spurious close and spurious open were both assigned the same probability. And generally these were in the 0.3 range or below. And in some of the sensitivities, we had them up to - double it to a 0.6.

And there, you know, crediting a 0.6 for spurious closing and a 0.6 for spurious opening, we get a limit to total failure probability to one.

Those numbers being the 0.3 or the 0.6, you start getting into the challenge with the rare event approximation and the impact. And so, we had some conservatism in the model initially in terms of not addressing the rare event approximation.

And when we did one of the sensitivities, we went further and looked to take that out to get a truer measure of that so we weren't having some of these conservatisms propagate.

MEMBER BLEY: Make sure I understood. When you had these high probabilities, you abandoned the rare event approximation and did the real calculation.

Is that what you said?

MR. JULIUS: No, in general - we kept it and generally there was the affected one cable or maybe one valve in the AFW. And the other valves - there's other randoms and other things in there. So, there wasn't like we had cut sets that had, you know, 4.6s or 4.3s in them.

So, in our initial cut, we kept the rare event approximation and we knew we were living on the edge in terms of the impact of the CDF.

MEMBER BLEY: Off the top, you don't have an idea of how much overestimate you have because of that, I assume, if you didn't do any -

MR. JULIUS: That's right. We haven't evaluated that.

MEMBER BLEY: Any time you get over 0.1, you're going to have some.

MR. JULIUS: That's correct.

MEMBER BLEY: Okay.

MR. JULIUS: Okay. Here's the slide where

I talk about the fire PRA uncertainty. And as we've come up to this point, we've talked about potential conservatisms or conservatisms in the 6850 approach regarding the higher ignition frequencies, the spurious actuation probabilities, the heat release rates in the fire growth model.

We do - we're looking at a balanced approach at this and we do recognize that there's - well, I guess the comment I want to make first on the ignition frequencies and the spurious actuation, for example, some of these are explicit and you could maybe treat with data. The ignition frequencies, you know, it's easier to do a sensitivity if these are facts scaled up or down.

Some of the things are implicit like the heat release rates and the fire growth model to say that you've got a lower heat release rate and what's the difference in the damage set. That's not just something that's easily scalable within the model.

CHAIRMAN STETKAR: It's not easily scalable within what model?

MR. JULIUS: Well, in the existing conditional core damage probability cut sets that we had in terms of working with an equation because the equations are developed based on the fire damage set.

But if the fire damage set changed, you'd have to go out and make sure you had the raceway mapping and the zone of influence.

And so to get that additional data set, just dropping the heat release rate wasn't something you cranked in.

We did some of that with the three point models, didn't we, Mark, in one or two areas?

MR. SCHAIRER: Right.

MR. JULIUS: And how was that done? You just - when you evaluated at the 50th percentile heat release rate -

MR. SCHAIRER: Yes, it wasn't always like a specific severity factor. It may have been dependent on the dimensional -

CHAIRMAN STETKAR: You didn't do anything like take the full uncertainty distribution for the heat release rate and propagate it through the - if you're just using an algebraic correlation, it's kind of brainless to do it.

When you have a conditional probability of damage over the whole range of the heat release rate, do you feed that in? It's either damaged, or it's not if you're looking at plume temperature or plant height or something like that.

MR. SCHAIRER: That's why we measure the distance to the target we were interested in.

CHAIRMAN STETKAR: But, I mean, that's known.

MR. SCHAIRER: We use the gamma distribution to figure out the severity factor, right. 6850 provides the gamma distribution for the heat release rate.

CHAIRMAN STETKAR: Right.

MR. SCHAIRER: So, we would use that.

CHAIRMAN STETKAR: But you didn't -

MR. SCHAIRER: The one area where we did do what you're mentioning is -

MEMBER BLEY: I didn't understand what you just said. I thought you just said you did use the gamma distribution.

MR. SCHAIRER: To identify - yes, we worked backwards.

MEMBER BLEY: Oh, and then you picked a point off it.

MR. SCHAIRER: Identified the distance to the target, the heat release that were required for damage, and then used the gamma to look up that heat release rate severity factor.

MEMBER BLEY: Do you have any wild idea how conservative you are because of not using the whole distribution?

MR. SCHAIRER: Jeff.

MEMBER BLEY: Might be worth just a couple hand calcs just to see for yourself one time.

MR. SCHAIRER: No, at this point we haven't done that.

MEMBER BLEY: Okay. Might be a lot.

MR. SCHAIRER: Yes.

MR. JULIUS: That's what I'm saying. We're looking at some of these where the - and also these aren't - some of the distribution - I'll take the spurious actuation failure probabilities. I mean, with a value of the 0.3 or the 0.6, these are going to be relatively skewed.

You're already at the high end. And so, to say it's an error factor of five, you know, you're not going to go - you're limited to one on the high end and then - so, they've got unique distributions associated with some of these elements.

CHAIRMAN STETKAR: But there are distributions.

MR. JULIUS: And there are distributions, true.

So, we did a thorough, though,

identification of sources of modeling and uncertainty. And that was commented on in the peer review. That was a good job there.

And in the sources, we also identified through the HRA process, you know, recognizing that the operator response, environments with either degraded instrumentation or multiple spurious cable failures, you know, the methods were limited. And we could use the methods in NUREG-1921, but recognizing that the operator response could be higher or lower.

So, when we got to the end, we looked at the importance tables of the operator actions and looked at the areas where we had higher risk achievement worse and risk reduction to double-check the HRA modeling in those areas.

CHAIRMAN STETKAR: Jeff - well, I'm going to run a little bit longer. That's okay.

MR. JULIUS: We've only got two more slides.

CHAIRMAN STETKAR: Yes, I wanted to ask - one of the things I noticed and things I'm a little sensitive to, there were, I believe, for control room fires some recovery actions where you had people go de-energize - I think they were characterized as panels in the control room, and I was curious is it actually de-energizing a whole panel section?

MR. JULIUS: For individual -

CHAIRMAN STETKAR: And you brought up human reliability and I was curious how you factored that back into, you know, did you look at what else was on those panels and how that might affect integrated -

MR. JULIUS: In terms of the hardware operability given the impact of doing that?

CHAIRMAN STETKAR: Not the hardware. It's how it affected the people in the control room. I'm assuming these are scenarios where the operators remain in the control room.

MR. JULIUS: Generally the ones that were in the control room were these that were leading to the control room abandonment. We didn't further distinguish -

CHAIRMAN STETKAR: Oh, okay.

MR. JULIUS: It was quantified as a single panel, but we -

CHAIRMAN STETKAR: Oh. So, they're de-energizing the panel just to get rid of a hot short or something like that, but still responding -

MR. JULIUS: The large in the shutdown.

CHAIRMAN STETKAR: That, I didn't

understand. Thanks.

MR. JULIUS: That's all right.

CHAIRMAN STETKAR: Then my question is irrelevant.

MR. JULIUS: Okay. Then the key point I want to make on this slide is that we're using the PRA as an input to the risk-informed decision making.

And in the Reg Guide 1.174 guidance or the risk acceptance criteria, it's to account for the quantification and meet the risk acceptance criteria and account for uncertainties.

So, the way we accounted for uncertainties was to identify the key sources and to develop error factors and to develop an estimate of parametric data uncertainty.

We did get an RAI. We had questions that we haven't done the rigorous statistical propagation. And we're doing that as a separate site calculation.

But the sensitivity cases that we did, we did five sensitivity cases with ignition frequencies, the transient weighting factors, impact of internal events PRA, quality issues, circuit failure likelihood and RWST level indicators. And then we have an estimation of the parametric data uncertainty.

And with each of those cases, not only the point estimate, but the point estimate and the increased CDF, we looked at the increased CDF/LERF, delta CDF and delta LERF. And we've met all the risk acceptance criteria for CDF and LERF and delta LERF for both units.

For one unit, for the parametric data uncertainty on the delta CDF for Unit 1, we are a little above the limit. And so, we're making the argument that we've addressed the sources of uncertainty and that now given that information, what do we do about it?

So, since it's the delta CDF, to quantify in the uncertainty in the delta CDF is a little more of a challenge because there you typically had two separate Boolean equations and you're taking the arithmetic difference. And now you're saying, well, what's the uncertainty in this arithmetic difference?

Well, the approach we've taken is that the ignition frequencies and the spurious actuation probabilities, you know, would affect both the compliant plant and the post-transition plant. And the biggest difference in the two where they're affecting the delta risk is the recovery actions.

So, in terms of managing or controlling the uncertainties, we've got - we're looking at these recovery actions. And when we first did a couple of sensitivity studies, for example, we exceeded the Unit 1 delta CDF limits. And by applying one additional recovery action, we were able to revise our recovery action list and keep within the delta CDF limits or within all the limits.

And so, now we still have activities in the implementation phase to improve the procedures, improve the training. And so, we have a follow-up in implementation phase to redo the HRA and to redo the fire PRA calculation to make sure that the actions we've taken to change the procedures and change the training will help keep not only the point estimates in the CDF and the LERF down, but also the delta CDF and delta LERF.

So, we're challenged in doing some of the parametric uncertainty in the delta risk primarily. And that the - and then the question is, what do you do once you have that?

And so, we try to translate that back into actionable or things that the plant can address in terms of the procedures and the training or maybe additional engineering analyses. For example, the success criteria maybe to change the timeline.

So, from that perspective, we've addressed the Reg Guide 1.177 concerns and met the guidance for not only accounting for the risk, but then the treatment of uncertainty in the fire PRA.

I'm sure there's some questions.

CHAIRMAN STETKAR: I quite honestly didn't follow that whole discussion. But because of the time -

MR. JULIUS: There was a lot packed in there.

CHAIRMAN STETKAR: There was. And I think because of the time constraints, we probably have to move on.

MEMBER BLEY: Just one short question. You talked about areas where you're going to make improvements.

Is there a schedule on -

MR. JULIUS: The areas where we're making improvements are, I mean, the procedures and the training implementation, that's part of the implementation phase.

MEMBER BLEY: Okay.

MR. JULIUS: So, there is a schedule on that.

I guess one of the higher levels maybe basically understood technical challenges, was that especially in the peer review process, was that peer reviews typically on the as-built, as-operated plant, and we're developing the analysis for the post-transition plant.

So, this is a plant of the future in some respects with regard to the procedures and the training. Some of the procedures -

CHAIRMAN STETKAR: Procedures in HRA, that's certainly the case.

MR. JULIUS: That's right.

CHAIRMAN STETKAR: At least you're not posing any substantial hardware modification to sites as-built, as-operated in that sense.

MR. JULIUS: But even like the recovery action that - these MOV - the 92.18 valves, I mean, if we were taking credit for recovery action and go and operate a valve, that you wanted to ensure that the hardware operability supported that recovery action.

I'll turn the floor back over to Dan to talk about some of the implementation challenges.

MR. MacDOUGALL: I'll be quick.

These implementation challenges are basically what we're seeing now and today, and then as we move into the implementation phase. And they're somewhat consistent with what the pilot saw and very consistent with what Harry discussed earlier today with respect to we're taking and trying to find availability data on non-TRM systems that are now risk significant that support - all of this is in support of all our assumptions and analysis that we did to try and maintain that moving forward.

Configuration management right now is getting more and more difficult because we have a LAR sitting out, we've got modifications coming through. Some of them are quite major and we're still trying to be safe today.

And for a single-unit utility - or dual-unit, single nuclear station utility without the luxury of a corporate staff or backup, we are heavily - the point being we're heavily relying on contract staff. I mean, we are. And our bench strength.

We've been unfortunate and we've had three positions that were primaries working Appendix R that either got transferred out, left the company or unforeseen events.

And we did have some bench strength, but now we're trying to rebuild that back up as well as we're growing. So, that's a real challenge.

CHAIRMAN STETKAR: That's important. As Harold mentioned, you know, it's - back in the flurry of activities when all the original internal events PRAs were being done, you naturally rely on contractors because they've got the people, they've got the expertise.

But if you don't develop your own in-house staff to take ownership over the PRA model or, in this case not only the PRA model, but all of the supporting information, you've in trouble because eventually these two guys are going to drive into a tree someplace and that's a problem.

(Laughter.)

MR. MacDOUGALL: In summary, most challenges were data conservative, were data limitations. We simply couldn't find it and we had to be conservative.

As we forward in implementation, some paradigm shifts are going on at the station and the guys are trying to understand beyond core damage LERF actions, recovery actions. That's new news. And the NPO getting with the outage folks and saying that, you know, we got to do this.

And then of course as we discussed, configuration management right now is a real challenge.

We're not in the change evaluation process yet. We're making changes to a LAR that's pending approval. We've got modifications coming through.

I will say this: without the industry participation and the networking we've done as a single station, everybody, the committee working together, the staff working with us, the visits, that's been - it's almost been a challenge to make all the meetings and take the learnings and read the facts and it's been complex, and I want to thank you for the opportunity.

MEMBER SCHULTZ: Dan, just one question on the last slide. You mentioned you're obviously setting up a program for all the implementation challenges.

Over what time frame does your current program - does that envision?

MR. MacDOUGALL: We're looking at June of 2013. Between now and 2013.

MEMBER SCHULTZ: 11 months on through with - still with interactions with the staff ongoing.

MR. MacDOUGALL: Yes.

MEMBER SCHULTZ: Okay. Thank you.

MR. MacDOUGALL: That's unvalidated, that schedule, if I remember correctly. He's smiling. My reg affairs manager is looking at me.

Thank you for asking. that was off the cuff. End of presentation then for us.

CHAIRMAN STETKAR: Well, thank you very, very much. That was an awful lot of material into a challenging time slot.

Any of the members have any more questions for DC Cook folks?

MR. LAI: Can I say one thing?

CHAIRMAN STETKAR: You may.

MR. LAI: Can you give me the supplemental sheets that I can put in the records?

CHAIRMAN STETKAR: And with that, we will recess for lunch and we'll reconvene at 1:15.

(Whereupon, the above-entitled matter went off the record at 12:37 p.m. and resumed at 1:15 p.m.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

1:15 p.m.

CHAIRMAN STETKAR: We are back in session and we're going to hear from Duane Arnold. Whoever wants to take it.

Anil.

MR. JULKA: Okay, I'll start then.

My name is Anil Julka. I'm the PRA manager for Next Era Fleet. Vinny Rubano is with me here. He's the program manager for NFP 805. And we also have - we're going to keep this at a - we developed this at a very high level, but we do have our contractors who worked on it here.

Kiang Zee from ERIN, and also people from Kleinsorg Group are here in case we need any information on fire modeling. And even licensing, Laura, is here and another person.

What we're going to cover is we're going to give you the background of Duane Arnold. It was the first BWR, as you know, as a non-pilot we submit not too many BWRs were really transitioning to NFP 805.

As part of our big fleet, we have eight plants with five sites. And this is the only BWR we have. So, seven of the plants are transitioning, with one plant not transitioning to. We're just incorporating the, you know, MSOs there. So, Duane Arnold is the only BWR and we are transitioning.

I'm going to give you the background. Risk reduction history, I think that plays an important role when we do the fire PRA, you know, what the internal events history has been.

So, there was tremendous amount of work done there as well. So, we're going to kind of highlight that what type of things were done and what improvements we made while we were doing that, which did help us when we did the fire PRA.

PRA peer reviews, I think, John, you talked about that earlier, peer reviews and how they impact that. And we're going to talk a little bit about peer reviews and how, you know, things were transitioning at the same time while we were trying to comply with Reg Guide 1.200f2 at the same time. That did pose some challenges for us, and I think maybe other sites as well.

New analysis methods, we did use two methods outside of 6850 not really defined in 6850. So, there was lot of discussion. Lot of our discussions at NRC staff during the review, RAI responses and stuff. We will talk about that, which two were there and why we use them.

We'll talk a little bit about HRA methodology. What type of sensitivity we use for the fire model.

And then I think we -- what we did was we developed, you know, said - we said, okay, let's see what can we gain from all of this from fire PRAs.

So, we tried to make up a list ranking, you know, see what is the high risk ranking areas for us and see what insights we can gain from it.

There is tremendous amount of work done. That's why we need to really look at it from a big picture perspective. What does it really tell us? So, we'll show you what that, you know, told us which areas were the highest risk areas.

So, what risk insight and modifications, there were really very few as compared to a PWR. Like I said, in our fleet we are working on other PWRs as well and they are getting much more involved, a lot more modifications needed to get to the compliance arena as opposed to a BWR which is very nominal.

Site overview, it's approximately six miles northwest of Cedar Rapids. It's a General Electric NSSS and turbine. Bechtel was the original constructor. It's Mark 1 containment. 630 megawatts electric. And it's been a good plant.

This shows the Cedar River which is, you know, the ultimate heat sink. And we got the forced draft cooling towers. This is just to give you a perspective where the plant is.

Now, one thing which is important to note here is we started doing Reg Guide 1.200 Rev 2 upgrade for internal events and we started the fire PRA at the same time. So, that was a real big challenge for us.

Internal events peer review was done before we had really completed all the Reg Guide 1.200 improvements - Rev 2, I mean. Rev 2 was not really issued at that time.

So, as a result, that kind of interfaced with, you know, getting us to go back and forth between the fire model and the PRA model, revising both models at the same time.

The peer review, again for the fire PRA peer review was also done up front in 2010. That was like two years before. So, that is another challenge that a lot of sites did that. We did fire PRA peer reviews not before we were really completed with it or at the point where we were pretty much done as opposed to, you know, really methodology was set at that time, but really we did not have quantification in a lot of the results.

So, that did challenge, you know, as far as later on responding to findings, and ultimately RAIs.

So, what we did was internal events, like I said, we did that a long time before we really had the complete compliance for Reg Guide 1.200 Rev 2. So, what we did was focused peer review.

And I think Steve Dinsmore mentioned that this morning that, you know, they need some sort of a justification that if you have a lot of findings.

So, we had quite a few findings. So, what we want to do was narrow that down. So, we knew that based on the industry looking at pilots and some other plants, the RAIs were kind of directly proportional to number of findings people had.

So, although we had fixed those findings, we wanted to make sure that they were appropriately incorporated. And in areas where we had - there were too many findings in one element, one supporting requirement, what we did was we looked at the entire element. And I think that was consistent with what NRC's expectations were at that time when we were talking about the peer reviews.

The LAR was submitted in August 2011. And we touched base this morning about the audit. We had the audit in December last year. It was very comprehensive audit. In fact, this is the first one we have seen which was that detailed. We went through a lot of details which we don't normally do with other applications.

We had about 120 total RAIs to respond to, which we did. Which is significant amount of effort for us. They were separated between two areas. One was 60 days, and 90 days. And we did submit all of them on time.

And there was a second audit which was done in May of 2012 which was mostly with fire modeling. It was not as comprehensive as the first one, but this one was like, you know, just two inspectors coming as opposed to 12 people in the initial audit. And in June, we had that fire modeling walkdown.

So, this is kind of the timeline of the history and right now I think we are waiting for, you know, the resolution of the RAIs and SER is supposed to be due next year sometime. I believe next year in June time frame.

So, I said we started both at the same time. It's been a challenge to keep both of these updated at the same time. So, at certain point we had to make a call saying, okay, this is the frozen model now and we're not going to update fire PRA along with the revision to the internal events.

So, in this case like you see the 1.200 focused peer review, when that was done we said, okay, that will be the model used for fire PRA.

So, although we did a significant reduction as you see further on, that is not in our fire PRA model at this time. That was again the modeling change and the procedure change for RHR cross-tie valve. And I will go over that, what that was, but this shows kind of the history of internal events changes.

You have a question, John?

CHAIRMAN STETKAR: Yes, I do a little bit.

The sense that I'm getting is that now your so-called fire PRA model is fundamentally somehow different than your so-called internal events PRA model.

So, you have two different models?

MR. JULKA: That's correct.

Now, also we have to also think about the fire PRA model is including all the modifications. So, our internal events model is as-built, as-operated plant right now. So, those two are inherently different.

CHAIRMAN STETKAR: What I'm concerned about, are any of the conclusions or modifications whether they're hardware modifications or procedural modifications in your fire PRA model, could they be influenced one way or the other by - if the fires were evaluated in the context of your as-built, as-operated internal event PRA model?

In other words, are you in danger of making the wrong kinds of decisions from your fire PRA especially considering this rather dramatic change, you know, between April 2010 and June of last year in the internal events model?

MR. JULKA: No, our plan is to for during the implementation phase, make them combined together.

CHAIRMAN STETKAR: I understand that.

Have you, I mean, after all, these are PRA models. And if you have a PRA model in place - okay. I was going to say it's not our role to question about how easy changes might be, but it's a bit troubling to see things diverging.

MR. JULKA: Uh-huh, uh-huh.

CHAIRMAN STETKAR: Especially in the context of major changes that may or may not affect conclusions from the fire modeling exercise. I mean, I have no idea.

MR. JULKA: Right, right.

MEMBER BLEY: Could you help me understand a little what it means to have two different models?

I thought you started with the internal events model as of last year; is that right? And then you made the fire-related changes to that, but it's actually got that same - everything else of that original model is still there; is that right?

MR. JULKA: But except for the last change. Like I said, that was done after we -

MEMBER BLEY: Oh, that was done afterwards. Okay. So, you got the model before that.

MR. JULKA: Right.

MEMBER BLEY: So, you have to when you merge them together, you've got to adopt these changes and then the fire mod changes in.

MR. RUBANO: The fire PRA model is built on the Rev 5 delta internal events PRA model and not the Rev 6 internal events model.

So, you're right. So, any changes that were created between five delta and six have to be incorporated into the fire side before we can combine the models and to keep it as one consistent set.

MEMBER BLEY: I assume that's pretty clean and you know how to do that.

MR. JULKA: We know how to do that and we do have a plan schedule laid out for implementation of NFP 805 where we will, you know, finally carry only one model forward.

All right. We are finding that with other sites, too, you have to kind of make the call where do you say, okay, this is the model, so fire PRA people can start working on it.

Once we continuously keep changing it, I think it changes all the numbers and we have to revise that and then it becomes a very cumbersome effort.

CHAIRMAN STETKAR: I mean, there's one school of thought that says there is the PRA model. The PRA model evaluates LOCAs, it evaluates losses of offsite power, it evaluates loss of feedwater transient, it evaluates fires in this room, it evaluates fires out in that corridor, but it is the PRA model.

And indeed when you, you know, you have to have a model of record especially for a licensing submittal, certainly. But it's an evolving model, but it's only a single evolving model. It's not multiple, different models.

MR. JULKA: Right. I agree. Yes, we need to bring it together.

CHAIRMAN STETKAR: So be it. Again, the only concern would be is if any changes between 5D and 6 might affect the conclusions from the fire PRA model either positively or negatively in terms of reordering importance of specific fire areas in the plant or - I know you don't have any formal recovery actions at the moment.

MR. JULKA: Right.

CHAIRMAN STETKAR: Identifying other needs, for example, is always a concern, but at least we understand where you are.

MR. JULKA: Okay.

MR. RUBANO: But that's, I mean, to further that point, every utility, every site that's transitioning to NFP 805 has the same problem because we had to draw a line in the sand.

But in addition to that as was stated this morning and we'll tell you again this afternoon, is that the fire PRA supporting NFP 805 is a forward-looking model, it has the modifications incorporated, whereas the internal events model is an as-built, as-operated plant.

So, there's an inherent difference and it won't come together until the modifications and changes that are scheduled for 805 are actually done. And then the models can be brought together.

CHAIRMAN STETKAR: Okay.

MR. JULKA: But I think I see your point. You're saying if you're making changes now --

CHAIRMAN STETKAR: I mean, quite honestly --

MR. JULKA: -- how are we going to see the difference between the two.

CHAIRMAN STETKAR: -- if you were talking about the difference from 5A to 5B to 5C since this is kind of a, you know, those are essentially no different. Those are fine tuning.

MR. JULKA: Pretty much the same, yes.

CHAIRMAN STETKAR: 5D to 6 looks like some sort of fundamental major change in the model.

MR. JULKA: Yes.

CHAIRMAN STETKAR: And I hope you understand whether or not that might affect the results of the fire -

MR. JULKA: It helps.

CHAIRMAN STETKAR: It would help?

MR. JULKA: It would help. Yeah, that we do know.

I'll show you what the change - on this page, I have that. And what that is, is a cross-tie to RHR system. You know, it spread from one division, but we did not have credit in the system for allowing recovery for operators to be manually able to align that to that evaluation.

So, that itself gave us a tremendous benefit once we have recovery on that valve to be able to use both sides of RHR system. So, that was the main -

CHAIRMAN STETKAR: Would that help you much in suppression pool cooling for your fire PRA?

MR. JULKA: Yes.

So, like I said, internal events was done on December. And we had 57 SRs which were not met, and 66 findings for F&Os.

We did a focused peer review because we had done a lot of work between 2007 and 2011. We had incorporated all the changes. And so, we did a focused peer review and then we finally came up with 12 F&Os which were remaining, which the peer review team felt that they were not completely closed out.

So, that was a big, you know, significant effort for us to get there and we did not want to go into, you know, have NFP 805 submittal done with that many internal events finding.

And we had a similar number of findings for the fire PRA which was done by the PWR OG. 89 findings which were again, like I said, that was done before we were really completely done quantification, before we completely had all the solutions, what we were going to do.

And the RAIs ranged from, you know, you got complete PRA evaluations, quantified results versus, you know, documentation.

CHAIRMAN STETKAR: Okay. I have to ask why did you have the peer review done at that stage in your PRA model development?

MR. RUBANO: Basically it was schedule pressure. So, as 805 has developed, we've had different regulatory deadlines when we've had to be done.

So, based on what we thought the deadline was going to be at that time, that's when we scheduled the peer review.

And in addition, there was a lot of people doing peer reviews and you really had to grab a peer review window pretty early to ensure that you actually had the coverage to get the peer review. So, purely schedule pressure-type stuff.

If I had to do it again, I'd move the peer review all the way out to the end.

CHAIRMAN STETKAR: I suspect people have gotten that message. But I've heard some of that undercurrent in the peer review process, and I wanted to - that's why I asked to get your -

MR. RUBANO: All of my sites have had similar problems. Their peer reviews were done very early. And, in fact, at Turkey Point we did a second full-scope peer review because the first one was so early.

MR. JULKA: And had a lot of findings.

CHAIRMAN STETKAR: Well, naturally. I mean, it's not surprising.

MR. JULKA: And we found out that, you know, if you really look at it, you know, taking away not ultimately hundred percent, but most of the findings, they are directly proportional to number of RAIs we got.

Now, I'm going to have, I guess, two, I think it was called, methods in the morning. We gave it a new name. New analysis methods. It looks a little bit better.

So, I'm going to have Vinny go through which ones we used and -

MR. RUBANO: Okay. So, at Duane Arnold we applied at the time of the application, there were two analysis methods that are not 6850 compliant or don't follow the exact guidance 6850.

One was a hot work cable spreading room pre-initiator, and I'll talk a lot about that one, and then a transient heat release rate and we used a reduced transient heat release rate.

Since that time, the transient heat release rate and the placement of transients has been a lot of discussion with the industry and the regulators over that subject.

And DC Cook pointed out this morning that we're still discussing the amount of credit you get for hot work controls and transient controls leading to the ability to use either a reduced placement or a reduced heat release rate for a transient.

So, that's sort of still a work in progress even though we did use it. And we've gotten several RAIs, we've responded to the RAIs. We're waiting for a response to that, to our response, but that is a - I would call it sort of a generic topic.

CHAIRMAN STETKAR: When you say the transient heat release rate, we'll come back to this notion of uncertainty distributions, do you mean that the value that you used is lower than the 98th percentile transient heat release rate in 6850, or did you use -

MR. RUBANO: That is correct.

CHAIRMAN STETKAR: - an entirely different uncertainty distribution?

MR. RUBANO: No, we used a reduced heat release rate from the 98th percentile that's in NUREG-6850.

CHAIRMAN STETKAR: But did you use a different heat release rate uncertainty distribution, or did you just pick another number off the 6850 curve?

MR. JULKA: Do you want to answer that, Kiang?

MR. ZEE: Yes, let me clarify a little bit.

CHAIRMAN STETKAR: You have to identify yourself.

MR. ZEE: This is Kiang Zee with ERIN Engineering.

Where it all really came from is - and I'm going to go with a little bit of detail so you can understand the context.

When we got to this requirement to deal with transient ignition sources, transient frequency and so forth, we went and looked at what the required treatment was. And the tests that formed the basis for distribution function in 6850, are a series of industry tests where general occupancy trash, I guess I will call it, burning trash bags, form the basis of it.

If we went back and looked at the industry events which were counted to generate the frequency of the event we were evaluating, what we found was the events were actually what we would better characterize as transient ignition sources.

Generally speaking, they were not burning trash bags, but instead they were miscellaneous, small ignition sources which did not occur in sufficient frequency to warn its own bin. So, they were generally grouped into a bin called "transient fires."

So, my characterization is that treatment is actually transient ignition sources, it's not transient combustible fires.

So, what we wound up doing was we made the connection between transient ignition sources and we went looking for another - a heat release rate distribution function in 6850 that we thought might be representative for transient ignition sources, and what we found is there is a bin in 6850 for motor fires. And that motor fire bin would be applicable for any electric motor fire generally regardless of size.

So, we made the logical connection that that would probably be a better representation for a distribution function for transient ignition sources.

Going a little bit deeper, some of the events that were counted that were used to generate this transient fire frequency involved things such as space heaters reaching end of life and smoking, catching fire. Extension cords catching on fire. Little work lamps catching on fire, things like that.

So, we felt the natural connection was connected to the distribution function for electric motor fires.

And so in that context, the heat release rate value that was used was the 98th percentile heat release rate for that distribution function, the electric motor fire bin.

CHAIRMAN STETKAR: Okay. Well, at least we know what you did.

What we're trying to understand here is - obviously there's an ongoing dialogue between you and the staff over these things. And as I mentioned this morning, the purpose of the subcommittee meting is for us to understand technical issues that have arisen over these three different applications and how those issues are being addressed.

MR. RUBANO: So, on that, just to go a little further on that, that was the original logic that they used to develop that heat release rate distribution for -

CHAIRMAN STETKAR: They've used the motor heat release rate distribution for transient -

MR. RUBANO: But since that time, it's sort of evolved to a larger question of how much credit you get for specific transient controls like DC Cook this morning discussed transient free zones or stricter controls.

So, can I, you know, is there a method or is there a logic to apply that lower heat release rate for special areas that have special controls versus the general area which may have the larger heat release rate or - so, that's an ongoing discussion right now.

CHAIRMAN STETKAR: But that's sort of two different issues.

MR. RUBANO: Right.

CHAIRMAN STETKAR: One is control of things that you call transients, the other is given, you know, given the ignition to this pile of paper here, what sort of heat release rate do you get from that burning pile of paper or trash bags or canvas coveralls or whatever is in that pile.

MEMBER SCHULTZ: Vinny, in terms of sequence, these new methods were in place in the methodology prior to the industry peer review of the fire PRA?

MR. RUBANO: Yes, they were.

MEMBER SCHULTZ: And were there any particular industry comments related to them in the PRA?

MR. RUBANO: Yes, we did - they were findings.

MEMBER SCHULTZ: Findings, okay.

MR. JULKA: I think they were -- it's just the policy that if, you know --

MEMBER SCHULTZ: It's a matter of course.

MR. JULKA: Yes, if they find it, but not necessarily every time. I think they may talk tomorrow more about it on how they do that, but they were listed here as findings.

MR. RUBANO: Correct me if I'm wrong, Kiang, but the transient heat release rate was submitted to the EPRI panel for review; is that correct?

MR. ZEE: That is correct.

CHAIRMAN STETKAR: I think we understand - or at least I understand what you did.

(Laughter.)

MR. RUBANO: Okay. So, the first one - really the first one we list is the hot work cable spreading room pre-initiator. We'll show you a picture of the entrance to the cable spread room at Duane Arnold.

The cable spread room at Duane Arnold is sort of a special room. It truly is a cable spread room. There is nothing in there but cables. It has a total flooding CO2 system to protect it. And it has very restricted access.

So, it requires operations' permission to even go in the room. And, in fact, the card reader at the door of that room has an elevated access requirement so that you have to go talk to security, too, to get temporary elevated access to even get through the door.

So, based on that we came up with basically an adjustment because 6850 really has no real adjustment for that.

And this is very similar to the issue

that's in FAQ-64 now about the influence factors of, you know, all the areas where transients are really difficult and hot work fires and things like that are really difficult to happen because of either the controls or the difficulty of getting there or things like that that some credit - we should be able to get some credit for areas that are special.

As I said before, it's a highly restricted area. You do need control room operator permission to get in there. You usually need security permission to get in there.

There is really nothing in the cable spread room that requires hot work. As I said, there's only the cables in there. In fact, there's not even instruments in there. So, there's not even technicians going in to do calibrations and stuff like that. So, it's basically all by itself.

If we had to do hot work in that room for whatever oddball reason that would come up, that would be a very specialized evolution that would require lots of controls and lots of precaution.

So, it's not something that you would just send a bunch of people out in the plant and say, hey, go start grinding on this thing and put up a new support or something like that.

That would be pretty rare and would have very special controls.

CHAIRMAN STETKAR: Do you work in there during shutdown?

MR. RUBANO: Even during shutdown there's very little work in that area.

If we had a - if we pulled a new cable or something, it probably wouldn't even involve hot work. I mean, there's lots of spare capacity cable trays and stuff like that.

We put a 0.01 pre-initiator in there basically for potential failure of administrative controls. As the PRA guys always tell me, they don't like zero. So, there's always some possibility that something is not going to go right.

We did actually do a sensitivity on that and we've determined that through that sensitivity, that the 0.01 factor is relatively conservative and is appropriate. There's nothing - it's not - it doesn't really change the results very much at all.

CHAIRMAN STETKAR: I'm sorry, if you increased it to one, how much would it affect the results?

MR. RUBANO: Well, so, one, you would end up with the full frequency distribution for hot work in there and we didn't go that far, but the difficulty in going that far is that you would have to go and do all the scenarios and put the locations of the fires and it's a relatively big analysis.

The cable spread room at Duane Arnold is mostly one division. It has one small corner that has the second division.

So, even considering that, you would not - the results would not be significantly different because you - the default for most of the fires in that room, the default would be single-train shutdown, you know, potentially relying on the diesel. And that drives the risk number regardless of how you got there.

MEMBER RAY: Could you describe what the administrative controls are just generally that you were relying on?

MR. RUBANO: The administrative controls in this room is that this room is normally not accessed during operation. In fact, it's usually not - there's the entrance right there.

It's card-reader-controlled. The card reader has a higher level of access so that it's, you know, very few people on the site actually have access to that room on a normal basis.

To get in that room, you have to talk to security to get an elevated access on your key card and you need operations' permission. Operations has to get a clearance to allow you in the room. It's a big deal to get in that room.

MEMBER RAY: Is that because of this fire concern, or for other reasons?

MR. RUBANO: That's for other reasons.

MR. JULKA: Other reasons.

MR. RUBANO: It's a CO2 area.

CHAIRMAN STETKAR: It's a CO2. They don't want people dying.

MR. RUBANO: So, we don't want people in there.

MEMBER RAY: Yeah, okay. I'm just trying to understand what the -

MR. RUBANO: And in reality, I mean, when you go in the room, the first part of the room you can move around. But to get to some of the areas, you really have to work hard to get to those areas.

If you were in that area and the CO2 system would get off, you would not get out. So, as a result, we don't allow people in there.

CHAIRMAN STETKAR: I just - I want to ask a little bit about this, because it does have - is it an automatic CO2 system, or is it -

MR. RUBANO: It's an automatic CO2 system.

CHAIRMAN STETKAR: Automatic CO2.

I guess, you know, why the concern about transient combustibles? You have an automatic detection and suppression system and you couldn't put out the fires fast enough if they happened in there?

MR. RUBANO: 6850 basically would drive you to a relatively large fire. The suppression system is not super fast. So, some damage would occur before the suppression system actuated. So, when you go put all those pieces together, it drives you down this risk path.

Now, part of it stems from the original Appendix R-type assumptions. So, if you took a full room burn-out, you have mostly one division, but there is a little piece of the second division there. So, you would have big problems.

So, if you have any fires that drive you in that direction, the risk goes up. That's an automatic kick-you-over-the-edge-type situation.

CHAIRMAN STETKAR: I understand, but that's, you know. We heard 900 fire scenarios from fire modeling from DC Cook to address those types of issues.

MR. RUBANO: There are at least 500 scenarios at Duane Arnold. It's not - fire modeling scenarios like you had talked about basically are taking the frequency and breaking it up into smaller and smaller pieces throughout. And not every part of that frequency results in that significant damage.

The problem you have is that we've generated a mountain of data with just what we have now to do that on an extensive basis. You keep generating more and more data that you have to keep configuration control over.

It's a balancing act of how much effort you want to put in to do that versus how much effort it's going to be to maintain that going forward.

And that's a real concern of ours that the more data we generate, the harder it's going to be to maintain this going forward.

CHAIRMAN STETKAR: That's certainly true.

MR. RUBANO: So, we'd like to take big swipes and big things that it's hard to - it's hard to make the configuration control difficult.

As far as the restriction in this room, this room's got restrictions for all kinds of reasons. So, it's going to be restricted. It's not something that's going to change.

And because of the CO_2 system, it's basically restricted during non-power operations also unless you really have to go in there.

MR. JULKA: Which is rare.

MR. RUBANO: And it's rare. And if we do got to go work in there, that's a special occasion. We'd have to do - there would be all kinds of pre-planning and stuff that had to be done to do that. So, it's not something we'd casually just go and do.

This is also the room where the NRC questioned about the placement of the transient fire. So, the part with the second division is back in the back. You have to crawl underneath a bunch of cable trays to get there. It's really difficult to get to.

It's hard to get in the room to begin with, but then to get to that particular area is very hard. So, we did put a transient back there to answer the RAI.

When they had done the analysis on the cable spread room, they had taken a bounding CCDP on the cable spread room. And the damage from that transient in that location is no worse than the bounding CCDP that we had already used the analysis. So, essentially there's no result in the end.

MR. JULKA: We already talked about this.

Do we need to talk anymore on this?

MR. RUBANO: So, at Duane Arnold, the only other factor - at Duane Arnold, only one percent of the CDF/LERF values are transient fires. And that's probably due to the fact that it's a BWR. It has very large fire zones. It's very hard to -

CHAIRMAN STETKAR: That's what I noticed. You only have a handful of fire areas.

MR. RUBANO: Yes.

MR. JULKA: 13 or 14, I think.

CHAIRMAN STETKAR: Yes. Well, I said handful. A small number.

MR. RUBANO: So, the reactor building is four-by-four. It's like it's tremendous size areas. All right. The smallest fire areas are the switchgear rooms. They're basically all by themselves, but the areas are typically very large. Even with the large fire areas, Duane Arnold has very good separation.

So, even within the reactor building which is each floor or each two floors is a single fire area, there's enough separation between the divisions that you can't get a fire that does significant damage to both divisions at the same time.

So, that's the - that's really an advantage of a BWR. BWRs are naturally better suited for that.

I couldn't make the same statement about the one percent for - my PWR is certainly more than one percent for transient fires. So, this is - Duane Arnold is a unique case.

We did go back and use - looked for specific areas where a larger fire would make a significant difference in the target set. And there was very few, because the areas are so big and the ceilings are high.

So, unless you - and almost impossible to form a hot gas layer. So, unless you're directly in the plume, you don't see much damage from those fires.

CHAIRMAN STETKAR: Given the fact that your fire core damage frequencies are relatively low - well, I won't ask that.

MR. RUBANO: Anything else on that?

MR. JULKA: I think we already touched base on that, that the models are out of synch at this point. And there are certain changes which are not in the internal as well as the external.

Right now we do not have any of the B.5.b type in our model, internal or fire at this point in time. Although some sites are trying to include that at this time, we have not done that as yet because of certain things have to be met before we use that as far as having it in the maintenance rule or places like that.

So, we are not at that point where we have utilized. So, that will be something which we'll be thinking about in the future. These three items, I think they're going to give us a good amount of benefit as far as risk impact.

(Discussion off the record.)

MR. JULKA: Sensitivity analysis, I think we touched base this morning. We did do a sensitivity analysis on several of the areas.

Kiang Zee, you want to offer any more detail on the sensitivity assumptions?

MR. ZEE: I guess if this were an analysis for a different plant, this discussion might be a lot more interesting, but it is a little bit of a softball.

Duane Arnold because of all the issues that Vinny mentioned, happens to be a pretty well-behaving plant with respect to having to do fire PIA on it.

Desensitivity studies are pretty much parametric things that can be simply propagated through the analysis. So, unless there's something specific you want to explore, I don't know that desensitivity studies are necessarily - are going to provide a tremendous insight into anything in particular.

CHAIRMAN STETKAR: And, Kiang, you did propagate all of the parametric uncertainties through the model, or did you not?

MR. LEE: Well, be careful now. We propagated the uncertainties parametrically that we can do mathematically with the tools that were available.

Now, I say this carefully, because in an earlier discussion I got an impression from where you wanted to go with this.

So, as an example, if I wanted to deal with the entire heat release rate distribution function, for example, and wanted to do uncertainty there, what would happen is I would have to run that part of the uncertainty analysis. And the results of that fire model with that set of uncertainty would get mapped to, if you will, a set of discretized results of the damage factor.

Because I could play as much as I want within the distribution function. But until I change the definition of the damage vector or damage set that

that fire causes, I don't have a calculable change in my CCDP solution.

So, conceptually you can think about it in the sense of fire modeling leads to a damage set which leads to a flag file that I want to propagate to a quantification. And until the definition of that flag file changes, there's really nothing to put in, in a continuous function.

So, it becomes a little difficult to try to integrate the two uncertainty analyses because they're actually detached and you have to actually intercept that uncertainty analysis and insert in that different solution to the CCDP model and then switch over and continue the uncertainty analysis, and switch again when you get to the next one. And while it can be done and it practically -- it can be done, but it can't practically be done.

If I want to take my half, I wanted to do this and you sent me away, I might be able to come back in six months and give you the solution for one fire area, but I would have to intercept that uncertainty analysis with each time the flag file has to change.

CHAIRMAN STETKAR: Okay. I hear what you're saying. I hear what you're saying.

MR. ZEE: It conceptually can be done.

CHAIRMAN STETKAR: Yes, it can be done. And people have done it. And it doesn't take six months to do. That's all I'm saying.

If you think about how to do it, it doesn't take six months to do. But you have to want to think about how to do it.

MR. RUBANO: So, a couple of things that are mentioned on this slide, I want to point out the second bullet there, potential impact to switchgear room modifications to provide additional source of AC power.

What you'll see in the next couple slides is the fact that the switchgear rooms account for the majority of the risk at Duane Arnold. And it's basically similar to what DC Cook described this morning on loss of offsite power and then relying on a single diesel. And then the diesel reliability terms and the out-of-service time for maintenance, stuff like that becomes a driver for the risk.

So, we actually thought about - we looked at what we could do to reduce risk in those rooms. And those rooms are very sensitive to this.

The problem is, is that it's tough to define a solution to that if cable trays aren't across the top of the switchgear. For some of the fire bins, we could come up with some protection. But the ones that are particularly difficult, the high-energy arcing faults, it's tough to define how much protection you really need to protect some of that stuff in that situation.

So, how to get that benefit is a little bit of a concern being able to convince everybody that that particular shield, that design or something like that would actually pass those requirements.

So, that's the difficulty in that. It's a big driver in risk. Those areas are in fact deterministic. So, you know, there's no - it didn't drive delta CDF. It just drove CDF and LERF.

CHAIRMAN STETKAR: And you said high-energy arcing faults are driving the switchgear rooms. Did I understand that right?

MR. RUBANO: That's one of the scenarios that's driving the switchgear rooms.

CHAIRMAN STETKAR: Okay.

MR. RUBANO: There's several scenarios. All the bins that involve the fires from the switchgear drive the results in the switchgear rooms.

CHAIRMAN STETKAR: Yes.

MR. RUBANO: There are potential solutions to some of those fires.

CHAIRMAN STETKAR: Some of the smaller ones.

MR. RUBANO: Some of the smaller ones. But the high-energy arcing fault, basically there's no good solution to that right now.

CHAIRMAN STETKAR: Right. As demonstrated by a few fires we've had in real plants.

(Laughter.)

MR. JULKA: So, in order to understand that we said, let's draw total picture. What does it look like? Sit back and see what does it look like from fire?

So, this is the picture which we are getting for the entire hazard distribution for the site. And I think looking at other sites, we are pretty much getting the same information on a - this is a BWR. So, PWRs are pretty much getting even worse than this right now. We're saying over 90 percent of the risk is driven by fire.

Now, like I said, we have some improvements to make, which we will be, but they are incremental. They are not really big picture. I think if you're going to do something, we got to look at it, see what can be done.

It's like we've talked to all the PRA analysts, we're looking back and saying, well, something is not right about this picture.

CHAIRMAN STETKAR: Why is something not right about that picture?

MR. JULKA: Is that true that based on the industry data, is fire driving the majority of the risk? We're questioning ourselves. Is this true, or is it not true?

MR. RUBANO: My original thoughts back in the beginning of like 2005 time frame, was that fire risk was going to be on the same order of magnitude as the internal events risk.

And what we're finding now, right now with the existing numbers we have, is that fire risk is considerably larger than that, and some of it may be where we stopped the analysis.

MR. JULKA: yes, I think that's -

MR. RUBANO: And as I said before, we've generated a mountain of data. We're trying to prevent generating a second mountain of data to make that fire risk section go down.

MR. JULKA: And I think like we were talking earlier, you know, we stopped at a certain point when the risk numbers were, you know, acceptable.

CHAIRMAN STETKAR: Go back to your Slide Number 7.

MEMBER BLEY: You're about where internal events used to be.

MR. RUBANO: Right.

CHAIRMAN STETKAR: So, back to - and you haven't incorporated those changes into this model.

MR. JULKA: Right.

CHAIRMAN STETKAR: Nor have you thought ever in your life about how you might focus plant improvements, procedure - either hardware modifications, procedure modifications, whatever, on fire.

MR. JULKA: Right, right.

CHAIRMAN STETKAR: Because you've never had these insights.

MR. JULKA: Uh-huh.

CHAIRMAN STETKAR: So -

MR. JULKA: Yes, as we gain insights, I think it's going to, you know. Yeah, you are right. That's where we started out when we did the IPE and IPEEEs, you know, in the late '90s.

We have come significant ways from where we were based on the insights we have gained.

(Discussion off the record.)

CHAIRMAN STETKAR: It's, you know, people say, well, I don't believe the fire risk is this high. This picture here, this red picture, is basically your understanding of what the fire risk is based on the analyses you've done to date.

MR. JULKA: Yes.

CHAIRMAN STETKAR: And if there are conservatisms left in those analyses, they can be addressed.

MR. JULKA: Yes.

CHAIRMAN STETKAR: If there are some real issues like high-energy arcing - if, for example, high-energy arcing faults in switchgear rooms are driving this, there may not be much to, you know, there's some elements of probably realism here. Some elements of conservatism.

MR. JULKA: Yes, there are some insights we get from the analysis, definitely. You know, in the historical data up until now, what we have been doing is for significant determination process.

We take the internal events. We double it saying this is our total risk. Can we do that anymore? Probably not.

So, that's where we are. So, what we

wanted to do was further look at it, you know. We do this full-panel chart, we call it. We do that for internal events for ops people to look at.

And one of the fellows who is there, Ted, he came up with the idea, hey, let's look at full-panel chart for this and see what does it show us.

So, this shows that essential switchgear room, you know, Div 1 and Div 2, they contribute most of the risk.

CHAIRMAN STETKAR: I'm going to ask you a little bit about this, actually. Dug in a little and you might need some help.

The - I'm terrible with colors. The CRS, CR, CB, HVAC, the three percent wedge in the upper left-hand corner from - that includes the cable room -

MR. RUBANO: Cable spread room.

CHAIRMAN STETKAR: Cable spread -

MR. RUBANO: Control room.

CHAIRMAN STETKAR: Basically fire area CB1.

MR. RUBANO: That's correct. It's CB1.

CHAIRMAN STETKAR: In your analyses, you do have a - I've forgotten what you call it. Your alternate shutdown.

MR. RUBANO: Remote shutdown panel.

CHAIRMAN STETKAR: Yes, remote shutdown

panel.

That, in the PRA model, essentially for - is it all fires in there people relocate to the remote shutdown panel the way they're treated?

MR. RUBANO: No.

CHAIRMAN STETKAR: No?

MR. RUBANO: So, there's several things we did for the control room. For the control room, we did the required abandonment criteria based on habitability. So, density and/or smoke and whatever else, heat. So, you've got a set of you have to leave the control room.

Then we came across a couple of panel fires within the control room that if you left the control room or had to leave the control room because of that panel fire, there's a low likelihood that even if you successfully got to the remote shutdown panel, that you actually could mitigate the consequences of that fire because the damage would be too quick, too soon. By the time you got there, you could not gain enough control, all right?

Some of those panel fires were more successful - you would be more successful in the control room because you had more equipment still available in the control room than on the remote shutdown panel.

So, all those cases were considered.

CHAIRMAN STETKAR: Okay.

MR. RUBANO: All right. So, there are some panels where essentially leaving the control room - the CCDP is one. There's essentially no recovery.

CHAIRMAN STETKAR: Okay.

MR. RUBANO: If you had to leave for that panel - if you left for that panel, the probability of success is very, very low.

CHAIRMAN STETKAR: Okay, okay.

But for the action when the operators did abandon the control room and go to the remote shutdown panel, in the PRA they were guaranteed to be successful; is that right?

MR. RUBANO: No.

CHAIRMAN STETKAR: No? You assigned an HEP?

MR. RUBANO: We actually assigned a surrogate which we did backup. So, in the industry floating around for a long time has been a CCDP of 0.1 for abandoning the control room and using the remote shutdown panel.

So, we went and actually looked at the actions. And if we did real calculations for HEPs, we'd come up with a number that is considerably less than 0.1. And we used 0.1 as a bounding factor.

CHAIRMAN STETKAR: 90 percent success.

MR. RUBANO: Right.

CHAIRMAN STETKAR: I was -

MR. RUBANO: And at Duane Arnold, it's reasonable at Duane Arnold because the remote shutdown panel is relatively well-equipped and the normal isolate switches are relatively easy.

It's not exotic as some of the other places are.

CHAIRMAN STETKAR: Let me ask you - I was thinking about this. I used to work in a plant and I've seen a few older plants that have backfit - your remote shutdown panel was backfit, right? It wasn't built when you built the plant.

I didn't see any fire scenarios in the - I know the remote shutdown panel is someplace out in the reactor building. I couldn't figure out exactly where it was, because I couldn't. I couldn't find any fire scenarios that seem to affect the remote shutdown panel.

Is the remote shutdown panel at Duane Arnold - in some older plants, what they did is they installed a remote shutdown panel basically in series with the control room.

Control signals start at the control room and went to the remote shutdown panel and went to the cabinets or motor control centers or switchgear or wherever they were going such that if you had to abandon the control room, you basically cut the tie from the control room and controlled from the remote shutdown panels.

In other plants, the remote shutdown panel is effectively in parallel with the control room such that you have to actually enable the remote shutdown panel.

MR. RUBANO: It's a mix, but mostly the hot shutdown panel is -- wrong plant. Remote shutdown panel is mostly de-energized. So, it's mostly in parallel.

CHAIRMAN STETKAR: Okay, okay.

MR. RUBANO: And I know what you're talking about. So, if you have a -

CHAIRMAN STETKAR: If you have a fire at the remote shutdown panel, it's worse than the main control room because you can't do anything.

MR. RUBANO: Right, right. I have - one of my sites has that problem.

CHAIRMAN STETKAR: Duane Arnold isn't -

MR. RUBANO: No.

CHAIRMAN STETKAR: Okay.

MR. RUBANO: But one of my sites has that problem. The remote shutdown panel turns out to be a pretty significant scenario.

CHAIRMAN STETKAR: Yes, okay. Thanks.

MR. JULKA: Then I guess we needed to get - say, okay, essential switchgear room dominates the risk. Why is that?

So, we started looking at all the cut sets.

CHAIRMAN STETKAR: Let me - I'm sorry.

MR. JULKA: No, that's fine.

(Discussion off the record.)

CHAIRMAN STETKAR: One thing I was trying to understand - do you have a separate slide that you're going to talk about the control room, or are we done with the control room?

MR. JULKA: No, we didn't have specific slide on the control room.

MR. RUBANO: The only thing we're talking about a control room is the modification we're making for detection.

CHAIRMAN STETKAR: Let me ask this then. And I may have misinterpreted what I was reading. I thought that I read that in fire area CB1 there were systems and trains of systems that were not credited in the PRA analysis.

And in particular, I thought that I read that Division 1 AC electric power was not credited. In other words, that you assumed Division 1 AC electric power was guaranteed to be failed for all fires in fire area CB1.

Is that true, or was I misreading something?

MR. RUBANO: I don't think that's true.

CHAIRMAN STETKAR: Okay.

MR. RUBANO: The cable spread room in particular is mostly Division 1.

CHAIRMAN STETKAR: Yes.

MR. RUBANO: So, fires in there would tend to disable all of Division 1, but that's not a - we did not make that a universal assumption. It actually had to be the consequence of the scenario.

CHAIRMAN STETKAR: Okay, okay. Thanks. All I was reading was Attachment C. And a lot of times, you know, it's kind of abbreviated information.

MR. RUBANO: Yes.

CHAIRMAN STETKAR: So, thanks. That helps.

Again, what I'm trying to do at least some of the questions I'm asking, is to try to understand from these three different applications are there any kind of shortcuts or simplifications or kind of hold-overs from Appendix R think, if you will, that are being pulled over into the PRA models either simplifying assumptions or something that might make the PRA results more conservative, but simplify the models.

MR. RUBANO: Well, one of - I mean, one of the common things that - and we haven't said much about that at Duane Arnold, but DC Cook talked about the conditional circuit failure probabilities this morning. Same issue at Duane Arnold.

So, we basically when you first do your cable mapping, basically you got a component, you got cables. Okay, if I damage those cables, the component does the wrong thing, right?

You can go back and you can get more sophisticated. You could still put a conditional probability of actually getting that state in based on that cable. You can take a closer look at what the cable actually does to that component's function and things like that. But again, first cut is I damaged the cable, component is bad.

And you typically don't go past there

unless you really have to. Again, you start - we have concerns about configuration management and stuff like that going forward.

Because if I take a particular cable and they say it's got a conditional damage probability because it's this and that and because it only does this function on the component and if I change the circuit around, now I have to worry about all those assumptions again. It sort of locks me into now I have to make sure that they actually fail that same way each time.

CHAIRMAN STETKAR: Yes.

MR. RUBANO: We use it when we have to, but we typically do not start that way.

CHAIRMAN STETKAR: Yes, okay.

MR. JULKA: So, then we want to understand, I guess, what are the further insights into this, what is this chart telling us?

And what we found out was that essential switchgear room, we already talked about it, was the dominant scenario of the LOOP, like I think DC Cook talked about earlier, due to fire with opposite standby diesel generator in maintenance.

So, we see that 46 percent of the risk is driven when I come to the maintenance. These scenarios involve the loss of offsite power. And due to fire damage opposite diesel as in maintenance, that contributes too.

So, I think we haven't really fully evaluated, okay, well, you know, how do we - what do we do about it? I think it's something we can do something with it. It's risk insight which is coming to us. What do we do with it? I think we still have to think about it a little more on how we evaluate this.

But it does show us that, you know, there is consistent - separation is there in the plant based on, you know, things we have seen so far. And the top contributors are diesel. We expected that. River water which is our ultimate heat sink, and service water maintenance dominates, you know, maintenance dominates. I guess that's the key thing we found out.

CHAIRMAN STETKAR: What does your internal - your internal events PRA results show similar combinations. I mean, you know, there are no internal - well, I have to be careful, but -

MR. JULKA: Pretty much. Pretty much.

CHAIRMAN STETKAR: -- for loss of offsite power, combinations of diesel maintenance and hardware failure.

MR. JULKA: SBO, station blackout.

MR. RUBANO: But the resulting risk is much lower because to --

CHAIRMAN STETKAR: True.

MR. RUBANO: You have a single diesel in maintenance. The other one is available that may have a failure.

CHAIRMAN STETKAR: Right.

MR. RUBANO: But now you got the rate of failure probability combined with the maintenance term.

CHAIRMAN STETKAR: Sure.

MR. RUBANO: Where the failure of the first train is essentially set to one by the fire.

CHAIRMAN STETKAR: That's why fires are so interesting.

MR. JULKA: So, yes, you know, it shows us that separation does exist in cables. Usually we didn't expect that based on the older plant. A lot of the plants are having issues with cable separations. And I know we are, but other PWRs tremendous problem with cable separation.

MEMBER BLEY: I've just been stewing over your cable spreading room. The reason I'm stewing is because even though you say these are a lot bigger than your internal events, these are really small numbers. They are.

So, if once every ten years you do hot work in that cable spreading room, and I would guess you would tag out the CO2 system if you're going to send a guy in there to do hot work -

MR. RUBANO: Yes.

MR. JULKA: Definitely.

MEMBER BLEY: -- you might be talking about numbers right in the same ballpark, you know. All your reasoning sounded good until you look at the numbers we're comparing it to, and I'm not so sure it's a reasonable thing to pitch it.

And I know you don't want to leave the CO2 on when a guy goes in there. At least I wouldn't want to be the guy.

CHAIRMAN STETKAR: Not with that size door, you wouldn't.

(Laughter.)

(Discussion off the record.)

MR. JULKA: There will be firewatch there.

MEMBER BLEY: There would be a fire watch there.

MR. JULKA: There will be fire watch.

MR. RUBANO: In addition, the way they tag out the CO_2 systems, they'll put it to manual. So, even if we were to have a fire there and we got everybody out, we could actually -

MEMBER BLEY: Close the door and pop it, yes. Okay. It was just nagging at me since you talked about it.

MR. RUBANO: It's not a total disablement of the system. It's just -

MEMBER BLEY: These small numbers trick us sometimes because they're a lot smaller than our everyday experience.

MR. JULKA: So, like we said, you know, if you combine them both right now, fire does dominate the way it is right now. So, yes, John, we may make changes in the future or improve it.

And also if you look at it, 6850 was developed a long time ago. And I think industry is learning more. So, as we go along, I think things will be updated in the future.

CHAIRMAN STETKAR: You did look at multi-compartment fires?

MR. JULKA: Yes.

CHAIRMAN STETKAR: Okay. I mean, the way you defined your fire areas, you probably didn't have many multi-compartment fires.

MR. RUBANO: I mean, I said this before, the smallest fire areas are the switchgear rooms and battery rooms, stuff like that, but those rooms are basically totally enclosed. So, the battery reliability is very good.

MR. JULKA: We're going to talk about some modifications.

MR. RUBANO: Modifications. So, we have essentially just two modifications that we have proposed at Duane Arnold.

The first one is incipient detection in the main control room, and I know some of the staff doesn't like the name incipient detection, it's a very early warning system, but essentially the same thing, and emergency service water circuit modification, and I'll just tell you about the service water modification first.

It's basically just adding some fuses to the circuit to prevent the circuit from being taken out by a fire in the turbine building. That's just the way the cables are run. We're just going to get rid of the problem by putting a couple fuses in. So, we just got rid of that problem.

Incipient detection in the control room, so there was challenges. We came across challenges, as I said before, between getting to the ultimate shutdown capability that we have versus what some of the multiple spurious combinations that we could come up with in the control room specifically like the SRV control panel and stuff like that.

So, the GE analysis that was originally done for Duane Arnold had a certain number of SRVs opening, had so much time to get isolation switches on the way to the remote shutdown panel. So, the isolating, you've got the remote shutdown panel, now you have control.

When you take a hard look at that, as I said before, if all those valves were to open, getting to those isolation switches and then getting to the remote shutdown panel, you may not have enough equipment left to mitigate the consequences of that particular event.

And we found several panels in the control room with similar type situations where the amount of equipment lost could put the plant in a very bad position and not as easily recoverable from the remote shutdown panel as you would think it would be.

So, what we're doing - what we did for that is to basically put this detection system - we're putting this detection system in those panels to ensure that we don't get that panel fire that encompasses the panel.

This also reduces the fraction of fires that would cause control room abandonment. By catching the fire in an incipient stage, you lower the probability that the fire will grow to a size that would cause the control room to be abandoned.

There was an RAI on this. We were challenged by the staff on the credit we took for the incipient detection. We based it on the fact it was on incipient detection.

It was pointed out to us that that fact was based on non-control room locations. So, some of the prompt suppression credit that is in the FAQ shouldn't be applied for the control room, because the control room is continuously manned.

So, we went back and we did an event tree type of analysis to show that the factors we use even when you take that credit out of there for that prompt suppression is still within the bounds that we have done in our original analysis and that we had submitted that response in the RAI.

We haven't heard back on that discussion yet. I'm sure we'll have more discussion on that going forward.

The industry is working on a FAQ to put forth the logic for how much credit you can get for a control room incipient detection system, and also how much credit you can get for an area-wide incipient detection.

Right now the FAQ only encompasses low-voltage cabinets, in-cabinet detection and we're trying to expand that to control room cabinets and area wide.

We believe incipient detection is a very good safety improvement. It's a much better detection system than the detection system we have.

It will detect a lot of equipment failures at a very early stage and allow you to essentially prevent the bad consequences.

CHAIRMAN STETKAR: I understand there's some evidence that works pretty well in cabinets. You mentioned area wide.

MR. RUBANO: Yes.

CHAIRMAN STETKAR: Has any testing been done about how effective it is for a larger -

MR. RUBANO: it is used area-wide in other industries. Obviously, we'd have to go and look, figure out how to credit that here.

One of my plants actually has an area-wide system. We actually use it in lieu of the detection system that was there, because the detection system there did not meet code.

Very difficult area to make it meet code because of the beam pockets. It's relatively high-radiation area, scaffolding. It would be very difficult.

We put that system in and, let me tell you, it picks up an awful lot of stuff.

MR. JULKA: It does. I think Canadians use it and they're very happy with that system. And Calvert has it in the intake structure area. And Nine Mile, too, installed it then for the feedwater area.

CHAIRMAN STETKAR: I've seen it put in. I'm sure they have it cabinet-specific.

MR. RUBANO: Right.

CHAIRMAN STETKAR: In the main control room, you're only going to selectively install it in the most risk-significant panels, or are you going to -

MR. RUBANO: It's selected panels. And I believe it's basically the risk-significant panels, plus one adjacent to each - we're still working on the exact details of that, but the purpose is to make sure that we have some defense for fires that if they were to develop in those particular areas, the risk to core damage is pretty high and there's not a lot of things you can do to mitigate that.

CHAIRMAN STETKAR: One last question. That third sub-bullet where you say "full credit for incipient detection was challenged by the NRC," when I see words like "full credit," numbers like zero come to mind or 100 percent.

MR. RUBANO: No, no, this is the full credit that was in the FAQ. So, the FAQ said you can multiply the frequency by this much, and they challenged it. No, you can't. It's got to be less than that.

CHAIRMAN STETKAR: Okay. So, there was still come chance that it didn't -

MR. RUBANO: Oh, yes.

CHAIRMAN STETKAR: Okay.

MR. RUBANO: There's two issues in there - there's a whole host of issues of why the system won't fail. One, the system itself has a reliability. Two, even if the system alarms, you know, someone responds and doesn't find it, you know.

Three, even if they do, they don't get the fire out, you know. There's a whole host of things.

CHAIRMAN STETKAR: But your model had -

MR. RUBANO: Right.

CHAIRMAN STETKAR: -- that stuff in it.

MR. JULKA: So, those are the only two mods. I guess it's something that you will not hear in any PWRs.

CHAIRMAN STETKAR: I think we heard one this morning that had zero.

MR. RUBANO: No, they got a bunch of - DC Cook?

CHAIRMAN STETKAR: DC Cook.

MR. RUBANO: No, they're modifying some valves. A bunch of valves.

(Discussion off the record.)

MR. RUBANO: None of my other PWRs have those, are going to get away with a few mods.

MR. JULKA: So, this just says that, you know, the Kleinsorg Group and ERIN Engineering did the fire PRA development.

CHAIRMAN STETKAR: Anil, there was -

MR. JULKA: Modifications?

CHAIRMAN STETKAR: No, the fire PRA.

MR. JULKA: Okay.

CHAIRMAN STETKAR: Somewhere, and I can't find my reference right now, there was reference made to a couple of different codes that I think were cited as EPRI codes. Fran something or other.

MR. RUBANO: FRANK.

MR. JULKA: FRANK.

CHAIRMAN STETKAR: FRANK.

MR. RUBANO: Yes.

CHAIRMAN STETKAR: I don't know what FRANK is. I've never - is that -

MR. RUBANO: That's the -

CHAIRMAN STETKAR: Is that a preprocessor or a post-processor?

MR. RUBANO: No, that sits on top of CAFTA.

MR. JULKA: Quantification -

MR. RUBANO: Pulls the CCDPs out of CAFTA to do the -

MR. JULKA: It's just a quantification -

MR. RUBANO: It's a quantification essentially.

MR. JULKA: Helps with the quantification.

CHAIRMAN STETKAR: Okay.

MR. JULKA: It's EPRI tool.

CHAIRMAN STETKAR: Okay.

MR. JULKA: In fact, we made up another one now, FRANX. We're going to be going to that probably very soon.

CHAIRMAN STETKAR: Okay.

MR. RUBANO: FRANK has some limitations.

CHAIRMAN STETKAR: All codes have limitations.

MR. RUBANO: And FRANX, which is - it's the newer version, had some bugs. Probably those have been worked out and it does - it has better capabilities, but the data transfer is not - does not just flop the data over into the next program. So, it takes some thought to make the transfer.

CHAIRMAN STETKAR: Okay.

MR. RUBANO: So, as Anil was saying, fire PRA was developed by ERIN Engineering. They were part of a - they were subcontracted as part of a bigger transition contract and that basically supplements in-house resources.

We do not have the in-house resources and did not have in-house resources capable of doing this type of work.

A fire PRA from scratch is a very time-consuming effort. And our experience is that it's a much larger effort than originally thought because - well, again, you run through with the first cut and the numbers don't look the way you want them to look, and then you start going back and refining it.

And every time you refine it, you're

adding another layer of detail to where you are and it gets to be a very big animal very quick.

So, the fire PRA did use the current safe shutdown analysis as input. This is a little bit different than some people. Some people using the current fire PRA, some people have redone their safe shutdown analysis either as a precursor to going into NFP 805, or as part of NFP 805.

Duane Arnold used the real existing safe shutdown analysis as input because that - we did a sampling of that analysis, and the analysis was pretty solid. So, we could use that information.

And we - part of that is to make sure that the PRA model modeled failures that were in the safe shutdown analysis.

So, one of the difficulties you have when you base the fire PRA based on the internal events PRA, is that fire can cause failures that the internal events PRA never sees. So, we've had to go back to the internal events PRA, put stuff in there so the fire PRA could properly quantify what some of those failures are.

And that turns out especially when we were doing the 1.200 upgrade at the same time. Lot of moving parts.

CHAIRMAN STETKAR: That'S one of the reasons for my initial question about diverging models.

MR. RUBANO: That is a concern. We're working hard to make sure that we know what the differences are and keeping track of that, but that is a concern.

We put it all back together again, and we could have another surprise.

MR. JULKA: That will be our priority in the implementation, make sure we do that.

MR. RUBANO: Duane Arnold is in a relatively good position in that respect, because the modifications are not exotic and they're not very long term. So, the time frame is shorter than some other utilities, other sites.

I know my other sites, they have a much longer window for some of the modifications. So, the internal events model won't catch up to the fire model for several years, because we've got to wait for those modifications to be complete.

CHAIRMAN STETKAR: I still like to think of one PRA model that has evaluated a bunch of stuff. Some better than other things.

MR. RUBANO: We would like to keep it that way, too, but it's difficult right now. There's a lot of moving pieces.

And we did the teamwork pretty well. We got some good cooperation between the PRA analysts and the safe shutdown analysts. They worked pretty closely together trying to understand why the PRA wasn't telling us sometimes the same thing the safe shutdown analysis was or vice versa.

So, we were able to work through a lot of those issues and we feel that we've captured all the information.

Challenges, all right. So, MSO list. The infamous MSO list is being updated at the same time as the review is being performed.

So, we performed an expert panel based on the MSO list that existed at the time. Came up with stuff we had to change in the PRA model. Came up with stuff we had to change in the safe shutdown analysis. Cranked in all those changes and the MSO list was revised. In fact, it was revised twice since the time we did the analysis. We'll probably have to go back and do some of that stuff again.

CHAIRMAN STETKAR: When did you have your final expert panel MSO evaluation in calendar time?

MR. RUBANO: 2010.

CHAIRMAN STETKAR: Two years ago.

MR. RUBANO: And we had to go back and do sort of a gap analysis for the latest revision to make sure we captured everything.

MR. JULKA: PWR OG.

MR. RUBANO: PWR OG maintains that list.

CHAIRMAN STETKAR: I know they've updated the MSO list in the last couple -

MR. RUBANO: Yes, PWR OG has updated that list also.

CHAIRMAN STETKAR: Right. But what I was asking is, you have not reconvened another expert panel for Duane Arnold to look at that updated list.

MR. RUBANO: No, we basically looked at the differences between the old list and the new list and the gaps.

The changes were not that significant so that we'd have to do the process again.

CHAIRMAN STETKAR: Okay.

MR. RUBANO: Again, it's a judgment call. And if you added one MSO or one item to it or something like that, it's not - convening the expert panel doesn't gain you anything. If they did a dramatic revision, then you would have to reconvene the panel and start again.

CHAIRMAN STETKAR: Okay.

MR. RUBANO: The review process for the analysis methods was certainly more involved than envisioned.

When EPRI first started down with that review panel, they were talking about an 11 or a 13-week schedule for getting it done end to end, and none of them even came close to that schedule.

CHAIRMAN STETKAR: I guess I had a question, you know, as I was going through whatever it is, Attachment J, I think, that lists the different fire models that are used at least among the three that we're discussing today, your list was much, much longer in terms of NAMs, if you call them, compared to either of the other sites.

And one of the questions that I had going in was, why? I mean, why did you feel that it was necessary to use different tweaks on correlations that are used in, you know, FIVE or FDT or CFAST or things like that, you know?

MR. RUBANO: Excellent question.

So, what's not - hasn't been expressed here is that - is the fire modeling that underlies the fire PRA at Duane Arnold, right?

So, the control room had the traditional

CFAST model to determine optical density and things like that for the control room.

The remainder of the plant was done using a generic fire model and treatment. Basically, a pre-solved set of - for each bin a - if you want to call it a damage footprint, but a zone of influence for each bin that's in 6850.

So, for an electrical cabinet with a heat release rate of whatever that number is, all right, the - and that treatment considers both qualified cable and unqualified cable. Actually, thermoset and thermoplastic is the proper term, all right.

So, when the PRA analyst goes - does a walkdown, he has basically a checklist with that information and says, okay, so if I have an electrical cabinet that is not well sealed, all right, and I have thermoplastic cable, all right, the zone of influence for this fire is so many feet above and so many feet to the side and one of my targets within that area, all right.

There are limitations to that, because that's based on a host of correlations and CFAST runs and things like that, that put a bound around that whole thing.

And that's why there's a lot of that stuff in there, because those form the boundaries of that analysis.

CHAIRMAN STETKAR: But I guess my question is that couldn't you have done the same thing, or am I misinterpreting perhaps that list?

Rather than saying, well, this correlation was documented in a certain contractor report, rather than using either the same correlation or a slightly different version of that correlation that's documented in FIVE or FDTS, you know, that had already been going through the V&V process.

I mean, you still have to do the calculation -

MR. RUBANO: Right, right.

CHAIRMAN STETKAR: -- whether you use this tool or this tool.

MR. RUBANO: That methodology that was used at Duane Arnold was originally developed for Oconee. That's where it started.

In fact, that was submitted to the staff. That general fire tree was submitted to the staff as a separate document.

CHAIRMAN STETKAR: Again, we're at a bit of a disadvantage here because we haven't -

MR. RUBANO: No, I understand.

CHAIRMAN STETKAR: -- formally seen the Oconee or Shearon Harris submittals. So, I mean, we've seen them, but not seen them.

MR. RUBANO: And we've used that same treatment generically at two of our other sites. So, it's not a Duane Arnold-specific analysis.

CHAIRMAN STETKAR: With the same suite of -

MR. RUBANO: Yes.

CHAIRMAN STETKAR: -- tools, okay.

MR. RUBANO: So, it's basically a common set of tools which we basically can transport from site to site to site.

CHAIRMAN STETKAR: Okay.

MR. RUBANO: All right. So, the bounds in there are a little bit wider, little bit slightly different in order to try to encompass the possibilities.

The questions we got from the staff - the fire modeling group that reviewed it at Duane Arnold liked the information. In fact, they thought it was very well done.

The biggest comments we got from the staff was not how did you come up with that information. It was how did the PRA analyst actually use it in the field? Did he understand the limitations that were built into that treatment?

CHAIRMAN STETKAR: Right.

MR. RUBANO: That treatment says you can use it as long as the room size is no bigger than this, no smaller than that, no wider than, you know.

Did the PRA analyst actually go out and say, well, this room doesn't fit this, so I shouldn't use it here? That's the questions we really got from the staff.

CHAIRMAN STETKAR: Okay.

MR. RUBANO: And we went back a couple of times now with actually the author of those documents with the PRA staff to ensure ourselves that we in fact captured all the limits and the analyst actually applied it the right way.

There's multiple ways you can attack this, all right? So, you can have the PRA guys doing PRA work and the fire modeler doing fire modeling work and then transmitting information that way.

CHAIRMAN STETKAR: I've heard that.

MR. RUBANO: You can have PRA guys doing walkdowns and developing the scenarios themselves with the fire modeling dividing the input there. There's multiple ways to attack it.

It's a tool to help simplify walkdowns and gathering information and what's in the box. So, that helps us with a little bit of configuration control going forward, because that box size which is somewhat conservative is not highly dependent on everything that's in that room, because it's generic enough that it fits multiple places.

So, I don't have to worry about if I change something small in that room, am I really impacting the whole analysis?

The more exacting the analysis gets, the more you have to be conservative with configuration management going forward.

So, this was an attempt to not burden ourselves with that going forward. It was a little bit different.

CHAIRMAN STETKAR: Yes, I was going to - that helps a little bit at least understand. Thanks.

MR. RUBANO: So, as we said before, the process for reviewing the analysis methods was a lot more involved than envisioned. The schedule took a lot longer.

The panel had lots of comments, changed lots of things, you know. So, again, every time they would change something, we'd have to go back and shuffle things around to see what we could do to encompass that.

We've got some NRC staff disagreeing with some of the conclusions. So, it sort of puts you in a funny place sometimes when you use that.

Here you got a group of experts that say, hey, it's okay to do this. And then the NRC says, well, we're not really sure. We're maybe not going to accept this. It puts you in a little bit of a box you got to be careful of.

So, the responses to peer review findings required more rigor than previous submittals. That's something that Anil had mentioned that we were surprised at the depth of the questions on the peer review response findings. It appeared to be a lot more depth than we had originally expected from this type of application. So, it was challenging.

CHAIRMAN STETKAR: Sounds like you got a good peer review.

(Laughter.)

MR. JULKA: Yes, normally for risk-informed applications what we do is only identify open items, open findings, not findings we have closed.

MR. RUBANO: We identified them all.

So, we had made a comment before about the concurrent Reg Guide 1.200 internal events update and the fire PRA development was - helped provide integrated results.

So, even though the models have some divergence, they're really not that bad because they were really, really developed together, but again gave us some difficulties in coordination. Now, we had a lot of moving parts.

So, the fire guys are like, hey, you know, Anil, I need to get this into the internal events model because I have no place to put that damage. And the internal events guy says, well, I'm changing that part of the tree right now. Can you add - it was quite a coordination challenge.

MR. JULKA: And it came at the same time. Reg Guide 1.200 Rev 2 came at the same time. So, everybody in the industry was really going after that at the same time we started developing the fire PRA.

CHAIRMAN STETKAR: Does Duane Arnold have any other risk-informed applications in-house right now?

MR. JULKA: We have - voluntary applications, we only have the 5 bravo.

CHAIRMAN STETKAR: Okay.

MR. JULKA: But, you know, we have ISI, risk-informed ISI and, you know.

CHAIRMAN STETKAR: Yes, but, I mean, that's less sensitive to the models.

MR. JULKA: Yes, right. So, the only one is 5 bravo. We have not done the 4 bravo as yet. That will be the next one, but that does need the fire PRA for 4 bravo.

So, we have not applied for 5069 as yet, but that's in the plan.

MR. RUBANO: Okay, implementation challenges. Right now we believe the fire PRA is very conservative. Some of it is due to the fact that we stopped where we stopped, some of it is due to the factors that go into 6850, some of it's due to the way we handled some of that stuff.

Regardless of how we got there, we have more work to do to make it more realistic.

CHAIRMAN STETKAR: And you didn't quantify uncertainties, propagate uncertainties through. So, you believe it's conservative, but you're not sure how conservative it might be.

MR. RUBANO: That's one of the problems. If I could put my finger on it saying that's the spot, you know, that's what I need, you can't.

When you examine everything that goes into this piece by piece, each piece looks reasonable.

Each piece doesn't look like it's out of whack or has anything like that.

But when you put them altogether and you get a result, you look at it and you say, well, you know, what is it trying to tell me?

We believe that the insights are valid. So, the insight we have that the switchgear room is the high risk and it's due to loss of offsite power with the opposite diesel in maintenance, that's a real insight.

We think the whole set of numbers is probably a little bit too high, but what it's telling us as far as what the real risk in the plant, is probably true.

CHAIRMAN STETKAR: That's an important conclusion. I'm glad to hear you say that.

MR. JULKA: And like you said, John, you know, we started with internal events high. I think that's a very good point. And where we are now, you know, it's order of magnitude improvement since we started.

MR. RUBANO: But as a result right now, the fire PRA numbers are very large compared to internal events, and we're not planning on using those as part of the upcoming maintenance rule (a)4 modification.

We're not using the fire PRA for that because it would basically swamp the internal events and you would see nothing but fire risk when you try to do something like that, which would actually tend to mask internal events and events changes due to a maintenance item.

You wouldn't see it on the internal events, because the fire would be the only thing that would show up. So, that's not - they really don't want to do it that way.

As said before, most of the work was performed by consultants. Technology transfer is going to be a challenge. It's going to be a challenge in two ways. One, we got to learn. And, two, we have to have the staff. Right now the staff is going to be stretched pretty thin.

We have two models, keeping them up to date. And until we get them together, is also going to stretch the staff further.

We have implemented, I would call it, crude intermediate configuration control to make sure that we're not doing anything in the plant that would invalidate our application, but it's not the full-blown change evaluation type process yet. We're still working on that. And that's going to come together at about the same time as we get the SE.

MEMBER SCHULTZ: Vinny, what leads it to become an effort that's greater than envisioned? What was missed?

Is it the magnitude of the evaluation, all the different pieces that have to be addressed, or what in particular makes it that -

MR. RUBANO: It's -

MEMBER SCHULTZ: -- so much larger?

MR. RUBANO: I don't think anybody will recognize that when we first cranked through this stuff, that the results we got were - when we looked at them we said, well, this can't be right. There's got to be something else wrong. And it caused us to go back and look at it again and again and again doing more and more refinements. It's not as simple as it seems on the surface.

Just like DC Cook said, you started off with a couple scenarios. And then as you look at the numbers, you're like, well, I can't live with that number. So, you crank in some more scenarios. You crank in some more conditional probabilities on failure probabilities of cables, you know. You crank in better fire modeling to see if I can not damage so much stuff. And it evolves over time and it becomes very big.

It's much - the data that's behind the fire PRA is much larger than the data that's behind the internal events PRA. And I think utility sites and groups were structured, you know, based on how hard or how much time it takes to do an internal events PRA and how much hard is it to update it and how do we keep that data going?

And when we got to the fire side, we discovered that that concept is wrong. It's not even close.

MEMBER SCHULTZ: Okay.

MR. RUBANO: And just keeping track of all the scenarios - so, if I have to - if I put a new cable in the plant - example this morning, put a new cable in the plant. Do I impact any of the scenarios?

Well, to determine that, I have to know where all the scenarios are, and there's a lot of them. That's something the design side of the house is going to have to learn how to look up and how to find out.

MEMBER RAY: Have you given any thought to how the NRC would oversee this from an ROP standpoint?

MR. RUBANO: Yes. So, there is a new inspection procedure out for the triennial that was piloted at Shearon Harris this year, I believe.

This year, Harry?

MR. BARRETT: Yes.

MR. RUBANO: This year and I think it was pretty successful. We probably have more work to do on it.

Shearon Harris, I mean, I think one of the reasons why it was successful at Shearon Harris is because a lot of people paid attention to it because it was new.

But ten years down the road when it becomes routine, we may find some bumps in the road because we don't have, you know, not everybody is paying attention.

So, I mean, I have that concern that how are we going to expect this in the future? How are we going to control it on both sides of the house?

MR. JULKA: But it's expected to be part of the inspection, I guess, qualified inspections people. And NRC does triennial -

MEMBER RAY: Well, it's become a lot more sophisticated with this change.

MR. JULKA: Right, uh-huh.

MEMBER RAY: At least first reaction is.

MR. JULKA: So, I presume they will need more people other than fire, like PRA people coming along with that.

So, I think some of the stuff we have already talked about. Lessons learned, in summary, is upgraded internal events. We'll have to incorporate, like we said, implementation plan. We'll have to incorporate the rest of them.

We did get some risk insights, positive risk insights for looking at, like we said, 46 percent of the risk from maintenance, which is something we can do about as far as going forward.

I think we need to talk about this new analysis method. It's something I think as an industry we need to look at. What is the process going to be going forward?

Because as we move forward, are we going to find things we can do better? Better evaluations, you know. NFP 6850 was developed in early 2000. It's significant time lapse since then. So, I think we're going to learn more of industry. There's more data gathering going on. I think the industry is going to learn more.

Further improvements in testing is going on at the same time. So, I think we're going to learn so much more. So, it will be good to develop a process whether it's a revision to 6850 or some process to evaluate these changes in an expedited manner so people can use it, people who have not done it as yet, or even us that will like to improve.

John, like you mentioned, you know, we've got to have significant improvement in where we are as far as fire risk estimates are.

Next year, Vinny talked about it, (a)4 implementation has to be done for all sites. And it does not have to be the quantitative model. People are using qualitative right now and NEI is engaged in industry process to see how that's going to be done and there's some pilots going on.

So, even for -- Duane Arnold will not be using the model as we have right now. It will just be used for NFP 805 application at this point. So, we are developing a qualitative - or going to qualitative. That's going to be next year.

Again, we talked about conservatisms, but some of it might be where we stopped, like you said, John. We did not - I'm not sure we're going to have the resources at this point to even go and refine it any further. Everybody has moved on to other things. Now, it's a matter of just keeping it up.

A lot of the work in the entire industry since there was a large amount of work and millions of hours, it was done by contracted staff with the overview by the utilities.

We understand that. We are hiring people right now and training them in fire PRA. We have hired two people already. We have added to our corporate staff. We don't know how many more we're going to need, but right now looking at pilot plants, they have not made many changes to their fire PRA since they implemented it couple years ago.

So, it's estimated that not too many changes, modifications coming in the plants will be impacting fire PRAs that much because, you know, major modifications are not really that common anymore after this set of modifications.

(Laughter.)

MR. JULKA: Fukushima will be coming up, initiatives they're driving a lot of. We do not have any of those at any of our sites. That's something I think we need to look at it in the future. That can drive the risk down and it is there.

So, I know in the past there was a concern whether people will be able to find equipment, affordable equipment whether it's battery chargers or a new diesel. Everybody did buy a diesel, you know, as part of the Fukushima activities going forward.

So, we have to - those are the things I think we have to look at and see how we incorporate those into our fire PRA and internal events, for that matter.

CHAIRMAN STETKAR: For PRA.

MR. JULKA: I hear you.

That's it. That's all we have, unless you guys have any questions.

CHAIRMAN STETKAR: I don't.

Any of the members?

MALE PARTICIPANT: Nothing.

CHAIRMAN STETKAR: Thank you, and you're getting us back on schedule. So, that was good. And, again, I really appreciate your coming here. I know it took a lot of effort to put this presentation together and I do really appreciate that.

What I'd like to do before we take a break, I was originally planning to open up the bridge line after each of the three presentations to see if we had any comments or questions from anyone who's on the bridge line.

I failed to do that at lunch because of the strange events of the morning. So, I'd like to open up the bridge line right now to accommodate people who perhaps don't want to sit around until six o'clock out there.

If there's anyone out there, could you just do us a favor and say a word so we have confirmation that the bridge line is indeed open. We have no other way of knowing that.

MR. KALANTARI: This is Bob Kalantari from EPM.

CHAIRMAN STETKAR: Thank you, Bob.

Now, is there anyone out there who has either any comments or questions on either the DC Cook presentation or Duane Arnold?

(No response.)

CHAIRMAN STETKAR: Hearing none, I will assume that there aren't any.

Is there anybody in the room here, member of the public, anybody? If not, what we'll do is re-close the bridge line, and then we'll open it up again at the end of the Virgil Summer presentation.

And we will recess until - I'm going to be generous - 3:15.

(Whereupon, the above-entitled matter went off the record at 2:54 p.m. and resumed at 3:18 p.m.)

CHAIRMAN STETKAR: We're back in session and we'll hear from Virgil Summer.

MR. KAMMER: Good afternoon. My name is Mike Kammer. I'm the NFP 805 project manager for VC Summer nuclear station up in Jenkinsville, South Carolina. A very well-populated area.

I've got Gerald Loignon with me. Gerald is the PRA supervisor and he'll be talking to the fire PRA technical issues, which is the subject of our discussion today.

Just to give you a little bit of background, the VC Summer station is nominal 1,000 megawatt electric three-loop Westinghouse pressurized water reactor.

Our LAR was submitted in November 2011 for NFP 805. Our NRC onsite review was conducted in June of 2012.

We did have similar observations with regard to our cable spreading room that Vinny had. It's a very - just noting similarities with some of the previous discussions. Very limited application, very limited access. We took a little bit different approach, but we'll talk about that in a little bit.

The other thing I noted in the earlier presentations, people were talking about 800 to a thousand scenarios. We ended up with about 1500 scenarios at our station, fire scenarios, in doing our calculations.

Little background about VC Summer station, with our Appendix R analysis we were kind of termed as a self-induced station blackout plant. So, we kind of focused on shutting down the plant on bravo train and taking equipment away from operations that they may be able to utilize during shutdown, but that's not the way our original Appendix R analysis was built.

We had many operator manual actions in the plan. And we had also one really good benefit. We had a cable routing database that existed and we knew where cables actually existed in the plant. There was no assumptions, there was no unknowns with regard to cable routing. And we took advantage of that in doing the NSCA analysis, non-power operations analysis and also the fire PRA analysis. And we built upon that to move forward into the NFP 805 analysis.

As far as our project goals for 805, it's not only just the transition to 805. That's one of the goals. And transition within the bounds of the rules of engagement with regard to 805, namely 6850 and the other requirements of NFP 805, but we also wanted to eliminate the SISBO strategy, which we did.

Along with eliminating the SISBO strategy, it comes along with a little bit of complication. It was that we didn't transition Appendix R. We didn't transition our existing analysis. We more or less started from scratch, and I'll talk about that in a second.

One of the goals is that we want to eliminate as many operator manual actions as we could at the station. We saw that as an operator challenge and that was one of the goals going into the project to see what we could do to accomplish that.

We wanted to maximize the usage of our existing tools. Again, I mentioned the routing database that we had and knowing where the circuits are is a great benefit to the 805 analysis.

The other goal that I had for our contractors was we want to stay within the box of 6850. We don't want to step outside and draw a lot of attention to a lot of issues that maybe some other utilities are experiencing. And we thought that was a good strategy and we kind of adhered to that strategy at VC Summer station.

Real quick, our approach to NFP 805, we started with a clean sheet of paper. We didn't take any assumptions. We didn't drag any baggage from our Appendix R analysis forward. We started from scratch, okay, including looking at critical safety factors, safety functions, developing our models, looking at our circuit analysis. We started from scratch.

We looked at this as a fresh, clean plant. Nothing we're going to do to kind of destroy what we're going to take forward into the future.

We didn't credit some of our fire protection features in doing these fire PRA analysis, and also the NSCA analysis first pass through. And when I say that, you know, there's some discussion about taking credit for fire wraps and unqualified fire wraps.

The way we approached the analysis was those fire wraps don't exist. Even though they may exist in the field, let's see what happens if we don't take credit for those. And we'll add those features and take credit for those features as we're doing the analysis. And kind of build that into the analysis on an as-needed basis to resolve deterministic issues or resolve fire PRA issues.

So, then we start defining what's required for VC Summer station to be compliant with these commitments going forward.

CHAIRMAN STETKAR: Mike --

MR. KAMMER: Yes.

CHAIRMAN STETKAR: -- since you mentioned it, and I was going to ask you later, and I don't know whether you have a slide for it or not. I doubt it.

As I was going through Attachment C for a number of fire areas, statements to the nature of automatic suppression systems exist in several of the fire zones in this fire area. However, they were not credited in the fire PRA.

Is that true? The fire PRA doesn't take credit for existing automatic suppression systems?

MR. KAMMER: Based on a given fire area if they didn't take credit for it - they may exist in that area, but they didn't take credit for it to get the PRA number for that area, whatever that area is.

CHAIRMAN STETKAR: Hm, okay. Again, I'm trying to understand. You have people talk about conservatism in PRA models and - okay, but that's true. You did not -

MR. KAMMER: It's a little less conservative if you really think about it.

CHAIRMAN STETKAR: Huh?

MR. KAMMER: It's more challenging for the station.

MR. LOIGNON: And conservatism isn't always equally bad in one place or another. So, if I'm in a room where the components don't impact my CDF and even though I've got a sprinkler system there, it doesn't really matter to CDF space.

So, if I'm not crediting it in 805 space, then I don't need to maintain it and surveil it and all of that good stuff. It reduces the scope of my program for monitoring.

MR. KAMMER: That wasn't one of our original goals. It was just a matter of let's see what impacts those features have on the CDF numbers.

CHAIRMAN STETKAR: Okay, thanks.

MR. KAMMER: One of the other things we took in our approach is we wanted to test the waters on doing performance-based fire modeling, and we did that also.

So, a couple areas we tried to do 4241, Section 4241 of NFP 805.

CHAIRMAN STETKAR: Are you going to talk a little bit about that?

MR. KAMMER: We'll talk briefly to that. It's part of the presentation.

CHAIRMAN STETKAR: Yes, okay.

MR. KAMMER: So, again, I just want to give you a little bit of framework, where we came from and where we started out, before we get into the fire PRA and trying to resolve some of the deterministic challenges we had in the plant after we went through the NSCA analysis.

Okay, any questions to start off with?

(No response.)

MR. KAMMER: Okay, Gerald.

MR. LOIGNON: When we were first asked to talk, it was bout fire PRA technical issues. So, these are the five things I think I wanted to talk a little bit about. There's probably a lot more we could talk about and we'll talk about each one of these bullets individually.

But in our discussion with the staff and John in particular, there were a couple other things he wanted - or I thought might be of interest to you. So, insights that we might have found through the project, the performance-based fire modeling we'll talk about in a little bit, plant mods and then implementation challenges. So, they're not really fire PRA per se, but we'll talk about them at the end.

One of our biggest challenges at least initially was what piece of software do you use. And we chose to use FRANX as a quantification tool. I was involved in the IPEEE fire model and we used FRANK back then with X in it. And FRANX has basically got them merged together.

And back in that day, early '90s, we couldn't make FRANX work. It had some - we ended up doing all of the scenarios one at a time by hand in the background without a nice tool to automate it.

And so I said, you know, we ought to go look and see what EPRI's got and make sure it will work and see what's going on there.

And the reason I wanted to use it was because it was supposed to be designed to work with CAFTA, which my base model is in, and it had some applications where I know I'm probably going to end up in the seismic world. So, I might as well figure out how to use it because I've got another tool or another model I'm going to have to build with lots of scenarios.

And so, I needed to get familiar with it and be able to use it. So, that's kind of why we chose FRANX as a tool.

CHAIRMAN STETKAR: Gerald?

MR. LOIGNON: Yes, sir.

CHAIRMAN STETKAR: Kind of little side conversations out in the hallway. Will FRANX support quantification of uncertainty, actual propagation of uncertainty distributions through the results?

MR. LOIGNON: It's supposed to. Let me get to my next slide here.

CHAIRMAN STETKAR: Okay, I'm sorry.

MR. LOIGNON: It says I have issues.

(Laughter.)

CHAIRMAN STETKAR: Never mind.

MR. LOIGNON: When we started, FRANX was in the beta version of 4.0. And the earlier versions we already knew weren't going to do what we needed to do. They weren't robust enough.

So, we decided there was an earlier version of FRANK with X in it that might have done it. And we said, you know, we might as well go with the latest tool.

So, as we built the model and started progressing and we get more and more scenarios, it eventually overcame the limits of the software. It can't handle 1500 scenarios.

When I did my tree, it's a single top tree and I did mutually exclusives at the very top of the tree, so I've got this mandate that says here's all my cut sets - my failure sets, but it's not this. Not mutually exclusive.

Well, it didn't like that mandate at all. So, I ended up having to push it down a level. I'm not sure why or what was going on in there. But working with EPRI if you pushed it down a level, it was okay. So, we ended up just putting another layer in there to move that mandate down. But, you know, working through those errors or issues, it just takes a while.

My mutually exclusive file is pretty large. And usually there's only three or more or less things that are in there. So, A and B not in maintenance at the same time.

Well, when FRANX comes in there it sets a lot of things to tree and prunes the tree. My mutually exclusive all of a sudden becomes a single event. That's not a good thing either.

So, you got to go look for those and you can get runs and there are zero cut sets, because mutually exclusive made them all go away.

We couldn't - QRECOVER wouldn't work for a long time. We had to work a long time with EPRI to get the recovery file to work.

The way our basic names were structured, FRANX didn't like that. So, we ended up having to expand the basic names.

And there were issues with checking and un-checking things. So, if I'm doing a what-if scenario or if I'm inputting a file that says, these are the impacts, I can go in there and un-check them and see is this going to help me a lot? Should I protect that cable?

We had issues with trying to make those kind of things work.

MEMBER BLEY: In the end, were you able to resolve these issues?

MR. LOIGNON: Most of them we got resolved.

It took us a lot of time working with EPRI to make things work. I still cannot do a one top model with the version of FRANX that I have.

They are now at 4.1. I'm still at 4.0. 4.1 supposedly can't handle all 1500 cut sets or scenarios. I don't know yet because some of the things I had to do in 4.0 as work-arounds, don't work in 4.1.

So, I've got to go undo some of my work-arounds so that I can make my transition and figure that part out. I haven't done that part yet.

So, because I can't run all 1500 scenarios in one big pass, I end up with multiple cut set groups that I can't merge together because I've got different basic event values in the same basic event name. And so, I can't really propagate uncertainties.

So, technically I got a problem. It's a

big manual work-around.

CHAIRMAN STETKAR: I mean, these are all things that - I'm not familiar with FRANX. I'm not a CAFTA user. So, these are all things that sound - make me feel a bit uneasy.

What are the real benefits of FRANX?

MR. LOIGNON: What is the supposed benefit?

(Laughter.)

MR. LOIGNON: I can import all of my scenarios into one file and crank through all of them at one time.

CHAIRMAN STETKAR: Which is different -

MR. LOIGNON: And I get one big cut set file that I can do importances and propagation and that kind of thing.

CHAIRMAN STETKAR: Forget FRANX. FRANX is something that interfaces with CAFTA.

MR. LOIGNON: Right.

CHAIRMAN STETKAR: If you just run a CAFTA model, don't you get the same cut sets that you can -

MR. LOIGNON: One scenario at a time.

I've got a fire with an initiating event, and that fire has consequences on these cables mapped to those basic events. I can put that in there and crank it to - turn the crank. That's one scenario.

I can't tell it 1500 different combinations.

CHAIRMAN STETKAR: Oh, you cant.

MR. LOIGNON: Not at one time.

CHAIRMAN STETKAR: Okay.

MR. LOIGNON: Not easily anyway.

CHAIRMAN STETKAR: Thanks.

MR. LOIGNON: CAFTA is a small event tree-large fault tree combination. And so, when I start trying to parse initiators into different scenarios, I basically have to have 1500 initiators.

Okay. The mitigating strategy. Since we're moving away from SISBO to a non-SISBO strategy keeping both trains available, that's basically a culture change and a big change in whole philosophy on what we're doing. So like Mike said, we basically had to just set aside Appendix R and start from scratch.

6850, though, in the 805 process is assuming I'm taking my current strategy and just migrating it over.

So, when it's looking at delta risks for me to do a delta risk of where I am, I'd have to have an Appendix R model, which is SISBO, plus I'd have to have my 805 model.

And we didn't see any benefit in trying to do two PRA models to get a delta risk. So, we worked with the industry and NRC and we went through an FAQ and said, okay, you don't have to do that current plant model. Just do a compliant 805.

CHAIRMAN STETKAR: Which, you know, depending on how you read -

MR. LOIGNON: It's the intent.

CHAIRMAN STETKAR: -- 805 is the intent of -

MR. LOIGNON: Is the intent.

CHAIRMAN STETKAR: -- that anyway.

MR. LOIGNON: But when you read the text, that's not the way I would have tried to impose it.

CHAIRMAN STETKAR: Yes.

MR. LOIGNON: So, we made sure it was clear that was good enough.

MEMBER BLEY: You'll probably tell me later, but did you have to make hardware changes in the plant to get rid of SISBO?

MR. LOIGNON: No, not to get rid of SISBO.

MEMBER BLEY: Okay.

MR. LOIGNON: Now, there were probably some hardware changes that I'm going to make as a result of moving away from SISBO.

MEMBER BLEY: Well, maybe that's what I

meant.

MR. LOIGNON: Well, then, yes, there are some that I'm doing.

MEMBER BLEY: But you'll talk about those in a bit?

MR. LOIGNON: Yes, we'll talk about those.

MEMBER BLEY: Okay.

MR. LOIGNON: But specifically it's because MSOs and hot shorts don't happen when I de-energize the train. So, there are some things, but mostly it's cable wraps and rerouting --

MEMBER BLEY: Okay.

MR. LOIGNON: -- for things that I would have de-energized under the old strategy that I leave hot under the current strategy.

My HRA also because this is almost like a new plant, so my HRA had to make assumptions about procedures and techniques that just don't exist right now. And we have them conceptualized, but there's not a real procedure written out for them.

So, we had to make some assumptions which I think are well-founded, but we'll have to - we have a step later on in the process that says, go validate that step that is still - that does the way you modeled it. So, we've actually already talked about this. This is the resolutions for it.

We do have a change management plan. It's a pretty detailed plan of how we're going to get from where we are to the new strategy. It includes procedures and training.

Some of our modifications, and we'll talk about those in a little bit more detail, are to mitigate deterministic requirements or because of this change in strategy that I need to do. Others are just so that I can reduce my overall CDF to 1.17 for considerations. And so, I can make the transition in strategy without those being completed.

Cable location data. As Mike alluded, we had a database. And in this case, this is not a hindrance to us. This was a great benefit to us. And so, I wanted to point it out.

Our database is three-dimensional down to every cable that leaves and enters the cable tray. I have a note at that location.

So, I don't have to walk the plant down except to validate, you know, spot check my queries. I can query by volume and I know every cable that enters and leaves that volume.

MEMBER BLEY: And this was used during construction.

MR. LOIGNON: Well, it was built on construction.

CHAIRMAN STETKAR: And it's kept up to date.

MR. LOIGNON: It's been kept up to date.

MR. KAMMER: Part of our design process is to manage that information.

MR. LOIGNON: So, that's already in our change management process. It's a living database. It's in our change management plan. So, I mean, it's part of our ECR or engineering change request.

So, every time we do a mod, do I have to in fact update this database? It's already in our process. It's second nature now.

So, we built on that and expanded it. So, okay, well, this cable is tied to this component, which is a PRA component. It's got these failure modes and it's got - this is tied to this basic event in my PRA model. We just put all of that in there and tied it also to the NSCA model.

So, now when I want to come back and I'm doing a modification, I go look at that database and it's just a matter of pulling out another query, push it into FRANX, turn the crank and I know what the change in CDF is - well, it's not quite that simple, but it's almost that simple.

CHAIRMAN STETKAR: The point is to be generating any cut sets, right?

MR. LOIGNON: Right.

MR. KAMMER: One of the bigger benefits if you kind of think about it from a fire modeling standpoint, you pick a fire anyplace in the plant. And we've picked all these scenarios and we put a fire at that location. We pick coordinates in the plant that say, give me all the circuits that are impacted from here to the ceiling. And we can pull that information out and run it through FRANX.

CHAIRMAN STETKAR: That's better than I've seen.

(Laughter.)

MR. KAMMER: We'll run it through the NSCA model from a deterministic standpoint and see if I have any hits in that area or that zone of influence. Let's put it that way. So, that was a tremendous help.

The downside of that is you have to have accurate data in that database. And there was some missing - there were some holes in data that we had to fill to follow that approach and philosophy.

So, what was a - we would call it a

challenge was to fill all those holes and gaps to make everything work true to the analysis that we set up.

MR. LOIGNON: So, we had to expand this database, expand the reports. And so, there are regular software kind of V&V controls that had to go into that part of the project. And like I said, it's tied to the NCSA and the PRA and the non-power operations analyses.

Conduits weren't quite as well done in that database. So, we did have to do a fair amount of field walkdowns to validate conduit. We had drawings for them. So, I mean, it's not like we didn't know where they were. It was a matter of transferring that data into the database.

So, it became - it is the single repository for all of that data, all our design data. And I've got another one for the fire modeling data with extracts from both of those that feed into FRANX. So, you just turn the crank. There's not a lot of manual inputting of data.

Methods, like Mike said, one of the things that we decided to do was basically stay within the box of 6850. And a lot of that had to do with - we were relatively earl, but it didn't look like there was a lot of easy ways to get things approved that were different or variations. So, we basically said we didn't want to fight that battle.

So, we're still watching what's going on with things like heat release rates and influence factors and circuit power transformers. And we did take credit for those in our LAR. So, we understand we're going to end up having to do a revision for that when it's finally resolved.

We are primarily kerite cable. So, we did have to figure out how we were going to handle that. We consider it damaged at thermoplastic, but we consider it thermoset for propagation and flame spread and that kind of stuff. So, we treat it both ways depending on what it is we're looking for.

And that became - that was the way we ended up resolving that with the regulators. So, that path we took turned out to be the correct path, but we knew there was some risk when we started down that path that we wouldn't end up there with the regulators, but we did.

Unknown cable qualifications. Early in the game we probably had about ten percent of our cable we weren't sure what it was. We're down to less than three percent now. So, we're treating everything as kerite and we've done some sensitivity looks that said even that three percent is just not going to change your insights or your consequences. So, we're pretty comfortable with that. That was one of those unknowns that might have had a problem earlier.

And, again, resolution is we're just following what's going on with the industry. As things get resolved if we can take advantage of something that might be able to reduce our risk, we'll, you know, or at least our calculated risk, we'll go back and modify our modeling and take a benefit for those when we can.

Some of them will probably - may turn out to be things that might make our risk go up and we'll accommodate those too.

CHAIRMAN STETKAR: Again, when I - I've come to think of fire models as things like FIVE and FDS and CAFTA.

MR. LOIGNON: Yes, I do the same.

CHAIRMAN STETKAR: Okay. I notice if I recall correctly, you use FDTS, the 1805, and CAFTA, is that right, as far as your tools?

MR. KAMMER: CFAST.

CHAIRMAN STETKAR: I'm sorry, CAFTA is the -

MR. LOIGNON: Yes, CFAST.

(Discussion off the record.)

MR. LOIGNON: CFAST and 1805; is that right?

MR. LOIGNON: I don't think we actually ever applied FDS anywhere though.

MR. KAMMER: We did not apply -

CHAIRMAN STETKAR: No, not FDS. FDTS.

Do you use CFAST for everything?

MR. LOIGNON: Or even simpler.

CHAIRMAN STETKAR: Or even simpler.

MR. KAMMER: We did some simplifying walkdown information with FDT tools and that was about it.

CHAIRMAN STETKAR: So, that's -

MR. NAJAFI: I think what -

CHAIRMAN STETKAR: You have to identify yourself so we got you on the -

MR. NAJAFI: Bijan Najafi, SAIC.

What you're referring to is FDT.

CHAIRMAN STETKAR: FDT.

MR. NAJAFI: NUREG-1805. And that is the simple model Mike is referring to, but it's been used for many of the fire modeling as 1805, simple Heskestad equations and things like that.

CHAIRMAN STETKAR: Yes, and you did use

that.

MR. KAMMER: We did use that.

MR. NAJAFI: Yes, that's the main use. There are CFAST in certain cases to calculate hot gas layer, control room evacuation, things like that.

CHAIRMAN STETKAR: So, just to make sure I understand, it's mostly algebraic - empirical correlations with some application of CFAST.

MR. NAJAFI: Correct. We didn't do anything any more exotic than that.

CHAIRMAN STETKAR: Okay. What I wanted to ask is, you know, you've been through the process now. We've heard kind of two other presentations today. One with miles of control room where they felt they needed to go all the way to the computational fluid dynamics.

MR. NAJAFI: Right, we didn't go there.

CHAIRMAN STETKAR: Another application that used - let me call it as far as - and licensee can correct me if I'm wrong, a different suite of empirical correlations that have some similarities and perhaps some differences to the tools that are in FDTS or in FIVE.

And you guys just sort of took the more straight-line approach -

MR. NAJAFI: We took the cookbook and we put in - stayed with the recipe.

MR. KAMMER: We stayed within the box that was defined.

CHAIRMAN STETKAR: Now, how upset are you about using that approach? Did it cause you any problems?

MR. KAMMER: We have solutions.

CHAIRMAN STETKAR: Okay.

MR. KAMMER: We have solution documentation and try to operate within the parameters.

CHAIRMAN STETKAR: I'm trying to - because we hear a lot of things about this fire modeling about how difficult it is, about not verification and validation of certain models, of conservatisms, and yours is sort of the simplest approach that I can think about in terms of application of those models.

Do you think it's because of a particular - that the configuration of your plant, or did you have to actually struggle with really complex geometries, but the simple tools were good enough for you?

MR. LOIGNON: I think most of our geometries were pretty simple. So, I don't think we had any particular outliers in that regard.

I'm the PRA guy, not the fire modeling guy. So, let me tell you what my impression is. My impression is that the methodology in 6850 is pretty conservative, which is different than I do anything else in PRA space. I do best estimates.

So, I look at this one as a different animal just from that perspective, but I follow the cookbook. And if the cookbook tells me I got a problem, I figure out how to fix it.

I might be able to fix it by doing a more rigorous CFAST. I might have had to go to something greater than that. We were prepared to, but we didn't use that. We chose something else instead.

We may have wrapped something. I may have changed a procedure or looked for an operator action, which we did not do, but those are two things that were in my toolbox.

I could have done a PRA delta risk that said it's okay to leave it, which we did some of those.

So, we looked at what tools were available in 6850 and used whichever one we felt most appropriate for that particular issue, but we stayed within the confines of 6850.

Do I think that's conservative? Yes, I

do.

Do I have a real technical basis for that? No, I'm not the fire PRA guy - I mean the fire modeling guy.

But from my discussions with those who are, I think those methods are very conservative. And so, I am concerned about how I am going to treat this number compared to other numbers in the future. I'm not sure how I'm going to do that part.

But did we follow the cookbook? Yes.

Were there tools there? Yes.

Were they the best tools? I couldn't tell you.

MR. KAMMER: There are some parameters we did challenge. We also went back and took a look at those with regard to, say, height of rooms versus floor area, those type of things and using the models. And went back and challenged those to make sure that we're not on the non-conservative side. And documented that, too, as part of our documentation package.

So, we weren't exactly clean between the goalposts in every case, but we did take a look at those and make sure that we're doing the right thing, is really the bottom line.

CHAIRMAN STETKAR: Thanks.

MR. LOIGNON: And I guess we've actually already talked about whether you want to call them improved methods or alternate methods or whatever. And you'll probably have some more discussion tomorrow about the fire methods panel, but it seems to me that there was a high level of justification done in the discussions that were in that panel. There was a lot of challenging of each other, from what I've heard about it anyway, to reach a consensus. It took them a long time.

And again as an almost disinterested third party, but not quite disinterested, I'm still the PRA guy. I'm a little bit distant from some of this stuff.

It seems to me that the NRC is treating this a lot different than they do the rest of PRA applications in that if I'm doing a PRA application anywhere else, I'm free to choose my own methodology, use it and defend it.

Usually if I can go in there and say do a sensitivity study and say, this really isn't a big deal in the results, nobody questions it anymore.

Here, I'm being told this is the methodology. Use it or, you know, here's the cookbook. If you deviate from the cookbook, you got to defend it whether it's important or not. And that's a lot different at least philosophically to me.

So, it puts different controls on my program and process that I didn't have to consider before. So, it's just a different animal in my point of view.

Can we work with it? Yes.

Do we necessarily like it? Probably not always, but we can work with it.

So, we're just following the resolution of the issues as they come out and work timely enough for us to use many of them. Because like Mike says, we're a pretty conservative utility. We like to stay pretty close to the cookbook.

We're not going to go out there and spend lots of dollars to try and argue with somebody else over a process.

But as the things get resolved, we'll have to look and see, well, is this good, bad, indifferent, is it important enough for me to go back and update to that new methodology?

Insights. I've got them kind of separated into surprises versus others. Considering the vintage of our plant, there were a few deterministic open items. So, I thought that was pretty amazing from my point of view.

Three things that kind of jumped out at me when I was thinking about this was, it was we have - 7.2kV is our top level switchgear. It's a great big ol' breaker. It's got a nice anti-pump circuit, because it doesn't like to sit there opening and closing. So, somebody built that into it.

And when we were doing circuit analysis for those, we figured out that you can actually bypass that and there are remote failures that will make that kind of just keep re-closing. You can't turn it off.

Water reactor coolant pumps are 7 kV. So, I had to postulate those because I could not turn off a reactor coolant pump in certain fire scenarios. That's not a good thing.

CHAIRMAN STETKAR: That's not a good thing.

MR. LOIGNON: So, that was a surprise. I never would have thought that I could do that when that remote - I mean it had pump circuits interval to the breaker. I never would have thought to look for that. So, it was a surprise to me.

When we do IPEEE since we're blacking out things, that kind of makes all the failures go away. So, we actually found some failures that would prevent us from energizing both buses at the same time from offsite power. And I didn't expect to find that either.

And then some failure combinations -

CHAIRMAN STETKAR: Is that because of cross-tie logic and stuff, or is it -

MR. LOIGNON: No, it's just the cable routing.

CHAIRMAN STETKAR: Oh, cable routing. Okay.

MR. LOIGNON: Yes, we run offsite power from both offsite circuits in a place where they T together so I can get to both buses.

CHAIRMAN STETKAR: Okay.

MR. LOIGNON: It's primarily in the turbine building where you're trying to get into the buildings.

And then we had disconnect switches from Appendix R where I could divorce the controls from outside and still be able to run the plant. We found some holes in the way some of those were designed.

CHAIRMAN STETKAR: As long as you brought that up - I have to remember to keep each one of these straight. Did you characterize all of your operator actions as recovery actions, or did you -

MR. LOIGNON: Mike said one of the objectives was to reduce operator actions.

CHAIRMAN STETKAR: Well, I -

MR. LOIGNON: So, what I'm getting ready to say it -

CHAIRMAN STETKAR: Given whatever inventory there are -

MR. LOIGNON: I have no remote operator actions if I am staying in the control room.

CHAIRMAN STETKAR: That's true.

MR. LOIGNON: None. So, all of my operator actions are really associated with leaving the control room, going to the remote shutdown panel which has fewer controls.

And therefore if I go there, I do have to send operators to do some remote operations, but they're pretty limited.

MEMBER BLEY: I'm just curious. How did you handle that first failure mode? It seems to me many different things could happen if you start cycling that big ol' breaker.

MR. LOIGNON: Yes, they can.

MEMBER BLEY: Including it could blow up or you might get some overload somewhere else opening the circuit.

What did you do with it?

MR. LOIGNON: We're protecting the circuits.

MEMBER BLEY: Okay. You're fixing that one.

MR. LOIGNON: We're fixing that.

MR. KAMMER: Some of the challenges we have as some pretty easy fixes is protect the circuit from the effects of fire in certain areas or certain zones of the plant.

Part of our - if you look at our enclosure chart, is basically just to identify all those impacts regardless of what they're impacting downstream. It's just saying here's my vulnerability in this area.

So, that's some of the insights you get from doing the NSCA analysis.

MR. LOIGNON: Other insights. Kind of like everybody else when you start doing this, you use a more conservative, easier to do type modeling and you get all these rooms up here that are risk significant, got CCDPs in one and whatever.

Then you start beating them down a few at a time. And when you run out of time, money or your number is as good as you want to get it, you stop.

The second most risk significant area in my plant basically turns out to be a hallway with a motor control center.

Wouldn't have expected that to be that way not based on what I did in previous IPEEE stuff, but it's just a matter of do I want to go spend modeling and make that number go down.

The initiating events that are 95 percent of my CDF are dominated by consequential LOCAs, reactor coolant pump seal LOCAs. And about half of them are remote shutdown control room evacuation scenarios, which is kind of what you would have expected from the IPEEE.

MR. KAMMER: When Vinny was talking about control room, cable spreading room, access areas, those are the types of areas we're talking about too.

There is very little work, not a normally occupied area, suppression system. In our case, it's pre-action sprinkler systems. Detection throughout the whole area. It's just not a highly-traveled area, but that's - those are some of our highest risk contributors.

MR. KAMMER: Some of those areas are actually dominated by transients because there's no real fixed ignition sources. So, they're transients and you're saying, does this really make sense?

So, that's one of those things that makes me believe some of the fire modelers are saying this is conservative.

MR. LOIGNON: But even for the transient fires, maybe Vinny took a different approach, we said 317 kilowatts is our fire regardless of where it's at. We didn't take a non-crude method in that case.

Do you have another question before we go on?

CHAIRMAN STETKAR: I do. You mentioned control room evacuation.

I had a question as I was going through Attachment C and I was trying to look to where I have the reference here for a second. And this holds for a couple different fires. I wanted to ask you something.

In one of the fire areas, and again stop me if I get too detailed for a variety of reasons, let me just say there's a couple of cable spreading areas where as I read through Attachment C, there are words in there that say things like, due to a potential control room evacuation for this fire scenario, recovery actions are credited for alternate shutdown capability.

What does that mean in practice? I mean, what did - I read those words, but then I don't see recovery actions.

Was control room evacuation modeled for fires in that area, or was - it was?

MR. KAMMER: Actually, in all actuality with VC Summer, we have four areas of the plant where we're going to be transitioning out of the control room. Those areas are control room, the upper cable spreading room, the relay room and the lower cable spreading room. We have cross-divisional trains of circuits through those areas.

So, when we talk about recovery actions when you say no manual action, outside of those four areas we've eliminated all those manual actions in the plant.

CHAIRMAN STETKAR: Okay.

MR. KAMMER: If we had a fire in those four areas, there's a decision process we'd have to go through to make a conscious decision to evacuate the control room to go to alternate shutdown because of the potential risk.

CHAIRMAN STETKAR: How did you treat that in the PRA? Did you just assume that the control room would be evacuated, or did you -

MR. LOIGNON: No, we did some modeling and like in the control room itself -

CHAIRMAN STETKAR: No, I understand the control room. I know how people do that. You mentioned that you use -

MR. LOIGNON: Even the others we did some - we did some different transient fires in different places and different sizes and determined whether or not they were propagated to a point where we thought we'd lose -

CHAIRMAN STETKAR: And what criteria did you use for abandoning the control room, because it's not - it's not visibility or habitability. It's something else, right?

MR. KAMMER: I would say there is a certain decision process you have to make with regard to recognizing you could be losing control of the plant. And that's up to the shift supervisor given the complete information that's coming to him.

Plus taking a wrong decision, either venting too early or too late, that's one of the challenges that we have with regard to rewriting our procedures and making sure we're making the right decision consistently throughout.

CHAIRMAN STETKAR: What I'm trying to do is understand how you actually treated that in the PRA, because I understand CFAST. You said you use CFAST for the main control room. And there's some criteria in 6850 about visibility and habitability requirements where you assume if you reach those conditions, people will evacuate, but these other areas are different from that.

MR. KAMMER: We didn't treat those other areas any different than any other area of the plant with regard to fire modeling or fire PRA scenario, development, failures and losses, but it's just a matter - what you're asking is.

MR. LOIGNON: Let me let Paul answer that. The question is outside of the control room when the other three areas we have control room abandonment, what did we use for the criteria that said abandonment?

So, we - all of them are control room abandonment scenarios.

MR. AMICO: Yes, the criteria -

CHAIRMAN STETKAR: You have to -

MR. AMICO: Oh, Paul Amico, SAIC.

So, for the criteria the way the procedure is written, it refers to shift manager discretion based on a loss of control of the plant. A belief that he can no longer shut down from the control room.

Now, it doesn't matter whether the fire is in the control room. It says for these four areas, if there are fire in these four areas that cannot be controlled and they believe they have lost control from the control room, then they would abandon at shift manager discretion.

The way we modeled that is there's a likelihood that they will fail to abandon when they should. Also, there is a likelihood that they may abandon when they should not for every scenario that takes place in these four areas.

So, that's the way we modeled it to make sure -

CHAIRMAN STETKAR: Okay, that's what I was looking for.

MR. AMICO: Yes.

CHAIRMAN STETKAR: It wasn't just a switch that you presumed that they abandoned.

MR. AMICO: No, no. There was a probability of failure to abandon, and there was a probability they abandoned when it wasn't necessary for all scenarios in those four areas.

CHAIRMAN STETKAR: Okay.

MR. LOIGNON: That's actually a carryover from our IPEEE model. We actually did that back then.

CHAIRMAN STETKAR: Okay. Thank you.

MR. KAMMER: Okay. Briefly talk about performance-based fire modeling. We saw this as a tool and actually a onetime shot to really kind of roll this out as an option to resolve open items in certain areas.

We picked a couple areas in the plant to see if we could utilize this tool, and basically it comes down to using the rules out of 805, defining your limiting fire scenario and maximum expected fire scenario and making sure you had margin between the two that you're not going to damage the equipment and cables that might be in proximity to that fire location where that fire location is.

The four areas we picked in the plant were three control building cable chases that are adjacent to control room, okay, and one air handling cooling unit.

I will make one mention that we tried it in another area and it didn't work. So, what I will tell you is this tool isn't good for any place you want to use in the plant. I mean, it's going to be configuration-specific. Obviously the tools do have some limitations, but we did find that we could be successful.

And really, it comes down to you really got to manage the fire itself in some regards whether it's a fuel package size or even a fire location. And that's the way we kind of ended up in those specific areas.

Again, one of the implications there is the more assumptions you have in your analysis, you've got to translate that information into actual application if you're going to try to manage the fire location and size.

And you do that normally through transient combustible controls or storage area requests or anything else that's going on in the plant too. So, it's consistent with the way we kind of manage fuel packages today.

CHAIRMAN STETKAR: And I was trying to - I was listening to what you're saying. And as I was going through the Attachment C, I was trying to understand was there - let me ask the question this way: Did you actively think about whether it was more beneficial to take the 4241 performance-based approach for, let's say, this room versus the PRA model, 4242 approach for this room, or did you just do it intuitively?

You know, because, for example, there are many component failure modes if I look at the inventory of equipment in this room where you applied the fire modeling, let's say, the 4241.

In many other locations you made the determination, well, I have to use the PRA model to address those, you know. Obviously that's a simplification because it's whatever else is going on in the area.

You're the only one of the three who used the performance-based fire modeling, the 4241. And I was curious what kind of rationale went into those selections.

MR. KAMMER: If you kind of took a look at the model itself, we kind of wanted to, number one, exercise the model and see if we could utilize that possibly in future applications. Don't know.

But at the same time, the areas that we picked didn't have a lot of ignition sources, so we were kind of bound to transients for the most part in these particular areas.

We looked at a couple factors as, you know, some that could be viewed as being challenging because we had cable trays in these areas.

So, we're trying to look at certain factors that may come into play utilizing this tool.

And I think we were successful. It remains to be seen after staff reviews of our applications, but could we have used the fire PRA? Probably.

CHAIRMAN STETKAR: Well, you certainly could have used the fire PRA. I was trying to understand what the decision process was for a given fire area to take one approach versus another.

MR. KAMMER: If you think about it, you have - when we went through - after we went through our NSCA analysis, we had kind of drew up a long laundry list of options or tools to resolve the open items that came out of the NSCA.

The fire PRA when we made our first pass, wasn't even available at the time. They were still working on developing. So, you're running parallel paths trying to create solutions.

So, we came up with a number of different areas, kind of solution sets for these open items. And this one we said, why don't we give this a whirl and see if we can make this work.

We come back later on and some of the deterministic solutions we turn into fire PRA solutions instead.

So, to us, it was just another tool in the toolbox to resolve open issues. And at the same time from a project standpoint, from a station standpoint, we looked at it as here's a tool that might be useful in the future. Not a lot of people are going to be trying to utilize it. And we felt that if you're going to get into your license, now is the time to do it. Now or never.

So, we opted for the effort to make it work and we think we've shown it can work. It's just a matter of where and how we apply it in the future if we choose to use it again.

CHAIRMAN STETKAR: Okay, thanks.

MR. LOIGNON: Well, we can look at the modifications that we're going to have to implement. Like I said, some of them are there to resolve deterministic issues. And some of them are there just to reduce overall CDF.

CHAIRMAN STETKAR: Before - I'm sorry, Gerald.

MR. LOIGNON: Yes.

CHAIRMAN STETKAR: Before you start, I had one other question on things in Attachment C, and only -- I'm trying to get my hands around words in some places.

There were several entries there that say things like for an alternate shutdown scenario, the following action has been evaluated in the fire PRA and is not required to prevent core damage.

And in the location that I pulled out, one example of that is locally start the emergency diesel generator. Another one is locally energize a switchgear at the bus, but those are not actions that are identified in Attachment G.

So, what does all that mean? Were they things you thought about? Are they actually in the PRA? Are they things that you put in the model and turned off or - I was trying to understand what they were or what they aren't.

MR. LOIGNON: That's why we have to look at it a little bit more myself for me to answer that one right off the top of my head.

CHAIRMAN STETKAR: It's, you know, all I have is the brief summaries. And that kind of phrase appears in quite a few places and I just had no idea what that meant.

MR. LOIGNON: Well, right now I'm not sure I do either.

CHAIRMAN STETKAR: Okay.

MR. LOIGNON: But I could get back to you.

CHAIRMAN STETKAR: I'd appreciate - well, but the key is they're not in the PRA model at all.

MR. LOIGNON: Yes.

CHAIRMAN STETKAR: Okay.

MEMBER SCHULTZ: Gerald, before you start on this section -

MR. LOIGNON: Sure.

MEMBER SCHULTZ: -- with respect to the plant modification process, you've got the fire PRA and you've got, admittedly, fire modeling methods that are conservative that you've chosen to use throughout.

So, when we get to making choices of plant modification to reduce CDF, how do you know that in a relative sense you're making the right choices given that you've got the conservative fire modeling techniques that are in place versus best estimate or better estimate?

MR. LOIGNON: I think because of those choices, some of these deterministic ones we probably are going things we may not have to do.

But do I know which ones they are? No.

MR. KAMMER: One of the things recognized as part of the project is you could always go back and iterate, fine tune and tweak, but you're not getting to the end and making this whole process converge.

And there are some tough choices. Obviously there are some probably features that we --

what Gerald said is true - we may not need to protect. But at the same time if we do protect it, it eliminates that issue from a deterministic standpoint and we'll just keep moving on type of thing.

So, we've had to make some tough decisions. Do we have to go back and justify every one of those, you know, hindsight is always 20/20.

MEMBER SCHULTZ: You might not be making the very best decision, but you're making a decision that -

MR. KAMMER: We think we're making a conservative decision based on the information we had at the time.

MR. LOIGNON: We're certainly making a safe decision, but there are things that we probably wouldn't have to do if we spent money to do a more best estimate kind of an analysis. But then I have to also figure out what is it going to cost me in regulatory space to make that fly.

And we said it's just not worth the effort and the time required given the schedule that we're trying to do. It's just cheaper to wrap it. I'm already wrapping stuff anyway. So, the incremental costs may or may not be that high. We just don't know.

MEMBER BLEY: I think - correct me if I'm wrong. I think 6850 invites you to do uncertainty analysis and I suspect that deals directly with almost all those areas you've talked about as being conservative in the approach.

MR. LOIGNON: And in some cases, I can do sensitivities. I can't do - easily, I can't do uncertainties.

MEMBER BLEY: I don't know quite what you mean by easily, but -

MR. LOIGNON: Because of the way FRANX had to make me do things in pieces, parts, it's a long -

MEMBER BLEY: So, it's the code you're using that -

(Simultaneous speaking.)

CHAIRMAN STETKAR: The hammer that you're using wont' saw this board all that well.

MR. LOIGNON: That's right.

For me, it's a long, arduous, manual process to go in and merge all of that stuff together so that I can propagate the list.

MEMBER BLEY: It's a shame to be constrained by your tools.

MR. LOIGNON: Yes, it is.

Ten years ago we were constrained by tools in internal events. The tools have gotten better. We're just further behind the curve in fire modeling tools.

MR. KAMMER: One of the reasons we picked the tools we did was not only to achieve the goal of the project, but also to manage it forward. How can we make it easier to manage forward?

So, there's pluses and minuses for every decision you make.

MEMBER BLEY: I guess it bothers me a little to hear people say they do PRA with best estimate. To me, that means best estimate includes the uncertainty.

If you just pick a point off your uncertainty card and call that the most likely one from all you've done in risk assessment, the rest of us say there are cases where the tail of the distribution drives the risk.

So, just picking a spot in the middle can really be deceptive.

MR. LOIGNON: It can.

MEMBER BLEY: So, to me when I hear I want to do best estimate, it's saying with uncertainty, and I'm sensing that that's not what you mean.

MR. LOIGNON: No, that is. I agree with

you. I understand the point and I do agree with it.

MEMBER SCHULTZ: That's what I hear you would like to do, but the tool doesn't lend itself to that at this point.

MR. LOIGNON: Yeah, I definitely understand you do have to take that into consideration and account.

CHAIRMAN STETKAR: FRANX is just the set of and things, right? You have a cut set, A and B and C.

MR. LOIGNON: What FRANX does it takes input and changes your PRA, your CAFTA model, turns the crank. And then it says, okay, what's the next set of input? And it changes the model again and turns the crank and adds the cut sets together.

So, if I tell it I've got a scenario in the turbine building and these are the three things that are impacted, it says, okay, I got this fire, it comes at this frequency, and here's the basic events that are impacted. It fails those and cranks out a number.

CHAIRMAN STETKAR: Just a number.

MR. LOIGNON: Just gives you the cut sets, but it gives you the total number for that scenario with these cut sets.

CHAIRMAN STETKAR: Okay, but it does give you cut sets.

MR. LOIGNON: It does give you cut sets. It's running whatever solution engine you have.

CHAIRMAN STETKAR: A cut set is basically an algebraic expression.

MR. LOIGNON: Yes, it is.

CHAIRMAN STETKAR: Okay.

MR. LOIGNON: But it has a name and a value.

CHAIRMAN STETKAR: Sure.

MR. LOIGNON: It doesn't have the same value for the same name in all of those times that FRANX runs it.

So, when I merge it together, I've got the same name with multiple values and now that makes my math all hosed up.

CHAIRMAN STETKAR: Yes.

MR. LOIGNON: That's the issue.

CHAIRMAN STETKAR: That's the issue.

MR. LOIGNON: As long as it's doing it all by itself and doing all 1500, it takes care of that. But when I say I do 600 in this group and 600 in that group and I try and merge those into 1200, they are not consistent.

CHAIRMAN STETKAR: Okay.

MR. LOIGNON: So, I've got to go through all 1200 scenarios and all the thousands of cut sets and make sure that the basic events get all straightened up.

CHAIRMAN STETKAR: Okay. All right.

MR. LOIGNON: So, mods. From my point of view, they fall into two categories. I'm resolving deterministic issues, or I'm just lowering CDF.

Deterministic ones fall in the categories of some system feature improvements like I got a sprinkler system that didn't quite cover the whole fire zone. I'm going to extend it out five more feet so that I can take credit for it over there.

Circuit and tubing protection is basically fire wrapping and barrier work. That scenario I told you about where I can remove power from both ESF buses from offsite power, we're rerouting some of that cable to make that go away.

The disconnect switches where we found some holes in the logic the way they were designed initially, we're fixing those, and some communication enhancements.

MR. KAMMER: Let me make a comment. You said the way it was designed initially. Actually, we're taking different failure modes out of NEI-0001.

MR. LOIGNON: That's true.

MR. KAMMER: And found some insights that we didn't -

MR. LOIGNON: We didn't know we were -

MR. KAMMER: -- have back in Appendix R days.

MR. LOIGNON: That's true.

(Discussion off the record.)

MR. LOIGNON: Rev 1 was available at the time, but we were working toward Rev 2 information. We had the experts available to us.

CHAIRMAN STETKAR: So, I mischaracterized that. I apologize.

MR. LOIGNON: For CDF reductions, we're committing to do reactor coolant pump seal replacements that are - whether we use the Westinghouse shutdown seal or a different seal, but something that will address consequential LOCAs.

Incipient detection in the relay room cabinets. An alternate seal injection system which is actually almost installed right now. Should be installed before we get to our refueling outage this fall.

And auto start on the instrument air compressor. We have a diesel-driven compressor that we have to manually start now. We're going to put an auto start on that.

And those really weren't being driven by VFDRs or anything like that. It's just they do have some significant risk reduction and just help in general.

CHAIRMAN STETKAR: And all of these are - you've included them in the PRA models.

MR. LOIGNON: Yes, they are included in our model. So, just like the other utilities, I do have two models that I'm trying to merge together.

So, I've got my current at-power model that I use right now in E00S and (a)4 space, and I've got one that I have at the end of my transition from SISBO to 805. And that model includes all of these mods.

So, as I get the -

CHAIRMAN STETKAR: But the only difference is if I can think of those as a serial progression -

MR. LOIGNON: Exactly.

CHAIRMAN STETKAR: -- they're not - from what I heard with Duane Arnold -

MR. LOIGNON: Yes.

CHAIRMAN STETKAR: -- it's more of a parallel serial.

MR. LOIGNON: Right, mine is a serial progression. If there are other mods that happen, I'll put it in both places.

CHAIRMAN STETKAR: Yes, okay.

So, you've actually committed to some substantial capital costs for these modifications.

MR. LOIGNON: Yes. The alternate seal injection mod was actually in process before we even made the LAR submittal, but we included it just so we could show the numbers right. We took credit for it for the number part.

CHAIRMAN STETKAR: Were you doing that also for internal events?

MR. LOIGNON: Yes.

CHAIRMAN STETKAR: Okay.

MR. LOIGNON: Like I said, it's being installed now and the model will be updated. Right after it goes operational, it will be updated.

It was being driven before 805 because of MSPI margin concerns. So, that's really what was driving it to start with.

Reactor coolant pump seal replacement has been on our radar screen for quite some time. So, we're going to do something about it now.

MEMBER SCHULTZ: Independent of this

project.

MR. LOIGNON: Yes. It's been on our radar screen for a while. Just we weren't sure which way we wanted to go. I think we finally came to a conclusion, but we're going to install it in the next couple outages.

MEMBER SCHULTZ: You mentioned earlier, Gerald, that with regard to what are the typical deterministic modifications, that you are doing those in selected areas where they'll make the most difference based upon the 805 work, things like the circuit tubing protection, wrapping.

MR. LOIGNON: We have specific circuits that we want to wrap that we're doing, yes. And they're basically because of deviations from separation criteria or whenever that weren't apparent before when we were doing Appendix R, because we de-energized them.

MEMBER SCHULTZ: Okay, thank you.

MR. LOIGNON: Implementation challenges, ours are similar to everybody else's. Maybe a little bit more in some respects because of the change in philosophy. The knowledge transfer from the vendor did most of the work.

We did a pretty good job, I think, of

shadowing the vendor. So, when they were doing the PRA model, we were watching what they were doing. They came and trained us. We made sure we know how to do it.

In fact, we are running the model now as part of our plant modification control. I am running two programs. I have an Appendix R program and an 805 program.

Appendix R they don't talk to me about too much. But when it comes to 805, I am in the process. They don't do mods without talking to me.

It used to be, you know, you want to put a cable, I didn't care. You want to touch a cable? I didn't, you know, we're talking a fair amount of work for me to say I like it or not and we're in the process.

So, just like they're updating the database, they come and make sure that they talk to the PRA guys and it's okay.

Because we're doing that operational response strategy change, there's a lot more procedure revisions for us, I think, in those. Our FEPs are basically going to be thrown away and be replaced.

Fire free plans have a little bit more insights. We put some insights in them from IPEEE, but they're slightly different now because we're keeping both trains alive.

The configuration management part of it we actually hadn't implemented, like I said. So, we've done some changes to our administrative programs and modification space to make sure that 805 concerns are captured right up front.

And we'll keep even during the transition that's going to be a couple years, we'll keep all the data on the fire stuff up to date.

MEMBER SCHULTZ: Gerald, who's the owner of that program?

MR. LOIGNON: Design Engineering owns the configuration management part. But PRA is specifically in their procedure, in their checklist. They can't go without us. Even though we're not part of design for Summer station, we're in their procedure.

MEMBER SCHULTZ: Okay, thank you.

MR. LOIGNON: The physical modifications, we obviously made some assumptions about what they were going to look like when we modeled them.

So, as they model them, we'll go back and make sure that we did it correctly or, you know, tweak on it if we have to.

There's a lot of things going on in the industry now that are keeping us busy. So, there's just lots on our plate to distract us and we need to make sure we keep our eye on it and get it done.

And that might be the end of it.

(Discussion off the record.)

CHAIRMAN STETKAR: Thank you. Any other members have any comments, any questions?

(No response.)

CHAIRMAN STETKAR: Well, thank you very, very much. That was a good summary and you've miraculously returned us to even ahead of schedule. So, I don't know what to do.

(Laughter.)

CHAIRMAN STETKAR: I can stand here and talk for an hour. You know I can do that.

(Discussion off the record.)

CHAIRMAN STETKAR: What I would like to do is one last time open up the bridge line and see if there are any comments from anyone out there.

While we're getting that done, is there anybody in the room that has anything to offer? I'm hearing clicks up there. Just again would somebody out there wherever you are, just say something so we can confirm that we have the bridge line open?

Anybody?

MR. JOGLAR: This is Francisco Joglar from Hughes Associates.

CHAIRMAN STETKAR: Thank you, Francisco. I appreciate that. You'd think we'd have some better way of doing this, but we don't.

Now that we know it's open, is there anyone on the bridge line who has any comments or questions regarding the Summer presentation?

(No response.)

CHAIRMAN STETKAR: Okay. Hearing nothing, no comments or questions from any of the other member, again while we're on the record, I really do want to again thank all of - especially the licensees bringing all the people you brought, expertise to answer questions.

It was, I think, certainly very useful for us and we really appreciate the effort you put into this. And I think we had a good discussion. And with that, we will recess until tomorrow morning.

(Whereupon, the above-entitled matter went off the record at 4:26 p.m.)

Stephen Dinsmore, Sr. Risk Analysis Engineer

PRA Licensing Branch

Harold Barrett, PE Sr. Fire Protection Engineer

Paul Lain, PE Sr. Fire Protection Engineer

Fire Protection Branch

Division of Risk Assessment

Office of Nuclear Reactor Regulation

NRC Staff Observations on NFPA 805 LAR Reviews

Technical Findings on NFPA 805 Transition

ACRS Reliability and PRA Subcommittee Brief

July 26 & 27, 2012

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Topics for Discussion

- Program Status
- LAR Acceptance Reviews
- Site Audit Observations
- RAIs & RAI Responses
- Summary

NFPA 805 Program Status

LAR Submittals	LAR Review Status
1. D. C. Cook 1 & 2	SE & RAI Development (2nd Round)
2. Duane Arnold	SE & RAI Development (2nd Round)
3. Callaway	SE & RAI Development (2nd Round)
4. Fort Calhoun	SE & RAI Development (2nd Round)
5. V. C. Summer	Awaiting RAI Responses & SE Development
6. Waterford 3	Awaiting RAI Responses & SE Development
7. Arkansas Nuclear One 2	Reviewing LAR Supplemental Information
8. Cooper	Reviewing LAR Supplemental Information
9. Nine Mile Point 1	LAR Acceptance Review
10. Turkey Point 3 & 4	LAR Acceptance Review
11. Arkansas Nuclear One 1	LAR due 8/31/12
Brunswick, Beaver Valley, Farley, & Prairie Island	LARs are due 9/30/12

LAR Acceptance Reviews

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- PRA Supplement Requests
  - RG 1.200 Compliance Paths
  - Incomplete Total Risk & Change in Risk Information
  - Not Identifying Relevant Sources of Model Uncertainty
    - Unreviewed Methods
    - Key Assumptions
  - Not Providing Required Sensitivity Study Results

LAR Acceptance Reviews (cont.)

- Fire Modeling Observations
  - Deviations from Accepted Methods
  - Quality Issues
- Other Observations
  - Programmatic
  - Nuclear Safety Criteria Assessment
  - Fire Protection Program

Site Audit Observations

- Information Integration During Analysis
- Fire Modeling
- Program Quality after Transition

RAIs & Responses

- PRA RAIs
- Fire Modeling RAIs
- Nuclear Safety Criteria Assessment
- Fire Protection Baseline Program

Summary

- The Staff will continue the License Amendment Review Process (LIC-101) to resolve site specific issues.
- The Staff will continue to work with stakeholders to resolve generic issues so future applicants can incorporate the necessary information.

Donald C. Cook Nuclear Plant

NFPA 805 LAR Insights & Issues

July 2012

Project Team Lead: *Dan MacDougall – NFPA 805 Project*

Presentation Overview

DC Cook Features

NFPA 805 Transition Project Summary

- NFPA 805 Transition Objectives
- LAR Development, RAIs and Implementation
- Fire PRA Overview & Results
- Fire PRA Technical Challenges
  - Ignition Frequencies
  - Fire Modeling
  - Spurious Actuation Failure Probabilities
- Uncertainty
- Implementation Challenges
- Summary

DC Cook Plant Features

- Two units, Total ~2150 Mwe, 4-loop Westinghouse PWRs with Ice Condenser Containments
- Ultimate heat sink is Lake Michigan.
- All plant cooling is direct lake water heat exchange.
- Alternate shutdown relies on other unit systems for pumped fluid services.
- Dedicated Fire Brigade is independent of operations shift staffing, not credited for safe shutdown strategy

Transition Objectives

- November 2005 study established goals for the transition.

- Objectives of Adopting NFPA 805:
  - Adopt a Risk Informed Fire Protection Program
  - Respond to NRC Industry Request for Transition to NFPA 805
  - Provide for an understandable Licensing Basis
  - Reduce Fire Protection Test and Maintenance Costs
    - Reducing suppression systems
    - Reducing emergency lighting
    - Reducing Fire-Rated Barriers
  - Reduce Operator Manual Actions

LAR Submittal

Used the NEI 04-02 LAR Template

- Submitted July 1, 2011, Supplement 1 issued Sept. 2, 2011 to include specific plant risk values.
- Some questions but no issues during LIC-109 review
- Fire PRA applied during the development of Fire Risk Evaluations (LAR Attachment W)
- Total 39 RAIs (~60% PRA & fire modeling related)
- 6 Separate Rad Release related RAIs
- Site Fire Modeling Evaluation, resulted in formal response to 11 questions
- Site audits were valuable meetings for the NRC & reviewers to discuss & understand the CNP approach

Fire Risk Evaluations

- Determined Delta Risk between Compliant Plant and NFPA 805 Post-Transition Plant
  - Delta in Core Damage Frequency
  - Delta in Large Early Release Frequency
- Over 260 VFDR Risk Evaluations using the 900 Fire PRA scenarios
- Based on RG 1.205 & RG 1.174 requirements for 805 transition & risk-informed PRA applications
- Cumulative delta-CDF & cumulative delta-LERF compared to RG 1.174 risk acceptance limits
- Close to the limit on acceptable delta-risk increase

Fire Safety Analysis

- 57 FSAs Document Each Fire Area
- Summary of deterministic/design and risk insights
  - Fire Protection Systems and Features
  - NSCA Compliance Strategy
    - VFDRs and Recovery Actions
  - Fire PRA Risk Evaluation Results
  - Radioactive Release Review
  - NPO Compliance Review
  - Monitoring Program Input
  - Defense-In-Depth and Safety Margin Review

NFPA 805 Implementation

- Modifications and Implementation Items
  - MOV IN 92-18 Mods
  - Conversion of CO2 Systems from Manual to Automatic
  - Transient Combustibles Control with Combustible Free Zones (CFZ)
  - Fuse Replacement – Coordination Study Deficiencies
  - Develop Monitoring and NPO Programs
  - Update Procedures and Other Documentation
  - Training After Receipt of NRC SE

Fire PRA Peer Review

- Fire PRA Peer Review - October, 2009
  - Conducted by the PWR OG
  - Fire PRA built from the Internal Events PRA
  - No Significant Findings
  - 61 F&Os - 36 Suggestions, 25 Findings – All Impacts Resolved
  - PWROG Indicated That Overall, the Fire PRA Quality was Found to be Very Good with Many Elements Being Performed at the State-of-the-Art Level
  - Fire PRA Peer Review process provided a good, independent look at the CNP model and basis

Fire PRA Summary

- Fire PRA Results <u>Reflect & Complement</u> D-I-D Approach
  - Insights are Not Surprising
- Fire PRA Results, in Many Cases, are Influenced Significantly by Conservative Data and Modeling
- Need to account for uncertainty, including conservatism:
  - Do not make changes based on overly conservative results.
  - Formal uncertainty analysis can reduce calculated results by factor of 5 to 10.

Based on the Efforts of Many (Plant, Industry and NRC) – we have come a long way, *but*

- ✓ Critical Evaluation of Results is Essential to Ensure PRA Results are Properly Understood and Characterized
- ✓ "NFPA 805 Fire PRAs" will need to be enhanced for use in Risk management and other Risk Informed Activities
- ✓ Continued Data and Methods Enhancements are needed

Fire PRA Model Attributes

- Plant model, success criteria, random failure probabilities are based on the Internal Events PRA.
- Follows NUREG/CR-6850, with Supplement 1.
- Approved NEI-FAQ's have been incorporated.
- There is a separate fire PRA model for each unit.
- Overall plant site includes 57 analysis areas (AA)
  – Some AA have cables for both units
- CDF & LERF (ΔCDF & ΔLERF) for each unit is calculated for each AA.
- Ice Condenser Containment is more limiting for LERF than other PWR containment designs.

Fire PRA Results—Risk Metrics

Unit	Fire CDF (per year)	NFPA 805 Delta-CDF (per year)	Fire LERF (per year)	NFPA 805 Delta-LERF (per year)
Unit 1	3.55E-5	9.01E-6	3.43E-6	6.85E-7
Unit 2	2.86E-5	8.46E-6	2.23E-6	5.97E-7

	Unit 1	Unit 2
Internal Events CDF	1.322E-05/yr	1.323E-05/yr
Fire CDF	3.55E-05/yr	2.86E-05/yr
Seismic CDF	3.17E-06/yr	3.17E-06/yr
Total CDF	5.2E-05/yr	4.5E-05/yr
Internal Events LERF	2.701E-06/yr	2.700E-06/yr
Fire LERF	3.43E-06/yr	2.23E-06/yr
Seismic LERF	9.82E-07/yr	9.82E-07/yr
Total LERF	7.1E-06/yr	5.9E-06/yr

Fire PRA Results–Top Areas

- Unit 1 Fire PRA
  - Top 16 areas contribute >95% of the fire risk
  - Top 10 areas (each area between 7.5E-6/yr & 1E-6/yr CDF):
    - 21% Unit 1 4kV AB Switchgear Room (El. 609'-6")
    - 20% Turbine Building
    - 11% Yard
    - 7% U1 Engr Safety System & MCC Room (El. 609'-6")
    - 7% U1 Control Rm Cable Vault & HSD Panel (El. 624' & 633')
    - 6% U1 ESW Pump Area & U1/U2 Basement MCC (El. 591' & 575')
    - 5% U1 Containment
    - 4% U1 Swgr Rm Cable Vault & Aux Cable Vault (El. 626' & 621')
    - 4% U1/U2 Aux Bldg & Fuel Handling Area (El. 609', 633' & 650')
    - 3% U1 Control Room (El. 633')

Fire PRA Results–U1 Top Scenarios

- Fire in Yard causes Loss of Offsite Power to both Units
  - Fire damage is limited to the offsite power supply
  - EDG failures lead to Station Blackout
- 4kV Bus 1B Fire fails Train B power & Offsite Power
  - Train A EDG random failures lead to loss of RCP seal cooling
  - Fail to locally trip RCP leads to seal LOCA
    - LOCA too big to mitigate via CVCS cross-tie
- 4kV Bus T11A Fire – same scenario as Bus 1B
- Turbine Bldg Fire Damages to AC Power
  - Random failures lead to Station Blackout
  - Failure to cross-tie AFW & CVCS leads to core damage
- Bus T11D High Energy Arcing Fault
  - Fire fails AC power to both safety trains, losing RCP seal cooling
  - Fail to locally trip RCP (fire fails control power) leads to seal LOCA
    - LOCA too big to mitigate via CVCS cross-tie

Fire PRA Results Insights

- Risk Significant Contributors
  - Cable vaults and rooms with 600V buses that impact both trains at the same unit (demanding cross-ties)
- Inter-unit system cross-ties effectively reduce risk
  - Required refinement of success criteria
- Recovery Actions credited (Draft NUREG-1921 used)
- Combustible Free Zones & Hot Work Restrictions minimized effects of transient fires in critical areas

Fire PRA Model Development

- First tasks of NUREG/CR-6850 developed the base fire PRA model and data
- Mostly straight-forward tasks, but some challenges
- Fire PRA Model Input development (by task number)
  - 1: Plant Boundary Definition and Partitioning (PP)
  - 2: Component Selection (ES)
  - 3: Cable Selection (CS)
  - 4: Qualitative Screening (QLS, not used at DC Cook)
  - 5: Fire-Induced Risk Model (PRM)
  - 6: Ignition Frequencies (IGN)
  - 9 & 10: Circuit Failure & Circuit Failure Likelihood (CF)

Fire PRA Technical Challenges

- 1st-Reducing total Fire PRA CDF below 1E-4/yr
  - ~ 2009, prior to Fire PRA Peer Review
  - Ignition frequencies shifted from NUREG/CR-6850 to FAQ-0048 Initiating Event Frequencies (IEFs)
  - Additional fire modeling needed
  - Need 1 train+ for good risk results (see #26)
- 2nd-Ensure LAR Delta-CDF below 1E-5/yr
  - ~ 2010 for LAR supporting analyses
  - Address Fire PRA Peer Review F&Os
  - Transition with as few plant modifications as possible
- 3rd-Uncertainty Considerations

Fire Ignition Frequency

- Based on NUREG/CR-6850 methods
  - First developed a set of IEFs from NUREG/CR-6850
  - Then developed a set of IEFs from FAQ-0048
- Current results use FAQ-0048 IEFs (NUREG/CR-6850 Supplement 1)
- IEF data still conservative for some contributors:
  - Crude rules for frequency & size of transient fires in an area when all precautions have been taken to eliminate them reduces worth of hotwork free and transient combustible free zones (FAQ-0064).
  - Effect on transient fire suppression of personnel in the area who may have caused the fire in the first place (such as during maintenance or hotwork).
  - No distinction between running & standby components

Fire Growth Trees

- **Complex Development & Quantification of Fire Damage States (FDS)**
  - Developing Ignition Frequencies into Cable Damage (and thus SSC Damage)
  - Fire Growth Trees address:
    - Frequency of the Ignition Source
    - Progression to Reactor Trip (assumed)
    - Fire Progression to Targets, which includes:
      - Propagation & Severity Factors
      - Captured via Fire Modeling
      - Includes Detection and Suppression
  - Fire Modeling is the key to Fire Damage States

Fire Modeling

- Used Verified & Validated (V&V'd) Fire Models
- 57 Total Plant Fire Areas
  - 18 Deterministic (evaluated at whole room burn-up)
  - 39 Performance Based (evaluated with fire models)
- Process followed NUREG/CR-6850 and the Fire PRA Standard
- Fire models developed scenarios consisting of specific ignition sources & targets
- Developed over 900 scenarios as input to Fire PRA quantification

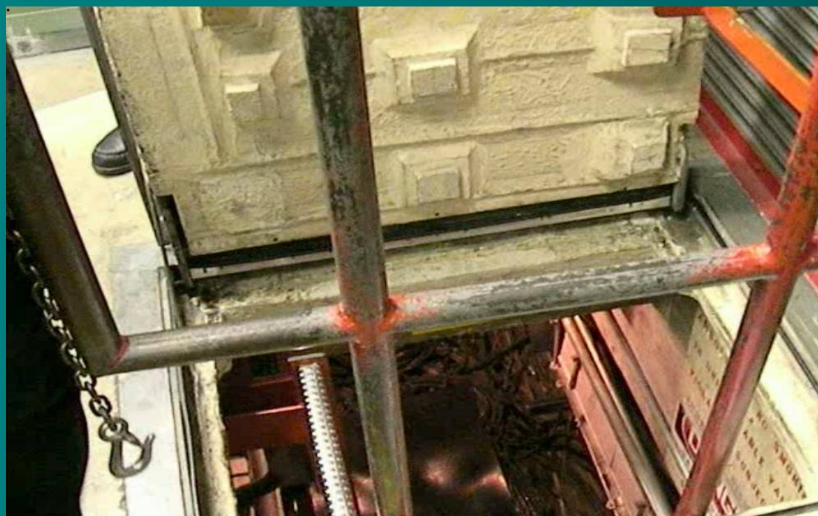
Fire Modeling (cont'd)

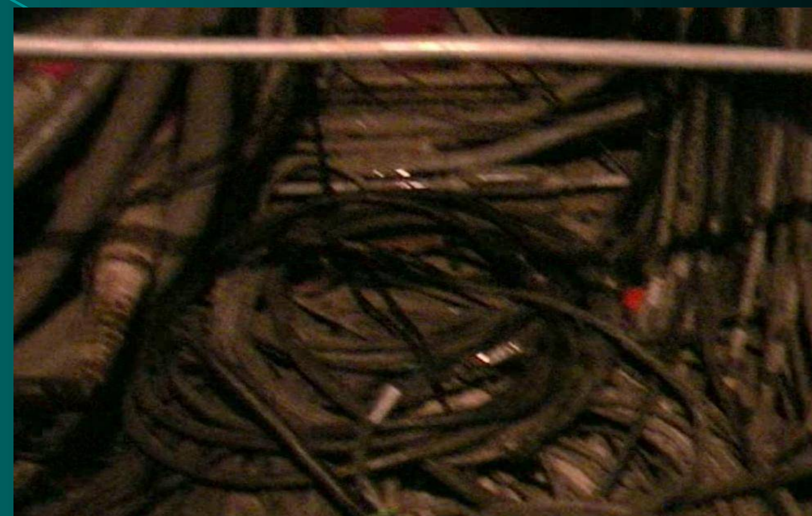
- First cut done with conservative data:
  - Published Heat Release Rate, taken at 98%
  - T-square growth model
- Produces time to damage, governs failure probabilities for suppression
- Associated target (cable) damage often limited by spatial knowledge of cable raceways
  - Sometimes multiple raceways high in the overhead, so initially assume all are affected
  - If CDF after first cut is too high, Fire PRA provides information of "minimum protected set" of cables, and walkdowns conducted to identify their location

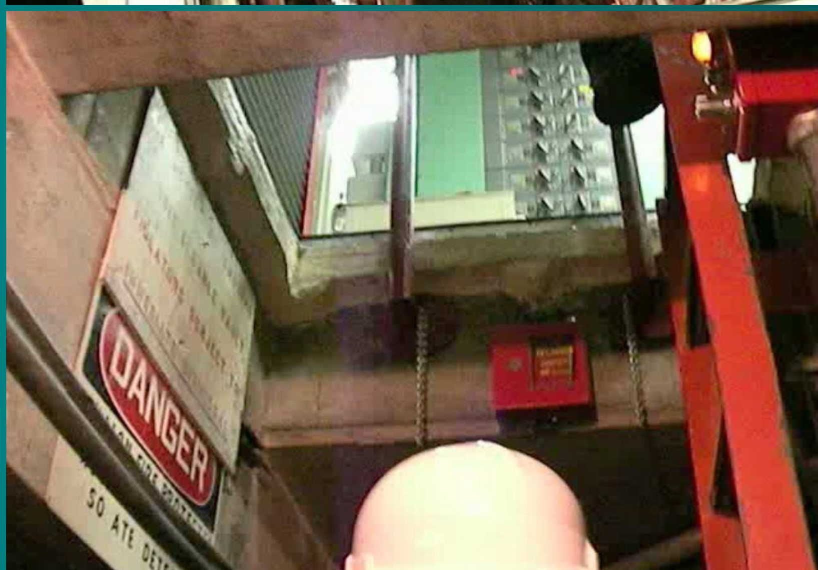
Fire Damage State

- Complex Development & Quantification of Fire Damage States (FDS)
  - Analysis of Individual Fires with Fire Modeling is Needed for Many Areas
- Level of Detail in Fire Modeling & associated SSC Impacts varies by Fire Location (Level of Effort Issue)
  - Iterative Process unless All Locations with NSCA SSCs are Modeled in Detail,
  - But not all cable routing known in detail
  - Summation of Results for Areas with Smaller CDF Results can Create Unrealistic Overall Calculated Results and thus Many Areas Typically Need Refinement.
- PRA Modeling
  - Straightforward for quantifying fire damaged data sets

Transient Source Fire Modeling Example







Fixed Source Fire Modeling Example

FPRA Insights into Mitigation

- Deterministically compliant areas can have Higher than Anticipated Calculated CDFs due to Conservative Fire Damage State Frequencies combined with Unreliability/Unavailability of Undamaged Mitigating SSCs

Mitigating Equipment	CCDP	PRA Risk Metric Results
Redundant Safety Trains, Non-Safety Train, & OSP Available	1E-4 to 1E-5	Good PRA Result
Redundant Safety Trains, and OSP Available	1E-3 to 1E-4	Good PRA Result
Redundant Safety Trains Available but without OSP	1E-2 to 1E-3	Good PRA Result Depends on Fire Damage State (FDS) Frequency
Safety Train with OSP Available	~1E-2	Good PRA Result Requires Very Low FDS Frequency
Safety Train Powered by EDG	~1E-1	A Good PRA Result is a Challenge

Circuit Failure Likelihood

- Detailed circuit analysis was performed on the risk significant components from the First Quantification (Task 7)
  - Cables that could cause spurious actuation
  - Note whether internal or external faults required
- In quantification process, probability for spurious actuation was assigned based on whether selected cables were involved in fire scenario
- Highest single spurious likelihood probability was used (FAQ-08-0047)
- Spurious open – Spurious close & spurious open were both assigned same probability.
- Issue – large spurious actuation probabilities
  - Challenge the rare event approximation
  - Total sum of all failure states should not exceed 1

Fire PRA Uncertainty

- Many conservatisms in NUREG/CR-6850 Approach
  - Ignition Frequencies
  - Spurious Actuation failure probabilities
  - Heat Release Rates & Fire Growth Model
- Also potential non-conservatisms
  - Operator response with degraded instrumentation & spurious cable failures
- Parametric data uncertainty addressed by estimation instead of rigorous statistical propagation
  - No value-added insights from statistical propagation as modeling assumptions dominate (e.g., fire modeling)

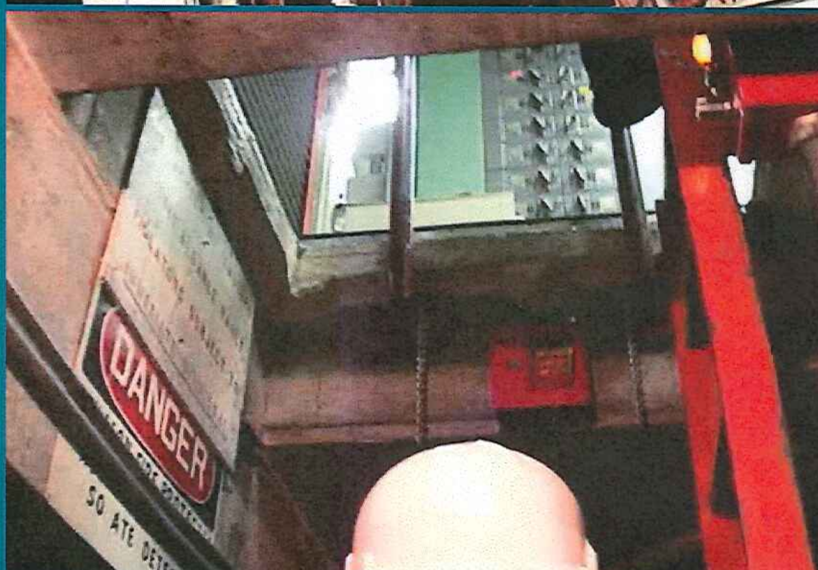
Implementation Challenges

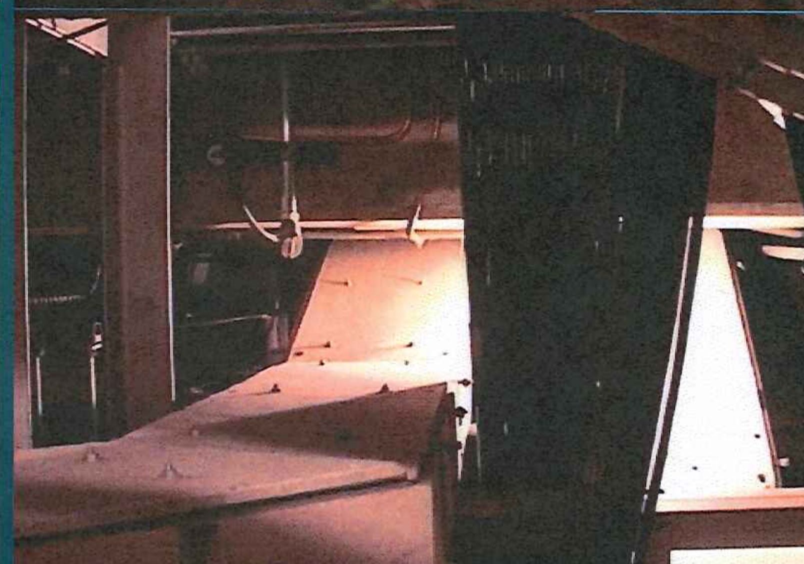
- Paradigm Shifts
  - Non-TRM Systems Risk Significant
  - Configuration Management (currently two programs)
  - Industry Participation
  - Qualification (Single Nuclear Plant Utility)
  - Qualitative 86-10 vice Change Evaluation
  - Recovery/Compensatory Actions (LERF/NPO)
  - Training (Ops, Engr., Outage Management, Work Control, Fire Brigade, etc.)

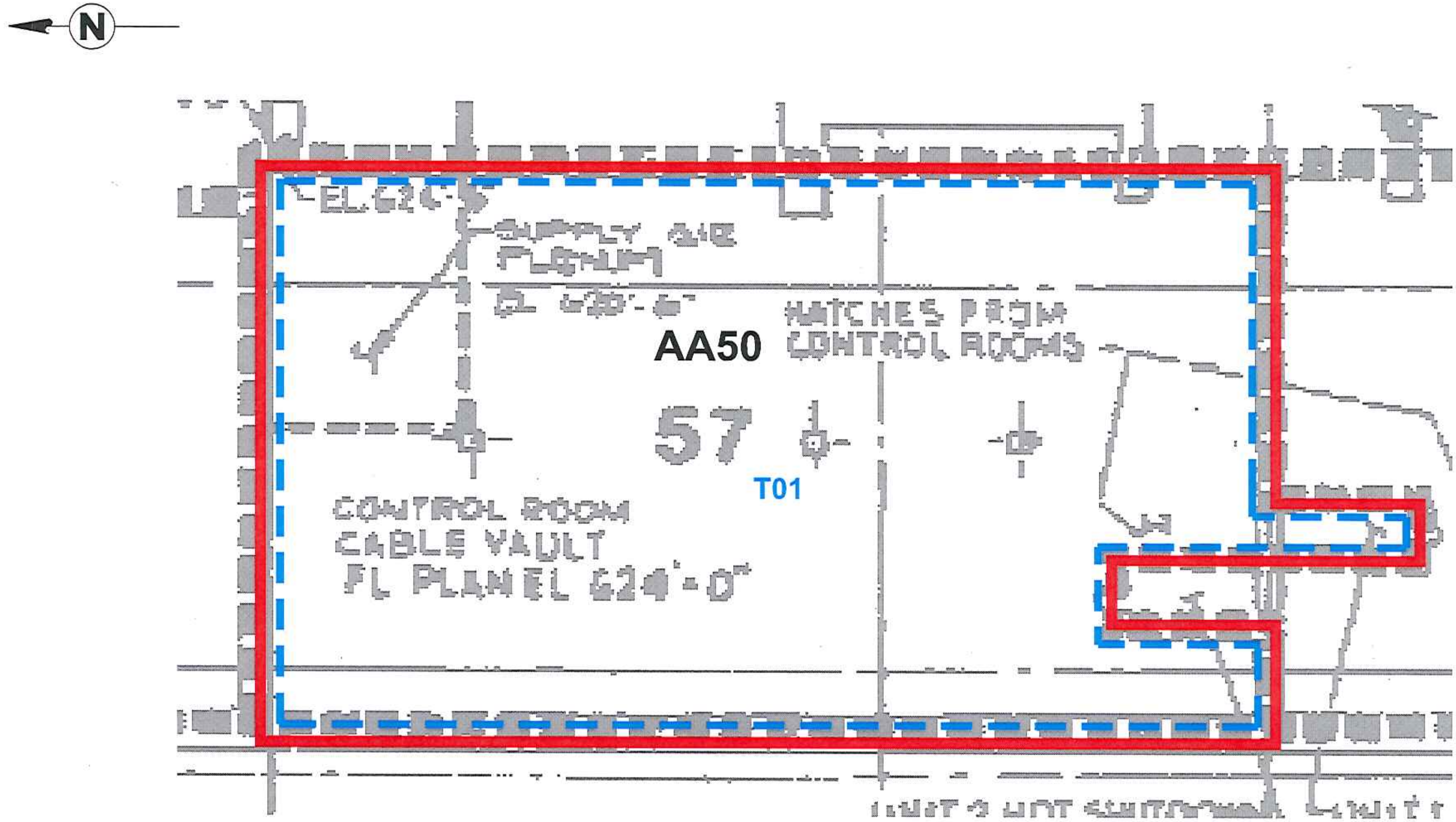
CNP NFPA 805 Summary

- NFPA 805 LAR submitted 6/29/2011
- Most Challenges were data conservatisms or data limitations (regulatory guidance, fire modeling & unknown cable locations)
- Paradigm Shifts (risk informed performance based)
- Configuration Management (RAI responses, FAQ/NEI 04-02 changes, two programs, qualifications)

Fire Modeling Example







Legend	
(blue dashed line)	Transient Scenario Boundary
(red solid line)	Fire Compartment Boundary
AAxx	Fire Compartment

Cook Nuclear Plant
Technical Eval. R1900-0411-AA50
Attachment 3

Fire Modeling Sketch of Compartment AA50 (Zone 57) EL. 624'-0"

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Sheet 1 of 2

ACAD-AA50a

Transient Fire Quantification

Prepared:	EMM - 7/24/2009
Reviewed:	ARB - 7/28/2009

Plant Cook Nuclear Plant
Fire Area AA50
Ignition Source Transient Quantification

Description of Fire Scenario

Only regular solid transient fires are postulated in this room. The 98th percentile heat release rate for transients is 317 kW.
All uncovered trays and conduits are failed before suppression occurs. Successful suppression at 4 minutes prevents failure to thermoplastic cables.
If suppression fails after 20 minutes, a transient fire will spread to surrounding combustibles to create a hot gas layer and cause whole room damage.
The fire risk quantification below is to credit automatic suppression in order to limit target damage for a the transient fire scenarios in Fire Zone 57.

Fire Modeling Input Parameters	
98th Percentile HRR (kW)	317
Damage temperature (°C)	330
Ambient temperature (°C)	25
Damage heat flux (kW/m²)	11
Radiative heat release rate fraction	0.4
Fire elevation (ft)	2.00
Fire diameter (ft)	2.26

Fire Ignition Frequency and PRA Input Data		
	Influence factor	1.00
Bin 5	Cable fire caused by welding and cutting	1.00E+00
Bin 6	Transient fires caused by welding and cutting	1.00E+00
Bin 7	Transients	1.00E+00
	Total Transient (Bin 6 + Bin 7):	**2.00E+00**
	Room CCDP (from FPRA Summary Sheet) =	1.00E+00
	Room CLERP (from FPRA Summary Sheet) =	1.00E+00

Lambda (Mean)		Reference
Bin 5	0.188	*From FAQ-08-0050*
Bin 6	0.188	
Bin 7	0.126	

Time to Det (Min)	
Bin 5	0
Bin 6	0
Bin 7	15
Manual Det	15

Transient Quantification Assuming Whole Room Damage

Scenario ID	Location Factor	Scenario Floor Area: Length (ft)	Width (ft)	Area (ft2)	Wg	Shortest Target Distance (ft)	Fire Condition	Critical Q (kW)	SF	Time to Damage (min)	Pns	Wg x SF x Pns	Total Trans Freq, λ	CDF using Room CCDP	LERF using Room CLERP	Fire Propagation	Scenario Description
Bin 5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.0	n/a	n/a	1.00E+00	1.00E+00	1.00E+00	Yes	Cable fires caused by welding and cutting
AA50.57-T01	1	N/A	N/A	4410	1.00E+00	0.00	Radiant	0	1.00E+00	0.00	1.00	1.00E+00	2.00E+00	2.00E+00	2.00E+00	No	Transient fire encompassing all of Fire Zone 57.

Total Area (Zone 55) 4410 ft²

Total CDF 3.00E+00 3.00E+00

Fire Event Tree

Plant	Cook Nuclear Plant
Fire Area	AA50
Ignition Source	Transient Fires

Prepared:	EMM - 7/24/2009
Reviewed:	ARB - 7/28/2009

Description of Fire Scenario

All uncovered trays and conduits are failed before suppression occurs. Successful suppression at 4 minutes prevents failure to thermoplastic cables.

If suppression fails after 20 minutes, a transient fire will spread to surrounding combustibles to create a hot gas layer and cause whole room damage.

The fire event tree and fire risk quantification is to credit automatic suppression in order to limit target damage for a the transient fire scenarios in Fire Zone 57.

Multiple fire damage states are analyzed to credit suppression at 4 minutes and at 20 minutes. This zone contains thermoplastic raceways and crediting suppression at 4 minutes provides benefit by limiting damage to thermoplastic cables. Industry guidance indicates that tray enclosures on thermoplastic cables are capable of delaying damage until 4 minutes. Enclosures on thermoset cables can delay damage until 20 minutes.

The fire will be detected by the nearest smoke detector in 11 seconds once the fire reaches 27 kW. The fire reaches 27 kW in 2.4 minutes (Attachment 6 t² growth with the peak occuring at 8 minutes).

The 4 minute delay to damage provided by the tray covers is assumed to be sufficient to bound all potentially challenging fire sizes including fires smaller than 27kW that may not activate suppression.

The time to automatic suppression is rounded to 4 minutes (2.6 minutes for detection plus a 50 second delay time pre-discharge).

Automatic detection is required to activate the Halon system.

Manual detection is assumed to occur at 15-minutes. When the suppression system is unavailable, a fire watch is present and prompt detection is credited.

Detailed Fire Modeling Risk Quantification - Scenario Specific

Scenario	Total Trans Freq	Wg	SF	Pns	CCDP	CDF	CLERP	LERF	Description of Damaged Targets and Associated Components
Bin5	1.00E+00	n/a	n/a	n/a	1.00E+00	n/a	1.00E+00	n/a	Worst Single Tray (TO BE DETERMINED)
AA50.57-T01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	2.00E+00	1.00E+00	2.00E+00	Attachment 8, Target Impacts, lists the damage for this scenario
Total		1.00E+00			2.00E+00		2.00E+00		

FDT 10 Inputs (Detection)	
HRR of Fire [kW]	27
Radial Distance [ft]	10
Height Above Fuel [ft]	4.0
Tamb [°F]	104

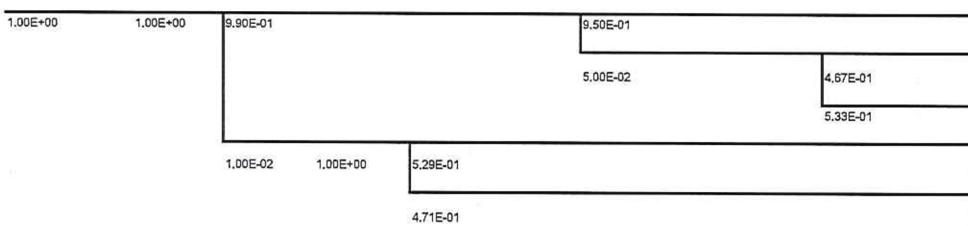
FDT 10 Results (Detection)	
Activation Time [sec]	11

Fire Protection System Data	
Suppression Unavailability:	1.00E-02
Suppression Unreliability :	5.00E-02
Linked Detection Unavailability:	1.00E-02
Detection Unreliability:	5.00E-02
Unlinked Detection Unavailability:	1.00E-02

Time to Detection and Suppression		
Time to Auto Detection (ionization detector):	2.6	min
Time to Prompt Manual Detection:	0.0	min
Time to Manual Detection:	15.0	min
Fire Brigade Response:	0.0	min
Time to Suppression:	4.0	min
Lambda (Mean) Prompt Detection Succeeds:	0.188	
Lambda (Mean) Prompt Detection Fails:	0.126	

Fire Event Tree for General Transients (Bin 7): Tree Applies to Fire Zones 57

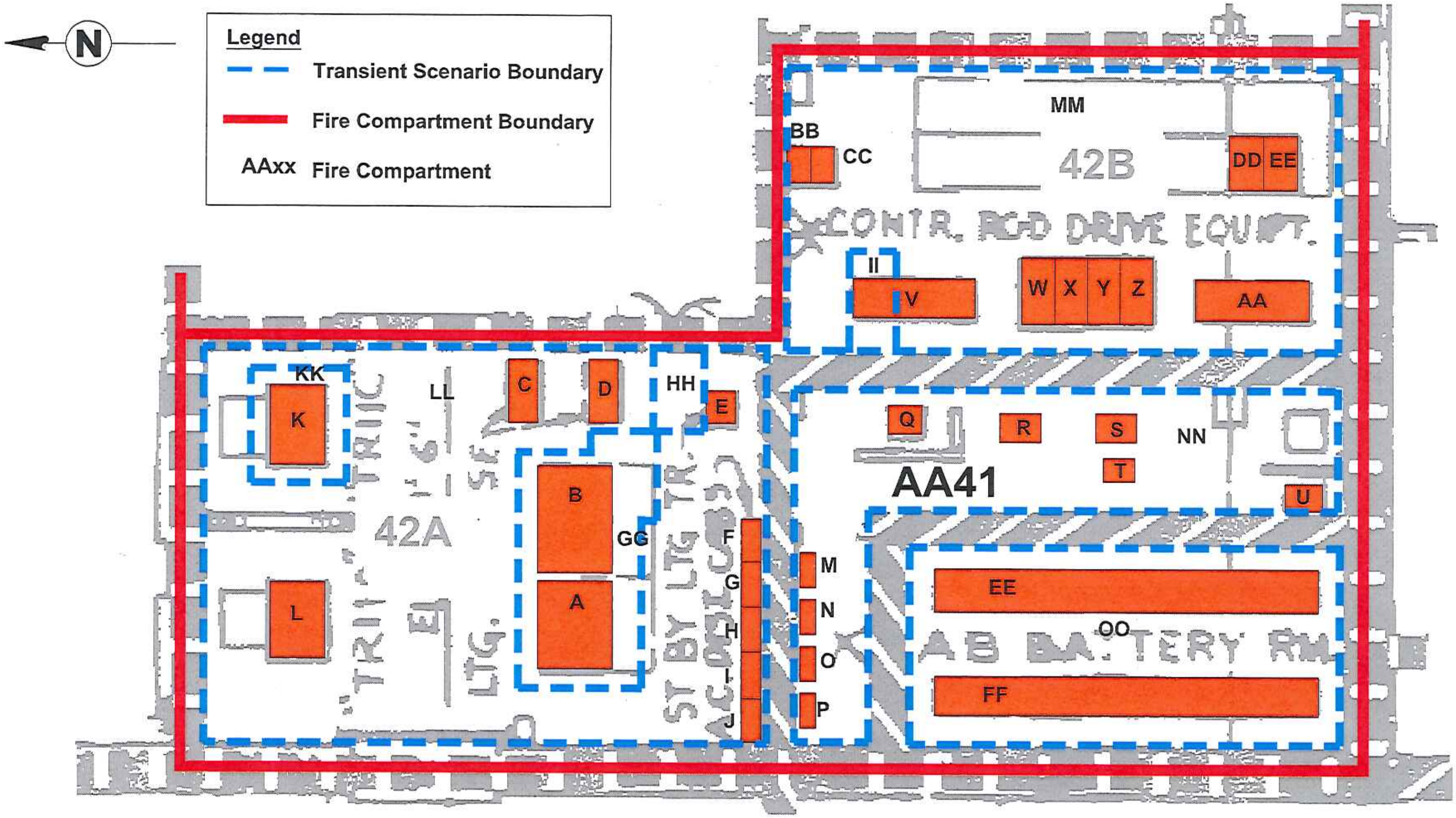
	Task 8	System	Prompt		Automatic		Manual		
Fire	Severity Factor	Available	Detec	Suppr	Suppr	Smoke Detection	Detec	Fire Brigade Response at or before, min	
FI	FS		PD	4.00	AS	AD (smoke)	MD	20	20



SF x Pns	End State	Description of End State
9.41E-01	FDS1	Automatic suppression is successful. No targets damaged after 4 minutes.
2.31E-02	FDS2	Automatic suppression fails, manual suppression is successful. All thermoplastic cables are damaged, however theremoset cables are not damaged and whole room damage is prevented.
2.64E-02	FDS3	Automatic suppression fails, manual suppression is unsuccessful. Whole room damage occurs.
5.29E-03	FDS4	Automatic suppression and detection systems are unavaliable. Prompt detection and prompt suppression are successful. Damage is prevented to all protected cables.
4.71E-03	FDS5	Automatic suppression and detection systems are unavaliable. Prompt detection is successful and prompt suppression is unsuccessful. Whole room damage occurs.
1.00E+00		

Detailed Fire Modeling Risk Quantification

FDS	Time (m)	Damaged Targets and Associated Components	SAFE scenario ID	(Task 6) λ	SF x Pns	CCDP	CDF	CLERP	LERF
FDS1/4	4	All unprotected cables within ZOI.	AA50.57-T01-S4	1.00E+00	9.46E-01	Refer to Final Quantification			
FDS2	20	All unprotected cables within ZOI as well as all thermoplastic cables.	AA50.57-T01-S20		2.31E-02				
FDS3/5	21	Whole room damage.	Whole room damage		3.11E-02				



Key: SIGNIFICANT IGNITION SOURCES

A. Bus 11A	H. 1-PSBW	O. 1-MCAB	V. 1-CRDMG-1N	CC. 1-RCS-PL-CC	KK. 42A-T03
B. Bus 11C	I. 1-TE1E	P. 1-DAB	W. 1-52-BYA	DD. 1-RCS-LC	LL. 42A-00
C. 1-TR-LTG-9N	J. 1-TE1W	Q. 1-CRID-4-INV	X. 1-52-RTA	EE. 1-RCS-DCH	MM. 42B-00
D. 1-TR-LTG-9S	K. 1-TR11C	R. 1-CRID-2-INV	Y. 1-CRDSWGR-G2	FF. 1-BATT-AB	NN. 42C-00
E. 1-TR-LTG-8	L. 1-TR11A	S. 1-CRID-1-INV	Z. 1-CRDSWGR-G1	GG. 42A-T01	OO. 42C-00
F. 1-AB1E	M. 1-TDAB	T. 1-CRID-3-INV	AA. 1-CRDMG-1S	HH. 42A-T02	
G. 1-AB1W	N. 1-MDAB	U. 1-CCRP-INV	BB. 1-RCS-PL-PC	II. 42B-T01	

Cook Nuclear Plant
Technical Eval. R1900-0411-AA41
Attachment 3

Fire Modeling Sketch of
Compartment AA41 - EL. 587'-0"

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Sheet 1 of 1

ACAD-AA41

Attachment 6: Cook Fire Growth Analysis Worksheet

Compartment:	AA41	Fire Zone:	42C
Fire Scenario:	AA41.42C-5		
Ignition Source:	1-MCAB		
Description:	250VC Dist Panel MDCAB		

Description of Fire Scenario

A fire starts in 1-MCAB and burns for 40 minutes.
Cable trays 1EI-C93 drops directly down into the ignition source and ignites in one minute after being exposed to temperatures in excess of 915°F (NUREG 6850 Table H-5). Cable tray 1EI-D3 and 1EI-D1 run vertically into adjoining cabinets which are located directly adjacent to 1-MCAB. These trays are exposed to a radiant heat flux greater than 18 kW/m² and ignite after 1 minute (NUREG 6850 Table H-7 and H-8).
Cable tray 1EI-C94 is located directly above 1EI-D3 and approximately 18 inches from 1-MCAB. The tray is also exposed to a radiant heat flux greater than 18 kW/m² and ignites after 1 minute (NUREG 6850 Table H-7).
After the listed cable trays ignite, the fire grows after one minute which causes a heat flux of 11KW/m² which occurs 4' away from the fire. This heat flux causes cable tray 1EM-C118 to fail in 19 minutes (NUREG 6850 Table H-7).
Cable tray 1EM-D9 contains thermoplastic cables and is also located 4' away from the fire. This tray fails at 4 minutes (NUREG 6850 Table H-8).

Ignition Source	*SI*	*English*
Width [m]/[in]:	0.91	36
Depth [m]/[in]:	0.30	12
Fire Elevation [m]/[in]:	2.36	93
Fire Diameter [m]/[in]:	0.60	23
Nominal Length [m]/[in]:	0.51	20.00
Nominal Width [m]/[in]:	0.51	20.00
Nominal Fire Diameter [m]/[in]:	0.57	22.6

Cable Qualification:	Qualified
HRR [kW]:	211
Fire location factor:	2
Cable Bundles:	One
Convective HRR fraction:	0.7
Radiative HRR fraction:	0.4

Attribute:	
Vertical Sections:	1
Intervening Combs?:	Yes
Open or Closed Doors:	Closed

Damage Criteria	*TS*	*TP*	*SS*
Temperature [°C]:	330	205	65
Heat Flux [kW/m²]	11	6	3

Compartment Parameters	*SI*	*English*
Ambient Temperature [C]/[F]:	32	90
Room Width [m]/[ft]:	3.7	12.0
Room Length [m]/[ft]:	13.4	44.0
Room Height [m]/[ft]:	3.7	12.0
Vent Height from Floor [m]/[ft]:	2.13	7.0
Vent Height [m]/[ft]:	2.13	7.0

	SI	*English*
Vent Width [m]/[ft]:	0.91	3.0
Vent Area [m²]/[ft²]:	1.95	21.0
Compartment Surface Boundary Area [m²]/[ft²]:	221	2378
Specific Heat of Air (kJ/kg):	1	
Ambient Air Density [kg/m³]:	1.16	
Flow Rate [kg/sec]/[cfm]:	4.206	7700

Compartment Material: Concrete	*SI*	*English*
Thermal Conductivity [kW/mK]:	0.0016	
Density [kg/m³]:	2400	
Wall Thickness [m]/[ft]:	0.30	1.0
Specific heat [kJ/kg]:	0.75	
Heat transfer coefficient [kW/m²-K]:	0.02	

(From Plant HVAC Drawings)

Fire Spread

Source Type	Source	HRR per Unit (kW)	Unit	Vertical Separation of Tray (in)	Tray Width (in)	Tray Length (in)	Directions of Spread	Fire Spread Rate (in/min)	Number of Units	Ignition Time (min)	Duration (min)
Cabinet	1-MCAB	211	Cabinet	N/A	N/A	N/A	N/A	N/A	1.00	0	40
Cable Tray	1EI-D1	25	ft²	0	12	12	1	2.13	1.00	1	75
Cable Tray	1EI-C94	20	ft²	0	12	144	1	0.71	12.00	1	75
Cable Tray	1EI-C93	20	ft²	0	12	20	1	0.71	1.67	1	75
Cable Tray	1EI-D3	20	ft²	0	12	12	1	0.71	1.00	1	75
Cable Tray	1EM-D9	25	ft²	0	12	12	1	2.13	1.00	4	75
Cable Tray	1EM-C118	20	ft²	0	12	12	1	0.71	1.00	19	75

Time (Minutes)

Source	0	1	5	10	20	30	40	50	60	75	85
1-MCAB	0	1	37	147	211	47	0	0	0	0	0
1EI-D1	0	25	43	65	109	154	198	178	178	178	178
1EI-C94	0	240	245	251	262	274	286	47	47	47	47
1EI-C93	0	33	38	44	56	68	79	47	47	47	47
1EI-D3	0	20	25	31	42	54	66	47	47	47	47
1EM-D9	0	0	29	52	96	140	185	178	178	178	178
1EM-C118	0	0	0	0	21	33	45	57	47	47	47
Total HRR (kW):	0	320	416	588	798	771	859	554	544	544	544

		0	1	5	10	20	30	40	50	60	75	85
Thermoset Zone of Influence	Flame Height (ft):	0.00	5.82	6.69	7.96	9.25	9.09	9.58	7.73	7.66	7.66	7.66
	Plume (ft):	0.00	10.41	11.78	13.81	15.85	15.60	16.38	13.43	13.33	13.33	13.33
	Plume Radius (ft):	0.37	1.85	2.05	2.36	2.66	2.63	2.74	2.30	2.29	2.29	2.29
	Ceiling Jet (ft):	0.00	3.45	4.49	6.35	8.62	8.32	9.28	5.98	5.88	5.88	5.88
	Flame Radiation (ft):	0.00	3.16	3.60	4.28	4.99	4.90	5.17	4.15	4.12	4.12	4.12
HGL	Hot Gas Layer Temperature (NV - MQH) (°C)		94	129	169	220	228	254	204	207	213	217
	Hot Gas Layer Temperature (CC - NV - Beyler) (°C)		47	78	125	211	245	306	230	245	271	286
	Hot Gas Layer Temperature (FV - FPA) (°C)		61	79	101	129	134	148	120	122	125	127
	Hot Gas Layer Temperature (FV - D and B) (°C)		45	64	89	125	131	150	111	113	116	118
Thermoplastic Zone of Influence	Plume (ft)	0.00	13.77	15.52	18.10	20.70	20.38	21.38	17.62	17.49	17.49	17.49
	Plume Radius (ft)	0.29	1.97	2.19	2.51	2.84	2.80	2.92	2.45	2.43	2.43	2.43
	Ceiling Jet (ft)	0.00	7.80	10.16	14.36	19.48	18.81	20.97	13.51	13.28	13.28	13.28
	Flame Radiation	0.00	4.27	4.87	5.79	6.75	6.63	7.00	5.62	5.57	5.57	5.57

DAEC Fire PRA - NFPA 805

July 26-27, 2012

NEXT ERA ENERGY REPRESENTATIVES

Anil Julka *[presenter]*	Nuclear Reliability and Risk Manager – Corporate
Vinny Rubano *[presenter]*	NFPA 805 Engineering Manager - Corporate
Laura Swenzinski	Nuclear Licensing - DAEC
Ted Kulczycky	Nuclear Staff Engineer – PRA – Corporate
Kiang Zee	ERIN Engineering - PRA

TOPICS

- Background
- Risk Reduction History
- Risk Reduction Improvements
- PRA Peer Reviews
- New Analysis Methods (NAM)
- HRA
- Fire Model Sensitivity
- DAEC Hazard Risk Distribution
- Fire PRA Risk Insights
- Modifications
- Summary

SITE OVERVIEW

- Approximately 6 miles NW of Cedar Rapids, Iowa
- General Electric (NSSS & Turbine Generator)
- Bechtel (AE and Constructor)
- BWR- Mark I Containment
- 1912 MWt Thermal Power; ~ 630 MWe
- Staff Complement: approximately 650

NEXTera ENERGY

Cedar River is ultimate heat sink and water makeup source

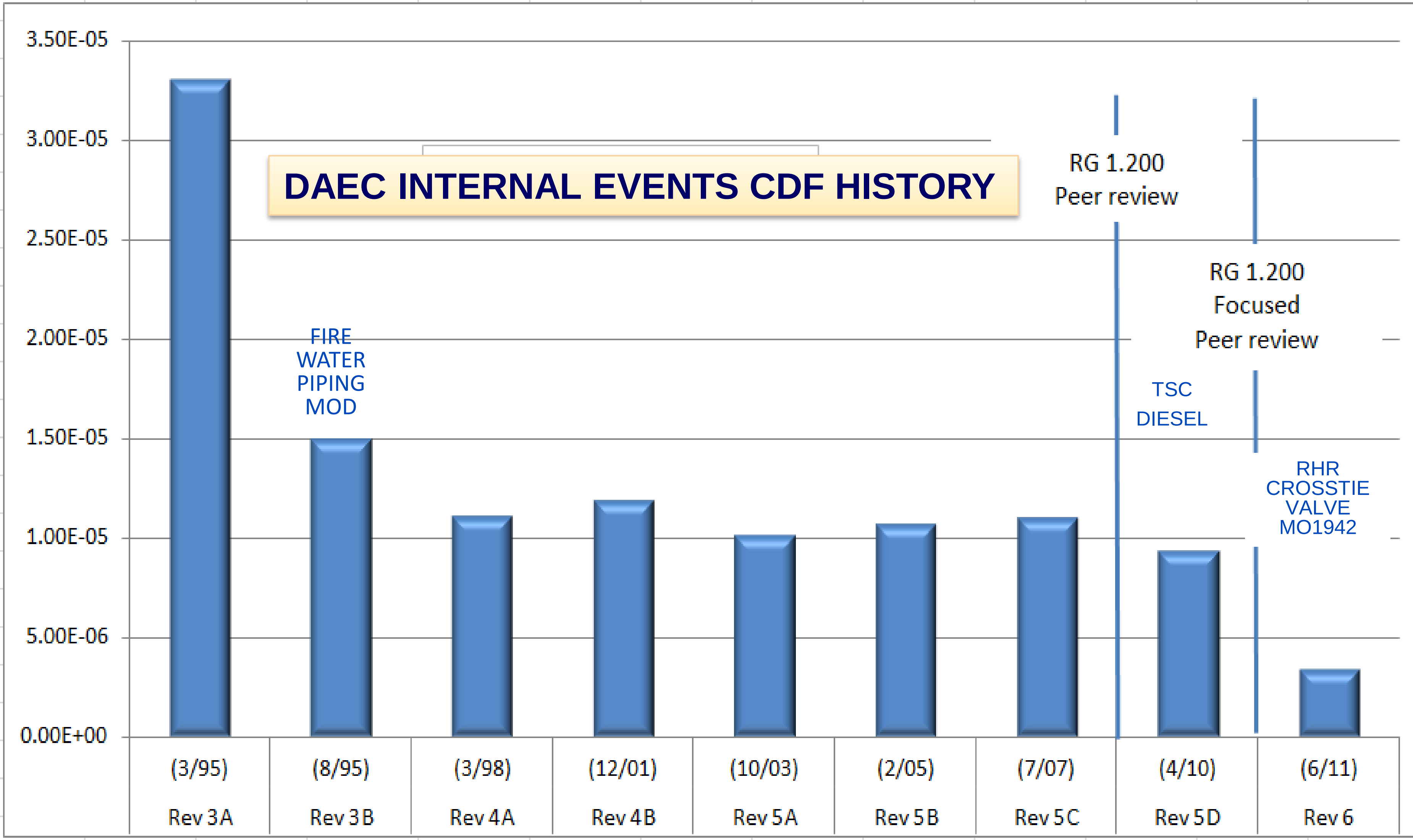
Approximately 6 miles NW of Cedar Rapids, Iowa

Forced draft cooling towers for condenser cooling

FIRE PRA TIMELINE

- **RG 1.200 rev 2 upgrade for Internal Events PRA and Fire PRA developed concurrently – started 2007**
- **Project Milestones:**

– Internal Events Peer Review	– Dec 2007
– Fire PRA Peer Review	– Jun 2010
– Internal Events Focused Peer Review	– Mar 2011
– LAR submitted	– Aug 2011
– Initial NRC LAR Audit	– Dec 2011
– RAI's rec'd – 120 RAIs	– Feb 2012
– 60 day RAI responses submitted	– Apr 2012
– 90 day RAI responses submitted	– May 2012
– NRC Fire Modeling Audit	– May 2012
– NRC Fire Modeling Questions/Walkdown	– June 2012



Note: RHR Crosstie credit not included in Fire PRA – will be updated post LAR

NEXTera ENERGY

Key PRA Driven
Risk Reduction Improvements

FIRE WATER PIPING

Fire water piping configuration changed in the Control Building HVAC room to eliminate possibility of flood water propagation to essential switchgear rooms.

TSC DIESEL

AOP-301.1 upgraded to direct alignment of TSC Diesel Generator to battery chargers to extend battery life in the event of a station blackout.

RHR SERVICE WATER CROSSTIE TO RHR SYSTEM

Procedures upgraded to direct operators to manually open RHRSW crosstie valve to the RHR system MO1942 in the event Division 1 power to the valve is unavailable. Implemented July 2011. [*Not credited in the FPRA*]

PRA PEER REVIEW HISTORY

INTERNAL EVENTS

Initial Peer Review - Dec 2007

- *57 SRs Not Met*
- *66 Findings*

Focused Peer review - March 2011

- *4 SRs Not Met*
- *12 Findings*

FIRE PRA

Peer Review - June 2010

- *89 SRs Not Met*
- *89 Findings*

New Analysis Methods (NAM)

Two NAMs Applied:

1. Hot Work Cable Spreading Room (CSR) Pre-initiator

2. Transient Heat Release Rate (HRR)

Hot Work Cable Spreading Room (CSR) Pre-initiator

- **NUREG/CR 6850 Hot Work Methods** :
  - Adjusts for frequency and manual suppression,
  - No adjustments for procedural controls.
- **DAEC CSR:**
  - Highly restricted area controlled by the control room operators.
  - Nothing is in the CSR that requires hot work
  - CSR hot work would NOT be authorized without detailed planning, analysis and compensatory actions.
- **Hot Work Pre-Initiator adjusted**. Credited CSR procedural controls by applying an HEP of 0.01 to all scenarios involving cable fires caused by welding and cutting.
- **Sensitivity performed in response to an RAI**. Result was that applying 0.01 factor was conservative but acceptable estimate for application.
- **CSR hot work scenario is not associated with any VFDR's**

Entrance to Cable Spreading Room

Note that door says NO ENTRY and requires prior approval required by operations. Shortened door is due to ductwork above the door.

Transient Heat Release Rate (HRR)

- NUREG/CR 6850 based on testing of transient combustibles and measurement of fire characteristics
- No guidance on reasonable measures to mitigate
- 69KW vs. 317KW used. Walkdowns provided input to estimate HRR for motor fires.
- 1% of CDF/LERF are Transient fires. Sensitivity showed that larger value results in CDF/LERF change of no more than 1%
- Industry data has not found that large (317KW) fires happen - the data shows most are much smaller.

Key Modeling Improvements – Planned
-- Current Conservatisms --

Fire PRA does not implement this risk important action:

MO1942 RHRSW CROSS TIE VALVE. MO1942 must be opened to allow RHRSW alternate low pressure RPV injection. However no credit is given to manually opening this valve w/o AC power [e.g. if lost due to fire]. Credited in post FPRA internal events model – significant impact on reducing CDF and addressing modeling uncertainty.

Internal Events and Fire PRA do not implement the following risk important actions:

EMERGENCY SRV OPERATION USING PORTABLE DC POWER. Procedures provide guidance to depressurize the RPV using SRVs when normal DC power is unavailable or when operation from the Control Room and/or the Remote Shutdown Panel is not available. This procedure is NOT credited in Internal Events PRA or Fire PRA.

CONTAINMENT VENTING DURING SBO. DAEC procedures provide detailed direction for venting PC given an unavailable pneumatic supply – can be used during SBO but is NOT credited in the internal events model. The procedure provides direction for using compressed air or nitrogen bottles to allow operating valves required for venting.

PORTABLE DIESEL FIRE PUMP. Procedures provide instructions for using the portable diesel fire pump. B5b action is not credited in the internal events model

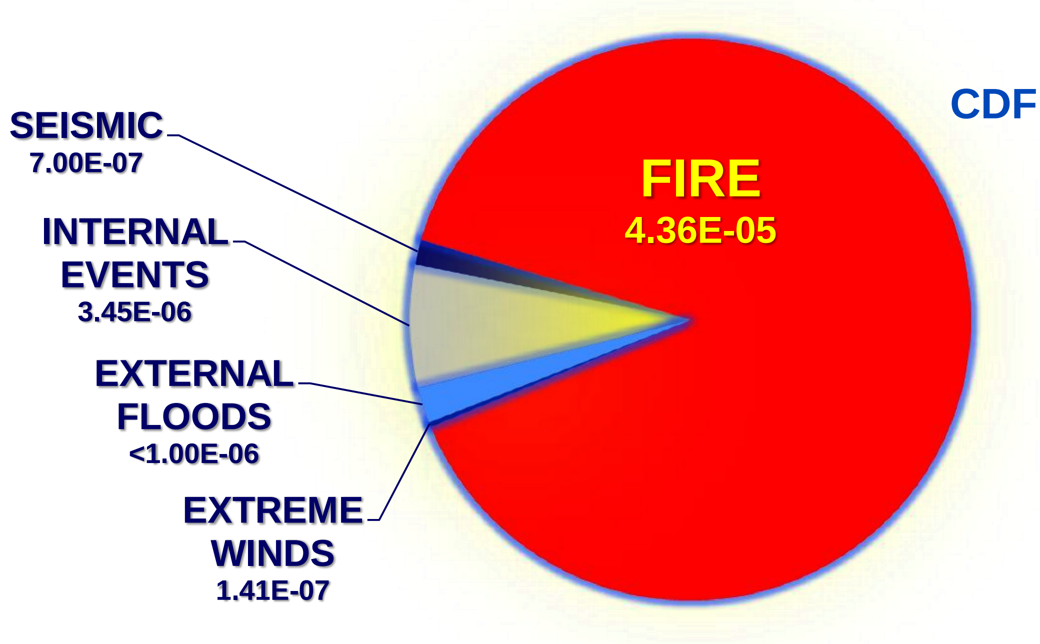
NEXTera ENERGY

FIRE MODEL SENSITIVITY

Sensitivity Analysis Performed these Assumptions:

- Use of NUREG/CR 6850 fire ignition frequency
- Potential impact of switchgear room modifications to provide additional source of AC power
- Application of circuit failure mode conditional probability
- Treatment of assumed cable routing (unknown locations)
- Use of refined HRR for general transient fires

DAEC PRA Hazard Risk Distribution



CDF HAZARD DISTRIBUTION

Note: Conservatism in FPRA masks Internal Events PRA risk

	Internal Events	Seismic	Fire	Extreme Winds	External Floods
CDF	3.45E-6	7.0E-7	4.36E-05	1.41E-7	< 1E-6
LERF	1.21E-6		1.59E-05		

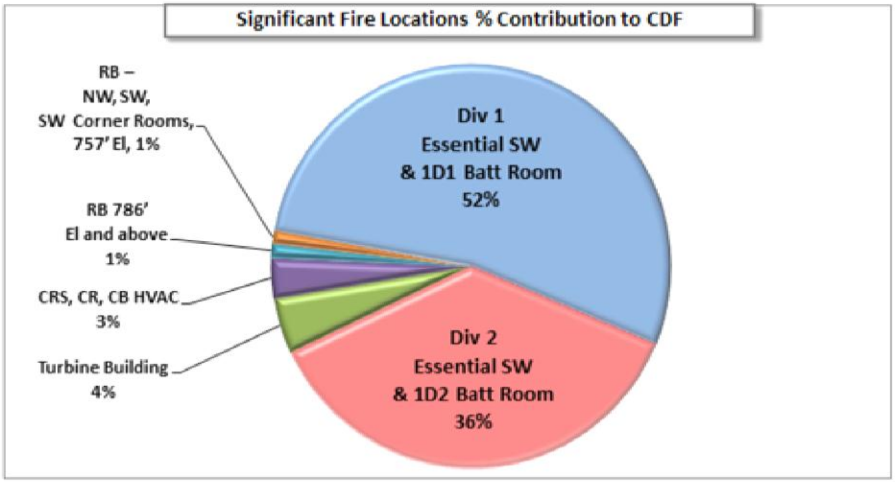
Note: Values for each hazard were updated at different time frames:

- *Fire CDF/LERF is not based on most current Internal Events model –LAR was submitted prior to latest internal events update.*
- *External Floods and Extreme Winds CDF values are from the original IPEEE submittal.*
- *Seismic CDF value is based on a post IPEEE update.*

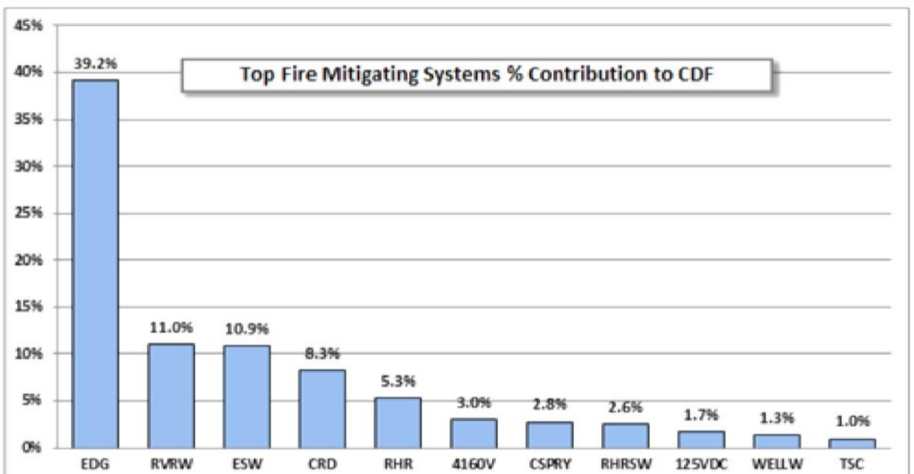
DAEC FIRE PRA Model [July 2012]

DAEC - Key FIRE PRA Results

Core Damage Frequency (CDF) =4.36E-05 /yr
Large Early Release Frequency (LERF) = 1.59-05 /yr



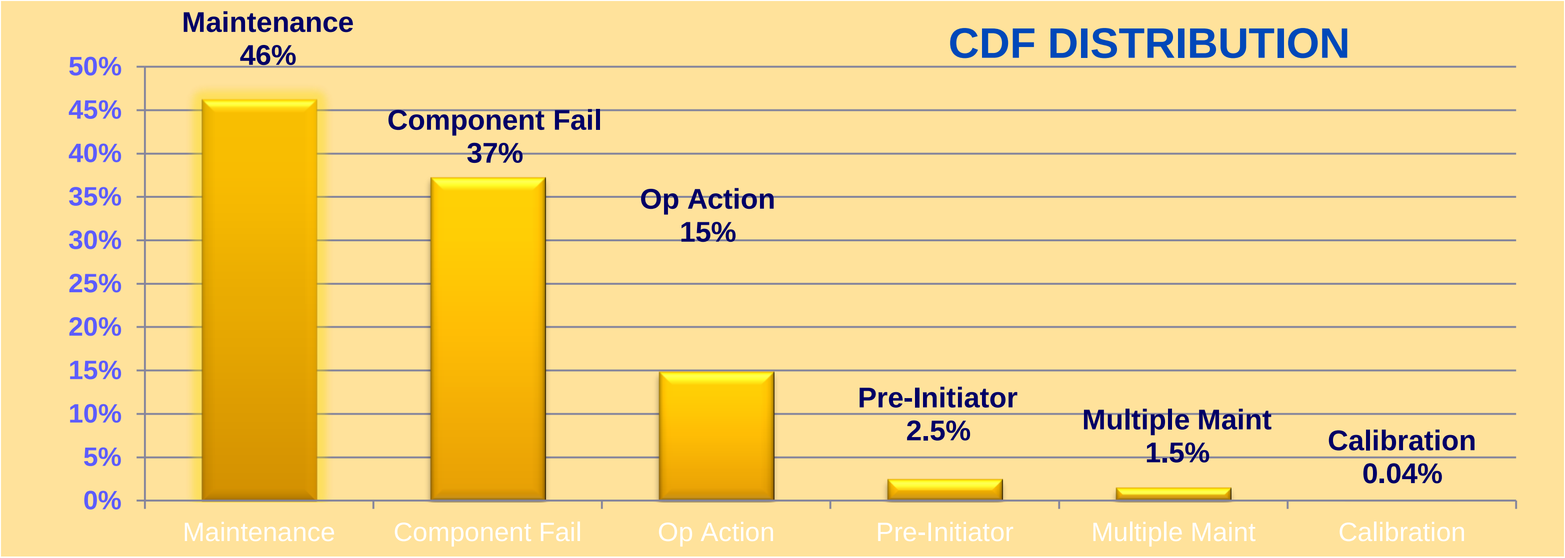
Top Fire Event Mitigating Components % Contribution to CDF		
	Description	CDF %
1	DIESEL GENERATOR 1G21 Fails to START/RUN/LOAD	8.0%
2	DIESEL GENERATOR 1G31 Fails to START/RUN/LOAD	5.7%
3	FUEL OIL TRANSFER PUMP 1B44B FAILS TO START/RUN	2.8%
4	FUEL OIL TRANSFER PUMP 1P44A FAILS TO START/RUN	2.0%
5	ESW CV2081 FAILS TO OPEN ON DEMAND	1.6%
6	4160V Circuit Breaker 1A411 Fails to close on Demand	1.6%
7	CV 4914, 1P-117B/D INLET TO STILLING BASIN Fails To Open	1.5%
8	ESW CV2080 Fails To OPEN ON DEMAND	1.2%
9	4160V Circuit Breaker 1A311 Fails to close on Demand	1.1%
10	CV 4915, 1P-117A/C INLET TO STILLING BASIN Fails to open	0.8%



Top Fire Event Operator Mitigating Actions % Contribution to CDF		
	Operator Action	CDF %
1	ALIGN STANDBY 125VDC BATTERY CHARGER	5.0%
2	INITIATE RPV EMERGENCY DEPRESS (TRANSIENTS)	4.9%
3	MAXIMIZE CRD FLOW FOR TRANSIENTS AND SLOCA-ST	3.2%
4	CONTROL FEEDWATER FOLLOWING SCRAM	2.7%
5	SHED BATTERIES PER AOP 301 DURING SBO	1.3%
6	OPEN LPCI INJ MOV-1904(-2004) GIVEN MOV-2004(-1904) FAILS	1.1%
7	ALIGN ALT LP INJECTION (TRAN, SLOCA, MLOCA, IORV)	0.8%
8	INITIATE FEEDWATER	0.8%
9	CROSS TIE ESW TRAINS	0.6%
10	OPEN PUMPHOUSE DOORS	0.5%

Fire Risk Insights

- Essential Switchgear Room Fires Dominate Risk.
  - ✓ *Dominant scenarios are LOOP due to fire with opposite standby diesel generator in maintenance.*
  - ✓ *EDG, River Water, and Service Water maintenance dominate top cutsets.*
  - ✓ *Maintenance unavailability contributes to ~46% of the Fire Risk*



Fire Risk Insights

(continued)

- Fire PRA indicates sufficient separation exists between divisional cables and equipment, consistent with fire safe shutdown analysis.
- Multi compartment fire is a small contributor to fire risk
- When combined with internal events, fire dominates:
  - **Internal Events CDF = 3.45E-6**
  - **Fire PRA CDF = 4.36E-5**

Modifications

- **Incipient detection in Main Control Room**
  - Mitigate potential multiple spurious actuation challenges to the current alternate shutdown capability (ASC) design and procedures
  - Mitigate challenges to potential loss of ASC in several control room panels
  - Full credit for incipient detection was challenged by the NRC. Performed sensitivity and results were acceptable.
- **Emergency Service Water Circuit Modification**
  - Postulated fire in turbine building has a potential to impact both trains of emergency service water

Fire PRA Development

- **Fire PRA developed by ERIN Engineering**
  - Subcontract as part of larger NFPA 805 transition contract
  - Supplements in-house resources

- **Fire PRA utilized the current safe shutdown analysis as input**
  - Ensured PRA modeled failures that the SSA identified
  - Developed team work between contracted PRA resources and utility expertise

Developmental Challenges

- MSO list was being updated at the same time review was being performed.
- Review process for NAMs is more involved than envisioned
- Responses to peer review findings required more rigor than previous submittals.
- While the concurrent R. G. 1.200 internal events update and fire PRA development helped provide an integrated result, there are difficulties with coordination.

Implementation Challenges

- Fire PRA is very conservative.
- Fire PRA CDF/LERF is large compared to internal events.
- Inability to use as calculated for upcoming maintenance rule requirement for online risk management
- Most of the work performed by consultants, as such technology transfer will be a greater effort than envisioned.
- Keeping Internal Events PRA and Fire PRA updates aligned will stretch the ability and resources of the current PRA staffs.
- The amount of data developed is well beyond what was originally envisioned – concerns for future data maintenance

SUMMARY

- Upgraded internal events model used for Fire PRA; further improvements to be incorporated prior to implementation.
- Risk insights have led to safety improvements.
- Need to streamline the approval process for NAM
- Fire PRA in its current form cannot be integrated with internal events and applied for maintenance rule implementation in 2013. Conservative bias in the Fire PRA will overshadow Internal Events Risk.
- Eliminate compounding conservatism to allow "apples-to-apples" comparison to other hazards and internal events. Conservatisms will complicate risk-informed decisions.
- Implementation will be challenging due to major work done by contractors with limited availability of in-house staff for turnover due to other high priority projects, e.g. necessary upgrades and updates, Fukushima initiatives, etc.


Daec Rd
Daec Rd
Daec Rd
Questions?

NRC ACRS Meeting

Reliability and PRA Subcommittee

Rockville MD July 26, 2012

VC Summer NFPA805 Project

FPRA Technical Issues

Gerald A. Loignon, Jr., PRA Supervisor

Michael Kammer, NFPA 805 Project Manager

Fire PRA Technical Issues

- Quantification Software
- Mitigation strategy change
- Cable location data
- Fire PRA: Fire Modeling Methods
- Improved Fire PRA Methods: Slow progress

Other Project Issues

- Insights
- Performance Based Fire Modeling
- Plant Modifications
- Implementation Challenges

Quantification Software

Quantification Platform: FRANX

- Base PRA model uses CAFTA/EOOS
- Desire: Single top fire model
  - Combines cutsets for risk ranking and HRA dependency analysis
- Future Utilization
  - EOOS
  - Internal Flooding and Seismic PRA models

Software Challenges

FRANX issues

- Software: Initially the only functional version was a beta of 4.0

Challenges:

- Unable to quantify all (~1500) scenarios in one pass
- Could not handle NAND gate at top of tree (used for mutually exclusive logic)
- Single events sometimes turned mutually exclusive logic true
- QRECOVER would not function
- Basic event names had to be expanded
- Problems “un-checking” components

Software Challenges: Status

Resolutions

- Early feedback to assist EPRI in development of software fixes
- Devise workarounds
- Deferral of One Top Model

Future Direction

- Implement FRANX version 4.1

Mitigation Strategy Change

Challenges

- Industry Guidance assumes the existing shutdown strategy is being transitioned
- Δ risk of current SISBO strategy to the new NFPA 805 strategy would require two new FPRA models
- HRA: Required assumptions regarding Operations procedures that have not yet been developed

Mitigation Strategy Change

Resolutions

- FAQ 09-0052 developed/approved to use the Δ risk of a “compliant” plant to the post transition “as built/operated” plant
- HRA insights provided to Operations Procedure writers for consistency during procedure development
- Separate Change Management Plan to coordinate:
  - Final Procedure development/ issuance
  - Modifications implementation
  - Operations Training

Cable Location Data

Background

- Comprehensive cable routing database with three dimensional coordinate data at nodes where cables enter/exit trays
- Project Decision: Manage all NFPA805 Cable information within the common cable routing database (Long Term CM)

Challenge

- Software Version did not support NFPA805 Development/Data Migration
- Missing Data to support Fire PRA Analysis

Cable Location Data

Resolution

- Cable routing software development and V&V
- Incorporate data fields to support NSCA, Fire PRA and NPO Analysis
- Define, develop and correct as built data to support circuit analysis (e.g. Conduit)

Benefits

- Single repository for all station cable information
- Same tool historically used by Engineering personnel
- Direct inputs for NFPA805 software packages

Fire PRA: Fire Modeling Methods

Challenges

- Untimely Fire Methods Review Panel Decisions
- 6850 guidance artificially increases Transient Combustible Importance
  - HRR vs. frequency mismatch
  - Influence Factor [FAQ 12-0064]
- Circuits with Control Power Transformers
  - Nearing consensus [LAR revision]
- Kerite cable
- Unknown cable qualification
- Electrical Cabinet Peak HRR

Fire PRA: Fire Modeling Methods

Resolution

- VCSNS FirePRA development followed issued industry guidance
- Finished Fire PRA Analysis in 2010 without benefit of new methods
- Monitoring industry movement/RAI on issues
  - Control Power Transformers
  - Kerite cable
  - Flammable liquid spill fires
  - Electrical Cabinet Peak HRR

Slow Progress: Improved Fire PRA Methods

Background

- The Fire Methods Review Panel was established to review/approve new Fire PRA methods through a consensus process
- Peer review per RG 1.200 determines that, as implemented, the methods meet the requirements of the standard

Slow Progress: Improved Fire PRA Methods

Challenges

- The high level of technical justification required for the Fire Methods Review Panel to reach consensus takes a very long time
- NRC endorsement/rejection also takes time and adds considerable uncertainty
- NRC endorsement at this point in the PRA model development process is inconsistent with previous applications of PRA in risk-informed regulation

Resolution

- VC Summer Fire PRA analysis follows NUREG 6850 without benefit of the new methods
- Monitoring for future impacts

Surprise Insights

Summary

- Considering the plant vintage, there were few significant deterministic requirement open items

Circuit Analysis

- 7.2 kV circuit breaker anti-pump logic, contained within the breaker itself, could be defeated by a specific remote short circuit
- Failures that could prevent energizing the 7.2 kV ESF busses from both the 115kv and 230kv off-site power sources
- Failure combinations could impact Control Room Evacuation isolation switches

Other Insights

Risk Insights

- The second most risk significant area of the plant is a hallway with a nearby Motor Control Center, and overhead cable trays
- "Fire Initiating Events Representing 95% of the Calculated Fire Risk (CDF)"
  - Loss of RCP Seal Cooling events resulting in a consequential small LOCA is the most common scenario
  - 27 of the 50 scenarios involve fires in alternate shutdown areas [Restricted Access/ Online work]

Performance Based Fire Modeling

Application

- Tool to disposition deterministic analysis open items
- Conservatively calculate a limiting scenario and maximum expected scenario,
  - Evaluate the margin between the two to ensure that it is sufficient to bound the uncertainty
- Four fire areas
  - Three control building cable chases
  - One air handler/cooling unit area [B SWBP]

Performance Based Fire Modeling

Insights/Controls

- Not for every area of the plant [Room configuration]
- May be forced to manage the fire itself
  - Fuel Package Size/Heat Release Rate
  - Fire Location
- Workable solution within defined analysis boundaries

Plant Modifications

Support Shutdown Strategy/New Analysis

- Resolve deterministic issues
- Reduce CDF

Typical Deterministic Modifications

- Fire protection system feature improvements
- Circuit/ tubing protection
- 7kV ESF bus feed reroute (TB Fire)
- CR Disconnect switch rework
- Communication enhancements

Plant Modifications

Core Damage Frequency Reductions

- RCP seal replacement
- Incipient detection (Control Complex)
- Alternate seal injection system
- Diesel driven instrument air compressor auto start

Implementation Challenges

Station Challenges

- Shift in “Operational Response” strategy
- Knowledge transfer from vendors to plant personnel
- Transition requires extensive documentation updates (e.g. Administrative Controls, Response Procedures, Fire Pre-Plans, Configuration Management)
- Physical modifications required assumptions about final design that will have to be “trued-up”
- Competing priorities/ demands for staff attention/resources