Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

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

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Monday, December 13, 2010

Work Order No.: NRC-602 Pages 1-386

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

RELIABILITY AND PRA SUBCOMMITTEE MEETING

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OPEN SESSION

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MONDAY

DECEMBER 13, 2010

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ROCKVILLE, MARYLAND

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The Advisory Committee 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

DENNIS C. BLEY, Member

DANA A. POWERS, Member

WILLIAM J. SHACK, Member

NRC STAFF PRESENT:

JEFF CIRCLE, NRR/DRA/APOB

STEVE DINSMORE, NRR

RAYMOND H.V. GALLUCCI, NRR

DONALD HARRISON, NRR

J. S. HYSLOP, RES

STEVE LAUR, NRR

CHARLES MOULTON, NRR

NATHAN SIU, RES

SUNIL WEERAKKODY, NRR

JOHN LAI, Designated Federal Official

ALSO PRESENT:

PATRICK BARANOWSKY, ERIN Engineering

TOM BASSO, NEI

BIFF BRADLEY, NEI

JOHN BUTLER, NEI

KEN CANAVAN, EPRI

JIM CHAPMAN, ScienTech

MARDY KAZARIANS, Kazarians & Associates, ACRS Consultant

DAVID MISKIEWICZ, Progress Energy

STEVEN P. NOWLEN, Sandia National Laboratories

DAN PACE, FENOC

DOUG TRUE, ERIN Engineering

KIANG ZEE, ERIN Engineering

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

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

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

8:36 a.m.

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

ACRS members in attendance are Dennis Bley, William Shack and Dana Powers. Our ACRS consultant, Mardy Kazarians, is also in attendance. John Lai of the ACRS staff is the Designated Federal Official for this meeting.

The purpose of the meeting is for the subcommittee to review the current state of licensee efforts on the fire protection program transition to NFPA 805. We will hear presentations from the nuclear industry and the NRC staff.

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

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

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

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register. A transcript of the meeting is being kept and will be made available as stated in the Federal Register Notice.

Therefore, we request the 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.

Thank you all who actually traveled anywhere in the northern tier of the United States yesterday, for making valiant efforts and showing up. I understand that we may still have some participants who are making said valiant efforts to arrive. We'll see what happens over the next couple of days.

Before we start, we had a previous subcommittee meeting on this topic on November 16th. At that time, we were in the process of essentially gathering information from the industry, from the NRC staff and other public stakeholders in terms of trying to identify what are some of the more thorny issues, if I can call them that, in this transition process.

I think that we have a fairly good idea of what the issues are. The purpose of this two-day subcommittee meeting is to elaborate on more details of some of those issues so that the subcommittee members can understand a bit more of the technical issues.

If there are agreements between the industry and NRC staff on some issues, that's good. We should try to see if we can understand what an appropriate path forward is on those particular topics.

If there are disagreements, I think it's also important for us to clearly understand the sources of the disagreement and whether there is any hope, let's put it that way, for a near-term resolution of those disagreements.

So, I'd like to characterize this two-day meeting as a combination of presentations, normal subcommittee discussions, questions, and also a bit of a working session if indeed we can identify some of those technical topics that merit a bit more detailed discussion.

And with that, I will turn the meeting over to Sunil. Do you want to say anything beforehand?

DR. WEERAKKODY: Not at this time. Thank you.

MEMBER POWERS: I would comment that I am certainly unaware of the ACRS ever taking a position promoting the transition to NFPA 805.

So, I mean, you sound as though we're trying to understand why people aren't making the transition, because we want to promote it, and I'm just unaware of the ACRS actually taking that position.

CHAIRMAN STETKAR: Yes, I don't have the SRM wording in front of me here, but essentially the SRM chartered us to identify technical and other issues that are impeding the transition.

So, that's, in a sense, the tone of my presentation is somewhat consistent with the tone of the SRM.

MEMBER POWERS: Has the Commission taken a position encouraging the transition? I'm unaware of that either.

CHAIRMAN STETKAR: That, I don't know.

MEMBER POWERS: I don't -

CHAIRMAN STETKAR: But it's not our charter to either advise for or against transition. It's to simply identify issues that the Commission essentially has concerns -

MEMBER POWERS: Well, those issues might get to be very financial and philosophical in nature.

CHAIRMAN STETKAR: They may. To this point, we've - in the subcommittee meeting in November, we had some presentations regarding what's called a nontechnical issue, schedule programmatic issues, a bit on financial.

We've tried so far to stay away from that because the ACRS traditionally does not become involved in those types of issues.

I believe that's correct not having served nearly as long as you, nor am I planning to.

MEMBER POWERS: Well, it seems to me we need to make very clear that as far as I am aware of, there is no evidence that plants operating under either Appendix R or Branch Technical Positions are not adequately safe.

CHAIRMAN STETKAR: That's true.

Well, this is a voluntary program. I mean, plant sign-up is -

MEMBER POWERS: If transition to NFPA 805 is, as you say, voluntary --

CHAIRMAN STETKAR: Right.

MEMBER POWERS: - and not essential for assuring adequate protection of public health and safety.

CHAIRMAN STETKAR: That's absolutely correct. I don't think anyone is arguing that. The plants make a decision and either adopt it or don't.

With that, I'll turn it over, I guess, to Biff Bradley with NEI.

MR. BRADLEY: Okay. Thank you, John.

I'm going to defer to John Butler, just to make a few opening comments for the industry.

MR. BUTLER: Thank you. My name is John Butler. I just want to make a couple of opening remarks as we start the two-day discussion session.

First, I want to thank the subcommittee for taking the time to examine the NFPA 805 transition process. We're approaching the completion of the second pilot.

And with that, it's an opportune time to reassess what we've learned from the transition process, and take those lessons learned and implement them where we can.

So, I understand that's part of the charge you have is to look at the process and identify those, I guess, first the low-hanging fruit, but the larger changes that are necessary for this process, because the reality is approximately half of the operating fleet is scheduled to transition to 805.

And so, now is the time for us to identify the changes that are necessary to make what is the most important element of 805 more viable, and that's the fire PRA.

If we don't take this opportunity, we're going to be continuing to have to correct ourselves during the process. And it's not a very efficient process to do that after you've implemented 805.

So, again, I want to thank the committee and I look forward to a very productive two days. Thank you.

I'll turn it over to Biff Bradley at this point.

MR. BRADLEY: Thanks, John.

All right. Appreciate - again, to say the same thing John did, appreciate the opportunity to brief the committee again. We were here last month and I think we had a good discussion.

I'd like to give a brief overview of what you're going to hear from the industry today and tomorrow.

Tom Basso of NEI and myself are going to open with a presentation primarily discussing the regulatory process issues and policy issues that are coming to bear with NFPA 805.

Dan Pace from FirstEnergy, is going to give a presentation from the utility management perspective discussing the impact of NFPA 805 transition on his plants specifically. And I think there's some very interesting information there.

And as you are aware, we provided a paper to the committee about two weeks ago or slightly less, which was our technical paper. We've developed discussing what we believe are the issues, the methodological issues within fire PRA that are in need of improvement.

And Doug True, the primary author of that paper, as well as Ken Canavan of EPRI, will provide a brief overview of that. I'm hoping the subcommittee had time to read the paper.

And as we get further into the meeting, I know we want to get to the technical meat of the topics. So, we do have presentations prepared on a number of the methods. And that would include our Fire Events Database and ignition frequency work we're doing in conjunction with the NRC staff. Pat Baranowsky will be presenting that.

We'll be discussing incipient fire detection, transient fires, electrical cabinet fires. All of these things were areas that were identified at the November 16th subcommittee meeting.

We can also discuss other methods as appropriate or as the subcommittee or NRC staff would like to do.

The FAQ process received a considerable amount of discussion at the last meeting, and I'd like to try to clarify industry's perspective on that and why we have expressed some concerns with that process, try to clarify that.

And then tomorrow we'll be discussing the research coordination between NRC and EPRI through the MOU, as well as discussing some what we believe are near-term improvements that we'd like to be able to make to achieve better realism within the next several months to a year.

So, this is information you're already aware of. The Shearon Harris plant was the initial pilot. And they have received their NRC safety evaluation. Oconee is the second pilot, and they are nearing issuance of their NRC safety evaluation.

And as everyone is aware, the clock for 23 plants will begin upon issuance of the Oconee SE and they would be expected to provide their 805 LAR within six months of that date. Otherwise, they're subject to the end of their enforcement discretion period.

There was a letter provided by NEI last month, November 15th, to NRC suggesting that consideration of a staggered submittal schedule would be appropriate.

There are concerns with 23 units providing LARs at more or less the same time, and Tom will speak more to that letter.

The discussion on staggered submittal is something that's ongoing now. And to some degree, that might help with the PRA methods issues in terms of giving plants more time to develop methods. However, the plants at the beginning of the queue would still be facing the same problem.

So, it's a partial solution if implemented.

MEMBER POWERS: Let me ask you about this kind of a schedule in comparison with the experience we had with Appendix R.

I guess my concern is not so much with the submission of the paperwork as it is with internalizing within an organization a fire safety regimen. Which I think it is my impression, it took much longer for Appendix R than was allowed for in the schedule.

I wonder what your perception on that is.

MR. BRADLEY: Well, I'll have to say first that I - that slightly predates my personal involvement in the -

MEMBER POWERS: A lot of things in life probably predate your -

(Laughter.)

MR. BRADLEY: I might need to defer to if we have someone else in the industry here. I really can't speak with a great accuracy to how the initial Appendix R was implemented. And I don't know if we have any folks here that were involved in that or not.

Dan, were you around then?

MR. PACE: I'll speak to some of that.

MEMBER POWERS: I'll be glad to hear it, because I think one of the essential things seems to me are in safety regimen, is they'd be internalized in the core - among the people that have to implement it. And they have to be able to interpret it intuitively and not with elaborate code calculations and whatnot.

I think that's an essential step and one of the challenges any highly-quantified methodology like NFPA 805 is that internalization so that you can do it by inspection and by brain power and not computer power.

MR. BRADLEY: Okay. As you know, the main topic we brought to the table last month on November 16th was the need for additional realism in the fire PRA methods.

As you know, the transition to 805 uses the methodology of NUREG/CR-6850 EPRI 1011989, henceforth referred to as NUREG-6850 just for brevity.

As we talked last month, we've worked for the last couple of years to try to achieve better realism using these methods. And we've achieved some limited success.

We talked about the fact that the method was never fully piloted and that the integrated result of doing full models led to some insights that we had not previously foreseen.

There remains conservatism in these methods. And our paper that you received was an attempt to demonstrate based on insights from a fairly large number of PRAs that have been performed using NUREG/CR-6850 and the approved FAQs. And even with those improvements from the FAQs which are represented in the paper, we're still seeing what we believe is a disconnect from the operating experience and we believe there's additional work needed to achieve a reasonable degree of realism.

That being the case, we have a regulatory process where plants are expected as part of the 805 transition, to justify any deviation from 6850 and the approved FAQs. And this is on top of and irrespective of the results of their Reg Guide 1.200 fire PRA peer review.

Note this is an unprecedented process. We've done a number of applications before in risk-informed, and this is the first time there's been an expectation - as a matter of fact, we've achieved considerable success with the use of Reg Guide 1.200, PRA standards and peer review to facilitate some fairly significant applications, including some major tech spec reforms.

However, in the history of our work with the staff, this is the first time that we're being essentially held to or expected to justify deviations from a specific methodology.

So, this is a new world for how PRA is being applied in the regulatory environment.

MEMBER POWERS: This is deterministic PRA.

MR. BRADLEY: The pilot plants had extensive interactions with NRC staff and were able to address some of these issues, but it was not what I would call an effective process that can be translated to 50 other plants.

We need a better way to achieve these methods, more realism, and to get in a position where reasonable methods can be used without the need to justify deviations. And we'd like to get back to a platform where we're closer to the use of Reg Guide 1.200 as we've used in other applications.

In a broader sense, we have concern with the regulatory process in that the - not only in PRA, but in some other issues as Tom Basso will discuss, it's not clear that the pilots thus far have established a clear, efficient, effective process and that the follow-on plants have sufficient information to efficiently go to 805 without facing regulatory uncertainty in a number of areas and potential revisions in the approach used from the pilots.

An example of this, and if for any reason I'm getting this wrong, I'm sure NRC staff will correct me, but it's my understanding that the Oconee safety evaluation will be issued and starting the clock on their remaining plants with PRA issues open and certain RAIs.

And my understanding is also that NRC believes that Oconee needs to undergo a peer review directly to NUREG/CR-6850, and this given that NRC has already reviewed the PRA. And the initial understanding was that the NRC staff would do the PRA review for other pilot plants.

So, I'm sure the staff can express their understanding of this or why you believe this is necessary. This is just an example, I think, in the area of PRA where we're - it's not clear we're stable and understanding the process.

CHAIRMAN STETKAR: Biff, Donnie.

MR. BRADLEY: Yes.

MR. HARRISON: Donnie Harrison from the staff.

I'll point out that where we have never said that a peer review has to be done against the NUREG/CR-6850, the current review of the Oconee pilot is still ongoing though the safety evaluation is expected soon, and it will have some implementation items for PRA and most likely a peer review. But, again, that's an industry peer review.

I'll point out that in doing a review as a regulator, when someone deviates from a method, if it was a risk-informed in-service inspection application and they deviate from the EPRI topical on that, we'd expect them to justify their deviations.

So, we're not forcing you to do NUREG/CR-6850, we're just saying you have to have a technical basis for your fire PRA if you do something different. And you should be able to - you should have documented that and you should be able to actually provide a justification for why it's adequate.

So, from one way or perspective, that seems like the appropriate thing to do. I'm just looking at the rest of your comments up there.

So, we still want people to do peer reviews of the fire PRAs and to address and resolve those comments. So, with that, I'll leave that.

MR. BRADLEY: Okay. Thanks, Donnie.

Yeah, I - it is the exercise of justifying deviations from 6850, and the level of proof or expected to do that is not an insignificant effort.

And if the method, you know, we believe the method is not giving results that are appropriately realistic. So, the concept of having to justify deviations from that is - seems unusual.

Let me move on here. So, I'm trying to give some practical perspectives on what types of solutions might be appropriate to help us and, from the industry perspective, achieve enhanced realism.

I know there is considerable time pressure on the Agency to get 805 implemented. And there has been a lot of time that has been spent already trying to get this regulation implemented. However, the real thing we need is more time.

We need time to develop these methods, to interact with NRC, get agreement on better methods that achieve better realism. And this really needs to be done in a way where the large number of plants coming in post-Oconee has some opportunity to take advantage of this and get better methods into their base model so that they don't go through this process of RAIs scrutinizing their deviations from 6850 and every plant individually having to justify at some level of proof which converge on deterministic, you know, why the methods they are proposing are reasonable.

As we will lay out here later in the meeting, we believe that by fourth quarter this year we can develop and revise interim methods for some of the key areas. This has been a message we have received from the subcommittee, the idea of trying to hone into a few key areas that could achieve a good deal of the improvement that needs to be achieved.

We'd really like to get to a point where we have methods that are not going to cause NRC staff consternation and result in RAIs and the process that Donnie just went through.

We'd like to have methods that there's agreement on, sites can use them, peer review to those methods and NRC can accept them.

That would get us closer to the intended use of the fire PRA peer review process, which we really don't want the peer review process to be a compliance audit to 6850. We'd like the peer review process to do its intended function of a technical review to the standard using a team of experts and looking for real insights and issues in the model.

And you can use a lot of time trying to go through a checklist of 6850 and the peer review that could be better spent looking in more depth at the model.

There's been a lot of discussion of the FAQ process. And I wanted to try to clarify why we expressed some concerns about that last month.

There was a letter that was provided to NEI back in June of 2009. At the time, NRC had established a revised FAQ process specifically for fire PRA issues.

And as their letter indicates, their process was focused on achieving clarity. They wanted in the interest of clarity, they wanted to have very clear positions expressed by NRC so there was little opportunity for misunderstanding.

The interesting quote, I think, that's in that letter is the "FAQs must give appropriate consideration of the balance between realism and conservatism in the fire PRA."

I think when we talk about the FAQ process, it was, in fact, focused exactly as that stated. The process really wasn't aimed at realism. It was aimed at, quote, a balance of conservatism and realism.

And how that's exactly defined can be difficult or in the eye of the beholder, but this is the first time that, you know, this is, again, I think, unprecedented where you have a regulatory application where the regulator states in writing that there is an expectation for some conservatism in the PRA.

The PRA policy statement discusses the need for realism consistent with the state of the art. And we believe going forward, we would all benefit from a process that could be focused on realism as all the PRAs we've done up to now have been.

MR. MOULTON: This is Charles Moulton from the NRC staff.

Just so we can achieve some clarity since that seems to be our goal, the purpose of that June 2009 letter was not to set up an alternate process for FAQs related to PRAs, but in fact to achieve closure on the PRA-related FAQs that were open at that time that had been open for essentially a year or a little bit more that we had not achieved any sort of meaningful advancement on.

So, it was a method to close out those questions and not a - necessarily a method for every single PRA FAQ going forward. That was the intent of that letter.

CHAIRMAN STETKAR: Thanks, Charles.

Biff, I was looking through the presentations. Is this our only opportunity to kind of quiz you, the industry, about the FAQs or are you going to have --

MR. BRADLEY: No.

CHAIRMAN STETKAR: - a separate discussion?

MR. BRADLEY: We have - many of the methods we're going to be discussing involve FAQs. So, in terms of the overall process -

CHAIRMAN STETKAR: The overall process, this is it.

MR. BRADLEY: Yes, yes.

CHAIRMAN STETKAR: Let me ask you then because the paper that you distributed was rather critical in some areas in the FAQ process, and I was curious that there were statements that said that despite strong technical work done by the industry, the staff's resolution of the FAQ basically held to the guidance in NUREG/CR-6850 or something to that effect.

Do you have some specific examples?

I'm trying to understand what - I can listen to the rhetoric, but I'd really like to understand a bit of a couple of real specific examples to sort of understand what you're up to.

MR. BRADLEY: Yes, we have examples. I think they're captured in our presentations later.

CHAIRMAN STETKAR: Okay. If I'd ask the presenters when you come up, if there was an issue that came up as far as part of the FAQ resolution on that particular technical topic, if you can highlight that just so I can kind of mark it and understand a little bit because -

MR. BRADLEY: Yes.

CHAIRMAN STETKAR: - as I said, the rhetoric is rather strong.

MR. BRADLEY: Yes. And, you know, I think just to give you my perspective, a lot of it had to do with the level of proof expected to justify the method and the expectation that outcomes needed to be bound in the model.

I think there were a lot of very good, but possibly deterministic kinds of thinkers on the - in the process and maybe not a lot of previous exposure to PRA methods or, you know, much exposure to deterministic bounding methods. And I think that just sort of played out into the process, but I will let others -

CHAIRMAN STETKAR: Okay. If you can. As I said -

MR. CANAVAN: John?

MR. BRADLEY: Right.

CHAIRMAN STETKAR: - the specific presenters - Kenneth, do you -

MR. CANAVAN: Ken Canavan, Electric Power Research Institute.

There's a presentation devoted to FAQs

tomorrow.

CHAIRMAN STETKAR: Oh, there is? Okay.

MR. CANAVAN: Yes.

CHAIRMAN STETKAR: I missed it.

MR. CANAVAN: And that presentation really deals with just the technical content of each FAQ -

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: - the status of its resolution and future research. So, we'll get into some real -

CHAIRMAN STETKAR: Thank you. I missed that one. I stopped when I saw NRC presentation on it.

MR. BRADLEY: Okay. Thank you.

MR. CANAVAN: Thank you.

MEMBER BLEY: Back on your last slide, Biff, the wording about appropriate consideration of the balance between realism and conservatism, I would have thought whoever drafted that was really getting at the issue of uncertainty.

And what traditionally we've done is if you don't put enough effort into the uncertainty area, you have to take some conservative approaches to make sure you're bounding the problem.

I haven't heard you say anything about

uncertainty and how that affects your objections to this statement and what's apparently rolled out of it.

Were you going to talk about that? Or if not, I'd like to hear something about it now.

MR. BRADLEY: We can talk about that.

The process of 1.200 and the standards requires explicit consideration of various forms of uncertainty. There are probably 30 or more supporting requirements in the standard that require that.

And it's usually done in conjunction with a realistic model, but with the uncertainties characterized and discussed and - versus putting the conservatism directly into the base model.

I think that's the difference here.

MEMBER BLEY: I missed the last subcommittee meeting and I apologize for that. I couldn't come. But I'm still where I was a long time ago, a little confused.

MR. BRADLEY: Right.

MEMBER BLEY: When industry and NRC work together to develop 6850, my impression was the hope was they've put kind of limiting areas, conservative, if you will, in places there that a thorough treatment of uncertainty could address more directly.

I would have also assumed if one puts

forward that uncertainty analysis, you have to justify it, which you always have to do.

So, I'm just a little confused and -

MR. BRADLEY: Let me -

MEMBER BLEY: It sounds like industry has walked away from 6850 and pretends as if they have no part in it, which makes me a little -

MR. BRADLEY: No, no.

MEMBER BLEY: - a little lost here.

MR. CANAVAN: Might I comment?

MR. BRADLEY: Go ahead, Ken.

MR. CANAVAN: Ken Canavan, EPRI again.

I actually encouraged everybody during their presentations, to put back in 1011989, but it's very difficult for them to say. Under no circumstances should anybody perceive any of these discussions as an indictment of NUREG/CR-6850 EPRI 1011989.

I'll have a further discussion during my presentation. But I believe that if you read that document, in the front of it there's an expectation for it to evolve. There's an expectation that those methods will move forward.

Where we are stuck, in my humble opinion, is our ability to move those methods forward in an efficient and effective manner. And that's what a lot of these discussions that you'll hear are about.

And we all have a lot of ideas about how to do that. And hopefully by the end of these two days, some of those are coalescing with you on how we can -

MEMBER BLEY: That will help me a lot if you can get to that point.

MR. CANAVAN: I hope to.

MEMBER BLEY: And from everybody who presents, if you can put a little of the objections in terms of uncertainties, it would help me as well.

CHAIRMAN STETKAR: Biff, before you go on, this is, you know, you know how the subcommittee operates. Their schedules are a suggestion. I've forgotten my train of thought. That's why it's a suggestion.

Did either of the pilot plants actually quantify and propagate uncertainties in their overall fire PRA results?

I've forgotten. I haven't read the full Harris submittal, and I don't have the Oconee submittal. So, I don't actually recall.

MR. BRADLEY: Dave Miskiewicz is indicating, I believe, that they did not.

Dave, do you want to speak to that? You're probably the resident expert here.

MR. MISKIEWICZ: Yeah, we did not, you know, propagate the, you know, the numerical uncertainties through the models the same way as we do the internal events models.

So, we use the same fault tree models for the fire PRAs we do for the internal events, and we propagate those uncertainties through the internal events.

But when it came to the fire PRAs, the matter in which they are constructed does not lend itself to working through the tools to do that because each fire scenario can have different probabilities for the same sets of events due to the spurious probabilities being different for different things. And it led to some difficulties in making the tools understand that work.

So, we didn't do that, but we did treat the uncertainties in the form of the - qualitatively for each of the different areas and talked about conservatisms or non-conservatisms.

CHAIRMAN STETKAR: Dave, let me make sure I understand.

Are you saying that you didn't do it

because the soft - the particular software tool that you were using didn't support -

MR. MISKIEWICZ: That was -

CHAIRMAN STETKAR: - quantification of uncertainty?

MR. MISKIEWICZ: That was part of the reasons that we didn't do the numerical propagation through.

CHAIRMAN STETKAR: Oh, that's interesting. Okay. Thank you.

MR. MISKIEWICZ: David Miskiewicz, Progress Energy.

MR. BRADLEY: Should I go to the next slide or are there any more -

CHAIRMAN STETKAR: Yeah, you can try.

(Laughter.)

MR. BRADLEY: I'll try. And this may, I think, be pertinent to the discussion we're having as well.

Reg Guide 1.174, as everyone knows, provides the framework for everything we do in risk-informed changes to the licensing basis. And it's been around for ten years. I think it's a very good document. A lot of good thinking went into it.

It is a risk-informed approach. It's not risk-based. And it discusses the five elements of a risk-informed change to the licensing basis. And those are to address not only the risk insights, but as well the safety margins, defense in depth, performance monitoring and how you comply with the regulation.

805 is not unique in that it - this - process 1.174 should apply to 805. And the - there was a reason 1.174 was not risk-based. And part of that had to do with the consideration of uncertainties, defense in depth, margins. All those areas have to be addressed as part of the process, and they can temper the results of the model or lead you to make decisions that are informed by other things than just a number.

I believe that that process was intended to address a lot of the issues that we're coming up against now, but now the tendency has been to try to put more emphasis on the number rather than using the other elements of 1.174.

We're seeing that here with the expectation for some balance of conservatism in the PRA.

I do recognize there are uncertainties and fire is a more challenging area than internal events and we're also earlier on in the process. We had 20 years or so to work on internal events and now we -

MEMBER POWERS: Isn't that what makes it more challenging, I mean, rather than - there's nothing inherent about fire that makes it more challenging. It's we just had less experience with it.

MR. BRADLEY: Yes, well, some might argue that there are some inherent issues, you know, with being able to model how a fire really grows from a small source, but that's a subject for the experts to debate.

But certainly we have less experience here especially with a widespread regulatory application where we're trying to make a lot of decisions in the plant on the basis of deltas.

This is a very expansive application and it is a challenge to a relatively new method.

ME3MBER POWERS: Certainly, if I look at the PRAs for internal events that were generated in the early eighties compared to what's generated now, they were crude.

And so, you can expect things to be similarly crude as you start doing fire PRA. They'll get better with time.

MR. BRADLEY: Yes, absolutely. And we believe we can evolve these methods, but it's going to take a little time. And, unfortunately, we all don't have the luxury of that given the schedule for 805. So, I think that's the central problem that we're dealing with here.

Ray.

DR. GALLUCCI: Ray Gallucci, NRC.

I want to point out that the first fire PRA was done as an appendix to Wash 1400. There were full fire PRAs done in the late seventies and throughout the eighties.

So, fire PRA has existed as long as internal events. You can debate the degree of developments relative one to the other, but fire PRAs have existed as long as internal events.

MEMBER POWERS: But, I mean, the real salient issue is the degree of development, Ray. I mean, that is the debate.

MR. BRADLEY: Right. It's one thing to have a model that may provide insights or vulnerabilities. It's another thing to have a very detailed model that's being used to make very specific decisions on the basis of deltas on a very, you know, a lot of these are very complex analyses.

I think there is a little difference from what was done 20 years ago for maybe, you know, or for the IPEEE versus what the expectations are today.

CHAIRMAN STETKAR: Well, most of the IPEEEs were not what we would call fire PRAs. So, let's be clear on that.

MEMBER BLEY: But some were.

CHAIRMAN STETKAR: Some were. But most, I believe, were fairly -

MEMBER SHACK: I think something like 40 percent, if I recall. But, you know, they may not have been the most sophisticated PRAs, but they were PRAs.

CHAIRMAN STETKAR: Sixty percent is still most.

MEMBER SHACK: But forty is not a, you know, it's not -

CHAIRMAN STETKAR: Oh, no, that's -

MEMBER SHACK: It's not trivial.

CHAIRMAN STETKAR: But the point is work was done back in the eighties. Work was done in the late eighties and early nineties to support the IPEEE process. And, granted, the - I think the problem is the IPEEE focus was for identifying vulnerabilities. It wasn't necessarily focused on trying to develop a realistic estimate of the fire risk.

So, even the fire PRAs with all these tools, a guy generally develops them as far as he needs to for his purpose. And, you know, we're asking these things to do a different purpose than we did before.

MEMBER SHACK: Right, right, right.

MEMBER POWERS: The PRA for internal events was developed in an environment where it was a research kind of effort for a very long time before it was part of the regulatory effort.

And I don't - I mean, if the sainted Professor Apostolakis were here, he would say that the trouble is that he can look at some of the work he did back in the eighties on fire, and he can look at more recent fire PRAs, and still be comfortable.

The technology just didn't progress at the same rate that the internal events were going along. Similarly, I think, some of the phenomenological model isn't just now getting to kind of level where it supports detailed PRAs of the type that maybe you need in connection with greater realism.

CHAIR STETKAR: You're next.

MR. BASSO: Good morning. I'm Tom Basso from NEI, and I want to talk about a couple other concerns not directly fire PRA related with the transition to 805.

I talked last time about the treatment of safe and stable, and bring it back up for a couple of reasons. One is it was identified late in the process.

And, you know, being that it was late in the process, if it doesn't get resolved -

CHAIRMAN STETKAR: Tom?

MR. BASSO: Yes.

CHAIRMAN STETKAR: For the benefit of the subcommittee members who were not here in November, please review what the concept of "Safe and Stable" is and why it's important, because that context is important.

MR. BASSO: In a Duke submittal in their LAR, they were - their "Safe and Stable" condition was going to be hot standby. And an RAI was issued to do - that said, they didn't demonstrate that they can be in that condition indefinitely.

And we - our position is that we didn't have to demonstrate that you needed to be in a safe and stable condition indefinitely. There's nowhere in the regulations or in the guidance that says "indefinitely."

805 does say you have to achieve and maintain it. And I guess it's what we are defining as "maintaining." Maintaining could be a lot of things. Duke's position was that they can be there for at least 72 hours and they would have actions after that.

So, in response to the RAI, Duke changed their position. They're going to have their position of safe and stable as hot shutdown.

Now, what that's going to do is they're going to have to go back, do more analysis, additional work to look at the components in order to get to hot shutdown and maintain hot shutdown.

So, this issue came up recently in the last month or two. It was a late-breaking issue. And looking at it from an industry perspective has significant impact to all the other non-pilot plants, because they're far enough in their analysis they've already established their safe and stable condition.

So, with this interpretation that had to be indefinite, that would then change where some of the other stations would put their safe and stable condition.

CHAIRMAN STETKAR: Tom, regarding that if I'm making - and this is probably more a question for the staff, but they can listen and respond later.

If I'm using an internal event PRA model today - I haven't made the transition to NFPA 805 to justify tech spec change or, you know, in-service inspection change or things like that - that PRA model defines success and failure.

What's the definition of "success" for the internal event PRA models that are being used these days?

MR. BASSO: I'm not a practitioner, so -

MR. BRADLEY: Well, there's a mission time. Maybe one of our PRA technical experts can speak to that.

Steve Dinsmore is going to speak to it.

MR. DINSMORE: Yeah, hi. This is Steve Dinsmore from the staff.

I know a little about this because I was investigating it the other day. But the internal events, the PRA, you go to 24 hours. If you can't demonstrate that you're safe and stable, you can simply put the frequency of that sequence in the core damage if you demonstrate you are, or you could extend 24 out to 36 at the point that you can demonstrate you're safe and stable.

So, it gives you an out. It gives you a way to just say well, this scenario, we're not quite sure what it's going to be, but we'll put it in - so, we'll put it in core damage.

We couldn't quite figure out -

CHAIRMAN STETKAR: Wouldn't the same concept basically apply, though, in a fire PRA?

I mean, I don't understand why -

MR. DINSMORE: Well, they'd have to take the scenarios and turn them into core damage scenarios. And I don't think that's the intent of -

CHAIRMAN STETKAR: No, I'm talking about the success path, Steve, that - I guess I didn't quite understand your discussion of the success path in an internal event PRA.

MEMBER BLEY: And when you go through it again, would you link it to the basis for this?

I don't recall ever hearing this before.

MR. DINSMORE: Okay. the standard says if - you've got to look at 24 hours. If within 24 hours you've reached a safe and stable state without really defining the - that's it.

If you're not sure, you can either extend the mission time or you can simply say well, that scenario goes to core damage.

MEMBER BLEY: Now, when you say -

MR. DINSMORE: If anybody else has - this is what I was reading the other day.

MEMBER BLEY: Well, if you're not sure, I mean, as far as I've seen, internal event PRAs go out to essentially 24 hours unless there's something going on that you could see will cause trouble in the near future.

But if everything appears stable, nothing else is changing to get you in trouble soon, that's where the analysis stops.

Why is the fire different?

MR. DINSMORE: I wasn't getting to the second one. I was just - you were asking what they do with the internal event PRAs.

MEMBER BLEY: Yeah, but they don't turn everything at 24 hours into core damage. They -

MR. DINSMORE: Well, they do if you can't - if you're not convinced that in 24 hours it's -

MEMBER BLEY: Well, that's right, or you take the time out further.

MR. DINSMORE: That's right.

MEMBER BLEY: But it sounds like the discussion here is about is there something more that needs convincing for safe and stable for a fire PRA than for internal events?

I'm not - I'm confused, honestly.

MR. CHAPMAN: Jim Chapman, ScienTech.

I don't think this is a fire PRA issue. This is a deterministic issue.

CHAIRMAN STETKAR: Well, but it's been presented in the context of Oconee needing to make changes to their fire PRA submittal for NFPA 805.

MR. BASSO: No, it's actually in -

CHAIRMAN STETKAR: Or I'm misinterpreting something.

MR. BASSO: It's not in their fire PRA submittal. It's in - they're going to have to look at any variances from deterministic results. They're going to have deviations.

They're going to have to look at now since they're going from hot standby to hot shutdown, there's other equipment they'd have to consider getting to that condition. So, now they have to evaluate those other components to get there.

So, they're going to a different - they're going to a different condition in their station for a hot - for a safe and stable.

So, there's more components and things that they're going to have to evaluate.

MR. LAUR: This is Steve Laur from the NRC staff.

I think Jim Chapman hit the nail on the head. This is not a PRA question.

CHAIRMAN STETKAR: Okay.

MR. LAUR: Okay. The NFPA 805 has performance criteria, performance objectives, performance goals, I forget what the hierarchy is. And if you meet the deterministic requirements of 805, you have to - you are deemed to meet these performance goals, objectives and criteria.

If you want to use a performance base, you have to contrast the risk of not meeting those deterministic requirements where you don't comply with them.

Okay. The safe and stable comes up in the performance criteria. That is you have to be able to achieve and maintain a safe and stable condition.

Now, I don't believe the staff actually said - we may have used the word "indefinitely" because we didn't want to say 30 days like is used for some analyses, because we don't have a time frame. There is not a time frame in the rule.

But what we don't want is to have a hypothetical licensee come in and say we can go X hours and then fall off a cliff.

And if you contrast the two pilots, the

one pilot made a case that they can maintain, I believe, hot standby in the case of Harris, and that was it.

I mean, we didn't look into can you cool down, do you have to cool down, because 805 allows you to pick the safe and stable condition which can be cold shutdown, can be cold - hot standby, hot shutdown, etcetera.

MEMBER BLEY: So, the difference in the two cases is one provided an argument why they were safe and stable, the other you didn't find an argument that was convincing.

MR. LAUR: Right. And that's pre-decisional at this point, so I'm partial to saying -

MEMBER BLEY: Yes, that's okay.

MR. LAUR: But the point is it's not a time like 72 hours, 80 hours, a hundred hours. It's more have you reached a point where it's routine actions?

And we even gave examples in some of the meetings, I guess, where if you're filling a condensate storage tank, and that's a normal action, or refilling a diesel generator fuel tank, that's a normal action.

But if you have to go and you're still doing repairs, for example, or what they call recovery actions in 805 after some drop-dead point, then just like in a PRA you have to extend the time.

CHAIRMAN STETKAR: Thanks.

MR. LAUR: Thank you.

CHAIRMAN STETKAR: I'm now going to try to keep it moving along -

MR. BASSO: Okay.

CHAIRMAN STETKAR: - because we do have a little bit of a schedule concern.

MR. BASSO: Well, I was bringing this up as an example of a late-breaking issue that had a significant impact of the transitions at the other stations.

Fortunately, we believe through the FAQ 54, we are coming to a position. The staff offered some changes to the wording of the FAQ that that's going to help us resolve this issue.

CHAIRMAN STETKAR: So, going forward with the remaining plants, there's at least more clarity and understanding of -

MR. BASSO: There's more clarity now. We believe what they're proposing is going to take us there.

The second point I have on here is resolution of pilot issues being referred through licensing conditions or transition actions.

And Biff kind of brought it up around in the PRA standpoint where now the post-pilot plants are not going to have the benefit of understanding, you know, how the second pilot is going to resolve those items because they're going to have about two - they're going to have two years through their transition to resolve these open items.

The post-pilot plants are going to have to have their submittals in within the next six months. So, they're not going to gain the insight from those items that are still open issues.

That also brings me to the third point about the compressed post-pilot submittal schedule. And I know Danny Pace is going to talk a little bit more about that. And, you know, what that is going to do, and I'll talk more, is it's not going to let us take advantage of some of the improvements that are going to be made in the fire PRA area.

Go to the next slide. So, just to put it in a little bit perspective, you know, post-pilot plant transmittal, you got 23 LARs being submitted by the July time frame based on the current schedule of getting the Oconee safety evaluation in December.

And the staff even recognized the

challenge that this proposes getting all of these submittals in and that the staff has gotten approval to extend the acceptance review from 25 days to 60 days.

So, we have all these submittals where you have acceptance reviews and then it's the review cycle.

If you look at the pilots, the pilots took over two years to get approvals of their LAR submittals. Originally, it was estimated to take six months.

So, you know, these are very complicated submittals. And what that's going to translate to in reviewing 23 submittals and, you know, I would think the goal - I believe the goal is to get them reviewed within two years, get their submittals out in - reasonable is two years. There's going to be multiple teams reviewing these complicated submittals.

Next slide. So, in November NEI did submit a letter for the industry recommending a staggered approach for the submittals. And the staggered approach would allow us to take advantage of the improvements in a methodology.

No, it doesn't address the first plants that would be in the queue. I mean, it could depending on if RAIs come out. They can respond to the RAIs based on, you know, improvements in the methodologies.

But the stagger approach for a large number of the non-pilot or post-pilot stations, they'd be able to apply those methodologies.

Also, a stagger approach will let them take advantage of a number of lessons learned. Lessons learned from the pilot as Duke works through some of their open issues, you know, we will maintain that communication in the industry through NEI to feed back to the other post-pilot plants the lessons learned, how they're responding to those open issues.

Also, some of the fleets, you know, they have two, three stations that they have geared up, you know, to make submittals. They'd like to take some of the, you know, when they get one submittal in, they like to roll in some of those lessons learned into their other stations.

And then RAIs that any of the early plants do get, we will share throughout the industry. And a staggered submittal approach would allow us to do that.

We also believe that there would be more consistent reviews. There won't be as many teams that are necessary to do these reviews. And, therefore, the staff and then the industry can also maintain more consistency throughout the review cycle of all the submittals.

And, lastly, we'll promote a more stable and predictable and efficient transition. I use the example of, you know, license renewal. I think it was understood when license renewal came about, the industry got together with the NRC and the staff. They realized hey, to do the right - a good job at reviewing these submittals, we need some kind of staggered approach.

And so it was agreed upon that we did that in license renewal and were able to take advantage of a lot of things that I talked about.

Okay. On the contrary, if we don't have the staggered submittal and we have the compressed schedule, the concern is we will lose that opportunity to take advantage of the improvements in the methodology.

The likelihood of inconsistent reviews increases. Review delays will place - delays in reviews will place burden on the licensees.

And if you consider this, you have - if a plant has their submittal in for several years, you know, a lot of these submittals are getting supported by PRA practitioners and other resources that are contracted. So, they're going to have to be able to manage those resources. There's not so much even the financial impact, but also these resources are getting pulled for other PRA-type work and applications. So, it's going to impact that.

MR. BRADLEY: Okay. I know we're behind. Let me just conclude our presentation getting sort of back to the fire PRA issue here.

As I mentioned, we need two things to get to where we believe we need to be. One is time, and the other is a process that's focused on achieving realistic results.

We've done our best to document what we believe are the sources of conservatism and the areas that need improvement and look forward to the staff's discussion of our paper and the committee's reaction to that as well.

We did put a lot of effort into that. I know we've been doing a lot of complaining and we wanted to make sure we put some hard evidence on the table. So, that was, you know, we hope we've done that.

Continue to believe that this is a -

potentially can all come out fine and that we can have fire PRAs that we can use in the sense we use internal events for a number of applications and not just NFPA 805. Would like to think we can use the same fire PRA for 805 that we can use for all the other uses of PRA.

Right now there seems to be a little complication with the expectation for some level of conservatism to support 805, but many of our other applications really - that just complicates certain other applications where we're trying to make decisions that are also informed by our internal events or other models.

As Tom mentioned, the staggered submittals are helpful, but it's not a total solution to the PRA issue, and we look forward to continuing to work with the staff to try to make this all come out in the best way.

So, I'm going to close. Any final questions?

CHAIRMAN STETKAR: Biff, thank you very much.

MR. BRADLEY: Sure.

CHAIRMAN STETKAR: And Tom. Next on our schedule, we're running behind, but that's okay. I guess we'll hear some introductory remarks from the staff.

Sunil, are you -

DR. WEERAKKODY: Yes, Mr. Chairman. I just received the staff most updated slides. So, I'm requesting time to upload this.

CHAIRMAN STETKAR: You can have time to upload it. We're not going to take a break yet though because I don't need one.

DR. WEERAKKODY: The staff can help.

MEMBER POWERS: You're a chairman after my own heart.

(Laughter.)

(Whereupon, the above-entitled matter went off the record at 9:37 a.m. and resumed at 9:39 a.m.)

DR. WEERAKKODY: Shall we start?

CHAIRMAN STETKAR: Whenever John --

DR. WEERAKKODY: We are back.

CHAIRMAN STETKAR: We're back.

DR. WEERAKKODY: We're back.

CHAIRMAN STETKAR: Sunil, it's your show.

DR. WEERAKKODY: Okay. Thank you.

For the record, my name is Sunil Weerakkody. I'm the deputy director, fire protection, Division of Risk Assessment in NRR.

What I wanted to do is I want to make sure when I conveyed what I call the management remarks, I do it in a way so that it's really in the construct of the Commission SRM.

So, I have three slides that simply goes over the exact words that we received from the Commission.

One of the sentences is, The ACRS should conduct a review and report back to the Commission on the current state of licensee efforts for transition to 805.

Next slide. The second statement in the same SRM - second statement said, "The review should include methodological and other issues that may be impeding the transition process, lessons learned from the pilot projects and recommendations to address any issues identified."

Let's go to the next one. "The review should determine whether the level of conservatism of the methodology is appropriate and whether any adjustments should be considered."

What I want to do is at this stage before I get into, you know, making some negative remarks, have, you know, convey to the staff that we really have a forward focus vision on this whole issue.

We really like the fact that the Committee is doing this. We are - we do look forward to receiving ACRS' input to help define our regulator processes. We are waiting for your report. If we have to do that, we'll do it.

And we have the director of research in charge of Fire Protection activities, Christiana Lui, sitting there. And if you get any insight from your input with respect to how you need to test our research, we look forward to that.

One of the other main points I want to mention is that NRC staff fully endorses industry initiatives to reduce uncertainties associated with fire PRAs.

You know, thinking back to the same discussions we have had two, three years ago, we are very encouraged that when the industry come to forums like this, they come in with proposals as to what they would do to solve or refine some of these uncertainties in fire PRAs.

Obviously, we like to see, you know, how much money and when certain things - because if you ask us, our Office of Research, we continue to enlist a significant amount of resources to enhance our understanding of risk-critical fires, because we know that it is a very risk-critical area, you know.

As we've heard this many times, if you look at the core damage frequencies of plants, you know, there's plants where the significant portion of the fire risk isn't even by fires. And that's what I got.

So, we do research if you suspect conservatisms, but we also do research if you suspect non-conservatisms. That is our job.

And along those lines, NRC, the Office of Research, again I'm speaking for the Office of Research because I'm sitting here, we continue to look forward to work in collaboration with EPRI on areas of common interest.

We have done that. I think Member Bley pointed this out. NUREG/CR-6850, I recall a time, this is five years ago, when we issued the rule. And when NRC and EPRI came out with 6850, I was, you know, as the branch chief of fire protection, I was elated. Because at the time, we were looking for a well-established guidance relatively speaking that would assist the plants who are transitioned into 6850, do their job.

And I think 6850 did that. And I think the only part that bothers me is when we convey, you know, I think, again, you know, that Member Bley pointed out, you know, the word "rhetoric."

Let's not, you know, it was a great stepping stone. Let's first peg that and let's move forward as opposed to saying it's this and it's that. So, in that context we really look forward to continued improvement.

Next slide. Now, this is where I really want to convey a couple of key messages. There is a issue on the table, and that's why the Commission basically asked the independent ACRS views on the subject with respect to fire PRAs.

But unless we confront and disposition some of the distractions that are being talked about, we are not going to get from Point A to Point B fast.

In that context, I'm going to make some critical remarks using some of the statements that was made right here by the Nuclear Energy Institute and I don't know whether EPRI or who. But the point is it doesn't matter who made them. The point is let's put them on the table and talk about them and get those behind us once and for all.

And the reason I do that, the reason I want to do this is as long as we don't confront these and discuss them, this type of statement would tend to kind of keep us all wrapped up in unnecessary hype because we did and we do have a great program Office of Research working with EPRI that has worked to refine some of these uncertainties, and that's gone.

And one of the statements that I heard over and over again on this podium is the one that I put that down there. "The uneven level of conservatism may mask key risk insights and confound decision making."

Now, I have some benefit here when I say based on my past experience with respect to the last bullet.

Like a number of you in the audience, I have had the privilege of working the PRA area for close to two decades.

Okay. So, when I read the first statement, I am not necessarily speaking only as a managing agency, but thinking back to some of the experiences I have had personally in the areas of IPEEEs, the Generic Letter 8820, Supplement 4.

And my statement here is "Over the last two decades, fire PRAs have matured sufficiently to enable NRC to make licensing decisions with respect to NFPA 805."

I put it this way and I made the similar statement the last time when we met, because I want to make the management remarks within the context of the Commission direction which is to find out how would this issue influence 805. And I have a couple of reasons as to why I feel pretty strongly about that.

One is with respect to what 805 does. And what it does is it primarily, it enables the licensee to evaluate their plants against the deterministic requirements. And if they don't comply with those, use calculations to either justify existing the way they do or move forward.

And, you know, and an example could be there, a licensee might find that there are cable trees are separated by not 20 feet, but by 19 feet or 18 feet. 18 feet.

You could do a fire PRA to show that that's okay, the delta risk is negligible, and move forward.

In that context when you apply fire PRAs in spite of all the issues we discussed today, I feel very comfortable saying that it has over the last 25 or 20 years, it has sufficiently matured.

And one of the personal knowledges I take advantage of when I made the statement is what we did with respect to the IPEEEs.

As a number of you may recall, when

Supplement 4 of Generic Letter 8820 came out, I was at the time, working at Northeast Utilities and my boss assigned me as the IPEEE coordinator.

Okay. And one of the things I had to decide was for the four plants that we supported; Millstone 1, Millstone 2, Millstone 3 and Haddam Neck, should we use the fire PRAs or should we use the fire methodology?

After looking at the plants, and I know you will talk amongst yourselves with respect to the percentage, I recommended to my boss, let's do two fire PRAs and two fire methodologies.

Okay. I didn't compare to the 6850 methods that we have in place today, but rather compared to the tools that we had at the time, you know.

6850 is kind of like God to me. Okay. Because what I did was as the coordinator, we had - the Generic Letter came out. They announced it was very specific as to when to get in these submittals identifying the vulnerabilities of those plants.

If you recall, one of the primary purposes of that Generic Letter was to say do an investigation and tell us if you have plant-specific vulnerabilities.

And 25 years ago I would say we had a good enough tool to do that job. Even fire was adequate.

In fact, even though I don't remember a lot of stuff that happened yesterday, I still recall some of the vulnerabilities of the four plants I looked at.

Okay. So, the point I want to make here is whenever you ask the question of sufficiency, I think you said this, you tie it to an application.

The fire PRAs 25 years ago were sufficient for me to do my job even though I did it by calling, I think, you know, Yankee Atomic, you know, Jim Chapman, and I said I need a consultant who knows fire PRA and he enabled that, but it was sufficient.

So, again, with respect to 805 when you look at it's my plant, if it is not meeting my well-founded deterministic requirements, is the tool sufficient to make a determination that can I deviate from in a safe way my personal need? And a remark I like to say is that it is acceptable.

And then if I go to the second bullet, "As set forth in Reg Guide 1.200, the licensee should identify the key assumptions for the application and identify appropriate sensitivity studies to support the decision making process," now, let me elaborate on this a little bit.

We're not dictating to 6850, you know. And I know the Committee hears that many, many times. We don't dictate 6850 through our licensing action process. We don't dictate 6850 through our peer review process.

What we do dictate, and we did it to the two pilots, is that if you deviate from a standard or normal method whether it's a topical or 6850, please tell us, you know. Give us the basis to do so, ask why you did so. Give us a technical basis. Not generalities, not fudge factors.

It can't be something like oh, the number is coming out too high. So, therefore, let me use the factor of three, and that we can't buy as regulators.

Okay. So, it is, and I'll say this as long as - and I know Donnie, he is very passionate about this too. We do not dictate the 6850.

We like 6850. It has great screening tools sometimes. It could lead to certain answers that appears high. And what we expect the licensee in those circumstances to do is, do your fire modeling. And some of the pilots instead of making the investment to do fire modeling, chose to invest in plant modifications.

Now, we have no complaints about that. Okay. We are not dictating to do that - that they do that, but I think the reason I'm repeating myself with 6850, once and for all we are not dictating 6850 on the licensees.

Let's go to the next slide. Okay. Some of the other things I want to - again, I will not go into the level of detail that I went with the first slide, but I do want to point to a number of presentations coming up for your information over the next couple of days.

In fact, one of the things that I wanted to make sure is unlike the last meeting, I basically told the cognizance NRC staff to be here and speak up. And if that's not okay, please let me know because I saw a couple of the staff members went to the phone during Biff's presentation.

The idea here is I want you to see the FAQ, because I know you'll go - you've got a lot of cognizant staff here, you know. Some of them had done reviews of Oconee, Harris. I'm basically inviting them to come up to the stage and give factual information that helps ACRS to make a good determination.

With that, let me go to the next one. "The manner in which fires are characterized in 6850 does not appear to conform with operating experience. The level of quantified risk appears to be overstated as compared to operating experience."

We have a presentation coming from Steve Nowlen. He's going to address parts of this. Okay. And let me leave at that.

"ROP experience is inconsistent with predictions coming form fire PRAs." Totally improper comparison.

CHAIRMAN STETKAR: Okay. You're going to have a presentation on it?

DR. WEERAKKODY: Yes.

CHAIRMAN STETKAR: I'm going to try to get us moving if this is some introductory remark.

DR. WEERAKKODY: So, may I make one more point? I have some strong feeling on the third point with respect to the FAQ process.

Okay. We establish the FAQ process when NEI requested that we establish process like - it worked great for us.

It had some issues, some problems. So, if somebody says hey, we could have done certain things differently, yes. Otherwise, we - to a great extent, it worked. Some of the PRA issues, I look back and say we basically say could have done better.

Next bullet. Again, there will be a presentation. Let's go to the next.

Let me just make a comment on this one. We have received the industry letter. I do not want to discuss the staff position with respect to that because the letter is at this time receiving Commission and senior management attention.

But in the meantime, our protest being what I say in the second bullet, we can make regulatory decisions with respect to 805. Some conservative decisions may occur.

But what I think the main point here that I want to make was when I look at the schedule of improving the uncertainties or reducing the uncertainties of fire PRAs, you know, that schedule, I don't necessarily tie it to the licensing.

Obviously, if we knew everything and all these issues were addressed, it would yield a more effective review process, but we can do our job even today.

Let's go to the next one. Again, I wanted to repeat my slide here because I did something that I normally don't do, which is to basically go down and point out some of the remarks that we want to kind of address head on.

Let's go to the next one.

CHAIRMAN STETKAR: Sunil, one observation or question from your introductory remarks.

Back on Slide 6, and you don't necessarily have to go back to it, I think in our November meeting we discussed briefly this notion of, if I can characterize it this way, adequacy of the PRA to support transition to the NFPA 805 licensing basis versus perhaps adequacy of the PRA to support risk-informed applications post-transition.

DR. WEERAKKODY: Yes.

CHAIRMAN STETKAR: Are you planning to discuss that topic or aspect of this process at all in any of your presentations?

If you're not planning to, I'd like to hear about it a little bit.

DR. WEERAKKODY: Okay.

CHAIRMAN STETKAR: So, it's kind of to alert -

DR. WEERAKKODY: Yes.

CHAIRMAN STETKAR: - you and the staff.

DR. WEERAKKODY: If you are referring to, John, how, you know, other risk-informed initiatives such as tech specs-

CHAIRMAN STETKAR: No.

DR. WEERAKKODY: Oh.

CHAIRMAN STETKAR: I think what we're hearing from the industry, is that the degree of realism, the degree of conservatism, the degree of uncertainty, however you want to characterize whatever that thing is, does not support realistic assessments of the risk and realistic risk-informed applications for a particular plant.

Your first bullet on this slide, and part of the discussion that we had in the November subcommittee meeting, seemed to indicate - and, in fact, the SER on Harris concludes that indeed the PRA submittal with other supporting information was adequate for the staff to make a conclusion that indeed the licensing basis for Harris could transition to NFPA 805.

So, therefore, you know, in the staff's determination, the PRA was adequate to support that decision.

From what I'm hearing from the industry, industry says well, that might be true, but you can't use the PRA for anything else because the PRA isn't sufficiently realistic.

So, I'd like to understand kind of the staff's perspective on that and also the industry. If

I'm kind of mischaracterizing a bit of that, I'd like to hear it also from the industry not necessarily now.

I see Biff kind of shuffling in his seat, but keep that in mind because I want to - our task through the SRM as Sunil stated, on one level, is to identify issues that could be impeding the transition to NFPA 805, so it's that licensing basis transition process, but I don't necessarily want to completely just disregard the going forward approach.

So, keep that in mind.

DR. WEERAKKODY: We were not planning a presentation, but we will come to you with a presentation with respect to the implications of this - I tend to use the word "uncertainties" as opposed to conservatisms, how it could impact on some of the other applications such as ROPs, such as - yes, we will do it.

CHAIRMAN STETKAR: Thank you.

Any other questions?

MEMBER BLEY: Yes. The industry is going to have a presentation on the FAQ process tomorrow. You talked about that you were pleased with it.

Can you just give us a few highlights of how you thought it worked and - because I wasn't directly involved.

CHAIRMAN STETKAR: You're pointing to -

MEMBER BLEY: Oh, you have it marked. Never mind. I'll hear it tomorrow.

CHAIRMAN STETKAR: That's Number 5. You pointed me to Number 6.

DR. WEERAKKODY: With respect to the specifics, we have several presentations on - technical presentations to some of those FAQs.

CHAIRMAN STETKAR: Yes, that's good.

DR. WEERAKKODY: Okay.

CHAIRMAN STETKAR: That's good. Any other questions?

Okay. With that, I am going to declare it time for a break. So, we will recess until 10:15, and we'll hear back from the industry.

(Whereupon, the above-entitled matter went off the record at 10:01 a.m. and resumed at 10:18 a.m.)

CHAIRMAN STETKAR: Okay. We are on and we are back in session. And, Danny?

MR. PACE: Members of the Committee, thank you for having me here today.

I'll start out with I'm not a PRA expert. I know enough to be dangerous about it. So, if you get into the detailed PRA questions, I'm going to refer to the staff here.

I have had associations with fire protection all my career, which is why I guess I continue to get invited to these sessions.

So, I started out as a system engineer on fire protection startup and was at Grand Gulf Nuclear Station, which was design manager when we had the pilot Appendix R inspections.

I was the engineering director at River Bend when we had the pilot fire protection functional inspections. And as I progressed through my career, I had responsibility for a fleet. So, I've been dealing with these same issues for 30 years.

I adhere to the practice that if two technically competent people sit down, they can agree on numbers that are realistic. And so I thought, wow, here's an opportunity to resolve this, the numbers and get technical people to agree with each other. So, I'll talk more about that as I get through here.

MEMBER POWERS: Getting PRA people together may be different.

MR. PACE: Yeah, maybe. We used to say that about I&C engineers, but -

MEMBER POWERS: Yeah.

MR. PACE: Okay.

MEMBER POWERS: Well, that's a given.

(Laughter.)

MR. PACE: These are the plants I currently have responsibility for: Beaver Valley 1 and 2, Davis-Besse and Perry. You see their stats there. For the sake of time, I'll move on, but a couple Westinghouse, a B&W, a GE, a partridge in a pear tree so far.

So, Perry is very similar to the plant I grew up on, I'll say. I actually certified on the Perry plant back in the days when I was an STA at Grand Gulf.

So, why did I make this ridiculous decision to drag my fleet into NFPA 805 transition?

Well, as I said, I saw it as an opportunity to bring real resolution to some of these multiple degraded shorts issues that we dealt with in the early eighties and manual operator actions in the mid-eighties and resolve these industry legacy fire protection issues that we have been struggling with.

I also am always looking for an opportunity for fleet standardization. And I think the only way to run these nuclear power plants is all the same. And the more we can make them all the same, the easier they are to run, the easier they are to raise standards.

And in my own selfish right, I use it to leverage improvements in my PRA models and my PRA staff. I came to FirstEnergy in 2005. We had a rather fragmented PRA staff with varying capabilities.

And so I saw this as an opportunity to do what I had done at my previous employer and pull that together in a very strong, simple organization with enough depth and succession capability for the practitioners in that area and build a real PRA staff.

I might tell you I hired a manager in that area, got 17 people and been spending about three million a year on model redevelopment - or been revising the models and putting them in standard form for the last several years.

MEMBER BLEY: You have one group for all your plants?

MR. PACE: Yes, they all report to one person, but there are people at the plants who report to that person.

So, there's a small staff in the corporate office that manages model maintenance, upgrade, development. And there's people at the sites who are site experts in that area.

I still have two fire models - actually, today I still have three. I'll soon be down to two different platforms. And as the technology evolves, maybe I'll get to one, one of these days. But Beaver Valley is a risk management plant and we're converting the other units too.

So, Beaver Valley, you know, NEI told us it would cost three million a unit. At the time, I was somewhat familiar with the process. I thought that's got to be ridiculous. It never took me more than 800,000 to a million to build a PRA model.

And so I came here, we said three-and-a-half a unit. That was - we were going to be done by 2008, submit it and have it in our rearview mirror.

It's 2011 here in a few days and we're at 15.4 million on those units and that doesn't include any NRC review costs. And, you know, more to come.

Unit 1 PRA model is complete, fire model is complete. We are doing ongoing refinements as you that do that, know will occur. And peer review is in January. Next month.

The Unit 2 model, we were bringing them together for a long time. And we stacked those dominoes and knocked them down so many times we decided to let Unit 1 follow as the pilot or proceed as the pilot. And when we thought we had a near complete product, Unit 2 will come behind it. So, it's 30 percent complete looking at peer review next summer.

Davis-Besse is going to be used in the Beaver Valley units as a pilot. And, you know, it started out at similar three million. It's now projected at nine million, plus NRC review fees. Got a full screening model. We're focusing on fire area modeling at this time. Our peer review there is in January 2012.

And our Perry plant which is a much more modern well-separated plant, like I said, much like Grand Gulf who had no manual actions and no multiply graded shorting issues that I'm aware of, will follow significantly behind those plants, I will say, if ever, at this point. That's further out than my horizon.

So, what are the key issues?

Some of the key transition issues is conservative methods being used in the fire PRA model. There has been a good bit of discussion on that this morning.

The schedule overlap between the pilot plants and post-pilots. We were going to see the pilot, get it done, then do ours and submit in 2008. And as you're all aware, we're still dealing with the pilots here.

And what that's done has caused me collapse within my fleet because we had all the plants scheduled out over a couple years between them. And now that the tidal wave has overcome them all, they're all on top of each other. So, that's creating a great deal of stress both in resources and in ability to manage that being a multiple front.

We talked a little bit about usability of the PRA in other risk applications. It needs to be apples to apples to be usable. And then cost benefit of the whole decision, we'll talk some more about that.

MEMBER BLEY: Are you going to talk somewhere in here about why these things cost you three to five times what you thought they would?

MR. PACE: Not specifically. I talked about it in previous presentations, but I'll give you a non-PRA analyst view of the world.

MEMBER BLEY: Okay.

MR. PACE: Doing the individual elements that go into the PRA model as much it can to stacking dominoes on every square inch of the floor of this floor of the building, and so you go about that with a certain set of assumptions and you very carefully stack all the dominoes. When you get them all stacked, you can run your model and quantify.

And the iterations have been going on on the variability and inputs. And what the rules of engagement have been is we get about three quarters of those dominoes stacked, and then come back and say no, we got to go back and change all the inputs.

So, we knock them all down and start back in the corner stacking dominoes with rebuilding the model. And the model has been built and rebuilt, and built and rebuilt and built and rebuilt at this point where all the page corners are curled and frayed. And it will be rebuilt again, likely, before next summer's submittal.

Now, that's the nature of building a very complex model with changing requirements, but that is all analyses.

Interestingly enough at Beaver Valley, we discovered some interesting insights on our fire protection program. And we've documented those and we're correcting those. But those would not have been acceptable under the current fire protection program.

I'd have to say at this point, we spent $20 million and we will not turn a screw or strike an arc in the plant on a modification.

So, we have a changed fundamental underlying safety of the nuclear plant. We have certainly much better documented it, if you follow me there.

So, the conservative methods in PRA is, as I understand it, is sort of the inability to change this 6850 requirement and the inability to learn from what the pilots have developed and what we've developed in many cases.

I see it akin to, if we were still stuck with Wash 1400, you weren't required - you weren't allowed to change anything in it. What would the internal events PRAs look like today, you know? They'd be pretty arcane.

So, in some ways you end up with a conservative best estimate model, and that sounds like an oxymoron to me. I'm not sure we can have both.

As a result, they're not comparable with our experience. All right. When you get ten to the minus third kind of numbers, even a nuclear engineer like me knows that means we have a fire that results in core damage in our fleet probably, whatever, less than a decade, right? Couple times a decade.

So, we should have with a hundred plants and a ten to the minus third, had fires and melted down five or six by now. And that doesn't comport with our experience in the industry, I don't think.

And the opportunities to use this to enhance - to facilitate better safety focus to improve our decisions around 805 and to use that fire PRA to support other risk applications will therefore be limited.

Because if the true value is, whatever that is as we see truth, if the true value was ten to the minus six or seven and you ended up merging that ten to the minus fourth fire model with your ten to the minus seven internal events model, you're going to have a ten to the minus four internal events model, right?

Is that about right?

So, now your decisions are made around a ten to the minus four fire model and it completely overwhelms your internal events model.

CHAIRMAN STETKAR: As an admitted non-PRA manager who understands an awful lot about nuclear power plants -

MR. PACE: Yes.

CHAIRMAN STETKAR: - the last couple of bullets there and the discussion that you just presented are - if I can characterize the - some of these issues, and you heard the previous discussion with Sunil, there seems to be concerns about transition to the NFPA 805 licensing basis, the amount of effort that's required, the realism in the supporting analyses.

And the last bullet on your slide there says, enable the fire PRA to support other risk applications.

That seems to be a concern looking forward after the transition; is that correct?

MR. PACE: Yes. I mean, we've got to use them eventually. Let me give you kind of a maybe overly-simplistic analysis. We're going to talk a little bit about fire cabinets and, you know, that kind of thing.

So, if I ran my combined PRA model, I take my fire and my internal events and I have now a PRA model that represents my plant, if I were running my internal events model, it might say that I would best use a few million dollars putting in an additional aux feedwater system. If you put one of those in, you get huge improvement in plant safety.

But when I combine these, it's going to say it would be best to use those few million dollars to move this 24-inch fire panel into another room.

And I think if you had realistic point estimates on how that fire panel reacted to the plant, it would not overwhelm the aux feedwater's decision.

That's what I mean by it will enable us to use the entire integrated model in making other risk decisions.

CHAIRMAN STETKAR: Today, right today, are most of your heartaches in the - recognizing all the money you've spent and all of the pain that you've gone through so far, are you more concerned about the use of those models after you transition - you've already indicated that the plants in your fleet are going to make the transition.

Are you more concerned about the fidelity of those models for post-transition risk-informed applications or are you -

MR. PACE: I would say -

CHAIRMAN STETKAR: - concerned about the transition process itself?

MR. PACE: Oh, I -

CHAIRMAN STETKAR: And that might be a little bit of a loaded question.

MR. PACE: - think the transition process itself may well be contentious. I don't know.

CHAIRMAN STETKAR: Okay.

MR. PACE: We're going to take exception to some of the things and provide our justification. Those may be welcomed with open arms saying yeah, we agree with you, and they may be, no way, go back to the brute force way. In which case that becomes kind of contentious, number one.

Number two, the amount of documentation we're having to build to support the deviations from 6850 looks like a two-volume set of an FSAR, maybe three, of engineering calculations. Very - cable by cable, terminal by terminal, function by function.

And the maintenance of that configuration is going to be a literal nightmare compared to a, say, shutdown analysis which is, in and of itself, was fairly complex dealing with every cable in the plant.

And third is if we are forced to use it under 1.200 to combine it with out internal events PRA, it's not going to be apples to apples.

CHAIRMAN STETKAR: Yes.

MR. PACE: I mean, it's apples to tanks. I mean, it's not even in the same gender. So, we've got to resolve that and we'll speak more about that.

CHAIRMAN STETKAR: Okay. Thanks.

MR. PACE: So, specifically some of the conservatisms that's been impacting our guys, I'll talk through some of these pretty quickly. I mean, you've heard presentations on these.

I understand you'll hear more tomorrow probably on them, but they deal with heat release rates and zone of influence of the fire, heat release rates and propagation of the fire, fire ignition initiation frequencies, and then I'll summarize with some compounding conservatisms and hopefully I'll get to below you all's understanding of our PRA because it's pretty crude. Mine is pretty crude.

So, heat release rates and zone of influence, the first one deals with fire ignition sources, heat release rates in the standard are pretty limited, you know, eight bins.

And, therefore, to deal with the components that we have in our plant, some of those bins cover a pretty broad spectrum. And, yes, we could probably go in and argue that my component doesn't fit well in that bin, but that is a justification. That's a deviation of 6850 and that's a regulatory risk on submittal. It would have to be something that we'll have to debate and others have been in the pilot, have not been successful in that.

Particularly, conservatisms that I'm going to share with you today is small electrical panels have the same heat release rates in the table as very large electrical panels. Small motors have the same heat release as very large motors. And, therefore, larger heat release rate, larger zone of influence, more cables are consumed in the fire, right?

So what? Wrap the cables, you would say. Well, this is a cumulative effect, right? There's dozens and dozens to these rooms. To go conditional probability in each one, those kind of add up, you know, a multiplicative effect. So, I'll give you some references here.

So, this typical fire protection electrical control panel is two feet square, four inches deep. It's probably got 20, 30 Number 10-gauge wires in it, right?

And this is an electrical process switchgear rack. It's stuffed full with racks and cables and high-power circuits.

Both have the same heat release rate in my model. So, if that 24-by-24 fire panel, it consumes all the cable trays above it in a very aggressive fashion and - so, it might tell me I need to move that panel rather than say that that's ridiculous, that panel can't have that kind of release rate.

On the left there, you'll see a ten-horsepower electrical motor. And on the right, you see a 600-horsepower electrical motor. It's about half the size of this table. Those have the same heat release rate in the model 6850 the way they've been grouped. And, therefore, I have to assume that ten-horsepower motor will have the same heat release rate and propagate the fire in the same fashion as the 600-horsepower motor on the right, as an example.

Another is transient combustibles. It's my understanding 6850 table requires 317 KW fires for all transient combustible fires. That's a 98 percentile fire, I guess you would say. You guys know more about what that means than me, but - so, I think that's very overly conservative for many of the areas in the plant.

If I had a locked, high-rad area where nobody is allowed to go in that area and it's a piping chase, I have to assume a 317 KW fire in there would consume all the cables and trays in that area.

So, the one I chose to show you here is the 142 KW fire is a 75th percentile. It's not even the point estimate. The point estimate, I believe, is like 69 KW for that fire.

So, if you have a room like this, the process rack area is pretty pristine. We don't let a lot go in those areas. We don't let a lot go in any of our areas of our plants nowadays if you haven't been in a plant in a while.

But in process rack areas, you know, it's not the kind of place you allow the engineers to stack their computer papers and the mechanics to haul lumber into and that sort of thing. It's pretty pristine.

This is not a staged picture. I told them I want a picture of this. They went out the day before yesterday and snapped a picture of this and put it in the presentation. That's the way it looks 24/7.

This is what a 317 KW fire looks like. Like a 30-gallon plastic garbage can stuffed full of paper and, I believe, one quart of acetone. That's one of the many 317 KW fires that were used to propagate that.

If I put that fire in any room in the plant, I'm going to have a problem. And what we're saying is that's not a fire that typically is available to many rooms in our plant. Most of the low-traffic areas and pristine maintenance areas in the plant, you don't get those kind of fires.

So, if you use a point estimate at 69 KW, we have very little to no issues. If you use a 98 fire or 317, we have issues everywhere. So, that's one of the things.

MEMBER BLEY: You're not the PRA guy, but what if you treated the uncertainty between those two point estimates because they do have a distribution in the guidance?

MR. PACE: It's a one, right?

A fire does occur at every place in the model. 1.0.

MEMBER BLEY: But they don't - but there is a range on the heat rates that are as described.

MR. PACE: It's described. I don't know.

MEMBER BLEY: Okay. We'll get that later.

MR. PACE: You can explore that with one of the experts tomorrow.

MEMBER BLEY: We will. Okay.

MR. PACE: So, it's a two percent chance I'd have that fire. You know, there's a two percent chance my diesel will trip two minutes into the run.

And if I assume that the diesel tripped two minutes in the run 100 percent of the time, I'd have a pretty risky plant. So, that's the way I see that one. I may be seeing that entirely wrong, but that's the way I see that one.

All right. The next has to do with these cable jacket materials. Just another example.

There's cables in there with thermoplastic fire propagation rates, heat release rates and propagation. There's cable data in there for thermoset, there's little - there's no guidance for mixed bands. And some of these cables, they pass flame spread rates, I mean, we put them in cable tray tests and can't get them to burn. We look at some of the tests they've run. They're pretty - they were established to burn. And in some cases, I understand we had to keep the heat source under them to make them burn beyond the 69 KW or even the 317 KW fire.

So, lack of specific guidance on that results in conservatisms embedded into the zone of influence on cables and the way it propagates tray to tray and what all has to get consumed.

So, part of what we're - next is ignition frequencies. There's been a lot of talk about this. I've heard it mentioned this morning using ignition frequency 6850.

Some of those are significantly greater than the fire ignition frequencies in the EPRI information.

You see the numbers there. Initial screening was 7E to the third. After we did the detailed fire modeling, we got it to 2E to the third.

Where we've evolved to now is about eight six to six. and if you use the EPRI number, it drops to six. So, about a 30 percent reduction in many of these areas.

We could say, so what? What's a 30 percent reduction there?

Well, it's a 30 percent reduction in many fire areas. And are we trying to - are we trying to build an elaborate analytical model that mimics deterministic feelings or are we trying to get an accurate projection of what the fire risk is in the plant?

And if you're trying to get an accurate projection of what the fire risk in the plant, many of these things need to be brought back to best estimate of values.

If you're just trying to build an elaborate menagerie that reflects deterministic feelings, then make everything 98 percentile and it's going to be robust, but not realistic.

So, conservative fire frequencies, modeling conservatisms, conservative heat rates, conservative fire growth rates, you know, conservative severity characteristics, if you take the most onerous fire initiation frequency and you apply it with the least capable fire suppression capability and you put in that the highest release rate of heat and the highest propagation rate, you'll burn everything up, right?

And that, in some ways, is what's - it's to the credit of the robustness to the way these plants are built, but these things aren't off the chart, to tell you the truth.

I mean, the fact that we're using all these 98 percentile numbers and we're still getting palatable, I'll call them, conditional core damage frequencies is a credit to how robust the plant is actually built.

MEMBER SHACK: Although, I as I read 6850, you don't have to use the 98th percentile. You could use the whole distribution, which would change your numbers.

I mean, that's a simplification you're making, and of course you're paying a penalty if you're using it.

MR. PACE: Do we not use point values in the internal events or did we start out with the 98 percentiles in the internal events?

MEMBER BLEY: I like to see people use distributions in the internal events.

MR. PACE: So, you guys can talk to the

experts tomorrow about that.

So, this is the way I see the industry, the plants as I've been following these. There's a distribution of nuclear plants in the U.S. on how much benefit they're going to get from NFPA 805.

If you're in a Grand Gulf or a Perry kind of power plant that's well separated with no manual actions that's built robustly to withstand a fire, you're going to get very little benefit from the 805 application to your fire sensitivity.

The pilots were not randomly selected.

(Laughter.)

MR. PACE: I mean, there were some that had problems. That's why they chose to be a pilot. And so I put them on the, up on the spectrum. There's some very fundamentally flawed - and I'm not picking on them, you know, but there's some flawed fire robustness in their basic plant design, is what I'd call it, right?

And I put all the rest of us on the distribution, right? I put my plants in blue dots there and you can argue about where they sit on the distribution, but I just wanted to share that thought with you.

So, the next area I talk about is the

schedule overlap between the pilot plants. We really don't have a pilot for numerous reasons, in my opinion.

One is they overran us, right? The pilot's going to be on top of us. We can't do a pilot and really learn and experience from the pilot and then go do a PRA.

My understanding is because they have challenges in their plant design that we just covered, some of the things they have to accept or justify in their analysis don't really apply to many of the other plants and they don't apply to us.

To the extent they do if there's a distribution generated off of those, then revise 6850 with a distribution, we'll all use it, but right now we're all generating our own. And that's creating mountains and mountains of maintainable configuration documentation, I would say.

So, I've lost my fleet benefit. The tidal waves pushed all the plants on top of each other. I'm trying my best now to push them about four to six months apart again so I can at least use my key players in driving it. The challenge is the limited resources, as we've talked a lot about.

So, there's some rationale to this

November letter NRC's got on spreading them out. Now, I say that is potentially a double-edged sword. All right?

I'll share with you - I've got a license renewal application in. I've got a PRA model against that license renewal application. It will be a two-year review period. And I have evolved my internal events PRA. I'd like to revise it and issue it.

But I dare not issue it, because it's not the one against the submittal. So, I'm stuck in a catch 22 until submittal gets done. So, I'll have this discontinuity for some period of time.

You can imagine the multiple reworks that have led me to where I am today. With my fire model, I'm almost ready to submit. If I happen to be the one chosen to go in in 2015, I'm going to pull my hair out, right? Because now I've got to keep the staff about and share in the resources and catch the outcome and - so, I think it's unrealistic that you're going to dump 40 plants or whatever the number is into the NRC within a few months period and that they're going to have any sort of credible review. I think that's probably an unrealistic expectation on them and the staff.

There will be a natural spreading out, but maintenance of the state of the technology in that fast-burning fuse is going to be a challenge.

MEMBER BLEY: Let me ask you a question because I'm not clear.

You talked along the way about having, you know, two large volumes of defense of exceptions to the NUREG.

After having done that, do you still have those real high results you were talking about or do you have -

MR. PACE: Oh, it's improving.

MEMBER BLEY: Okay.

MR. PACE: It's improving. I think -

MEMBER BLEY: But there's still -

MR. PACE: I may be terribly showing my ignorance here now, but I think if it would have gone through and developed some of those distributions rather than the point estimates that are in there now in the tables as a part of a pilot, and then revised 6850 to include those, say these are usable distributions, these are usable arguments, but I don't sense that that's what's going on.

I could be wrong, but I sense that there's a real protection and not - you can't change that standard, right?

No matter what we learn about or improve our knowledge on, it's going to be Wash 1400 forever and you got to live to it, kind of a mindset.

And even in the pilots, which if you had a pilot and you took and developed a new set of knowledge, seems to me that would be shared with this pilot gave us some insight, here's the new set of knowledge, everybody use this knowledge now.

And at least in some cases, they've gone to this is an exception only for the pilot. So, if you come through, you've got to do all that work over again if you want the same exception, and you're not guaranteed it. That's my understanding.

May be naive, but - so that all aside, those are - I don't want to be throwing - I'm not throwing stones. That's all I'm saying.

I'm saying as an industry, we've got to resolve these technical and modeling issues and we've got to come up with a framework of which when you've done all this work, when you've done this calculation, that becomes part of the collective knowledge of the industry.

And now if you want to do a PRA next, you can take that, you know, intact and use it just like we did with internal events, right?

I mean, that knowledge has evolved over the last 30 years in a substantial way, I believe.

MEMBER BLEY: I wanted to ask you another question.

MR. PACE: Not sure if I can answer it, but I will try.

MEMBER BLEY: Well, in the beginning you talked about having to essentially abandon your work half a dozen times and go back and start over due to changing requirements.

Did 6850 change or were those requirements inferred from questions from NRC or what were the changing requirements of -

MR. PACE: My understanding is they were resolutions, if you want to call them as such, to FAQs, right?

MEMBER BLEY: Oh, okay.

MR. PACE: It was ambiguous in this area. How do we deal with this? Oh, you deal with this that-away. Holy smokes. That's not the way we're dealing with it.

So, student body -

MEMBER BLEY: And you had to start - go back over it.

MR. PACE: Yes. And in some cases, those are interim solutions. And then they later become final and they may be different. And so you -

MEMBER BLEY: And so we're doing this for every plant that's doing an analysis.

MR. PACE: Yes, and the contractors -

MEMBER BLEY: We're doing this kind of in parallel.

MR. PACE: Our contractors love it. I wouldn't want to put any disparaging thing on any of the -

(Laughter.)

MR. PACE: - marvelous contractors that are out there in our business that do this, but you can obviously see they have no incentive to resolve this.

Stating a fact. I'm not throwing stones, but they have no incentive to resolve this. And, you know, both the staff and the licensees have a lot of incentive to resolve this. So, I think we just got to get solutions, I guess.

MEMBER BLEY: Thank you.

MR. PACE: So, where was I?

So, my NFPA 805 transition decision, my original assumptions are no longer valid. I mean, it's not a $3 million exercise that can be done in two years, you know. That was naive, possibly.

There is in this past six years, NEI and the NRC have issued guidance on how you deal with degraded cables, right?

Which was if I go back to the early eighties, it was hot shorts and open circuits, multiple degraded circuits, right? That's what we argued about for the first 25 years. That's what we argued about in the pilot fire protection functional inspection in 1996. That's what we're arguing about today.

MEMBER BLEY: It's hard to stop.

MR. PACE: Right. So, we started out with a couple of really thorny issues that we couldn't agree on. We reduced it to a very complex model. And now we have hundreds of thorny issues that we can't agree on. So, one could argue we didn't improve our lot.

But I guarantee you today if I'm sitting at a BWR 6 plant, I'm going to take the Reg Guide for cable resolution and I'm going to set this thing aside, right?

There's no way in hell I'm going to jump in this pool until the water settles down. I believe that technology will evolve. I believe we'll resolve these modeling issues. I believe we'll have a more stable environment sometime down the road, but it is not there today. It's full of crocodiles today.

And one could even argue that a plant that I spent $20 million on analysis, I might have been better off spending that $20 million moving 24-inch electrical panels around and not, you know, at least really made a fundamental change in the physical plant itself rather than in the calculation base that I maintain.

So, the risk-informed approach was very good intention, right? I mean, I think it's probably still the right way to go, but we got to have technical people get calmed down and come to conclusions we can live with and not - not trying to make it overly conservative because this is my last bite at the apple, if you know what I mean, right?

I mean, I can't give up my ground on this pick of topic. I can't give up my ground on this combustible thing here because you guys in the industry will take it to the extreme and it will be stacked full of lumber next week.

I mean, we've got to find that middle ground as we did in the others and put practical numbers in these things and get practical answers that all kind of makes sense to us.

We got to solve these technical and fire modeling issues before we can move forward. It's critical to us.

I guarantee if you don't - don't take on another one, right? Let's don't take on seismic when we're fist-fighting over how we're going to model fires, right?

We haven't learned - we haven't demonstrated we have the maturity as an industry and as a regulating body to reach practical solutions in this area. And I think we stick with fire until we demonstrate that, and then move into these other areas.

Right now the Reg Guide 1.200 revision is coming so damn fast, you know, and I'm throwing money at it. I can't imagine my old company, we didn't throw money at it, how we would ever have any sort of level of success.

The front-end transition plants like my Beaver Valley plant, we're all in, right? I mean, the cards are dealt. We're all in. We're going to finish one way or the other. I may end up with a model I don't feel real good about. And then as Sunil and I were talking on the break, we really got to look down the road, right?

Like my license renewal example, six months from now, a year from now one of my young, energetic engineers does more detailed modeling, I want to upgrade my model, I got to be able to do that.

There's a doubt amongst the practitioners now that we'll be able to have that flexibility. And quite frankly, there hasn't been a lot of dialogue around that, what that's going to look like going down the road.

But it was arguably so contentious getting to where we are now, once I submit it and you approve it, you know, it just doesn't seem practical. I can go change it tomorrow to something more practical.

So, we've got to deal with that down the road what the inspection's going to look like, what do revisions look like, how do we maintain this beast once we get it?

And I believe the follow-on plants, my advice to them today would be to stay out of the fight for a little while. Let us that are in the fight resolve some of these issues and you'll be better off and save yourself a ton of money jumping in here a little bit further down the road.

That's all my prepared remarks. Thank you for your time.

MEMBER POWERS: Your cost results, I share your disappointment in how much it's costing. But when I think back to the implementation of Appendix R, for some reason I carry around a number in my head of cost per unit of about $10 million, which --

MR. PACE: That would have been a pretty large number in 1983.

MEMBER POWERS: Yeah, it's a little higher than what you're getting there. The 20 million for Beaver Valley, maybe you're getting close there and whatnot.

So, maybe I'm not too surprised by the cost.

MR. PACE: At my last job, I was rebuilding models at under a million a pop.

MEMBER POWERS: Yeah, yeah.

MR. PACE: So, if the rules are crisp and clear and the inputs are easily obtainable, it shouldn't take you $5 million to build a model.

MEMBER POWERS: Right, but all your initial conditions, none of them are met here.

MR. PACE: I think if I started crisp and clean - that's two units, right? So, we're talking -

MEMBER POWERS: Yeah.

MR. PACE: - 10 million a unit.

MEMBER POWERS: And they're pretty much standard.

MR. PACE: I guarantee you today if you blow the whistle and let me start a model, I could build it for well under $2 million. Because in the last six years, we've fought a lot of battles and gained a lot of understanding and, you know, we know a lot, a lot less uncertainty, and it's going to be a lot less rework.

Now, I may start rebuilding it tomorrow depending on how this dialogue continues going forward, but I can build a model to the state I had it in today for a couple million dollars, not seven or eight.

MEMBER POWERS: Okay.

DR. PACE: And Appendix R, you said something earlier and I didn't address it. I told you I would in my presentation.

I looked through Appendix R, and Appendix R did - Browns Ferry and the fire protection regulation BTP 9.5 Appendix R changed the way we view fire protection in our plants, right?

MEMBER POWERS: Yes.

MR. PACE: Fundamentally.

MEMBER POWERS: Fundamentally.

MR. PACE: I remember at Grand Gulf, that plant was ready to go online. I was the fire protection startup engineer. And the NRC all came down and said when you guys get your fire protection system right, we'll talk to you about a license.

That's how much gravity it held in the mid-eighties.

MEMBER POWERS: Yeah, we almost melted down the plant. So, we got kind of serious about this.

MR. PACE: Fortunately we didn't, but, yeah, it was close.

CHAIRMAN STETKAR: It was about as close as it gets.

MEMBER POWERS: It got our attention somehow.

CHAIRMAN STETKAR: The folks in the control room that day -

MR. PACE: Will we --

CHAIRMAN STETKAR: - were interested.

MR. PACE: Will we with our - the way we're characterizing fire modeling in these rooms, establish in the mind of the young engineers that are working for me that a 24-by-24-by-four-inch fire panel can burn down every cable in the western end of the plant?

And is that a good thing? Because that's where we are today.

MEMBER POWERS: Yes.

MR. PACE: That's what we're telling them, you know. And that little panel there is no worse than that room full of switchgear. So, don't worry about them. They're no different.

Those negative training or those negative thoughts are potentially more damaging to people who aren't - don't have the experience background that we do on how to view the plant going forward.

To me, I want to make damn sure they know that that 6.9 KV switchgear is a heck of a lot more important to me than that fire alarm panel with eight wires in it, but it's not today.

MEMBER BLEY: I got to tell you, and I guess I want to hear from everybody who talks to us the next two days, your story is funny. I can't imagine, though, pouring the level of effort you had to do into details that lead to a very large, complex model when these overriding issues that are affecting the results essentially get considered as rules and not addressed in an analytical way. Just doesn't make any sense to me.

And I wonder from other people who talk to us, why it's seen that it has to be viewed that way. And why some - even though the extent of uncertainty that's provided in the tables and information in the NUREG, you know, haven't been stressed for people using the analysis to think about this stuff.

It's just - to me, it seems appalling.

CHAIRMAN STETKAR: No, I'm hoping that we will get into that technical detail. I think -

MR. PACE: Well, hopefully, folks more technical than I can explore those, but I'll tell you that's -

MEMBER BLEY: The realistic things you talk about are there and people ought to be -

MR. PACE: That's why it's troubling to me when I hear -

MEMBER BLEY: I just can't -

MR. PACE: So, in this menagerie that we've built, the whistle blows and we start out of the running gates when the SER hits the street, right?

When the Oconee - did I get the right one? The SER that's being developed right now, the whistle blows, the flag comes down, the cars all start.

If it is as I saw on the slide this morning, as I heard this morning, if that SER is going to be issued with open items, the PRA as an open item, essentially, that's an overstatement on my part, but, I mean, many of these issues are open items to be resolved, that is the only item, right?

I mean, the only thing that needs to be resolved is these PRA issues. I mean, 805 in its context without the risk model is simple, right?

You got a fire brigade, you got to have so many alarms, you got to have sprinklers and, you know, I could do that code comparison in a matter of days with a couple of us.

So, the only thing that's caused us to be contentious, my word, over the last six years and difficult to achieve, is gaining technical congruence around how we're going to do some of these issues.

And if those get left as open items, then you're starting the whistle and I don't have the wheels on.

So, I think we're still prepared to go forward. I think our plants are in pretty good shape. We're going to have two or three items that are going to be deviations from 6850, and I think we'll have an acceptable model.

Hopefully, we'll be treated fairly by whichever contractor gets my one of the 40 plants, you know. If we go forward against that model, you're going to have to bring in an enormous amount of staff support to review those kind of models. So, that falls into the be-careful-what-you-ask-for category too.

And so one option is to stay here a little while longer and resolve some of these open issues. I think we're all better off for it. The other is we'll roll the dice and see where we land.

I've taken up way too much of your time.

CHAIRMAN STETKAR: No. Thank you.

MR. PACE: Thank you.

CHAIRMAN STETKAR: Any other questions?

Well, thank you. That was illuminating, if nothing else.

Now, we're scheduled to hear form EPRI on a brief review of the EPRI Technical Paper.

(Off-record comments.)

CHAIRMAN STETKAR: And, Ken, if you can make it brief, if at all possible, I'd appreciate it to see if we can get - well, I think you're missing the discussion here.

What I'd like not to do is if there's much repetition from what we've heard - if there's much repetition of what we've heard in the November meeting, if you could kind of go through that a little bit more quickly because I think we'd really like to get to, you know, some of the specific technical details.

I think you've heard some of the questions and -

MR. TRUE: The way we framed this was basically what you saw last time is this document. You probably noticed this.

(Off-record comments.)

CHAIRMAN STETKAR: Right. I'm getting tired of reading about this.

(Laughter.)

MR. TRUE: Right. So, we have - we pulled some slides out that we were going to hit on some key - some of the kind of main conclusions and then the list of topics, and then it's open season.

CHAIRMAN STETKAR: Now -

MR. TRUE: You guys can ask whatever questions you'd like of us.

CHAIRMAN STETKAR: Okay. But let me just make sure we understand. If I look at the agenda, we have separate presentations on the Fire Events Database, incipient fire detection, transient fires, cabinet heat release rates and so forth.

So, I'm assuming that we're going to spend much more time and detailed discussion when those presentations are made.

MR. TRUE: Yes.

CHAIRMAN STETKAR: Is that -

MR. TRUE: We really didn't intend to go through the technical topics at all -

CHAIRMAN STETKAR: This will be an introduction.

MR. TRUE: - in our presentation, but we wanted to have them available so that in reviewing this and considering this over the last month if you have specific questions about any of those topics, we can, you know, we'll go with it and we can talk about it.

So, this is really, you know, it's a time for you guys to ask us questions now that you've had a chance to read the report and digest what we talked to you about last time.

MR. CANAVAN: And I want to put a few ideas in your head as well, things for you to think about in the back of your head as you walk through these two days starting with, you know, some misconceptions we have early that we can maybe take off the table pretty quickly.

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: So, with that said, for the record, I'm Ken Canavan of the Electric Power Research Institute, and we're here to talk about the Roadmap for Attaining Realism in Fire PRAs.

I'm going to jump right into it and talk a little bit about the purpose of this - of the report that you have in front of you, as well as these presentations.

And I want to start by saying one of the key misconceptions that I think is widely held, although I think I start every meeting by trying to dismiss it, which is 6850/EPRI 1011989 - and, by the way, I did try and put in all the 1011989s and I promise to try and get a better numbering scheme for EPRI -

CHAIRMAN STETKAR: And you've got them all on this slide, but it's okay.

(Laughter.)

MR. CANAVAN: But what we hope to do is to make - and I even put it first.

(Laughter.)

MR. CANAVAN: The point of putting it first on this slide and the point of discussing it is that EPRI 1011989 was indeed what I consider to be a breakthrough. A collection of the more recent technologies that we had available, a pragmatic and practical way to go about doing a fire PRA.

As we discussed in many, many presentations before, in the beginning of that report I believe it clearly states that this is expected to evolve.

I've got Steve Nowlen shaking his head. We're in violent agreement.

(Laughter.)

MR. CANAVAN: And we also - it was a state of the practice and its biggest advantage was that it's standardized.

It's not that we can't do fire PRAs, by the way. We can do fire PRAs in the absence of 6850 and without other methods. They are what I like to call "boutique," right?

They're done individually. Rather than consistent, every analysis is done individually with the individual analysis with individual assumptions. Takes a long time to develop and a long time to review. Exceptionally long. So, it wasn't a practical matter to move forward that way.

So, 6850 is the first step in making it more consistent, easier to develop and easier to review.

When we started doing the transition to NFPA 805 using 6850 as the primary method for fire PRA development, and it is indeed the primary method, I realize, but we talk about other methods, I can only envision me putting together an application that did not reference 6850 and seeing how far I get, which would not be very far.

I think I would be inundated by RAIs about why I did this, why I did that. It really is the framework upon which these submittals need to be developed. It was the intent of the documents.

So, we wrote this - so, it's being used as the major report. And we wrote this particular Roadmap to address some of the simplifications and bounding assumptions that influence the PRA results as we see them. And the objectives of the report that you have in front of you is to provide objective evidence of the conservatism.

None of these are new. If you go back to the transcripts of the ACRS from several years ago, you will find the exact same discussions. Those discussions didn't have the same level of detail that we've provided you in the last ACRS meeting to support those statements of the fact that there was conservatisms in the fire PRA.

It also - one of the key objectives of the report is identify areas that need additional realism. So, what are the research priorities in moving forward, and also to inform and update the fire PRA action matrix.

And, lastly, was to provide a vehicle for discussion. I realize that some of these discussions can be uncomfortable, you know. There are licensees that would like to see their submittals approved. There's people who were involved in the research early who appropriately have put a lot of work into that and don't want to see their efforts characterized in an inappropriate light. There's a lot of skin in the game here, but we need to have a discussion, nonetheless. It's the way to improve the methods.

I also think that in the back of your heads, one of the things that we should keep in mind is we don't - I don't think there's been a disagreement that 6850 and EPRI 1011989 haven't served an important purpose.

The issue I think we're discussing in my opinion, Ken Canavan's opinion, is the inability to effectively and efficiently move those methods forward to do what 6850 says in the front cover in an effective and efficient manner.

It's been several years, and we have not made progress. And I do not believe that that's a subject of discussion. The lack of progress is evident.

So, the real question will be how do we get there and how do we fix that?

And so, it leads me to my next point. You've all seen this graph before and on this -

MEMBER SHACK: Just coming back to that, I mean, if this represented the state of the art at the time, how would you expect it to move forward without, you know, considerably more research and considerably more data gathering?

MEMBER BLEY: And applications.

MR. CANAVAN: Yes. And I think that would be how you would expect it to move forward.

The question would be in the interim several years since that publication and since its use and since the first studies were put out, that's - we started discussions on areas for improvement and very few of those areas have gone as far as we would like them to go.

And I say that very carefully. We'd all like to see more progress than we got, and it's a consensus. And I don't you'd get an argument from anybody who's involved in that. We just haven't been able to reach consensus on a few items.

And I think some of that comes back to the approach of how you look at improvements to the fire PRA using distributions or point estimates for an example, is a good case that we can get into a little bit later.

I like this skyline chart. You know what this looks like to me? This looks like Level 1 PRAs in IPEEE days. It looks to me like Electrical Cabinets 15 has loss of offsite power. That's what it looks like to me. So, I see this as a repeat.

And then I look and I say, well, if we take that out, what happens?

This is important, because if we take the electrical cabinets out, we then see the skyline of the next things.

And so in Level 1 PRA space if Bin 15 is corollary to loss of offsite power, we spent a lot of time 20 years ago fixing loss of offsite power, and we did it a bunch of different ways.

Some plants did loss. Everybody did analysis. Everybody sharpened their pencils. Everybody did convolution right instead of simple. We had very simple convolutions. We had loss of offsite power recovery, human actions, developed procedures, developed all - and refined and improved. And all of that resulted in loss of offsite power being a more modest contributor.

And when that happened, we ended up with our next set of contributors that we had to work our way through.

And so the last 20 years of the evolution of Level 1 PRAs was a result of first seeing the biggest contributor, finding the next set of contributors and then working our way through that. And all of these contributors were important to getting to a plant-specific realism of PRA. And in fire protection and in NFPA 805 and fire PRAs, we're still here.

CHAIRMAN STETKAR: Well, we're here and we're in the other place because you can -

MR. CANAVAN: Yes.

CHAIRMAN STETKAR: So, we know that.

MR. CANAVAN: We're smarter now, right? So, we know to work on the other things too, which is what we're trying to do. And you'll find that the action matrix hits all these little - tries to hit all the major contributors here as well.

One last point, John, and I'll take

questions. The thought here was that as we hit these conservatisms, it took us 20 years. Maybe less. Maybe 10 years. To get it all right and worked out in Level 1 space. And we're trying to cram that into a much smaller period of time here.

And maybe that's one of the issues that affects our ability to move this forward is our propensity to grab a hold of interim solutions that partially answer the question to which all parties can agree so that we can get that part out of the way and then we're left with other parts we need to continue to chase, and I think you'll see some of that.

So, in the back of your head as we go through all this, my suggestion would be to keep in your mind the evolution of IPEEEs to PRAs to their use in risk-informed regulation today, and see if you can see the corollaries that I see as we work through this process.

And then let's talk about some of the solutions to how we move that all a little forward a little faster.

CHAIRMAN STETKAR: And this is good. I wish this little graphic had been in your paper. This is quite illuminating in terms - well, only because the paper discusses the fact that despite the, what we're calling the ridge line, the rather substantial contribution from electrical cabinet fires, if you remove that, if you read just simply the paper, you're led to believe that you have remaining 100 equal one percent contributors that are all very excessively conservative.

This is a much different graphic. This turns up the microscope and this says electrical stuff is important. This doesn't say that transient combustibles are important, it doesn't say that oil fires are important, it doesn't say that pump fires are important. It tells me that electrical stuff is important.

So, now if I think about a path going forward, I wouldn't spend a nickel on trying to refine heat release rates from oil fires, because that is yet further down in the noise, according to this turning up the microscope, with the exception of - I don't remember what Bin 33 is, but it's up in the upper end. So, it's probably some sort of human-induced transient combustible sort of thing.

With the exception of that one plant in the back there that shows some contribution from Bin 33, I wouldn't spend a lot of effort or priorities on those issues in terms of research programs.

So, this actually is a very, to me, illuminating graphic in terms of setting priorities in the overall research program for moving forward.

MR. CANAVAN: And for ignition sources.

CHAIRMAN STETKAR: And for - well, but the ignition source - for ignition sources, for heat release rates related to those ignition sources, for - I don't, you know, whatever those electrical things are. I was careful not to say frequencies or anything like that. Electrical stuff is the way I characterized it.

MR. CANAVAN: Well, Doug may be about to say this, but -

CHAIRMAN STETKAR: Now, let me ask you, though, there are some plants that show, for example, whatever the green plant is there and whatever - the plants numbered two and three, I guess.

That also could be the fact that those particular plants don't have an awful lot of redundancy.

For example, if they're a two-train electrical plant, I would expect to see those types of contributions from fires in a room that doesn't have an awful lot of separation.

So, that isn't necessarily a

methodological phenomenon, it's a plant-to-plant variability phenomenon, and some plants out there just don't have the same degree of redundancy as other plants.

So, am I misinterpreting something in this graphic?

MR. CANAVAN: Well, I think you now bring up that this is - so, this is corollary to internal events. This is the contribution by initiating that. There's also contribution by system, contribution by component.

CHAIRMAN STETKAR: Yes.

MR. CANAVAN: And if you look at some of the battery chargers, for example, it might not be so much that the battery charger as an ignition source is important. It might be where it is.

CHAIRMAN STETKAR: Sure.

MR. CANAVAN: Some places it might be that the equipment is important. It might actually physically be the charger is important, or it might be located in the cable spreading room. And that cable spreading room, its zone of influence, its heat release rate, its frequency might affect certain important cables. And those important cables make the battery charger as ignition frequency important, but the phenomena of heat release rate, cable fires and propagations and all the other things that we talk about play into how important that is.

So, this chart is sort of one-dimensional on a multidimensional issue and probably could be followed up by charts on well, you know, what phenomena contribute the most to these, which we didn't do.

Did I do that okay?

MR. TRUE: Yeah. This is Doug True from ERIN Engineering.

I think that - a couple of things. First of all, this is a set of plants. It's just one set of plants. And the message is the message in the blue box in the corner. It's that this isn't a one-dimensional problem that electrical cabinets are the only issue. It shows up in a lot of different ways.

Sometimes it's a design issue, sometimes, you know, because the plant is designed that way. Sometimes it's an artifice of the calculation.

And the purpose of this chart wasn't to direct every single research activity. It was to say we can't be myopic and just and only focus on electrical cabinets, that it's going to crop up elsewhere as we begin to deal with electrical cabinets.

That's all. I wouldn't go too far into all of this. And we'll talk about transient. There's some unique things about those that we'll talk about as well.

CHAIRMAN STETKAR: Okay. But, Doug, if this chart showed a fairly uniform distribution across all of the ignition bins for all seven plants, that's a much different story in terms of the areas at which you would like to direct resources going forward whether it's fire ignition frequencies or whether it's heat release rates or whether, you know, partitioning bins or whatever.

This is, I think, really useful information compared to, for example, the impression I was left actually reading the report. Because, honestly, the impression that you're left reading the report, this graphic is in the report.

MR. TRUE: Yes.

CHAIRMAN STETKAR: But you don't see the same resolution as that next one.

MR. CANAVAN: If only you could fix electrical cabinets and this is what you think.

CHAIRMAN STETKAR: Well -

MR. TRUE: No, I think John's saying he

thought it was broader than -

CHAIRMAN CANAVAN: I was left reading the report saying, you know, that there are probably 20 equal, roughly, five percent contributors in a sense. And, therefore, we need to do a huge research program in all of those areas, heat release rates equally for transient fires, equally for oil fires, equally for diesel-generated fires, and this is a much different story.

MR. TRUE: That's unfortunate. What I was trying to do was respond to the initial lurch towards if we just fix electrical cabinets.

MR. CANAVAN: Right.

MR. TRUE: And I don't think it's that simple. And maybe it came across more flat in the distribution than I should have -

CHAIRMAN STETKAR: Well, but in Ken's analogy, you know, as Level 1 internal full-power PRAs have evolved, yeah, this is the typical risk assessment process.

MR. TRUE: Yes.

CHAIRMAN STETKAR: You dynamite the big boulder and, you know, you see some bigger rocks - or smaller rocks peeking above the surface, and you go after those smaller rocks.

You don't go after every grain of sand in the -

MR. TRUE: Right. Absolutely.

CHAIRMAN STETKAR: Thanks.

MR. TRUE: All right. We just wanted to talk quickly about a couple of the main evidences, we have referred to it as, and we compared to operating experience.

Because we can't do that comparison at the CDF level, we looked at interim results and we - this is the same, exact slide I think we presented last time.

The conclusion was that from a spurious operations perspective, we should be seeing across the U.S. fleet, an event involving spurious operations every one or two years.

The most obvious example is Browns Ferry. And even if there were one or two that we missed across the industry since then, it's still there's a significant amount of gap between what we're seeing in the calculations versus what we're seeing in the operating experience. And that's one piece of our observation.

CHAIRMAN STETKAR: Before you leave this one -

MR. TRUE: Yes.

CHAIRMAN STETKAR: - is this - this presentation, I was looking for it in the agenda. This presentation is our only opportunity to discuss that comparison with operating experience; is that correct?

MR. TRUE: Yes.

CHAIRMAN STETKAR: This is it. Okay.

MR. TRUE: This is the only - and then we're going to talk about the -

CHAIRMAN STETKAR: I think that's important. So, we may want to spend some time.

MR. TRUE: Okay.

CHAIRMAN STETKAR: I'm not sure that the statement that no spurious operations have been observed since Browns Ferry may be entirely correct.

MR. TRUE: From the fire PRA community, it was what the consensus was of the fire PRA test was.

CHAIRMAN STETKAR: Especially if you consider perhaps nonsafety-related systems that could have been affected by fires that might not necessarily be characterized, but that's - your point is valid. Regardless of whether you've missed a couple, it doesn't change the overall conclusion.

The numbers that are there, you guys are familiar with the plants, you're familiar with the analyses of those plants. So, you should be familiar with the contributors to that sum of the scenarios that make those totals.

I thought the paper was really good about characterizing the - a scenario by an ignition frequency, the fire growth and suppression model with - the ignition frequency, let's say heat release rate, fire growth and suppression model damage from the fire mischaracterizes up through damage of the fire.

MR. TRUE: Right.

CHAIRMAN STETKAR: Of those four areas, what's the most important thing driving this, in your sense?

What's the most important thing driving those numbers as being, obviously, inconsistent with operating experience?

Is it the ignition frequency of the fire itself? Is it the plant configuration coupled with the heat release rate? Is it the non-suppression probability, the effectiveness of the fire brigade or detection suppression equipment, or is it the assigned conditional hot short probabilities?

MR. TRUE: All the - let me try and unravel it.

CHAIRMAN STETKAR: I know we're going to talk about heat release rates later in more -

MR. TRUE: I think the -

CHAIRMAN STETKAR: But I'm trying to get a sense of -

MR. TRUE: First of all, I didn't unravel it that way. So, I can't give you a precise answer. But my - from the review of the material as it was compiled, I'm pretty sure that it's safe to say that it's driven largely by electrical cabinet fires.

CHAIRMAN STETKAR: Okay.

MR. TRUE: Because there are a lot of cables involved and it's one of the highest frequency bins.

So, if we're talking about electrical cabinet fires, as we'll talk about tomorrow in that segment, then you're talking about the frequency, the growth rate which impacts the non-suppression probability, and the peak heat release rate also, as well as propagation within the cabinet because there's some issues related to that and how that gets handled in the methodology that - basically dealing with these cabinets, there's no good way at the moment within the 6850 methods to compartmentalize the level of damage within the -

CHAIRMAN STETKAR: Within cabinets.

MR. TRUE: Yes.

MR. CANAVAN: To a compartment where -

MR. TRUE: To our adjacent cabinets, you know, like Danny's picture of his switchgear room.

CHAIRMAN STETKAR: Okay. Thanks.

MR. CANAVAN: And, again, Level 1 puts your initiating events together. Then take the representative initiating event and model that. So, large LOCAs, the spectrum of LOCAs, but you pick the worst one, the double-guillotine-ended break of the largest hype. And that's what you run as representative even though it literally represents a range of frequencies.

So, we take a cabinet. It has a bunch of compartments in it. We take the worst compartment/location that the fire can be. That's the location, that's the biggest peak heat release rate, and move on from there.

And so one foot underneath, you know, an event that - well, that - the vented openings is where the fire is, right, in the vented openings.

MR. TRUE: Okay. If we turn to the CCDP thing, we looked at this for a set of five plants that were done actually by different analysts, differing companies, actually.

And we looked at two levels of CCDP in this graphic. One was CCDPs greater than 10 to the minus three. Which under the accident sequence precursor program would be considered a significant precursor. And then greater than ten to the minus four, which are what they call "high CCDPs."

And the staff did a nice job of documenting all these events and putting them into an annual report that covers pretty much the whole life of the industry.

And the ranges, surprisingly, across the different plants and different analysts, the range is pretty darn small, I think, on these results. That, you know, we'd expect the numbers in the sort of mid minus threes for the ten to the minus threes and mid minus - or low minus twos for the ten to the minus four CCDPs.

So, what that translates to is we should be seeing, you know, a ten to the minus three significant precursor every one to ten years. And one to three each year or some number each year of the high CCDP events. And we're just not seeing that in the operating experience.

And this speaks specifically to the

accident sequence precursor program, but you'd expect some parallels in the reactor oversight process because any time there's a performance deficiency and there's an event, if there was a fire that involved that, then you'd expect to see a conditional core damage probability calculated for that under the ROP process that would have a high CCDP.

And even if every fire doesn't have a performance deficiency, some of them are going to have some performance deficiency which is going to end up with some sort of a high CCDP. And at one to three per year, we should have seen 20 in the last decade, and we haven't seen any at the ten to the minus four level.

That would be a red ROP finding which would be - and we haven't even seen them in the yellow category. So, we think this really shows a significant gap between the results we're calculating and the actual operating experience.

MR. CANAVAN: And since if we look at most electrical fires, we find that most electrical fires are usually associated with some form of the protection system not working right, it would be associated with the finding most likely.

If you look at most of these things, the breaker didn't open, the circuit stayed energized even though it was shorted, and that's the reason why it proceeds to fire. Otherwise, the breaker would trip, the fires would self-extinguish or the wire would not overheat, and we would not have the same situation.

So, you find a lot of these as a result of things that would be performance deficiencies because equipment failed and/or wasn't maintained properly, etcetera. You'd expect to see these.

CHAIRMAN STETKAR: Let me interrupt you for just a second and ask Sunil, is the staff going to discuss this in one of the presentations?

DR. WEERAKKODY: Yes.

CHAIRMAN STETKAR: Okay. Thanks. Continue.

MR. TRUE: So, we had the three basic insights that we presented in the report. This characterization is compared to operating experience. We think we've presented information that says that there's an over-prediction in the number of severe fires. That the growth rate, and we talk about this in some specific examples, electrical cabinets and oil fire, that those severities are overstated.

And that the treatment of suppression, it really only focuses on suppression and misses the fact that sometimes there's a fire that the grade controls by some means that prevents it from causing external damage, but we really only take credit for it if it's actually extinguished.

The level of risk being overstated, the - we have these high CCDP predictions from the fire PRAs. Both the ASP program and the ROP have not identified this as being the case, and then the spurious ops we just talked about.

The last one which since Sunil brought it up, I think that we should spend maybe a little bit of time talking about this.

You guys are sort of all PRA analysts. You know that conservatism is a challenging thing to manage in PRA. And that if you allow conservatism to creep in, then you're going to end up with something being overstated.

If it's a negligible contributor, then you can live with that. But when it's an important contributor and it's leading to a mischaracterization of the significance of something, then that's a big problem.

And that's what we're concerned about in this masking thing is that we may be identifying something as being this is the most important thing in my plant. Danny goes off and spends a bunch of money to move that 24-inch cabinet when really he should have been focused on some other problem elsewhere in his plant.

And confounding the decision-making process is it's not that you can't make a decision, it's that it takes a lot of effort to go through those analyses and extract what's really driving the bus so that you can actually make that a good, informed decision. And that, you know, that's a process we can go through.

But I think the other thing that I want to go back to about the whole report, is that it was an excellent compilation of methods. It did create a process that is repeatable across plants. But I think the problem was this lack of being able to test it out until we were already into the Oconee and Harris PRAs for the 805 transition, and the simplifications that result in this bounding treatment.

It's just like any other PRA. You make a simplification, you do an analysis, oops, that's too simple, I got to go back and undo it. And that's the process we'd like to see engaged over time is let's deal with the simplifications, let's work our way through this.

And I think that it's -

MEMBER BLEY: Are there other forces stopping that?

I mean, you brought up lots of examples and you just said it, Doug, we always put conservatisms in our PRAs.

MR. TRUE: Yes.

MEMBER BLEY: And then we test them.

MR. TRUE: Yes.

MEMBER BLEY: And if they don't matter much, we live with them. As long as we're sure they're conservative.

MR. TRUE: Yes.

MEMBER BLEY: And if they matter, we go back and add more detail and attack it.

MR. TRUE: Right.

MEMBER BLEY: But it seems like all the stories we've heard of PRAs being done here, the folks doing them have just charged ahead and -

MR. TRUE: I think that there's -

MEMBER BLEY: I don't know why that is. Is that driven by requirement? Is that it? Or don't we have the people involved - I mean, you guys are doing it for everybody now, but I don't know why the people doing the individual PRAs didn't turn to this early on.

MR. TRUE: I think the problem - well, first of all, because 6850 wasn't tested and we didn't realize the ramifications of this, it didn't come up until the end of 2007 when Harris and Oconee were starting to do - to really get results. We saw how that all brought together.

MEMBER BLEY: Okay.

MR. TRUE: When we did that, we raised this as an issue in early 2008 with the staff. And the very strong message that the industry has been receiving, and Biff made this pretty clear, is that you follow 6850 and then the FAQ process reinforced that the standard of deviation, the standard for being able to justify deviation was extremely high.

And so the tendency for the safe path for a licensee is to continue to stay within the path that's been trod by the accepted methods from the regulator. And that's just the way it is.

It's not like the way we used to do PRA when we would be able to look at a problem and say oh, and this clearly isn't right, and here's my analysis that says I can do a simplification of it. It isn't being done in that way.

And then confounding that even more or complicating that even more is the peer reviewers get the message that you got to follow 6850. And so they kind of reinforce the whole process of deviations are a bad thing and they're nervous about making a judgment, that it's okay because the NRC might say it's not okay.

It's a really - it's a much different environment than we used to do PRA and to have a cookbook that we're expected to follow and then go through a high standard of justification to deviate.

CHAIRMAN STETKAR: You know, Doug, I don't think we should spend much time in this subcommittee meeting belaboring how or why we are where we are today. I mean, you know, it's what has happened is what has happened.

I can tell you that the first time I saw NFPA - or NUREG/CR-6850, the problems were pretty obvious. I didn't need to do an integrated PRA to see where the problems were five years ago.

So, this assertion that we didn't know where the problems are until we did the pilot studies, if indeed you had experienced PRA people involved in the process, I think is a bit of a reach.

And I just want to put that on the record because -

MR. TRUE: Fine. All right.

CHAIRMAN STETKAR: - I think it's kind of mischaracterizing the situation. Again, how we got here, why we are where we are is background information. I don't think it's particularly useful, you know, to understand what the issues are and what the path forward should be, you know, on how those issues could be most effectively resolved, you know.

I think what you're saying, it's been kind of a learning experience for a lot of people over the last three or four years, and now we've learned.

MR. CANAVAN: Yeah, one more dimension on what you say though. I do agree with, you know, the problems haven't changed. I think they are the same.

I do think there was an expectation that 6850 addressed them better.

CHAIRMAN STETKAR: That might be, yes.

MR. CANAVAN: And so that - and that expectation was held by everybody that we had a better handle on how to do it because we had collected together. Now, we weren't going to be the boutiques. We were going to be this very lockstep way. And then by being consistent and lockstep, we could modify it quickly.

The problem was that last part, modify it quickly, that's the part that didn't happen. And we'll talk about all those areas and I don't think you're going to be surprised by any of them.

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: I really don't.

MR. TRUE: So, we put together, as you know, in the document, this framework of issues. And from this point forward, we just have a slide on each of the categories. It has a list. And if you'd like to ask us any questions about any of the statements that are made in the report, we'd be happy to -

CHAIRMAN STETKAR: We actually may come back to that tomorrow after we had more of an opportunity to talk about more of the specific -

MR. TRUE: We wanted to be available to respond to any questions.

CHAIRMAN STETKAR: Yes.

MR. TRUE: So, we can make this as long or as short as you'd like.

CHAIRMAN STETKAR: Make it as short as you can.

MR. TRUE: Well, this is Category 1. Here's Category 2.

MEMBER BLEY: That's pretty short.

MR. TRUE: Here's Category 3. And, you know, on the end, let's go with the last one.

MR. CANAVAN: You're going to hear about these.

MR. TRUE: In the end, I mean, what we're trying to do is take some industry actions, to put in place activities that are coordinated across the industry groups to take the right actions on developing the improved methods.

And the Roadmap was a tool to help align and help establish those priorities, communicate within the industry. We've got senior executive attention now for a variety of reasons, and this gives us a useful tool for dealing with them.

And there's an NEI fire PRA task force that is, you know, we did this for that is very much engaged on these issues.

So, the industry really wants to move forward and figure out how to make things better.

MEMBER BLEY: I wanted to ask you a couple of questions if I might, two in particular, that deal with - you list a lot of high-priority research needs. In a couple of those areas, I wonder if, you know, extensive data gathering is needed as much as a mix of some new modeling with existing data.

On the picture, John had used it, you have the fire initiation which starts with some kind of source and eventually gets to a viable flame that could propagate. The data I've read through and rummaged through has an awful lot of those things way at the left of that that are potential sources to start a flame, but not actually -

MR. TRUE: Right.

MEMBER BLEY: - getting to the stage of -

MR. TRUE: Right.

MEMBER BLEY: - viable fire. And I think people know enough about modeling that if we did more with that -

MR. TRUE: Yes.

MEMBER BLEY: I know we always get in trouble if we want to throw those events away, because some of them actually do -

MR. TRUE: Right.

MEMBER BLEY: - go through. And it seems to me some work there rather - I'm just worried if you go collect lots more data on fire initiation, we'll have the same problem.

We'll have this bunch of stuff we want to throw away, but we can't quite. And we won't have solved that piece.

The other one is I remember from stuff I saw from the labs and from industry on these fires and various things, that we don't just have peak heat rates. We have time histories of heat development and there have been a lot of experiments and data collected there.

Do we need to go off and do more research at building the fires or can we piggyback on what we know about the time histories and uncertainties involved to build methodology without a long-term research project to get somewhere?

MR. CANAVAN: I think we're trying to do that in a bunch of areas. Heat release rates will be an example where we're analytically trying to take the results of the experiments and extrapolate them to a wider - use them as a benchmark to a model and extrapolate that model to a wider range of possible scenarios rather than go off and test, for example, cabinets with no ventilation.

That's a presentation for later. So -

CHAIRMAN STETKAR: Ken, I was going to, again, I'm going to give the staff enough time, but tomorrow afternoon we're going to come back to the research program; is that right?

MR. CANAVAN: Yes.

CHAIRMAN STETKAR: In more detail, I'm assuming.

MR. CANAVAN: Yes.

CHAIRMAN STETKAR: You're going to show the priorities -

MR. CANAVAN: Yes.

CHAIRMAN STETKAR: - within each of the different categories. And it may be better at that time, to have a little bit more of these focused discussions on specific topics and what might make sense -

MR. TRUE: I think -

CHAIRMAN STETKAR: - to do that. And I'm assuming we're coming back to it, right?

MR. TRUE: Yes.

MR. CANAVAN: Yes.

MR. TRUE: And I also want to convey, Dennis, just so it's clear, that that list is not all high priorities. Some of them are higher than others and the matrix tries to pull that out. And one of the high priority ones is the Fire Event Database and making sure that we're doing as much as we can to mine information about all aspects of fire, not just the numerical likelihood of a fire from the fire events that are out there that have occurred, and to look at that and use it in various - as inputs to various other tasks.

So, and Pat Baranowsky will be talking about that later today -

CHAIRMAN BLEY: Okay. Great.

MR. TRUE: - how we're going to be trying to do that.

CHAIRMAN STETKAR: Any other questions from the members?

MR. CANAVAN: I was going to say we'll be here all week, but thank you.

CHAIRMAN STETKAR: It's going to seem like all week by the time we're done, but -

(Laughter.)

CHAIRMAN STETKAR: Good. Well, we'll look forward to hearing more from you on the research program tomorrow afternoon.

Now, I guess the staff is going to talk about the report.

(Off-record comments.)

MEMBER POWERS: Mr. Chairman.

CHAIRMAN STETKAR: Yes, sir.

MEMBER POWERS: Mr. Nowlen and I are acquainted, work together in the same institution.

CHAIRMAN STETKAR: You have my condolences, Steve, but -

(Laughter.)

MR. NOWLEN: Thank you. I appreciate that.

MEMBER POWERS: I attempt to assist him in all of his endeavors.

CHAIRMAN STETKAR: So, you're going to go easy on him.

MEMBER POWERS: So, consequently, I shall recuse myself from comment.

CHAIRMAN STETKAR: Thank you. I'm not thanking you for recusing yourself, but thank you for -

MEMBER POWERS: For keeping quiet, huh?

CHAIRMAN STETKAR: Thank you for just informing us.

MR. NOWLEN: If I could, it's been pointed out by a distinguished colleague that with mentors like Dana, I don't need tormenters.

(Laughter.)

MEMBER POWERS: Mr. Chairman, let me point out -

CHAIRMAN STETKAR: It's okay.

MEMBER POWERS: - that I fully intend to get even.

CHAIRMAN STETKAR: I'm sure you will.

DR. WEERAKKODY: I just wanted to make opening remarks to introduce Jeff Circle and then

Steve Nowlen here.

For the benefit of the members who are not here until about 6:00 p.m. the last time we met, I took an action to come back and speak to the members about some of the numbers that the industry and NEI was presenting with respect to the accident sequence precursor program and the ROP and some of the other things as to why the operating experience is not consistent with what the fire PRAs are saying.

The reason I say that is because the challenge in the sense that we got some information from the industry to find out where the numbers are coming from, and we are going to have three presentations that hopefully will address most of the concerns.

Because if you look at the numbers that I put in front of you, one might say oh, my God, fire PRAs conservative by a factor of ten or 20, you know.

So, I invited Jeff Circle here who's been our ROP expert, to speak about the ROP process and how that data should or shouldn't be related to the fire PRAs. And Steve Nowlen is going to talk about spurious operations.

With that, who wants to go first?

MR. NOWLEN: I think I'm up first.

DR. WEERAKKODY: All right.

MR. NOWLEN: Okay.

DR. WEERAKKODY: It's safer there.

MR. NOWLEN: Okay.

CHAIRMAN STETKAR: You're not safe anywhere.

(Off-record comments.)

MR. NOWLEN: So, for the record, my name is Steve Nowlen. I'm a distinguished member of the technical staff at Sandia National Laboratories. And I was the NRC technical team lead for the writing group who developed - and I'm bowing to the pressure of 6850. I try and use the 1011989 regularly. But for this presentation, it's just 6850 - EPRI TR-1011989, and I am the first to admit that this document is by no means perfect.

And I agree with what Ken said in his opening remarks. The intent was that this method would evolve over time. That's the nature of PRA.

This was the first attempt to put together a consolidated set of guidance based primarily on existing methodologies, to consolidate it into one place and give one document that would reference that material.

I do take exception to the

characterization as a cookbook. It is not a cookbook. There is no PRA cookbook anywhere, that I know of, for any topic. And I don't think it's fair to try and characterize that 6850 was intended to be a cookbook.

Clearly, there are areas where research can lead to improvement. And even in the original report, you'll see we self-identified a number of areas that we were not able to address within our scope of work that we felt should be developed further.

And I don't think that list has actually changed too much. There are certainly areas of conservatism that we can relax to give more, you know, given that we have more data and better insights, we can relax some of the conservatisms, and there are conservatisms in the method.

I think in some ways they're being overstated here, and I'll talk a little bit about that. And I think this is another area: There are also areas where clarification of our intent would probably help a whole lot. Because I think, for example, the two examples that Mr. Pace gave this morning are a very distorted perspective of what the method was intended to be.

Both the trash fire case and the small

electrical panel case just do not represent what the method recommends. Trash fires we'll talk about tomorrow. So, I'm not going to talk about that in detail today. There's also a discussion about cabinet fires tomorrow. So, I'm a little uncertain whether I should defer that, but I think the cabinet fire one especially, you know.

That little panel, you should look at what's in there, you know. You cannot build a 500 kilowatt fire out of a panel that size. You're supposed to consider fuel burnout. And if you look in that panel, you're going to find there's so little fuel that you cannot sustain a five-minute fire there. And that's what you should be doing and the method says that.

The trash fire, I think the points that were raised relative to the distributions are the key there. There are distributions. They're using the 98th percentile of one particular source. I don't know what to say there.

So, that said, I still think 6850 is a workable methodology. I think it's far and away better than what we had in the IPEEE days in terms of consolidated guidance. We addressed a lot of the issues that showed up in the IPEEE days. And so, I think it is a workable method.

But, again, it's not a cookbook. It wasn't intended to be a cookbook. And we need to come to grips with that issue.

If analysts are unwilling to attack the issues where it just doesn't make sense, then we are going to continue to have problems. We have to find a way to make that practical.

Now, I look at this figure, and I wish I'd had the other one, because the other one is very, very interesting as well. But, frankly, I look at this figure and I don't see anything in terms of the distribution of fire frequencies.

Now, there's no absolute numbers here. So, I don't - I don't have a real reference here. But in terms of a distribution, this is exactly what I expect with some sort of interesting ones.

Cabinet fires dominate. No surprise there. I mean, it's by far our largest fire ignition source group in the database. It outnumbers any other source by two to one.

CHAIRMAN STETKAR: Steve, let me ask you - and we are going to get into data. But just because you have such longstanding historical involvement with this, why were all electrical cabinets grouped together into a single group?

MR. NOWLEN: Not quite all were, but there was a very large group of electrical cabinets -

CHAIRMAN STETKAR: Except for high-energy arcing faults, if you want to consider that as a separate -

MR. NOWLEN: Well, we broke out high-energy arcing faults. And we also broke out the main control board in the main control room, right?

CHAIRMAN STETKAR: Right.

MR. NOWLEN: But beyond that when you look at the event data that we were working with, there's a certain fraction of events that give you very good detail as to exactly what this cabinet was. But when you sort those aside, you're left with about half of the events where you have no idea what kind of a cabinet it was.

And so breaking it up, you're left with so many uncertain ones you don't know where to put it that we ended up just collapsing it back into one set and saying this is electrical cabinet fires and that's the way -

CHAIRMAN STETKAR: It's expediency from an event counting for frequency - ignition frequency. It's certainly not expedient from a PRA perspective where there might be substantially different heat release rates from those different categories though.

MR. NOWLEN: Understood, yes. And in terms of the heat release rate, I think there are elements of 6850 that are not being taken advantage of.

CHAIRMAN STETKAR: We'll talk more about - okay.

MR. NOWLEN: Yeah, we'll get into that, but this was more of just the data limitation. The event data that we had to work with was not ideal.

CHAIRMAN STETKAR: That's surprising because -

MR. NOWLEN: You got a lot of -

CHAIRMAN STETKAR: - I've looked at that event data and you can usually pretty well tell whether it was a - it might not tell whether it was a motor control center or 480 volt load center, but you can usually tell that it wasn't, you know, a relay cabinet, for example.

MR. NOWLEN: Usually. But there are enough where you can't tell that the - when you parse it out, it just falls apart because you have so many that you don't know which bin to put them in. And so we ended up just sort of collapsing it back.

Could we do better? Actually, we're going to talk about the database as well. I think with the new database, we will probably be able to do much better because we are trying to drill down and get at that information. But the old database, it really wasn't very practical.

CHAIRMAN STETKAR: Thank you.

MR. NOWLEN: Okay. Now, there are a few outliers here that are kind of interesting. I mean, Plant 7 which is the pink one in the back, has Bin 33 as a pretty high contributor there. It looks like it's roughly ten percent. That's a turbine generator exciter.

I would love to see how that came about as being a significant contributor. Because what the description of those is, is we've never seen an exciter fire do anything but damage the exciter. So, look for something very, very near the exciter. And if you have that, then deal with it. Otherwise, screen them out. So, how they got there, I mean, and there are some other ones -

(Off-record comments.)

MR. NOWLEN: Yeah, I don't know how they got there.

Junction boxes are visible contributors. And, again, I think those are ones that we'll get to in the cabinet fire. I would expect that those go away again based on the total fuel load. There's just not enough fuel to do damage, but you never know.

And what's also interesting is the transients are all relatively low. They're not big contributors, but they are visible for a number of plants. And I think that's consistent with expectations.

Now, I have a bit of a problem here because I have no direct access to these PRAs, right? The only one that I saw was Oconee at a very early stage when it was nowhere near complete. So, I cannot look at these PRAs and say I see, I can see how they got there. I don't have that access.

So, I'm reviewing this from the perspective of this report that's been written, the insights that they're documenting and the presentations that are talking about the methods.

CHAIRMAN STETKAR: Steve, just for clarity for the record, you're speaking for you, Steve Nowlen, you're not speaking for NRC staff.

MR. NOWLEN: Yes, sir. That is correct. I am a contractor. These are my views as an author of the report.

CHAIRMAN STETKAR: Just to make sure that's

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MR. NOWLEN: Yes, absolutely.

CHAIRMAN STETKAR: Thanks.

MR. NOWLEN: These do not necessarily reflect staff views.

CHAIRMAN STETKAR: Because the staff, in principal, does have access to the audit process to Oconee and Shearon Harris and could indeed do that type of analysis or evaluation that you're talking about.

MR. NOWLEN: Yes.

CHAIRMAN STETKAR: Okay.

MR. NOWLEN: I'm just stating my own limitations. In preparing these slides, I have not looked at those studies.

CHAIRMAN STETKAR: Okay.

MR. NOWLEN: So, one of the things that is a question in my mind is the extent to which they're really using all the tools that we put forth and how far they're taking the method as within the bounds of even what we established.

Everything I see every time I see a presentation, you know, for example, the example of the trash fire and the cabinet fire this morning, it tells me they're not taking advantage of the things we put out there.

Another one that I'm particularly interested in is I haven't seen anyone apply this THIEF model. It's a cable damage model. There's a NUREG/CR on here that I think provides all the validation basis that you need, came out in this.

CHAIRMAN STETKAR: That only came out, though, in the last year or so.

MR. NOWLEN: About three years ago.

CHAIRMAN STETKAR: Three years ago?

MR. NOWLEN: Three years ago. THIEF has been around longer than that, but the NUREG/CR was draft for public comment about three years ago. Final publication two years ago.

CHAIRMAN STETKAR: It was updated as a result of the CAROLFIRE.

MR. NOWLEN: This was CAROLFIRE. That's been a while.

CHAIRMAN STETKAR: Yeah, I guess it has been three years.

MR. NOWLEN: I mean, we're done with the DC stuff now. That took us two years.

CHAIRMAN STETKAR: Okay.

MR. NOWLEN: So, you know, that, you know, are they using these heat release rate distributions?

Are they using things like THIEF?

THIEF will delay damage to the cables by many minutes. Okay. And I think that becomes a real problem when you start looking at these piecemeal, you know, attack this part of the problem, you have to look at it in the integrated whole to if I attack the cabinet fire heat release rate problem, I have to look at, you know, well, am I doing THIEF? Because I don't want to inject optimism here and then come back and take THIEF now and further reduce my risk.

So, there's got to be an integrated look at this, and that's one of the challenges. It can be done, but it's a challenge.

So, I'm going to skip that entirely because Dr. Stetkar has admonished us not to talk about how we got here.

The areas for improvement in terms of the issues that NEI identifies, I haven't got any problem with any of them. I think they're all good topics for discussion. I think some are going to be pretty hard to do. Some have more bang for the buck. I think there's some here that probably won't have a lot of impact on the results.

I would actually add one. We had identified manual firefighting in our inability to do plant-specific characterization of fire brigade performance and efficiency and effectiveness. That's not on the list. I would add that one. I think it's still an important one.

But that said, I don't agree with everything that's in that Roadmap report. I'm going to pick -

MEMBER BLEY: But would it -

MR. NOWLEN: - on a few things.

MEMBER BLEY: Would it be fair to say that you think, and I think you just said this, that a number of their recommendations are actually - means to deal with them are actually built into the current guidance?

MR. NOWLEN: I think parts of it are, yes.

You know, for example, the cabinet heat release rate issue, I think there are tools and guidance in there that aren't being taken advantage of.

The distributions on cabinets, you shouldn't be carrying 98th percentiles forward. That's crazy, you know. Why would you do that?

You should deal with the distribution. Now, that's a challenge. But, you know, we didn't say carry 98th percentile forward.

The other one I think that's being missed is this concept of fuel burnout. It's a line in the report that says you should, you know, consider fuel burnout.

Now, the challenge there is you walk in a plant and say hey, do you mind if I open this cabinet? You're likely to be escorted offsite under guard, you know. They don't want to open these cabinets up, and that becomes a challenge.

Because if you want to get plant specific, if you want to get case specific, you got to know what the specifics are. That's a challenge. I understand.

CHAIRMAN STETKAR: Okay. Doug.

MR. TRUE: This is Doug True from ERIN.

I just want to make one thing clear that I can't speak to Dan Pace's presentation and what he was reflecting on, but I know that the results we've talked about and the inputs into the Roadmap document we got from industry are not based on using 98th percentile heat release rates. They're based on using the whole spectrum of heat release rates.

That's being done everywhere when you get to the - we're following the methodology. You start with 98. If you can screen it, you're done. If you're not, then you go ahead and go to the distribution.

So, there seems to be a growing misconception that 98th percentiles are the basis for the analysis, and I just want to make sure that isn't what we're talking about going forward.

CHAIRMAN STETKAR: Good. And I assume we'll discuss that when we get to the heat release rate.

MR. NOWLEN: Yeah, I can't tell you how glad I am to hear that.

CHAIRMAN STETKAR: That's -

MR. NOWLEN: It's very important. You won't get there without it.

MR. MISKIEWICZ: Hi, this is Dave Miskiewicz from Progress Energy.

You know, I've heard a number of things and, you know, I don't want to make a big statement on the pilots at this time, you know, if later on we can, but a lot of things you're mentioning we did do at Harris.

As Doug talked about, we started conservative. When we found issues, we dug deeper. We did open a lot of cabinets. We did, a lot of times, disposition and justify the fire modeling insights and calculations, lower heat release rates.

We did the same thing for transients.

So, we used all these principles, but we used it to the extent we needed it to get our 805. We didn't use it for the entire PRA. We still have a lot of these conservatisms in there.

CHAIRMAN STETKAR: Right. You did enough so you felt comfortable being out -

MR. MISKIEWICZ: That we could make the decisions and consultations -

CHAIRMAN STETKAR: You could make the decisions to transition -

MR. MISKIEWICZ: - to support the transition.

CHAIRMAN STETKAR: Okay.

MR. MISKIEWICZ: But we didn't apply that to everything. So, we have a, you know, a lot of the issues we talk about, you know, some cabinets we let the big fire go because it didn't impact our decision.

But do we believe that that damage set is real? We don't. We save tools we think we need and we identified a lot of these issues earlier on when we were doing it.

But we did do calcs, we did take it further, we do have some documents, a lot of pictures of open cabinets and bases why we do things.

It takes a lot of work. It's not cookie cutter. And even if we have a lot of new methods, it's still going to take some, you know, I just wanted to clarify we did apply all these things in the pilot process. So, we didn't blindly stop when 6850 specific guidance didn't help.

And while that was plant specific, it wasn't industry-accepted stuff.

MR. MISKIEWICZ: Thanks, Dave.

MR. CHAPMAN: Jim Chapman, ScienTech.

Let's get this to the 98th percentile because the plants that my company is supporting also have replicated what Doug and Dave just said.

CHAIRMAN STETKAR: Again. Thanks.

MR. NOWLEN: Again, I'm very gratified to hear that. But, you know, you read the report and you see statements like this: When transferring information from task to task, simplifications and bounding assumptions are applied.

That's not consistent with the method. And conversely these simplifications and bounding assumptions have the potential to overstate risk, you know.

I mean, simplifications are inevitable, right? I can't model the world yet. So, we have to simplify. They've been applied where necessary and based on the current state of knowledge and that's typical.

So, I'm not - again, I don't see the simplifications that they're applying. So, I can't get specific simplifications that I think might be, you know, too simple. But, again, I think simplifications are fine.

I think this concept of bounding assumptions, the only time we recommend bounding assumptions be carried from task to task is screening, but that's screening. That's what screening does.

You apply bounding assumptions, you progressively relax those, and you identify what you're going to move forward.

So, I don't think there's anywhere in 6850 that it's telling you to carry forward bounding assumptions to quantification. That's not accurate.

One challenge, of course, is the realism. This is all plant-specific stuff, you know. When you get to fire, the plant specifics are so important. They need to be incorporated and it's difficult.

The base methodology was intended to provide the generically applicable approaches, but they may not fully reflect the plant-specific detail.

It does provide guidance for how you should refine the sorts of things you should look for in incorporating plant-specific information, you know.

For example, I give the case of the examination of the electrical cabinets. Look at the internals. Look at the venting and adjust your heat release rate, fire duration assumptions accordingly, you know.

The small panel that Mr. Pace showed, if you open that up and what you find is 20 16-gauge wires, that's a ten-minute fire at a half a watt, you know. That's not a 500 kilowatt benchboard cabinet fire. So, that's got to come in.

CHAIRMAN STETKAR: Steve?

MR. NOWLEN: Yes, sir.

CHAIRMAN STETKAR: I hear that and I've read the words in the guidance, and the words kind of say that.

On the other hand, if I am an analyst producing something that's going to be submitted to the staff for a staff review as part of a license transition, I'm a bit concerned about whether or not the staff reviewers are going to be at all acceptable of my particular judgment on my plant when it deviates from those nice little tables of numbers that everybody likes to look at.

Because it's real easy for a staff reviewer to look at a table of numbers and say you didn't use this number. Why didn't you? You haven't told me enough information. You need to go out and do six years of research to justify why you used a number that's a factor of three lower than this number in this table that is in the NUREG. It's a published NUREG by well-respected experts in the field.

How do you answer those questions? Because that's a little bit of what I hear. Although, the words in NUREG/CR-6850 say everything that you've been saying, they by and large stop at words in many cases.

MR. NOWLEN: Yes, I understand and I appreciate that dilemma. It is a challenge and I do understand that.

I tie it back to the consensus standard, you know. If you look at the PRA standard, it says if, you know, if you're applying a method, you need a basis. You need to establish the basis.

I think 6850 is an acceptable basis. That is if you say I got to write out a 6850, you've got your basis. That's it.

The challenge is for those where they're doing other things. And, you know, according to the standard, they need to establish a technical basis for what they're doing.

You know, I understand getting that reviewed and getting it approved and things like that can be a burden. I don't have a good solution for that problem. I do appreciate it.

I think that some of the things I'm talking about here are 6850. 6850 says consider fuel burnout. Look at the internals. And if you can't sustain a fire, don't assume the fire is going to be sustained.

So, I think that's easily within. If they documented that the total fuel load here is a hundred BTUs, and if I burn the fire at, you know, a hundred kilowatts that lasts 15 seconds, as a reviewer I would say great, well done, move on.

So, I, you know, and again -

MEMBER BLEY: I guess I'm - Steve, I guess I'm wondering because all we have are little hints, I'm wondering if that kind of review is the kind that's going on or if we need some kind of guidance either in 6850 or in SRP of some sort to staff on how to review those kind of things that respond to a one-liner in the NUREG that then requires maybe a very simple analysis, but hope and understand what it takes to buy into that kind of analysis.

I'm just wondering this now. I'm not suggesting -

MR. NOWLEN: Yeah, I'm not sure I can answer that question.

MEMBER BLEY: Yeah, and I wouldn't ask you to answer it, but I might ask the staff to answer that.

DR. WEERAKKODY: In fact, Donnie Harrison is -

(Off-record comments.)

MR. HARRISON: Donnie Harrison of the staff.

I would just say maybe a point of evidence would be with what Harris did. And, again, they did refinements and the staff did probably have some RAIs, but it wasn't a prolonged review on that. It was more of do you have a technical basis.

Where we had more of a back and forth was more on when they went and did the modeling for incipient detection. That took more effort because that was completely a new approach.

And we had a back and forth that went on, on that, until we came up with a way to resolve that through a sensitivity study by Harris, which is a normal thing you do in a risk-informed application when you're trying to deal with an issue like that. Plus, we developed a FAQ to address incipient detection.

So, I think if Harris is an example of - especially for refinements that are allowed in the method, how they went through, that worked forward.

The things that go beyond 6850 into new methods, I think the industry task force on fire PRA methods will be a good step forward towards resolving those early before they actually show up at the NRC.

My comment has always been you don't want to surprise the NRC with a new method in the midst of a risk-informed application. You'd want to address that as much as possible before you got there.

So, I think the task force the industry is developing to address those issues with methods is a good step forward in doing that.

MEMBER BLEY: Sorry, Steve. Go ahead.

MR. NOWLEN: No, I enjoy the discussion. And I've already mentioned the last bullet there.

So, here's another statement: "In addition, there is an implicit assumption I most fire PRAs that every fire leads to a plant trip." And that's, again, that's not what 6850 says.

This was an issue during IPEEEs. There were folks who said, you know, you have a machine shop fire. Aren't they going to trip the plant?

And so you should at least, you know, for every fire - well, we don't do that anymore. 6850 specifically says not to do that.

The idea is that if you are damaging PRA targets, you know, then probably as a minimum you're going to trip the plant. That's a pretty common assumption that is made.

But by that time you're incorporating severity factors and probabilities in non-suppression and damage target and all of that should be folded in.

So, again, I don't want to belabor that one, but I think it's a little bit of a misleading statement.

The industry experience, no spurious operations since Browns Ferry. This is not accurate. One point is that when we do post-fire investigations, we don't actually go out and look for them. The NEI report really doesn't give us a basis for their statement. I think Biff clarified that it was the collective judgment of the panel.

There's no systematic study of this. So, it's hard to say. It's a very difficult statement to prove, but we know of at least one that's been documented in the literature.

NUREG/CR-6738 talks about the Waterford switchgear fire. This was 1995. Fire damage to overhead cables. We had a spurious trip induced by the control cable failures of a breaker. And we also had the operators report a number of erratic indications on their control board that they attribute to the cable fires, cable damage. So, that's a concrete event that's well-documented in the literature.

We have two more, and I got these simply by looking at the first 250 events that we have in the Fire Event Database update work. And I simply went through the reports in search for spurious, and I found two out of 250 events.

One is Dresden. This one is pretty clear cut. The second one is St. Lucie. A little bit dicier. I'm not sure quite what happened here.

But the first one is during a Dresden fire, it was a pump fire, a condensate charging pump, and three minutes into the event they had an MSIV spurious closure. And they attributed that to loss of the AC control circuit to the relay that was holding the thing open.

There was a concurrent fault in a companion DC circuit, but together they caused the MSIV to close.

That's a spurious operation and we cover that one in our circuit analysis. This one happens to be a loss of control power.

MR. TRUE: This is Doug True again.

That's not a spurious operation. that's a cable fault. That is a different thing than a spurious op. And, Steve, you know that.

CHAIRMAN STETKAR: Doug, Doug.

MR. NOWLEN: Well, this is - what I point out here is this is not the classic hot short-induced spurious operation, but this is a circuit fault spurious operation induced by fire. I think it counts, but that's okay. We can debate that.

CHAIRMAN STETKAR: In the interest of time, and there's emotions, there's - people have spent an awful lot of time in these areas.

I think the point was - I'm sure you have examples. People can argue about specific examples. You can bring up international experience. I have international experience. I can bring it up too.

MR. NOWLEN: Yes.

CHAIRMAN STETKAR: On the other hand, that's not relevant because they're only looking at U.S. fires.

The point is that not can you find no other events, which I think is probably an overstatement in the NEI report.

MR. NOWLEN: Yes, that's the point.

CHAIRMAN STETKAR: The point is that if you look at the frequency of spurious operations which are fire-induced hot shorts in their models, you ought to see one every couple of - and I'm trying to be numerically very precise - couple of years or so, and we're not seeing that, you know.

We might have seen a handful, again, a very precise, numerical estimate over the last 20 to 25 years, but that's not once every couple of years.

MR. NOWLEN: Yes.

CHAIRMAN STETKAR: That's the whole point.

MR. NOWLEN: Yes.

CHAIRMAN STETKAR: Rather than belaboring -

MR. NOWLEN: Right.

CHAIRMAN STETKAR: - individual items and discussing whether that one was an open circuit that lost DC and whether, you know.

MR. NOWLEN: Right. Because we do have the international experience. I won't even cover it, but I do agree with that. I believe that the -

CHAIRMAN STETKAR: At least you don't have the Paks fire there. That was a really interesting one. They had a lot. So, I think it was 1993 or something like that.

MR. NOWLEN: We missed that one. I just went by the report we had written a few years ago.

And I agree with the observation and I think it's a fair thing to do to compare it to, you know, what we see in reality versus what the PRA is predicting.

And, you know, the spurious actuation one is a compounding pile of things that are impacting that. I mean, we've got, you know, how the fires are treated, how we treat the cable faults, you know, what's the timing of the fire damage, the probability of non-suppression, the hot short probabilities. I think those definitely, you know, we're in the process of revisiting those now.

So, there are so many things that go into that insight. But, again, I think it's - the statement's made very strongly in the NEI report. I don't think it's defendable.

CHAIRMAN STETKAR: Words like "no" are very precise words.

MR. NOWLEN: It's a very strong statement.

CHAIRMAN STETKAR: But then again, you know, the concept, I think, is valid that we should be challenging the results from these PRAs especially if they're PRAs that have fully - or I don't want to say "fully," but taken substantial advantage of a lot of the modeling and analysis refinements.

I'm not talking about screening-type analyses. If those are still showing measurable differences from operating experience, then we should understand why.

MR. SIU: Nathan Siu, Office of Research.

I think - and I completely agree with Steve, of course. One should be calibrating to the operational experience.

The thing - the question is, I think, what's the reason for miscalibration if there is one.

MR. NOWLEN: Right.

MR. SIU: And that's part of what the whole point of this discussion is.

CHAIRMAN STETKAR: Yes, that's exactly right.

DR. WEERAKKODY: If I may, John, one point I also want to make was that because of the commitment

I took that last time, we were trying really hard to get to the bottom of some - why does zero, zero, four - it's difficult when you have a couple of sequences without knowing, you know, these may be two potentially conservative sequences that are being used to show that we should expect so much.

So, I would rather - the only purpose of bringing this to the table was to say don't use that type of experience to make a judgment of the fire PRAs conservatisms.

CHAIRMAN STETKAR: Okay. And I hope, you know, when we get into the more detailed discussions, we'll begin to appreciate what those issues are.

MR. NOWLEN: Yes. Okay.

Another example that's put forward in the report talks about diesel generator fires. And this was an interesting one for me, you know. They talk about the day tank containing 500 to a thousand gallons. So, a small spill is 50 to a hundred gallons. This is interesting.

When I first heard this one and I actually first heard about this one in about the first of November, I went back to the document and said, how did they get that?

And so I traced it, and you can. You can trace it. I can see how they took a piece here, a piece there and a piece there and got that answer, but it clearly was not our intent.

I mean, they are correct in their report. There's no precedence for any kind of fire like that, right? And it wasn't our intent in 6850 to suggest that they should be postulating unprecedented fires.

I think one of the challenges we have to look at is precursor events, you know, close calls, you know. We had a very, very large spill of oil recently at one of our pilot plants that didn't ignite, but it was very close, right?

So, we have to be a little careful. But, again, it wasn't our intent to force them to postulate crazy scenarios.

So, I wish we had gotten a chance to attack that one via the FAQs and I think we could have probably resolved that one. Certainly, I mean, an unintended consequence. And I rack this one up with the main feedwater pump fire.

When we saw the way main feedwater pumps were being done, we said, oh, wait a minute, that's not what we meant. So, let's fix that.

This one I think we could have fixed, but I can see how they got there.

CHAIRMAN STETKAR: Okay. It's part of the learning experience.

MR. NOWLEN: It is.

CHAIRMAN STETKAR: And until somebody applies what's written in the text and what's tabulated in those tables, you know, you perhaps as an author might not have intended it to be used that way, but you now understand how people can.

So, I think that's useful insight.

MR. NOWLEN: Yeah, I think that someone used the words earlier about crystal clarity.

CHAIRMAN STETKAR: Yes.

MR. NOWLEN: I don't think we're crystally clear here in some cases.

This is another one that comes out of the report there as an example. And I don't want to go into too much depth here, but the postulate is you have a single cabinet fire. You have two cable trays overhead. Tray 1 has System 1. Tray 2 has System 2. You can have potentially two zones of influence. Zone of Influence 1 or B only captures the first tray. Zone of Influence A captures both tray. And they say the baseline risk would predict Zone of Influence A, the larger zone of influence.

And you would carry that forward through the quantification. And then they go on to say for this example, you can't do something - now, these are my words - short of an online risk monitor-type application where if I want to take System 1 or System 2 out of service because they're only carrying forward the one case where both trays are damaged, they can't distinguish between those systems being in and out of service, right?

So, that's the example in the - this is a fundamental misunderstanding of how the methodology is supposed to work. This is a very common situation. We have fires. I mean, fires are dynamic. And there's a probability that we interrupt that dynamic behavior sometime along the schedule.

So, what should be done here and, again, this is within the methodology, this is nothing outside the methodology, is you break this into two sub-scenarios. You have a scenario where the cabinet fire causes damage to the first tray. And you have a scenario where the cabinet fire causes damage to both trays. Okay. And you've got to do the probability of non-suppression right for those, but that's easy.

For the one tray damage, it's the probability that the fire lasts long enough to damage the first tray, but not long enough to damage the second tray. And for the second sub-scenario, it's simply the likelihood that the fire progresses long enough to damage both trays.

So, you know, and that's all well within the methodology. To get the correct baseline risk, you carry those both forward with their associated likelihoods and severity factors and probabilities and non-suppression. This is really pretty straight forward.

And if you do it that way, then your online risk monitor is right back in the game again because you've now broken the scenarios out where you can lose one system or both. Taking one system out of service would then be properly reflected.

So, again, I think - I don't know where that example came from, but it's just a fundamental misunderstanding of the way we build fire scenarios and we look at the progressive nature of fire and fire damage.

Let's see. The ignition end of it are the same for all plants, and this is another statement that's made in the report that again sort of reflects a misunderstanding of what we did.

This is talking about the plant-to-plant variability analysis that was done. And 6850 postulates that plant-wide fire frequencies are the same for all plants. That's where you start. And, again, we're going to talk about that later.

But the plant-to-plant variability didn't have anything to do with that. That's not what that was about. The plant-to-plant variability was an attempt to address the issue of known under-reporting of fires.

We know we're not capturing all the fires that would be interesting from a PRA perspective. We capture ENs and LERs. We capture voluntary reporting from NEIL in more recent years. We don't catch them all.

And if you look at the database, you can see that there are licensees who don't participate in voluntary reporting and they're absent.

So, the plant-to-plant variability analysis was associated only with that problem, and it made some minor adjustments to reflect our expectation that if we had more complete reporting, how might that impact the results.

But it had nothing to do with the variability of actual PRA fire frequencies from plant to plant. So, when you read that, it's just been off base.

Sensitive electronics, there's also a statement in there: Currently, there is no guidance for the treatment of potentially sensitive electronics. There is not even an adequate definition of blah, blah, blah.

Consequently, they assume that such components fail at time zero. Again, this doesn't reflect the methodology.

There is an Appendix H which gives you damage and ignition temperatures in terms of both - or I'm sorry - damage and ignition criteria in terms of both temperature and heat flux.

There is - Appendix S covers how you treat sensitive electronics for cabinet fire scenarios and adjacent cabinets, for example. There is discussion that damage to sensitive electronics should not occur for at least ten minutes after the peak heat release rate.

So, you grow to peak in 12 minutes. Ten minutes later you might have damage to sensitive electronics in an adjacent cabinet.

So, again, I think that, you know, the report doesn't reflect accurately what is in the guidance.

Now, is it perfect? No, we don't know

that much about sensitive electronics. They are a challenge, but -

CHAIRMAN STETKAR: However, Steve, you're pretty careful to say damage in an adjacent cabinet, damage in the ignition cabinet is assumed to occur at T zero.

MR. NOWLEN: Yes, that's probably true. That's a - that's a tricky one. That's a real tricky one because how we treat the performance of stuff within a cabinet that has now ignited is very difficult.

Generally, that is an area where we do make the conservative assumption we wipe out the cabinet. And 6850 does tell you to do that.

CHAIRMAN STETKAR: I'm interested - and we'll talk, I think, more when we talk about cabinet fires and heat release rates, the sense that I get, and I might be wrong, is that the within cabinet fire damage is less important to the current results that we're seeing than the, you know, external damage.

I could be wrong with that, but -

MR. NOWLEN: That was certainly our expectation as authors. And from everything that I've heard, that is the case.

The big problem with cabinets is - well, let me be a little careful. I have heard cases where people would like to be able to relax that assumption and do something within the cabinet that's on fire.

I'd be open to it. I think it's a real challenge because you get in the cabinet, you got all the panel wiring and you have no idea where that goes. And it goes to everything that's in there.

So, how you're going to do that, I mean, I'm open to the concept. We didn't go there. But, yeah, primarily what I have heard secondhand again, is that it is the fire that damages cables overhead.

And in particular, cables that tend to be very close overhead, you know, within a foot or so, those are hard to get rid of when you start doing the risk scenarios.

CHAIRMAN STETKAR: Thanks.

MR. NOWLEN: Okay. Let's see. So, in summary, I agree 6850 can be improved. Despite it's flaws, I still believe it's a workable method. There are clearly some legitimate issues.

I think a lot of the things that came out in the NEI report, there are more misinterpretation or misunderstanding of what 6850 contains as opposed to fundamental shortcomings of what the 6850 contains.

And I think this is, you know, the "easy button." If you push the "easy button" - there is an "easy button," and it's right there. But if you push that "easy button," you know, the price you pay is conservatism and simplification.

And I understand the resource issue. I think that no one expected that someone would spend $15 million on a fire PRA. I'm a little shocked at that myself, and I get that. I understand it.

But, again, we have to be careful when we look at the methodology as a flawed methodology and say well, how much of it is driven by the "easy button."

If we're carrying bounding assumptions and - from task to task and simplifications into quantification, I - that's what you're going to get.

So - and we have to be a little careful that we don't - we don't fix the "easy button" so that it gets you the right answer, and then later on come back and put all the excruciating detail back in and now we drill down two more orders of magnitude and now we've gone in the wrong direction.

So, with that, I'll close.

CHAIRMAN STETKAR: Any other questions? Dennis?

MEMBER BLEY: No.

CHAIRMAN STETKAR: Divergent views here.

MEMBER BLEY: If this was easy, I guess we wouldn't be sitting here.

CHAIRMAN STETKAR: Jeff, let me ask you something. It's 12:30. Do you have any -

MR. CIRCLE: It's going to be a very short presentation.

CHAIRMAN STETKAR: Well, it may or it may not.

(Laughter.)

MR. CIRCLE: Maybe we should go to lunch.

CHAIRMAN STETKAR: What I was going to ask you is I'm not going to presuppose how long or short it might be. I can count pages, but that's almost irrelevant.

Personally, do you have any problems coming back after lunch?

MR. CIRCLE: No, not at all.

CHAIRMAN STETKAR: Let's break for lunch then, because I don't want to rush you through, you know, use of operating experience and those kind of comparisons.

So, with that, we will recess for lunch. Come back at - let's come back at 1:20.

(Off-record comments.)

(Whereupon, the above-entitled matter went off the record at 12:29 p.m. and resumed at 1:24 p.m.)

CHAIRMAN STETKAR: We are back in session and only five minutes late plus one presentation, but who is counting? Jeff, sorry to interrupt you before lunch --

MR. CIRCLE: Quite all right.

CHAIRMAN STETKAR: -- but hope you had a good lunch. Let's hear from you.

MR. CIRCLE: All right. Well, good afternoon. It is afternoon. My name is Jeff Circle I am with the Division of Risk Assessment in NRR, NRR staff. For the last four years I have been the technical lead of the SDP headquarters review in the ROP.

Before that I came out of industry. I was at one point supervisor, one of the two supervisors in the New York Power Authority. So I have a lot of experience with the ROP.

In fact I was in charge of the FitzPatrick pilot plant for the ROP back in `99/2000 time frame. Before that I was the project manager of the two fire PRAs the power authority had done for the IPEEE.

So I can speak volumes about what was discussed this morning about some of the ignition frequencies and the modeling questions that came out, but I am going to limit my comments today to just the ROP.

I had the opportunity to take a look at the NEI fire PRA task force and looking at that document and the ROP argument that was made, what piqued my interest was the statement that was made that to date no actual fire events have been considered red or yellow, with a CCDP greater than minus five.

And it then goes on to say that the fire PRA models would predict that several of these events should be seen each year across industry. And it did bother me to some extent, because the staff as well as myself, we believe that the argument is misleading and we don't want you to be misled by this statement.

The ROP is a risk-informed process and it is really used to marshal inspector resources on performance deficiencies. So the entry condition for the significance determination process that we use is a performance deficiency occurring at the plant.

And I just reproduced in the slide what you can find in our inspection manual 308 about performance deficiencies. And you know, it's an issue that is the result of a licensee not meeting a requirement or standard. It could be a self-imposed standard or a standard required by regulation.

Going that far, you know that, you can see that the actual performance deficiencies don't necessarily have to be violations and vice versa.

But the argument that was made by originally, this morning, by Ken and by Doug, was that they didn't see any reds or yellows in the SDP and therefore the fire PRAs that were done are overly conservative.

But not all fires are performance deficiencies. And that is the important message that we want to give you.

We haven't seen many yellow or reds in industry, it's true, because what has happened is that a lot of the findings that we have in our process are really findings that impact mitigating systems that include the fire response, not on fires directly.

Also, if you take a look at a lot of the LERs, a lot of the incidents that have happened in industry, a lot of the severe fires, and I am using an example of the -- next slide -- I am using as an example the Vermont Yankee fire of 2004. That was a pretty severe fire but the consequence was very low.

And actually when we do this SDP

evaluation and we look at an event that has happened, we look at several factors.

One factor is whether or not it is a performance deficiency, it enters into the process. The other factor is the exposure time. A lot of times the licensee will fail to do something, will have the plant vulnerable let's say in a month or two months or so. That's going to produce a very low CCDP, and it won't warrant a red or a yellow or you know, that type of a finding or even a white finding for that matter.

The Vermont Yankee fire was a perfect example where you had a severe transformer fire that was started in the bus duct. It destroyed the transformer completely but the consequence of that fire was low.

That doesn't mean to say, that because that fire did not have a high CCDP, or a high CDF, meant that that wasn't a severe fire and it shouldn't enter into the database, and therefore the arguments that we used were overly conservative when we modeled severe fires.

Basically, a lot of the traditional PRA values that we use in the base model come from industry events and I know you are going to discuss tomorrow a lot of the ignition frequencies and how they came about.

When a basic tenet of PRA is that when we look at data that we put together for the base case, we tend not to look at data as a result of performance deficiencies. We assume that licensees follow their rules. They follow their guidance, their procedures.

We don't go back and say well, this licensee made a mistake and therefore it is entered into the database. The way the process is here, it's the same thing.

We have a performance deficiency that is a result of a licensee deviating from its normal practice and then we assess it accordingly, and we assess it against the base.

So you can't really make an argument that the base is artificially high because the licensee did something wrong, okay, and use that as your basis. So that's basically what I wanted to say about that.

CHAIRMAN STETKAR: I guess I am not very familiar with the details of how the reactor oversight process is implemented kind of on a day to day basis. What I think I hear you saying is that if an event occurs in a plant, could be a fire could be a pump fails, that our pump failure, let's say, leading to a plant trip, are all of those events evaluated through the SPAR model for that plant, to determine a conditional core damage probability given whatever that condition is?

MR. CIRCLE: Not necessarily, if they become performance deficiencies, so if that pump failed as a result of a licensee performance deficiency -- I'll give you an example.

You can open up the morning reports and you can open up LER reports every day, and you can see cases where HPCI failed surveillance, high pressure coolant injection.

That doesn't mean that the failure of that HPCI pump is a result of the licensee doing something wrong, and those cases generally are not evaluated and it's up to the regional office. They handle it. But a lot of these cases will just fall through the cracks.

CHAIRMAN STETKAR: Well, let me give you a fire example then so I understand that concept. Suppose now I had a fire in a plant that damaged a piece of equipment -- I'll be non-specific -- that damaged a piece of equipment and also ignited some cables that resulted in other pieces of equipment mis-performing. Let me call it that and caused a plant trip, or maybe it didn't cause a plant trip; but that there was nothing in either the location of the cables or the way people were doing business. This was simply that the pump decided that it -- or the piece of equipment decided that it wanted to ignite at some given time.

If there was nothing in that combined set of failures that indicated a performance deficiency on the part of the licensee, that event wouldn't necessarily be quantified through the SPAR model or the accident sequence precursor models for that plant?

MR. CIRCLE: Yes, for the ROP that's true. If you can't find a performance deficiency from the licensee, if they didn't do anything improper, remember part of that definition uses the words "foreseen." It's something that the licensee did not foresee, and if you go all the way back to the definition, right.

And it was reasonably within the licensee's ability, foreseen correct. We don't have a performance deficiency it won't enter into --

CHAIRMAN STETKAR: Yes, but for example if this particular licensee is perfectly in line with Appendix R and they are following all the --

MR. CIRCLE: Let's say they -- yes, and they followed their administrative procedures and the pump, let's say it started with the pump and the pump was maintained properly, they followed all their procedures correctly, we didn't find any Appendix B violations on the pump, let's say.

Then it would not be a performance deficiency and we would not evaluate it through the ROP.

CHAIRMAN STETKAR: But I think it, if I hear what you are saying, this again, we are talking about details, but I'm trying to understand the process, is that what I hear you saying is that there may have been fires that occurred in the industry that, had they been evaluated in the SPAR models or under the accident sequence precursor program or wherever, they might have demonstrated conditional core damage probabilities on the order of, pick a number, 10 to the minus four, but they weren't evaluated. We just don't know what that population might be. Is that correct?

MR. CIRCLE: Well, yes. A lot of them will be within the regional office. We'll know it because the regional office would consider it. But as far as headquarters is concerned, it does not --

CHAIRMAN STETKAR: But in terms of the published reports at the end of the year --

MR. CIRCLE: Right.

CHAIRMAN STETKAR: if they come out of headquarters, we wouldn't know.

MR. CIRCLE: No.

CHAIRMAN STETKAR: Okay.

MR. CIRCLE: We would have to go to the regional offices. Yes, Biff has it.

CHAIRMAN STETKAR: We'll get to Biff in a second. He's here. I'm just trying to understand a little bit about, you know, what sort of information we are comparing here. That still, though, leads me to the observation made in the report that we should be seeing something in the order of a couple of -- I'll again be numerically very precise -- events per year, and it's, and it's unlikely that none of those would raise above the bar that indeed would be evaluated. I mean, I can understand, one every two or three or four or five years over the whole industry --

MR. CIRCLE: Right, and that opens up another --

CHAIRMAN STETKAR: but a couple a year is --

MR. CIRCLE: Well, that opens up another question and that other question has to do with the modeling. That goes beyond what I am discussing here, but there is a question as to the rigor of some of these models and that's probably going to be discussed either later this afternoon --

CHAIRMAN STETKAR: Rigor of the SPAR models that would be used or --

MR. CIRCLE: No, of the fire PRAs that are being done right now.

CHAIRMAN STETKAR: Okay, that's a different --

MR. CIRCLE: We will talk about that later, but yes, I have read that and I saw the very high CDFs and it opens up another can of worms with me. Being the manager of two fire PRAs for the IPEEE, we used the EPRI fire PRA implementation guide, which is the grandfather of 6850.

It uses a lot of the methodology of 6850 and it's not as refined. It's very conservative. It uses the five spreadsheets instead of using a rigorous CFAST analysis, we used these old spreadsheets that were part of the five methodology.

We never got CDFs in the order of 10 to the minus three. I can tell you that. The James A. FitzPatrick CDF for fire was 2.5E to the minus per year. Indian Point was the high minus five, wasn't minus four.

So I am very surprised at what I am seeing today, even with the complaint that yes, there are a few other issues in there like, spurious operation of cables etcetera.

CHAIRMAN STETKAR: That's not, by the way, a few other issue -- that's a rather substantial issue.

MR. CIRCLE: Yes.

CHAIRMAN STETKAR: So, don't try to kind push that to the side.

MR. CIRCLE: I'm trying to -- I don't want to --

CHAIRMAN STETKAR: That's a big deal.

MR. CIRCLE: But you see what my point is about this. And you mentioned that a couple of -- it maybe a lot less, it may be two orders of magnitude less for all I know. And this is just my opinion, just as a staff member.

CHAIRMAN STETKAR: Thanks. Biff, I promised that indeed -- I am not ignoring you, I'm just --

MR. BRADLEY: I appreciate it. Biff Bradley, NEI. Just a couple of points of clarification. I believe MDA.3 of the ROP initiates the ROP on any event leading to a plant trip, so given that we have --

MR. CIRCLE: No, no, Biff. MDA.3, it's

actually IMC 309 right now, doesn't say necessarily the ROP. That's our inspection resource. That's the reactive inspection portion. And when we do have an event that warrants IMC 309, and if it's in the overlap of course headquarters gets involved.

They do look into this, they do send an inspection team. Not all inspections end up in the ROP and not all events end up as performance deficiencies in the ROP. I can tell you that there are quite a few that have happened over the years that we have never -- we might have escalated it to a special inspection team, and we may not see a performance deficiency out of it.

And I know one that comes to mind was the circuit breaker issue with Farley, which was quite a few years ago. That was back in `07, where we had a potential for common cause failure and we sent a special inspection team to look at those circuit breakers and in the end, we found no performance deficiencies came out of it that came to headquarters.

MR. BRADLEY: Do you intend to speak to the ASP, because the ASP is not predicated on a performance deficiency, and our paper spoke to both ASP and ROP and in a similar vein. So how do you -- how would you address that?

MR. CIRCLE: Well, I've left that up to the research since they own the program, to discuss it.

CHAIRMAN STETKAR: Let's, if I can, I want to try to get us back on a little bit of schedule and I can see where this is headed. I think we are -- we have something on the record. I'll tell you, from my perspective, unless I'm interpreting this a little bit wrong, and please correct me if I am, I -- what my takeaway, personal takeaway from this discussion is a little bit similar to the discussion we had before lunch regarding statements of no fires that have exhibited spurious actuations.

That in my interpretation is perhaps a bit of an overstatement in the NEI paper. On the other hand, the NEI paper's numerical results lead me to believe that, despite the fact you might be able to find a few spurious actuation fires, there certainly aren't enough of them that would dispute sort of this apparent discrepancy.

And sort of what I am taking away from, in terms of the reactor oversight process, or the ASP, is that that is probably also true, that indeed perhaps in the annual summaries of significance or even in the individual significance determinations, there may not be a comprehensive evaluation of every event that occurs at every nuclear power plant.

So perhaps, in some of those annual summaries published by headquarters or coming out of the regions, we might be missing a few, but we are probably not missing a couple or three events per year.

So the statement, again in the NEI paper that there are no events in industry experience that show this computed high conditional core damage probability, might be an overstatement but it's not likely that a lot of them have occurred and we have missed them.

MR. NOWLEN: Yes, the real answer undoubtedly --

CHAIRMAN STETKAR: So the real answer seems to be somewhere between the extremes.

MR. NOWLEN: somewhere, yes, right.

MR. CIRCLE: And you just have to look at the other factors such as the exposure time, the consequence, because clearly the Vermont Yankee fire was a severe fire but thank goodness it didn't have a huge consequence. It just -- it destroyed a station transformer and that was it.

CHAIRMAN STETKAR: But I think it's important for us as a subcommittee to have heard your presentation and understand that it's not simply a process that takes every event that occurs in a nuclear power plant, runs it through the available PRA model and calculates a conditional core damage probability, that there are other factors that are considered before an event is raised to a level at which it might be run through a PRA model.

MR. CIRCLE: Right, and it would be a poor gauge to use to make that statement. That's what I really wanted to say with that.

CHAIRMAN STETKAR: Thank you.

MEMBER SHACK: But is the staff going to say anything about the ASP results?

DR. WEERAKKODY: We have another presentation.

MEMBER SHACK: Ah, you have another one.

DR. WEERAKKODY: Not necessarily on the ASP but what I -- the context of this whole issue is closer to what John is saying. We saw a number of statements that appear to convey that the five PRAs have these ultra-conservatisms based on some of the numbers.

And what the staff is saying is that when you make that kind of statement, whether it's spurious actuation or ROP, we have got to put them in the context of the purpose of the different programs, and one of the technical points that the staff mentioned when I had discussions with the staff that Jeff mentioned that I won't reiterate, is that if you look at the Vermont Yankee fire, it was a severe fire. Fortunately it was not at a wrong location.

But it does tell you something about the probability of such a fire, because component likes that --

CHAIRMAN STETKAR: We're not -- I don't care if you burn up a large transformer every hour, if it's sitting up by itself in the middle of the field. The analyses that were done in those PRAs is a combination of the frequency and the consequences, not carried out to core damage, but consequences to damage of equipment.

So it's not just -- we are not, I don't think, discussing at all the frequency of large transformer fires. We are discussing the frequency of potentially risk significant fires, which does involve both the component and its location in the plant. Obviously that has plant to plant variability, but across the industry --

MR. CIRCLE: One thing I do want to add also is that the significance is the delta CDF, which means that that change has to be so high, it's not just the fact that the base is high, it's the change in CDF has to be high in addition to that.

So if you have a high base, it doesn't really -- using the argument that we haven't seen very high departures from that base is not -- you understand what I am saying.

CHAIRMAN STETKAR: Yes I do.

MR. CIRCLE: Yes.

CHAIRMAN STETKAR: Although I --

MEMBER SHACK: That's a different argument.

CHAIRMAN STETKAR: That' s a different argument.

MR. CIRCLE: This is what -- the argument that was made by industry was that, gee, the base is very high, well then we would see very, very high SDP results, not necessarily.

CHAIRMAN STETKAR: Any other questions among -- Biff is back.

MR. BRADLEY: Just a minor reiteration. I did hear NRC say that Research would speak to the ASP and why these events aren't occurring in the ASP, I heard the ROP but I'd still like to understand the ASP side of the argument.

CHAIRMAN STETKAR: We'll figure out what we hear. Sunil I think said that they have another presentation that's going to discuss this comparison between the PRA results and the operating experience, so we'll wait to hear that.

And I think we do need to move on because the next presentation is actually starting to talk about some more of the technical issues, I hope.

MEMBER POWERS: We'll prove that old soldiers never die. Speaking of ASP --

MR. CANAVAN: I could loosen my tie and unbutton my collar and put on some glasses and pretend I am Rick Wachowiak but -

MEMBER BLEY: Can you sing and dance?

MR. BARANOWSKY: Good afternoon. I guess we are ready to start. I am Pat Baranowsky with ERIN Engineering and research and I am going to do the presentation today on fire event database update and fire ignition frequency analysis, work sponsored by EPRI. Rick Wachowiak is one of those souls who got stuck in the snowstorm so Ken is going to fill in here to help us kick it off and then I'll pick it up unless you want me to get going.

CHAIRMAN STETKAR: Pat just be real careful of that microphone there. If you hit it with your paper, it's really, really sensitive and it explodes in our reporter's ears.

MR. BARANOWSKY: In that case I'll take this clip off so I don't have to flip pages.

CHAIRMAN STETKAR: She will do things do to you that you really don't want to have done to you.

MR. BARANOWSKY: So I am going to cover what we are doing to improve the fire events database, including the new data acquisition to support those improvements and then I will give you sort of a preliminary snapshot on some of the fire event reanalysis we are doing on the fire ignition frequency.

The fire event database that we are talking about here, also known as the FEDB, sponsored by the Electric Power Research Institute, is the principle source of fire incident operational data used basically in all the fire PRAs.

It was put together as part of the NUREG 6850 activity to provide a fire PRA methodology and it had some limitations and now we are looking at making improvements that include expanding and proving the details of the data fields, improving data consistency, the quality of the information, characterizing the fire severity a little bit more rigorously or at least with some improvements in the classification scheme.

And these improvements will allow us and the nuclear industry and NRC to reassess the fire ignition frequencies, to provide better data to update as desired the fire detection and suppression effectiveness models that are currently in use and provide a little better characterization of damaging fires that have occurred such as we just heard a discussion a few minutes ago, although we won't be doing a risk analysis of the individual events.

CHAIRMAN STETKAR: Pat, before you get into this and you have quite a few slides here, the -- what is the primary purpose for updating the fire events database? Are you simply focusing on refining the frequencies for each of the fire ignition bins?

MR. BARANOWSKY: That was one of the original purposes of doing it, but there have been other reasons to improve the data to support other fire PRA quantitative analyses, such as the non-recovery or non-suppression, rather, analysis work. But mainly the fire ignition frequencies and then lastly, to provide some benchmarks on severe fires that have occurred and have sufficient documentation of the nature of the fire to allow it to be looked at in terms of how well is it represented in the PRA scenarios?

CHAIRMAN STETKAR: How -- you've run out all the uncertainty distributions on all of the fire ignition bins. One of the things that I noticed is that the uncertainties, if indeed they are characterized correctly and I assume they are because there are events that were screened for the original fire events database, accounting for plant to plant variability across the industry.

The uncertainties are not extremely large. They are for some of the human-induced fire bins, but by and large, for most of the equipment-related fires, they tend to range in equivalent numerical error factor or about four to five.

That says that if we are going to refine the data, and if indeed the data fall within those uncertainty bins, I wouldn't expect a very large change in the mean frequency unless you substantially changed the way you are either screening fires or change the population or somehow other perturb that database.

So numerically, I guess I would be surprised if I had very large changes in those frequencies, certainly not large enough to get me a factor of 50 or 100 in the core damage frequency.

MR. BARANOWSKY: No, no, I think we are talking --

CHAIRMAN STETKAR: Twenty or 30 percent maybe.

MR. BARANOWSKY: No, I think we are talking factors of -- from the 6850 numbers, we are talking a factor of two.

CHAIRMAN STETKAR: Okay, I'd be interested in understanding why you think that's true. The second question I had, because these are uncertainty distributions that account for plant to plant variability, are plants that apply this generic data also performing Bayesian updates to specialize this generic data to their own plant-specific operating experience? Or are they simply using the generic data?

MR. BARANOWSKY: Good question. I would say it should be updated using current operating experience.

CHAIRMAN STETKAR: Well I would say it should be also. I guess I'm asking the question of what people really are doing.

MEMBER BLEY: Steve Nowlen, Sandia Labs. I can offer what the standard --

CHAIRMAN STETKAR: No, no, no, I understand, I know what the standard says Steve. I want to understand what people are doing. So if you are not doing the analyses, I would like to understand what people are doing. Here's someone.

MR. MISKIEWICZ: This is Dave Miskiewicz from Progress Energy. We did -- and we did not do Bayesian updating, but we did evaluate for the Bayesian updating. So had we done that, if we had zero for many of the bins and stuff, the numbers would have went down, down, so we decided to not do --

CHAIRMAN STETKAR: You decided to retain a conservative analysis --

MR. MISKIEWICZ: We addressed it in our analysis.

CHAIRMAN STETKAR: You decided to retain a conservative analysis.

MR. MISKIEWICZ:. Right.

CHAIRMAN STETKAR: Okay, so that was your own plant-specific decision to keep the numbers conservative.

MR. MISKIEWICZ:. Right, but we didn't -- it's evaluated as per standard.

CHAIRMAN STETKAR: Okay.

MEMBER SHACK: Jim's going to stand up now and probably rebut this.

MR. CHAPMAN: You would have had perhaps

zero events in 20 years. It wouldn't have changed the prior very much. So it is a question if you want to call it conservative.

CHAIRMAN STETKAR: In some cases, it might change the prior if the tails are fairly long.

MR. CHAPMAN: Posterior.

CHAIRMAN STETKAR: The posterior --

MR. CHAPMAN: I said it wrong.

CHAIRMAN STETKAR: Yes, the posterior would have shown --

MR. CHAPMAN: It might.

CHAIRMAN STETKAR: But again, within 20 or 30 percent change --

MR. CHAPMAN: Perhaps.

CHAIRMAN STETKAR: Perhaps, on a mean frequency basis. With zero events in 20 or 30 years, that's right. I ran out some examples too, but I won't show those. Okay, I was just curious whether people were actually doing that.

MR. ZEE: Kiang Zee with ERIN Engineering. I guess for all the fire PRAs we have been doing, to the extent that the FLECHT can actually give us the event reports, we have been doing Bayesian updating for all the plants we possibly can get the data for.

I mean, for some plants, some of the

records are hard to retrieve.

CHAIRMAN STETKAR: The records must be available because they were used for the EPRI generic database. That was actual fire events from real plants, so it's curious if they are not available to you doing the fire analysis at the plant, but they were available to EPRI doing generic analysis five years ago.

MR. CANAVAN: I guess you asked a couple of questions which I thought we were going to get to. One was, we were going through the goals, of what the analysis were, and so one of the reasons is to patch the holes in the data where not every plant contributed to the generic database.

As a matter of fact, it's quite under-represented in the old EPRI database.

CHAIRMAN STETKAR: Oh, is that right?

MR. CANAVAN: Yes, it's something on the order of, and I'm looking at Steve Nowlen, I want to say 30 percent plants reporting, 40 percent plants reporting, something on that order.

MEMBER BLEY: So most are not reporting.

CHAIRMAN STETKAR: Is that right? I didn't know that because that's interesting, because in November, we were questioning about timing of updating the database and at that point you said well, for the people who are transitioning at the moment, we should -- you, EPRI should have decent cooperation to be able to mine that data, but for the people who are not transitioning, it's a longer protracted --

MR. CANAVAN: Well, the new database is 100 percent participation. So the new database from 2000 to current, current being April 2009, is 100 percent participation. So we are collecting everybody's data. We have yet to go through all of it and verify.

CHAIRMAN STETKAR: But the old database, that's the basis for 6850 --

MR. CANAVAN: Correct.

CHAIRMAN STETKAR: is a subset of the --

MR. CANAVAN: A subset of old plants. It was taken from LERs, INs, and voluntary contributions through the NEIL database and does not represent all plants, because --

MR. NOWLEN: This is Steve Nowlen. I've actually got a little bit on this in my presentation, which is up next. But roughly, he's correct.

MR. BARANOWSKY: I think we need to be a little bit careful because we are talking about a database that spans whatever it is, 30 or something years and the quality of the data in 1968 is not the same as 1998.

CHAIRMAN STETKAR: Yes, I'm not talking about quality of the data or historical --

MR. BARANOWSKY: I mean completeness and where it came from, yes.

CHAIRMAN STETKAR: I'm talking about what fraction of the actual industry out there --

MR. CANAVAN: What Pat's trying to say is it's hard to gauge because in 1968 and the early `70s, different people contributed than contributed in the `80s than contributed in the `90s.

CHAIRMAN STETKAR: No, no, no, yes, but if I'm counting fire events for plant x, what I'm hearing is that I might have some fire events for plant x in the `60s and `70s but that plant x dropped off the radar in the `80s and `90s, so that I don't necessarily have a continuous --

MR. BARANOWSKY: Reporting, the reporting changed and the severity of the fires that reported may have changed also. It's not that clear because what was it, 1984, the new LER rule came into play and then you had Appendix R coming in in the `80s.

So there was pushes to report, pushes not to report, it's pretty confounded which is why we are going a slightly different route this time, basically going to the plants and, as I was going to try to point out, we are actually looking -- we are asking and have asked all the plants to do keyword searches on things like fire, burn, explosion, I forget what the rest of the keywords were.

But we have literally hundreds of thousands of hits that we are screening through to try and be sure that we have a fairly complete data set on fires of at least a minimal magnitude.

In other words, if someone says I had a burned out resistor, we are not going to go and collect lots of data on every burned-out resistor, but if there was evidence of a fire flaming, damage that looked like a fire, we are capturing it, or heavy smoke and that kind of thing. That's really what this presentation --

CHAIRMAN STETKAR: This is 100 percent of all of the currently operating units.

MR. BARANOWSKY: Yes, and what we have done is we have had -- we have worked with Steve Nowlen and J.S. Hyslop and Shawn St. Germain out at Idaho National Labs, to try and come up with a good data field set that we could use to go and screen through this fairly comprehensive source of potential fire incidents and we used screening criteria and maybe you ought to just jump ahead to --

CHAIRMAN STETKAR: But Pat, before you get into that, I want to understand the scope of this, because scope, especially when you account for plant to plant variability and actually quantify uncertainties, is important. So when you say you want to update the data through 2009, what data are you updating and how are you proposing to do that?

MR. BARANOWSKY: Okay, the data we are updating is the -- we are taking the existing database and we have revised the database structure to capture more consistently information that would be used in fire PRAs.

CHAIRMAN STETKAR: I understand. I want to talk about database structures. I don't want to talk about you know, Microsoft. I want to talk about actual experience. I have a plant here, called plant x. That plant started up in, let's pick a year, 1972. It has now been operating for 38 years.

That plant has experienced some number of fires in that 30-year period. What number of those fires in that 38-year period are you going to include in this update of the database?

MR. BARANOWSKY: Okay. We are going to include all the fires that occurred since around 1990 forward but we are not going to do them all exactly the same. We don't have information from 2000 on so we are going back to the plants and asking for everything that has to with the word, like I said, fire.

For the prior 10 years, we are going back and taking the existing database and in it, there were, let's say, about 200 fairly important events and another 150 undetermined, where we couldn't tell what kind of fires they were, we are going back and getting some additional information on them.

That's the update set. From 1990 through 2009 we will try to have fairly comparable detail and completeness.

CHAIRMAN STETKAR: Okay. I guess EPRI has -- the reason I want to dwell on this is EPRI has repeatedly stated that the fire event database used in CR 6850 is flawed and excessively conservative. I am now hearing a statement that says well, we are going to go back and we are going to kind of try to say that maybe we will do something with this data for these years and we are going to try to kind of make things oh, probably fairly complete, within the limitations of what information we had available before.

This doesn't sound like a very comprehensive or rigorous process.

MR. BARANOWSKY: I guess, maybe if I went through the presentation --

CHAIRMAN STETKAR: Okay.

MR. BARANOWSKY: I think I could change your mind on that --

CHAIRMAN STETKAR: Okay, let's --

MR. BARANOWSKY: And if not --

CHAIRMAN STETKAR: Do that, but let's downplay characteristics of database fields in a spreadsheet or what software you are going to use --

MR. BARANOWSKY: Yes, I'm not -- I'm just acknowledging that we have Idaho National Lab assisting us in the software. But it is important that the data fields are tightened up so that we don't have misinterpretation of the data set when you go to apply it.

That's the only I want to make about the new database.

MR. CANAVAN: Right, because there was -- many reasons for the database being suspect is the fields, collected, right?

CHAIRMAN STETKAR: I would be more concerned about completeness and consistency in the data than the database fields.

MR. BARANOWSKY: Let's just jump ahead --

CHAIRMAN STETKAR: Event counts.

MR. BARANOWSKY: Let's jump ahead to, I think this is nine. I just want to quickly mention the fire severity classifications that we are going through, because there were some arguments about traceability on this stuff and whether these were significant fires or not.

So we have worked literally over a year or so with NRC and their contractors to come up with a revised classification scheme and this classification scheme on NUREG/CR-6850 so that we don't completely reinvent the wheel, but it makes a few improvements in describing the severity classifications.

We now have a new classification called "challenging" fires, which are the fairly larger ones that actually do damage or they are big enough that they could have done damage.

The potentially challenging ones are essentially the ones that were in NUREG/CR-6850 with a few minor adjustments to the definitions, and they are linked very closely to the data elements that are being collected in the data set, so that you don't just have someone picking up an event and saying, that looks kind of potentially challenging, in a rough sense.

We have a very rigid connection and then if someone doesn't agree with that connection, they have to document why not, so there's some good traceability there.

Then there's the "not challenging" fires. These are still fires but they are not very challenging from a PRA point of view, mainly because they are low-level smoldering events that sort of go out on themselves. They don't involve human interaction, they don't involve fire protection systems, and they don't go outside the component envelope itself.

The undetermined ones were a problem in the original database. About 40 percent of them were undetermined. We couldn't tell whether they were not challenging or potentially challenging because they were missing some key elements of information.

So we have actually developed an algorithm to go and pump the existing information through to see what information is needed to make the determination so we can put it in one of these categories and have a better accounting of the data from some point on.

From a practical point of view, and from an analysis of the existing data point of view, we chose 1990 as the break point from which to go forward and do this kind of work, so that we would have a full, 20 years of high quality data to do fire PRA prior distributions and things like that.

The older data is not lost per se, but it's going to be left in its existing state, and if you do need to go back and look at some older data, a good example might be high-energy arcing faults. They are fairly rare. You wouldn't want to lose that information. It's there. It's in the database.

But we are not going to update data back in the `80s and `70s and `60s because we really don't think the plants looked, in the `60s and `70s, like they do today, and that data is not representative, and that's part of the analysis that we did, which I will get to in a minute.

So that's sort of a description of the database. How are we going to go do this? Let's jump ahead to that pyramid, Ken.

For the most current data, post-2000 and beyond, we are going, and have gone back to all the nuclear power plants with this keyword list, to go search through their corrective action and condition report data files and find every incident that has one of those keywords in it.

We estimated about 1- to 3,000 hits per

plant, we are coming up with about 2,500 hits per plant and that is then going to be screened down to remove those events that are things like false alarm or a compliance problem and things like that from which we had originally expected to get about 10 to 50 per plant and we are now getting more like 100 per plant.

That will then run through our fire severity algorithm that I told you about in which we tried to classify it in one of those classifications from the prior slide.

And we expect to get about five to 15 in there, and of that five to 15, maybe a few of them will be the challenging kinds of fire.

So that's sort of the pyramid, and it's a successive screening because there's too many events to go through in any rigor.

CHAIRMAN STETKAR: Pat, I was making -- I have to -- I was making some other notes here. This is being applied from the industry experience from 1990 through 2009 or only 2000 through --

MR. BARANOWSKY: The full process is being applied from 2000 through 2009. If you look on the figure you will see a little box on the left, important existing FEDB fire events, zero to five per plant. In essence we took everything that are either undetermined or potentially challenging, we are now going to go back and try and fill in blanks on that data too, to bring it up as close as possible to the quality of the post-2000 data.

CHAIRMAN STETKAR: I think a little bit of the reason for my trying to understand this is something Dennis mentioned this morning. This process not only will help to better understand the frequency of fires, but it will also help to understand the conditional probability of various levels of severity, as a function of bin and fire, but only if the data are processed consistently.

So for example, in the 1990 through 2000 period, if you are not going back and looking for the small fires that may have not been reported at all, or that may have been screened out, you won't be able to do that type of process because you don't know those conditional probabilities from that 10-year set of data, which is more than half of your database period.

MR. CANAVAN: We discussed -- we had the same discussion that you are bringing up now, and our conclusions were that the records are really hard to get. People aren't in positions anymore. The CR listings back then were not automated; they were paper. And we have 250,000 records for the 10 years we are looking at and to do that on paper is not pragmatic --

MEMBER BLEY: Let me say John's statement a different way. When you try to calculate these conditional probabilities then, you will only use the most recent 10 years or will you use 20 in which half of it may be missing key information?

MR. CANAVAN: I think, as anything, you will have to do it carefully, so for those of you --

MR. BARANOWSKY: That's true. We have to go through and do both a qualitative review and a statistical analysis of data to make sure that it makes sense.

MR. CANAVAN: That you can draw that conclusion, so that's how we plan to look. And so I think for things like high-energy arcing faults, you really can't throw out any data. You have got to keep it all the way back to the `60s. I mean, it's a rare event, it happens, the events that are in the database, they are all relevant, we don't want to throw any of that information out.

MEMBER BLEY: And there aren't little ones that you miss?

MR. CANAVAN: There are little ones -- well

--

CHAIRMAN STETKAR: Well, there might be, if they were high-energy arcing faults back in the `70s that occurred in non-safety-related switch gear, that wasn't reportable as an LER, necessarily.

MR. BARANOWSKY: That's why we have plenty of data with 20 or even 30 years on high-energy arcing faults. I have looked at the data myself and I have gone back and you are not going to gain a lot by going to 1968.

CHAIRMAN STETKAR: The key here, though, I mean, one of the reasons I am being so critical and challenging, is that I have no idea what my tenure on the ACRS is, but I don't want to come back here in six years and hear the same arguments from the industry, saying that well, the data in NUREG/CR-6850 Rev. 18 is excessively conservative and we need to go back and collect data the right way this time.

MR. CANAVAN: I think, we are challenged with the resources to go back any further, just because they are paper and they are --

CHAIRMAN STETKAR: Those are the same arguments, though, that you are using to say that the data that are in the current version are flawed.

MR. BARANOWSKY: I'm not sure, John --

really what we are saying is that the data in the current version that is being used involves really old stuff, okay? That's the biggest flaw and I have done analyses and when you get over that hump, the rest of it is fractions.

MR. CANAVAN: The other error is the inability to classify the existing data because the fields are incomplete, and there's a bunch of examples that I bring out that usually really get people polarized.

But there's a bunch of examples you could pull out of the database where they are still used to make conclusions, and when you read the statement, everybody in the room will have a different opinion on exactly what that meant and so that kind of data, I liken it almost to the teaspoon of vinegar in the fine wine. I don't think we have fine wine here, we probably have table wine.

But you know, it, but certainly --

CHAIRMAN STETKAR: What's your problem with cheap wine?

MR. BARANOWSKY: I don't think we are going to miss potentially challenging events in the whole 20-year period. I think we might miss some non-challenging events but not potentially challenging ones, when you look at the definitions.

Someone would have to be asleep to miss a potentially challenging fire. If a guy shoots off two fire extinguishers at a fire and they don't write it up, I don't believe it, I'm sorry.

CHAIRMAN STETKAR: I'm not worried about missing the ones at the bottom of the pyramid because I agree that you will find those. What I am worried about is what fraction of the events at the top of the pyramid, if indeed one of the purposes of the fire event database update is to develop a better refinement of conditional probabilities for fires of varying severity as input, kind of a sanity check, on the other analyses that are being done to look at fire severity --

MR. CANAVAN: I appreciate your challenge, and I think we'll look back, I mean, I understand it. We are looking at this database for suppression and detection and for growth in all kinds of ways, different ways to mine this data to get the most useful information we can.

We'll go back and we'll take another look at what we can do for those earlier periods to be more inclusive, but the real benefit of this process was this is now an ongoing process. NEI is going to take it -- not NEI, INPO is going to take it over. We are going to start feeding the machine and we may not have enough right just yet, but hopefully down the road, with this very careful collection, we won't be looking back in six years and saying, you know, we missed the boat on that.

And that is the hope.

CHAIRMAN STETKAR: I think that is very, very important going forward, is just in terms of the short-term benefit of doing this, you have to be really, really careful.

By the way, Pat, you mentioned something that was --

MR. BARANOWSKY: What's that?

CHAIRMAN STETKAR: You mentioned something regarding early years. I know EPRI has done a study looking at post-1990 fire frequencies, but only thing I've seen was a draft of the report that took it 1990 through 2000 I think.

Have you looked at all, if you simply took the existing database, did nothing with it, cut out the data pre- about 1985, because there are a lot of qualitative justifications about transitions to Appendix R, about poorly categorized events prior to the change in the reporting requirements in the mid-

`80s. Have you looked at that from pure frequency perspective, what different that would make keeping the same plant to plant variability --

MR. BARANOWSKY: You mean using 1985 onward instead of 1990 onward?

CHAIRMAN STETKAR: Yes. Or -- yes.

MR. BARANOWSKY: No.

CHAIRMAN STETKAR: Okay.

MR. BARANOWSKY: But I think we will probably explore some of that this next time around because we are going to have data up through 2009 so it will be a little better data set.

CHAIRMAN STETKAR: Okay, I was just curious, with the sensitivity to absolute frequencies --

MR. BARANOWSKY: Yes, the one bin that I like to keep an eye on is the HEAF bin because it's relatively rare and relatively important so as Ken said, if there's an exception I would go back there.

The others -- can we flip a couple of charts up here, the frequency one -- this is a chart, the one on the left, that shows basically the counts of events in time that we did for that report up to 2000.

Now, we did it a couple of years ago so I also show a plot of some NRC severe or whatever they -- severe fire events? Yes, severe fire events off the NRC's website for comparison.

This is just the potentially challenging events in red that you see plotted there. It's not all the events, just the potentially challenging ones.

The blue, the NRC plot, is a little bit different but they are fairly important events. They use a screening criteria that is a little bit more severe in its requirements and therefore there are fewer counts.

The point I am trying to make is that the trend s track pretty good, in fact if I was to plot the undetermined ones on top of this, you would see all these things looking pretty much the same and they go on.

I just looked up before we came over here today, the most current NRC data, and it still looks like that. It's down at that level.

So what went on in the early- and mid-1980s, I am not sure why there are lots of reports there. I suspect it had to do with the implementation of Appendix R, you know, when you start going and implementing a new requirement, you'll start looking harder and you report more things and the inspectors, they gig you a little bit. Who knows?

But I am saying that post-1990, things are relatively flat, and if you look at the NRC's website on operating experience, you'll see the same thing. And that's why I feel that we are probably going to get a pretty good 20-year period of data.

I don't know for sure. We will go through it. We'll look at it qualitatively and quantitatively, but that's part of my confidence level.

CHAIRMAN STETKAR: I went through the exercise of adding together the challenging and potentially challenging and ran out a bar chart and it's not -- what I noticed is that your chart shows `88, `87/'88 as a big high peak, as does mine.

The mid-`80s the fire frequencies across the industry were indeed higher than the mid-`90s but they were comparable to the early `90s. There's sort of a peak in the early `80s and down kind of in the mid-`80s, but there still seems to be a trend. I kind of agree with you.

MR. BARANOWSKY: Well, we did a -- as you may have known -- we did a Laplace test on this data and it gave a pretty dramatic indication of a change around `88, `90, somewhere around there. I can't say in what year for sure. Pretty close.

I know we are probably running a little --

CHAIRMAN STETKAR: That's okay. The database merits some consideration because it's gone to a lot of discussion and it --

MR. BARANOWSKY: Well the chart on the right --

CHAIRMAN STETKAR: Yes, help me with that one. I haven't quite figured that out.

MR. BARANOWSKY: Okay. Let me tell you what the chart on the right is. It kind of melds in a little bit with some of the discussions that you heard earlier. The blue bars are straight out of 6850, mean frequencies for the bins.

The red ones are from that EPRI report using the data from post-1990 but with a constrained, non-informative prior that represents the prior data from 1968 through 1990.

CHAIRMAN STETKAR: And that was just pooled industry data though, you just took n fires divided by n plant --

MR. BARANOWSKY: Yes, it's a homogeneous model if you will --

CHAIRMAN STETKAR: This doesn't account for the variability --

MR. BARANOWSKY: We actually did a

hierarchical Bayes analysis for the electrical cabinets to get what the breadth of the distribution might be for the industry and it's -- I'll show you in just a second some charts, and you will see why we want to go through and use that kind of analysis in the reanalysis stage if you will.

But this was meant to be an interim, kind of quick look at does the current experience as described by the 1990s, which was as current as we had, compare with what you got using 6850 which went all the way back to 1968, and I'll just point out that the first peak you see around eight or nine is the emergency diesel generators.

The next very tall one is the electrical cabinets and the very next one after that is off gas systems and RCS pumps, main feed water pumps, turbine generators and transients a you work all the way toward the tail.

Typically a factor of two different, there was one bin where they were actually higher in new data and that was for air compressors. I don't know why there weren't any fires in the earlier period with air compressors, they were all in the later period.

So that one went up. And that's just what we did a couple of years ago and we plan on updating it, the trends and the analysis, but using slightly different analytic techniques.

CHAIRMAN STETKAR: Accounting for the actual variability in the --

MR. BARANOWSKY: Yes.

CHAIRMAN STETKAR: Now, one thing, I think we mentioned it in November, but I want to make sure. In the new database, are you retaining bin 15 as a one bin catches all for all electrical cabinet fires?

MR. BARANOWSKY: Yes and no. yes for the initial calculation because look, we have a bunch of PRAs that are using the existing bin structure and we can't go and come up with a new set of bins if you will that would have to be somehow mapped into the existing PRAs.

However, we are going to explore how the bins might be modified in light of what the data is, including concerns about the engineering factors, whether we have high and low voltage cabinets in the same bin and things like that.

CHAIRMAN STETKAR: Are you -- when you compile the event data, will you actually have information in your database fields that allow you to distinguish between fires in 480 volt motor control centers versus six kV switch gear versus you know, digital electronic cabinets? That information will be --

MR. BARANOWSKY: That's in the database and we hope to be able to get that -- for the events that meet the potentially challenging and higher classification.

Because it just -- you have to go back to the plants and get, for each one of these events, that information.

CHAIRMAN STETKAR: Maybe we should talk about that part just for a second though.

MR. BARANOWSKY: So that will happen somewhere toward the bottom part of that inverted pyramid, where we go ask for supplemental information on that 5 to 15 per plant.

MR. CANAVAN: Very detailed.

MR. BARANOWSKY: Yes.

CHAIRMAN STETKAR: That's still not going to help me if I am trying to develop a growth model for heat release rates within a relay cabinet compared to a six kV switch gear, using data as a sanity check, if I can call it that.

MR. BARANOWSKY: You are not going to get what I would call the very earliest ignition characteristics, where you are almost at an incipient stage.

But you will get anything that had an actual flame and started to burn stuff.

MR. CANAVAN: Right, you're going to get the corrective action for the probably fires in that mid 10 to 50 range. Then there's going to be a site follow up for the ones that are called real.

So there will be another one -- there's two levels of information here. The first is the keyword -- actually three -- first is the keyword search. You get nothing but the keywords and the title of the event, and if you can discount it, you discount it.

Then you request the actual corrective action write-up, a paragraph or two or the whole write-up on the CFR for the 10 to 50s, and then for the real fires, you want to request even more. Did you do a root cause? Did you do a -- you want all the pieces of information for those. So --

CHAIRMAN STETKAR: But at that 10 to 50 level, the plant should have the information about --

MR. CANAVAN: Yes.

CHAIRMAN STETKAR: where the fire actually occurred.

MR. CANAVAN: Oh sure, the CR will be --

should be enough detail to get exactly what you're at -- after -- but for the real fires you are going to get even more information, even more detail.

For example there are recent events where I've seen the root cause determination for the fire event at a plant and it's 60, 80 pages of information that, if we can, we will include in the database. We will capture that. And that's more than you would need to know to classify that event.

CHAIRMAN STETKAR: But if I understand you right, at the moment the plan is to only differentiate, at least in the electrical cabinet area, at the -- what you are characterizing as the real fire event level.

MR. CANAVAN: Correct.

MR. BARANOWSKY: Right, so if someone had a burned-out relay, no, but if there was a flame associated with a burning relay, yes.

MR. CANAVAN: Well, and let me take that one more step further. The database is being created as a task, and there's a bunch of tasks being proposed that are not really the database per se, but for example fire growth was recently discussed and one of the -- there's several ways to look at -- approach fire growth: one is analytical, the other one is a database or a hybrid of the two.

And we were actually thinking of adding a task that says when the database is all done, go query the database potentially all the way back to as far as you can go, for what information can be found on -- but until all the information is collected, and actually fire growth is the one that has been suggested for that query, until we have all the information collected, we don't even know if it's a worthy pursuit.

But for now, it is being considered for the list, exactly what you say. But it's not a database task. It's a mining task, if you will.

CHAIRMAN STETKAR: Okay. Continue. I don't want to hold up the discussion --

MR. BARANOWSKY: Why don't we jump ahead to the slide 20. So as I indicated, we had done some earlier analyses in the interim EPRI report using what I will call a homogeneous assumption model.

And just for comparison purposes, I wanted to show you how some of the prior distributions will come out on this particular chart.

In fact, look especially at the far left side, bin 15.1, which is electrical cabinets. You can see the homogeneous models represented by the CNI, constrained non-informative prior, which is the green with the triangle, or the Jeffreys prior, which is the furthest to the right.

They got a fairly narrow set of 90th percentile uncertainty bands, and where that becomes important when you do a plant-specific update, it makes everything get compressed into essentially the industry-generic number.

When you put in plant to plant variability, if it exists, and in this case we tested for it and it exists in a statistical sense, you get different prior distributions that are basically a measure of the variability across the industry and that's the three different priors that we have looked at as part of our methodology enhancement activities.

We are not quite done. We are looking at different types of priors to do these analyses in, but I wanted to show how, as you move across the chart, you see bins that have fewer and fewer fires in them to start off with. And when you get to the far right-hand side, bin number four, that actually has only one fire in it, and the range of the uncertainty distributions for the homogeneous models at least is starting to look something like what you might see with the plant to plant variability models, and not surprisingly, if you went to zero, they become almost the same.

And so it's the kind of thing that we have been doing some additional work with to make sure that when we do the update analysis, we have accounted for the impact of plant variability across the full spectrum of the bins.

Next chart shows an update analysis, hypothetical one, because we want to know what the ramifications of these things are. And this was really very interesting to us.

We did the simulations for a 20-year period and then we assumed a single fire, additional fire in each one of these bins, and the interesting point to me is that -- the update analyses are the darker shades on the different colors -- especially as you move to the far right, where you see bin 4 with one fire, you notice that whether we used a homogeneous model or a plant variability model, represented in our hierarchical Bayes analyses, we got pretty much the same means.

The uncertainty distributions were a little bit different but even as you moved to the higher density bins, bin 9 for instance, the means aren't too far from being different.

The homogeneous model, a little bit lower, but they are not like out of the ballpark, they are well within the uncertainty bands. So just something to keep in mind about what is gained by doing certain kinds of analyses.

We -- I'm going to go to the last chart now. What we are going to be doing is providing a draft of the methods that we are proposing to do the update analysis with for discussion with NRC and their contractors under the MOU, that's the EPRI/NRC Memorandum of Understanding, and we expect to have that done first quarter of 2011. We are working on it now.

Then there will be an Interim Technical Report written, not necessarily published, but one that can be used for a broad industry review after we have our discussions with the NRC, while we are collecting the data.

As the data comes in we will start to populate the calculations so we can do some real calculations instead of simulations, so that by late 2011 we will have both the methodology and the updated analyses in draft form that are suitable for whatever kind of peer review is appropriate.

Certainly the NRC will get to look at it and it is possible we could come and talk to the ACRS and then publish early 2011 the updated analysis with the new data.

CHAIRMAN STETKAR: 2012.

MR. BARANOWSKY: Oh yes, 2012, sorry. Typo. Yes, early --

CHAIRMAN STETKAR: If it's early 2011, I'm really in --

MR. BARANOWSKY: Yes, make that 2012.

MR. CANAVAN: Yes, a quick status is we just got our 200,000 records and we are working our way through them quickly as we can with the --

CHAIRMAN STETKAR: Again, the 200,000 --

MR. CANAVAN: Well, 75,000 records.

MR. BARANOWSKY: It's in the presentation, the numbers that we have to date. They are going to go up a little bit but --

CHAIRMAN STETKAR: But they are from all units, all sites.

MR. CANAVAN: Yes. Yes. There are some questions about hey, did you give us all of them, so we are going back to some sites --

CHAIRMAN STETKAR: 2000 through 2009.

MR. CANAVAN: Yes.

MR. BARANOWSKY: Yes, and we are expecting a total of about 300,000 records that will be screened down through that sort of inverted pyramid structure.

MR. CANAVAN: The numbers don't sound too bad until you start having to count.

MR. BARANOWSKY: Other than that, I would say we are shaping the future of electricity.

Any other questions?

MR. CANAVAN: That's why we got 12 people.

MEMBER BLEY: So can you tell us anything more about what you are thinking of doing with the electrical cabinet fires, since you kept the single bin?

MR. CANAVAN: Well, we are going to look at how they vary -- the frequency varies between plants, whether or not there are things like a basis for saying there's a per component or a per plant value that should be used, and again, as John mentioned, not only are we going to be looking at voltage levels, but we are looking at mechanism and causation factors a little bit, where there is enough data, and you might do that with the electrical cabinets.

CHAIRMAN STETKAR: Yes, I mean the good news of anything -- there are countable numbers of events of those fires.

MR. BARANOWSKY: Yes.

CHAIRMAN STETKAR: There's not a sparsity of --

MR. BARANOWSKY: There's nothing like having one fire event in the battery bin --

CHAIRMAN STETKAR: Right. Right.

MEMBER BLEY: Let's not lose sight of the fact that's a good thing.

MR. BARANOWSKY: That's a challenging analysis.

MEMBER BLEY: That's all right. That's a place to take the challenge.

MR. BARANOWSKY: Anything else?

CHAIRMAN STETKAR: Any other questions? Okay, that's a good presentation. Yes, we should march on, absolutely.

MR. HYSLOP: My name is J.S. Hyslop and I am a member of the fire research branch in research and the PM for this task. As was stated earlier, Steve Nowlen of Sandia National Labs is supporting NRC along with Shawn St. Germain of Idaho National Labs.

As you well know, this is a joint project between EPRI and Research, and it did arise out of fire ignition frequency. There was an NFPA to find FAQ, which this arose from and NRC provided an interim solution on fire ignition frequencies where we accepted the industry resolution with conditions.

As you have heard we are collecting more data. I think we may be collecting as much data in the 10 years as we do in the 32 years, at least from conversations that we have had off line during our project, so that's a good thing.

I am going to turn the presentation over to Steve to give, and go ahead Steve.

MR. NOWLEN: Okay. Before I jump into this, and I'll tell you right now, I'm going to skip half these slides because they overlap what's already been said. I wasn't sure what Pat was Pat was going to say, so.

But I'll answer the question that came up before with respect to electrical cabinets from my own perspective: the database, the data fields we have created should give us the ability to break cabinets up.

I mean, we are asking for voltage, we are asking for the function, we are asking for the information we would want. The question is, are we going to be able to fill that information in.

So until we really know how much of that we can fill in, it's a little hard to say, oh, definitively, we are going to break it up into 10 bins.

I think functionally we could do this relatively straightforward. We can provide a number for the collapsed bin and we can also provide a set of numbers that breaks that out into sub-bins, and when a utility gets to their next maintenance update of the PRA, it'll become their choice if they work that in and that sort of thing.

So I think there is a path forward and I certainly hope that we can do a lot better on electrical cabinets. They are so important, so we are trying, whether we succeed is yet to be seen.

Okay, so I thought that I would go into a little bit of background because I think it is relevant here. The database that 6850 worked from was actually not created as a part of 6850. We were working from the existing EPRI database.

We did modify it, because we went in and we inserted the concept of the potentially changing fires and I'll talk a little bit about that.

But the database has a really long history, I mean if you go way back, individual analysts were out there collecting events because they were trying to do PRAs and there was no database.

So, really it was around 1985, under the

RMIEP program, risk, methodologies, integration and evaluation program, if anyone remembers that one, there was an effort sponsored as a part of that to develop a consolidated fire event database and that was published, there's a NUREG/CR out on it.

That's really the first attempt to bring it all together in one place and it was used in RMIEP. There was actually an update of that database that was sponsored by DOE as a part of the new production reactor project in 1991 and it covered events through 1989. Curious date there, and I'm going to talk a little about that.

Now the EPRI database, it came about really in the days of the IPEEE studies. They wanted an update. They wanted to have a database that would be available to the licensees to use, so EPRI developed a database. Their first version was 1993, NSAC-178L.

What they had done is they imported all of the information from the RMIEP database but it was the original database, not the update, okay?

And then they added information and the ones they cite are EPRI loss data, the Seabrook & Shoreham PRAs, and plant daily status reports. They did a search of these and they added more information, and that version covered events through 1998.

The next update was done in 2000 and that version actually imported the 1990 RMIEP database update, so they captured now the set from through 1989 plus they added primarily for the update, they added utility reports based on a voluntary survey. They sent a survey to the licensees, and said, please tell us.

They got about 20, 30 percent of the licensees responded, typical of that sort of thing. It's voluntary. People are busy. We understand.

And then they also imported for the period from `92 to `99, they got the NEIL data, right? And NEIL data is about the same way. The number the Ken cited is a typical NEIL thing, about 30 to 40 percent of the utilities were reporting their events to NEIL.

And so I think the message that I am trying to send here is that you have a real mixed bag of collection basis here.

The two Sandia reviews were fairly comprehensive. We had access to the NRC databases through Oak Ridge, and we did some pretty comprehensive searches through that, similar to what EPRI is doing with the utilities today.

So they were fairly comprehensive collection efforts. I have to point out though that post-`89, it's a little more ad hoc.

CHAIRMAN STETKAR: But Steve, those Sandia reports
were based in LERs, right?

MR. NOWLEN: No.

CHAIRMAN STETKAR: No.

MR. NOWLEN: It was much more comprehensive than that. It's LERs, ENs, we also went through the equivalent qualification databases, whatever was equivalent to EPIX back then. We went through a fairly comprehensive search. We tried to search inspection reports, didn't have real good success there.

But there was really an effort to make a comprehensive -- we also looked through public sources, you know, whatever we could do through just open literature reviews.

So it was fairly comprehensive and again, I think we are doing that today for the 2000 to 2009 period, we are going to get a very comprehensive -- but I think you have hit one of the nails right on the head, is we are going to end up with this gap of 1990 to 2000 that we are going to be uncertain about.

We won't know real well how well we are covered in that gap. And so one of the things we are looking at is, and we understand, 250,000 records, I've had to look at these things. I don't want to have to look at 250,000.

And I understand that, and I understand the limitations, but our strategy is to look at what comes out of this 10-year comprehensive search and then look again at what we have in that 10-year gap period and as Ken says, we will have to do it carefully.

You know, if we see a difference, we will have to deal with that. But I think it will -- it should be obvious yes or no. I think we'll be okay.

CHAIRMAN STETKAR: You know, it's -- more than anybody, you know, recognize the problems with the practicality of trying to go through all of these records. The -- I'm trying to listen to all of the presentations. What I hear -- well, electrical cabinets right now, is that ridge line that is a very important contributor and you say okay, we really need to address electrical cabinets because without doing that, there's not a lot of incentive to address anything else.

The good news is, is a reasonable amount of experience for electrical cabinet fires. So whether you look at 10 years versus 20 years, it's always better to look at a broader data set. But 10 years, you are reasonably likely to have a pretty good population there.

And suppose we solve that, everybody is happy that we have solved the electrical cabinet problem. Now we come back down to the next level where you are starting to talk about fire ignition bins that typically have more sparse data.

MR. NOWLEN: Yes.

CHAIRMAN STETKAR: And the industry is concerned about well, what do we do now, in the next phase, to address those next set of contributors, you know, the next rocks that are poking up above the lake level?

And that's a bit of the concern about what are we doing only looking at nine years of data versus 19 or 20 years versus 30 years for example, because now, you know, missing a couple of events or missing evidence to give you information from operating experience regarding conditional severities of events, could become important in what's waiting right behind that next door.

MR. NOWLEN: Yes.

CHAIRMAN STETKAR: That's a bit of the concern about, you know, asking about the scope and consistency of treatment of the data.

MR. NOWLEN: Yes, and we fully appreciate that. We do. We -- you know again, we are not the ones who have to pay for the data collection, so we have -- we understand the challenge. And I think in some of these bins, it will in fact turn out to be a challenge.

Like you say, electrical cabinets, I'm pretty confident with a comprehensive search of 10 years, we are going to have all the data we need, really.

But main control board fires. There's one that's important potentially, and very sparse. Right now we have one but I already know of two more. So we have just had one recently, very recently.

So, you know, it's not going to be an empty bin. So I'm okay good, at least we've got a start.

Some of the others, like Pat mentioned batteries. We have one battery fire in the database and it was back in the `60s, okay, well we can add battery fires. Honestly, batteries don't show up very high on any --

CHAIRMAN STETKAR: Batteries don't show up very high but some of the other categories might --

MR. NOWLEN: I am less concerned about one that --

CHAIRMAN STETKAR: where you have a handful of fires, for example, one each at two or three or four plants.

MR. NOWLEN: Yes, and I think from my perspective personally is I'm satisfied that EPRI has taken a good approach. Let's get this most recent 10-year -- that's low-hanging fruit but it's a rather large harvest.

Going back another 10 years does present various challenges and we understand. And I think our strategy is, let's see what we get. There's plenty of work to keep the folks busy. It's not like we would be -- right.

So if we find we need to look further then I think we have to discuss again. But our strategy is let's see what comes out of this first 10 years and you know, reevaluate there.

CHAIRMAN STETKAR: Having personally gotten finger cuts from looking at pieces of -- the same pieces of paper though, it's not something that you later want to determine that you need to do again.

MR. NOWLEN: Well, and we have had discussions about that relative to the 2000 through 2009 data, is, look you're doing this once, we want to make sure we capture anything that we might be interested in and I have got a couple of points on that.

I'm less concerned about the older data, because they are not even doing it once. We are going to go after key events, but you know it's not that we are potentially not taking advantage of work that is being done. It's work that may or may not get done, but hopefully we will only do it once if we decide it's necessary.

Okay, so that was just a little background there. I did put this one up. I think the numbers at the bottom are kind of interesting. These are four vintages of plant-wide fire frequencies, and all's I did here is I just did a simple sum of the mean value for all the bins from these various sources. It's always hard to compare, because people bin them differently, so -- but if you just add them up, this is per unit, you can see the trends.

EPRI, the 1995, in coordination with the database, there's a companion fire frequency report as well, the numbers are here.

So from the `95 EPRI database there were numbers, 2000 there was a companion fire frequency 6850 and then the FAQ on fire frequencies.

And you can see, even 6850 reduced frequencies compared to the IPEEE days. That was one of the things we really worked very hard at, is getting more realistic frequencies. We all sort of were in agreement that the IPEEE frequencies were leaning conservative, and so we tried to work that.

There's a statistic here. We did this potentially not challenging, or potentially challenging - not challenging assessment, and roughly 40 percent of the events in the database across the board were set aside as not challenging, not relevant to risk assessment. They were not counted in fire frequency.

Now Pat gave another number that 40 percent were unknown. Of what we had left, of the 60 percent, roughly 40 percent of that group were -- we couldn't classify as either conclusively as potentially challenging or challenging and they were treated statistically.

But that just gives you an idea of what we were dealing with.

CHAIRMAN STETKAR: Steve, couple of questions. That change from the 6850 to the FAQ number, roughly a factor of two.

MR. NOWLEN: Roughly two.

CHAIRMAN STETKAR: It's my understanding, again, that the FAQ took a lump population data and simply did a single stage Bayesian update with the uncertainty distribution in 6850. Is that correct?

MR. NOWLEN: I can't answer that question. I didn't do the calculation and I'm sorry. I'd rather not speculate.

CHAIRMAN STETKAR: I'm curious, doing that -- some contribution for the 0.28 in 6850 is due to the uncertainty in the plant population data, which does indeed account for plant to plant variability.

If you update that with a single data point that says n fires divided m years, you will artificially reduce the uncertainty compared to actually accounting for that data on a plant by plant basis.

So that factor of two reduction, it's not clear to me how much is due to the way the numbers were crunched versus the numbers that were actually being crunched. But that's kind of a -- everybody likes to compare these numbers, but the point is, I think I heard earlier, that going forward with the new database, you will account for the actual site to site variability, plant to plant --

MR. NOWLEN: Hopefully we are going to

eliminate the plant to plant variability in reporting. We'll have everybody's events.

So there will be variability and some plant having more fires than others, but at least our reporting will be even, right? That said, I also think that --- again, I can't speak to the details of the analysis, but by and large if you look at the pre-`90, post-`90 data on an equal basis, just do the simple events per year, events per reactor year, there is a drop-off. The question is what's the reason for that?

And one of the issues with uncertainty is, if -- what's the basis for 1990 being a watershed year? We don't know and so that give us a little trepidation as to whether -- how much reliance we should put in the trend.

Hence the FAQ solution says consider sensitivity.

CHAIRMAN STETKAR: In some cases, just more information allows you to sharpen your pencil about what is a potentially challenging fire versus --

MR. NOWLEN: Well, that was done consistently because they were all ranked on that scale, but I'd offer up the mixed bag of reporting. I mean, 1989, there was a comprehensive search for events through `89 and after that it is a little ad hoc.

Does that explain it? We don't know. I mean, I don't know the answer, but there are potential other things in there, and again, if we are doing this comprehensive, the last 10 years, I think we are going to definitively put that question to bed.

CHAIRMAN STETKAR: Question to you, only because you put the asterisk on your slide and I forget to ask Pat when he was up. Is the fire event database that is being compiled including all fire events during all plant operating modes, or only at-power fire events?

MR. NOWLEN: All.

CHAIRMAN STETKAR: All.

MR. NOWLEN: All modes.

CHAIRMAN STETKAR: Okay. Good. Thank you.

MR. NOWLEN: Good. Yes. That confirms it's all modes.

CHAIRMAN STETKAR: Good.

MR. NOWLEN: And again, yes, the whole --

CHAIRMAN STETKAR: I recognize what has been done so far is only at-power but --

MR. NOWLEN: Well, no, actually it's not. The existing database has both at-lower and low-power shutdown and those were, depending on the bin, they were either lumped together or they were split and --

MR. HYSLOP: Some at-power events include low-power for the ignition frequencies so --

MR. NOWLEN: Yes, but nominally there are shutdown events in there as well, low-power and shutdown events. Lots of startup events, lots of low-power ones, going through startup, something happens, okay? Pat talked about that so I can skip that slide.

I think I can skip that slide. I mean, our hope is less uncertainty, more refinement. We would like to refine the electrical bin for electrical cabinets, that's what I'm hoping.

CHAIRMAN STETKAR: You are aware that -- hopefully less uncertainty but indeed by restricting the denominator, you might have broader uncertainty?

MR. NOWLEN: Yes, perhaps, but we can do away with the uncertainty in under-reporting. That's, to me, that would be a big leap forward. Get rid -- end that debate. We have argued about it over and over, end the debate.

Okay, this is another statement that is made in the NEI report. One of the more problematic aspects is that it's -- if you have fewer of a particular component, you actually get a higher frequency per component. And that is true, but I think the statement that it was felt to be adequate at the time, I would modify that a little bit and say it's the best we could do at the time, honestly.

We wanted to move towards a component-based fire frequency. That is, you have one pump, there should be a frequency for that pump, right? That was the goal, but the goal was unobtainable, so we went as far as we could by saying within the plant, partition your plant-wide frequency based on the number of pumps that you have.

That's the 6850 approach, but the problem is that we didn't have the population statistics. If you want to know the per pump fire frequency, I have to know how many pumps exist in the entire industry. For every category I need statistics.

So what I need is this sort of stuff, and this is out of the NEI report also. I love this, okay? I don't have all the plants yet, but I got a bunch of them there.

This is -- I had nothing like this. I had a handful of plants that we had sort of rough estimates for. With this we can start doing this.

Now, I picked electrical cabinets -- interesting, we are talking a lot about those -- but this is one of the ones where it varies more, why I picked it as my example.

But with this information, I think we now have the chance to move forward and really go to a component-based frequency and I think it's a place we can and should go.

CHAIRMAN STETKAR: Steve, and this is from the NEI report. I looked at these numbers and I noticed five plants in this population have numbers of electrical cabinets that are greater than 1,000.

To me -- I've looked at a lot of plants and it's -- I've looked at some plants that have more equipment in it than you've ever seen in your life, four-train plants with two additional bunkered safe shutdown trains, and they don't come close to 1,000 cabinets according to the counting criteria in NUREG/CR-6850.

So I'm curious what plants we have operating in the United States have all of those cabinets in them, unless people are counting junction boxes on a wall.

MR. NOWLEN: Well, that's one of the potential questions, is, when they do the counting in my own mind the thing that is most important is that they be consistent with -- self-consistent.

So if they are going to count junction

boxes, then they should count then all. We can deal with what that means kin --

CHAIRMAN STETKAR: But not if the fire data don't include junction box fires.

MR. NOWLEN: Well, and, there is guidance and again, is it crystal clear? Probably not. But there is guidance as to what you should exclude and small, wall-mounted panels, that kind of thing, now -- the fire panel that was shown this morning, the red box, that's actually a fire alarm panel.

Do I count that one or not? Probably, according to 6850, you should have counted it. It's got enough little devices on the face.

CHAIRMAN STETKAR: It's big enough.

MR. NOWLEN: Yes, well, and it's also the number of -- it had all these lights and switches and stuff on the front panel. That's an indication that there's stuff inside. I think if I were doing that, I'd have counted that one.

Now, the question is, how far did they take that? That could explain some of this. And so, in using this population information, we are going to need to understand that, we will have to look at why are some of these plants 1,300 cabinets. Is it because of the way they counted versus the plant who has 500 and they simply didn't count those?

We have to be careful when we -- and maybe we need better refinement of okay, don't count these, count those --

CHAIRMAN STETKAR: My only point is that this chart in particular is shown in the report as evidence of perhaps a factor of four variability in the per component basis for those fire frequencies.

If indeed, for example, some organizations, or perhaps a single organization doing the studies for those five plants, didn't consistently count the number of cabinets, the perceived variability in that frequency might be a lot lower. In fact it might be less than a factor of two.

MR. NOWLEN: Absolutely true. It's --

CHAIRMAN STETKAR: I was just curious whether you had --

MR. NOWLEN: Yes, you know, again, I haven't had access to them, so I -- no I haven't looked at it. It is a legitimate question and -- you know the other thing that I have pointed out before is that you know, if I have a plant that has 500 cabinets and I have another plant that has 2,000 cabinets or 1,000, let's go two to 1,000 cabinets, if the 1,000 cabinets holds exactly the same functional devices as the 500 cabinets, is it really twice as likely that the 1,000 cabinet plant is going to have a fire?

I, to me, it's more about the ignition sources. How many individual functional components, devices do I have that could create a fire?

So I think, again, I am a fan in general of the component-based approach. I like it. It would help resolve some of the plant to plant variability and how people apply this and all that. It's -- there are challenges in doing it right though. That's all I say.

Okay?

CHAIRMAN STETKAR: Okay, thanks.

MR. NOWLEN: Let's see, I already talked about this in my other slide. This was actually not supposed to be here anymore, so I'm going to skip that slide as well.

Yes, this is a point that we are still discussing among the EPRI and NRC teams and I think that the roadmap report, when I read through it, this sort of jumped out at me.

There's one of the items in table 4-2. Incipient growth in electrical cabinets will use information from the fire event database to characterize detection and termination prior to an actual fire event.

I think we may have a mismatch here because you know, as Pat says, if it's not an actual fire we are not going to put it in. So these are really, what they are really talking about here is trying to redefine the time zero in the time line to go back into the incipient stages when a component is going through failure, overheating and maybe someone picks that up for whatever reason, I have incipient detection.

You know, we are resetting the time line and so when we look at the fire statistics, we have to be careful that our time zero matches, because if we want to do that, then we have to include all of those events, and in 6850 we would have called a lot of these non-challenging. I think in general we would have called them non-challenging, so they didn't go into fire frequency.

If we are going to redefine time zero we have to do it very, very carefully. Again, I am open to the concept, but there are -- it's all this finely-tuned mesh of stuff and it has to stay that way, and so when we do this, we have to make sure we do it carefully.

That's -- and so again, we are debating

it.

CHAIRMAN STETKAR: Okay, debating it, but we saw from the industry's presentation that the industry is moving forward.

MR. NOWLEN: Yes.

CHAIRMAN STETKAR: So, you know, collecting events during a period at which there is still debate about how those events may be used is not the way to proceed, I mean --

MR. NOWLEN: Yes.

CHAIRMAN STETKAR: we have kind of learned that 35 years ago when we started collecting data for equipment failures that if you don't know how the data are going to be used, you are almost guaranteed to not have an appropriate database.

So, it seems a bit disconcerting to hear you say that we are still trying to work out the details on how the data will be used, because what data I collect and how I characterize that data may be very different if all I am trying to do is refine the frequency of bin number 15, or perhaps subdivide it into six different bins, versus not only doing that but providing operational experience that I can use to quantify conditional probabilities, perhaps not precisely, but have some insights about conditional probabilities for fire growth and severity, that I can then compare to other testing programs that I may or may not have data from.

MR. NOWLEN: Yes. I understand and I -- I skipped over it, but --

CHAIRMAN STETKAR: The first bullet up there that you have hearkens back to why I was challenging EPRI about what are you doing in terms of that pyramid.

MR. NOWLEN: Yes.

CHAIRMAN STETKAR: How far back are you going into those whatever it was, 1,000 to 3,000 fire records per plant.

MR. NOWLEN: Absolutely, it's at that -- it's not 250,000 down to 10,000 or whatever. That one I'm not concerned with. It's the next step and to the bottom, those are the ones that we have to look at, and I skipped over the second to the last bullet there, but I am here for the week and J.S. and Shawn Hunt and one of my staffers will be looking at what EPRI is doing.

We are participating in an audit basis so we will be looking at what is it that is not making it into the database because of the screening criteria that are being applied, and are we happy that we are not missing anything that we want to keep.

So we have a chance now, you know, the data entry is ongoing, we are going to be doing this for the rest of the week, and we'll be pulling the string on some of these ones that haven't made it in, and if we start to see that well, I want this one in there, we'll work that out with them.

So I think we are early enough I the process that it's not too late. We'll work this out. Hopefully, what we find is that what they are screening out we are perfectly satisfied with. We will see. But again, we have that opportunity. We will be starting that process on Wednesday morning. And I am confident that we will get to the right answer.

Okay? Pat covered most of this. This was just a status update. We have done the beta testing on the data entry and what-not. So they are working at it. They have covered the 2001 to 2009 is the first period.

Let's see. I've covered those. I think longer term, you had asked the question about what the applications are, and I didn't actually cover that in detail here, but fire frequency is the first application but I think there are others.

Didn't really cover it there either, but we certainly use it for fire suppression information, you know, the effectiveness and timing of fire suppression.

We are hoping that by enhancing the amount of information that is available, we will be able to draw more qualitative insights from the nature of the fire events that occur.

This issue of what is really a fire of PRA interest, with better information we should be able to gain some insights and I thin it's legitimate to look at things like timing of events.

How long does it really go from inception to where it's -- this is a fire. The challenge there is always when did we really have that inception, right? Because our first indication is a fire alarm went off. So the first thing in the report is at 17:32 we had a fire alarm in room x.

So getting back at that incipient behavior is going to be quite a challenge. But again, I think there are chances there to do some things, and just the refinement of the source bins. I don't think electrical cabinets is the only one that we can refine. There are others. I'd like to see that happen.

So I think in summary, just the event data are key to what we do and I actually like that. I like the fact that we have real events to work from. Fires are real. They happen. And having that data gives us a real advantage and so I want to see us take the absolute maximum advantage of that information that we can.

I am hoping that through the collaborative effort, we will resolve a lot of these lingering issues, the uncertainty about reporting, getting closer to component-based frequencies would be good.

And I think what's going to come out of this is no matter what you look at, it's going to be a very complete, high quality fire event database that should suit a range of applications.

We will have differences in coverage, in terms of epochs of the newest data, slightly older and really old, but I think we can handle that when we look at the data and analyze it, but we will have to be cognizant of it. We have to know that that's true. And that's all I had.

CHAIRMAN STETKAR: Other questions? Anybody? Thank you. That was very --

MR. NOWLEN: Thank you.

MEMBER POWERS: Let me ask a question, Steve, we've chatted a little bit about in the past. I'm harking back to a fire at San Onofre that involved cabinets, and when you think about electrical cabinets, do you think about what's in them?

MR. NOWLEN: Yes, we -- in various ways, yes. You know, we don't look at all cabinets the same and I think that's an unfair characterization. You know the fire panel that's mounted to the wall I'm going to treat totally different from the way I treat a switch gear cabinet. And in my mind I can do that within the methodology.

I think from a functional standpoint, we are weaker at that, and again it's because we don't discern well in the data. The one case where we clearly do it is high-energy arc faults. Those only apply to certain types of cabinets, based on what we have seen and what we think can happen.

The other case is main control board. We treat it different than we do any other cabinet in the plant.

Outside of that, the treatment is less picky. It does tend to become more homogeneous. We do try and look at the characteristics of the cabinet, the vending conditions.

You can argue that maybe we don't go as far as we could. That's tomorrow's discussion. But it is a challenge.

The other challenge is going through the plant, and if I'm the plant with 1,300 cabinets, can I look at all of those? No, it's not realistic. Hopefully I can look at a representative sample and the recommendation is take those insights in. Is it crystal clear exactly how to do that? Well, crystal clarity is not --

MEMBER POWERS: Take your example, high-energy arc fire. I don't think we really understand what happens when we get a high-energy arc fire. High-energy arc is for -- I mean, in a way, in a real sense it's kind of like putting a shape charge through something.

MR. NOWLEN: That it is.

MEMBER POWERS: And its ability to propagate beyond the cabinet itself to affect other things that will be adjacent to it, is manifest. And it seems to me if I have that potential in a facility then I want to know about it a whole lot.

If I have large capacitors in systems, I want to know about that a lot, because it's not the cabinet I'm worried about. It's everything around it.

MR. NOWLEN: Yes, that's absolutely true, yes. The high-energy arc fault, yes, the high-energy arc fault in the individual cabinet, if it stays there, we are done.

MEMBER POWERS: We don't care.

MR. NOWLEN: Yes. I lose a switch gear. I might lose one electrical train or one bank but that's the end of it. It's the one that goes on to damage the overhead cables as did San Onofre. We had damage to cables six feet above the top of the train.

CHAIRMAN STETKAR: But I think, Steve, and correct me if I'm wrong, in the NUREG, there is different guidance about potential zones of influence for high-energy arcing faults versus other electrical cabinet fires.

MR. NOWLEN: Yes, absolutely. The high-energy arc fault fire has a completely different characteristic from what we call the thermal fire, just the regular old thermal fire. There's no 12-minute growth period. It goes boom and certain things are damaged at time zero and certain things are ignited at time zero.

That actually, the San Onofre event is the prototype that we use to develop those rule sets. Now, we have recently had the Robinson event and it's -- we are going to have to look at Robinson event and ask ourselves if our zone of influences still match.

And some of the initial reaction was holy cow, we found the door of the cabinet 20 feet away, we need to expand the damage zone. But I say well wait a minute, what could that door have done that we didn't already capture?

The door is not going to cause any ignitions. It might put a dent in the door to the room but do I really need to expand my zone of influence to 20 feet? I don't think so. We have to be a little more careful about that.

But certainly Robinson now is a very well-documented event. We have got a lot of information. We actually think we are going to get some cable samples out of it.

We should learn a lot and I think we can adjust. The other thing I'll bring up is that research does have a plan to address that problem specifically experimentally and I am looking forward to this set of tests. This is going to be fun.

We are actually doing this as an international collaboration. J.S. has been over talking to IAEA, or I'm sorry, OECD. So we are collaborating. What we are trying to do is get the OECD members to give us equipment and then we will run the experiments, because switch gear at $50,000 a pop, I get one test, it gets very expensive.

So, but we have equipment being offered from Japan and Korea and Germany and potentially France. So the high-energy arc fault one, we are going to attack.

MEMBER POWERS: Yes, but that's the one you know about.

MR. NOWLEN: That's always the trick, right? You don't know what you don't know. Is that where you are headed?

MEMBER POWERS: Well the amount I don't know is huge.

MR. NOWLEN: No comment.

(Laughter)

MR. NOWLEN: Sorry.

MEMBER POWERS: You've known that, right?

MR. NOWLEN: My tormentor.

MEMBER POWERS: You know, I'm sitting here saying you know, gee, if I'd just had a few more fires at nuclear plants, then I could find all these highly energetic things and sort them all out, and flag -- I'm coming back to your question about the 1,300 cabinets, are you going to look at them at all, all of them or not.

And the problem is, right now I might not be smart enough to know what I am looking for and do we have a good list of what you ought to look for when you go through and -- if I bring two wires in and connect them at a post, I probably don't care too much about that cabinet. I will probably take it off my list and not do anything with it.

MR. NOWLEN: That's right.

MEMBER POWERS: If I have got a transformer in there or a few things with large capacitance to them, I'll probably care a little more. And I'm wondering if we have enough information to tell.

MR. NOWLEN: I think we have some. Could we do better? Of course. The guidance right now directs you to look for the types of ignition sources that you have present, which is generally the components, the population of those, how many of them are there in the cabinet, the density of the fuel and arrangement of the fuel, you know, the idea that kindling is easier to burn than logs, you know if I've got one 750 MCM cable running in the back corner, other than the high-energy arc fault, which that tells me I've got that potential from the thermal fire perspective, I'm walking away.

So there's some guidance. Could we do better? I'm sure we could do better. Again, I'm hoping that what is going to come out these licensee applications is that they will show us the challenges that they ran into in trying to characterize their cabinets and as methods developers, we will be able to say ah, that's a great example, let's get that in and show others how we would handle that example.

MEMBER POWERS: I'm coming -- I mean the reason to bring this all up is you're mining a database and I'm saying is there more we should be trying to mine out of that database than simply frequencies and things like that?

MR. NOWLEN: Oh, absolutely, beyond frequency, absolutely. You know the detection suppression is another obvious one. The insights on spurious operations. I fully expect that we will be mining that database, we will be looking at all the reports, looking for those events.

So again, I think there's just a whole range of things that we can do with good event data. I have always learned from reading interesting events. Some events are boring and they don't really go anywhere. But that in itself is an insight.

How many of these events never get past the boring stage? That's actually a valuable insight. That's why I'm fairly interested in making sure we catch the boring ones in addition to --

MEMBER POWERS: Well, I think that's what John's concern is about.

MR. NOWLEN: Yes.

MEMBER POWERS: Whether you have an adequate base of boring things because that's what life is like --

CHAIRMAN STETKAR: Well, to infer the conditional frequency of not so boring things, you need to know how frequently boring things happen.

MR. NOWLEN: That's right.

CHAIRMAN STETKAR: Which means you have to go look for those boring things rather than only looking for the spectacular stuff that for some reason you know you need to worry about.

MR. NOWLEN: That's exactly the point, exactly the point.

CHAIRMAN STETKAR: Anything -- I want to see. We were getting close to getting back to schedule. We are slipping again.

MR. NOWLEN: Sorry.

CHAIRMAN STETKAR: No, that's okay.

MEMBER POWERS: The story of Steve's life.

MR. NOWLEN: Yes, don't give me an opening on schedule.

CHAIRMAN STETKAR: Any other questions for

Steve and J.S., no? With that, let's take a recess until 3:40. I'm assuming somebody is going to fill in for Rick on the incipient fire detection stuff. I am going to do that. We are recessed until 3:40.

(Whereupon, the above-entitled matter went off the record at 3:24 p.m. and resumed at 3:42 p.m.)

CHAIRMAN STETKAR: We're back in session. During the break, what we have decided to do, is because Rick Wachowiak is, I hear, valiantly trying to wend his way from wherever he lives to the great capital of the United States, and apparently he is best suited to discuss the topic of incipient fire detection, we are going to skip items 12 and 13 on the agenda, postpone them until tomorrow, and pick up on the agenda with transient fires and Doug True claims that he can appropriately stand in for Rick on the topic of transient fires.

By the way, just for the record, someone reminded me during the break that the previous presentation that we had from Steve Nowlen, I am assuming -- is Steve still here?

MR. NOWLEN: Yes.

CHAIRMAN STETKAR: Those were your own, personal experiences. They don't represent the NRC staff, is that correct?

MR. NOWLEN: Correct.

CHAIRMAN STETKAR: You need to state that on the --

MR. NOWLEN: Yes, that's correct. All the presentations that I am making today and tomorrow are the same way. These are -- I was asked to provide my perspectives and my perspective is not staff's.

CHAIRMAN STETKAR: You know, that's fine because we are trying to gain information from all relevant experts and you certainly qualify as a relevant expert. There was just a bit of confusion because on the agenda, it's listed as NRC staff input.

MR. NOWLEN: Yes, you will notice they are all on Sandia format. They are not on staff format.

CHAIRMAN STETKAR: Yes, yes, yes. Just want to make sure it's clear for the record. With that --

MR. BRADLEY: Question on that. Can I -- do we plan to hear the NRC staff perspective on these issues at some point in the meeting?

CHAIRMAN STETKAR: Sunil?

DR. WEERAKKODY: Yes. If you have questions on things that Steve Nowlen presents, we will be more than happy to answer any of those questions.

CHAIRMAN STETKAR: We should have time tomorrow when the staff is up to discuss that. They should be prepared.

With that, Doug, tell us about transient fires.

MR. TRUE: Okay, we are back on again. All right. I'm Doug True from ERIN Engineering. I'm here to talk about transient fires. This came up in the November meeting as one of the items on the industry list of areas that need some refinement.

May I preface by saying that -- and I think maybe Steve or somebody pointed this out -- that if you look at the skyline chart or whatever you want to call it, they are not generally a big contributor. It's a very plant-specific thing.

One of the things, though, about that is that many of the studies, including the pilots, have taken a deviation from 6850, so the results reflect a departure from the 6850 methodology to some degree. And I'll talk a little bit about that.

We also got four specific questions from I think John Lai, that your consultant Mardy Kazarians had, so I have a track at the back to try to respond to those four questions.

CHAIRMAN STETKAR: Those are probably filtered through me so don't blame Mardy for everything.

MR. TRUE: No, they were reasonable questions. So --

CHAIRMAN STETKAR: One of the reasons by the way is, and you'll probably get to this, although we talk about transients as if it's sort of the same thing as bin 15, but there are several of those bins that relate to both directly transient fires and human-induced ignition of transients.

So it's an area where if you are concerned about the next level of contributors, prior to that chart that you showed this morning, there was a bit of concern that if I saw equal contributions from four or five transient related bins at that next level, I wanted to make sure we understood that whole topic. So that's why that --

MR. TRUE: Overall I'd say it's currently a big risk driver, although as I said that's --

CHAIRMAN STETKAR: And it doesn't show up much on the radar either even at that next level down that you presented this morning, right?

MR. TRUE: Right, but like you say in part that's because of some departures that have been taken from the method, so --

CHAIRMAN STETKAR: And those departures were also applied -- you showed results for seven plants.

MR. TRUE: There were departures in there also.

CHAIRMAN STETKAR: Okay. Thanks.

MR. TRUE: Okay. So, I want to kind of walk you through, sort of like we did with the diesel thing last time, I want to walk through from ignition source bins to frequencies to allocation to what our operating experience says, what the severity of the fires, how we model the severity of the fires, how its growth is dealt with, talk about a summary and then come back to the four questions.

So, in Table C-3 of EPRI 1011989, there are a total of seven bins that deal with transient ignition sources. There are basically three that deal with transients from cutting and welding and then three that deal with transients and a fourth one that has kind of both together in for the PWR containment.

Included on the right hand side of the table, the number of events that were counted. There was some assessment done and Steve can probably speak to exactly how they did this.

But in deciding how much weight to give different events, and that is frankly not traceable in the documents so I can't tell you how we got to 2.4 or

7.3. It's not important.

There's some relatively modest number of events in the database.

CHAIRMAN STETKAR: It's not two, it's not 24 and it's not 240.

MR. TRUE: Right. As part of the EPRI interim report which then got fed into FAQ 048, EPRI did the analysis that updated the plant-wide ignition frequencies for all of the bins. You know the bar chart that Pat showed that had the blue and red bars, this is the results for the relevant ignition sources.

Some went up a little bit. Most of them stayed pretty much in the same basic area. A few of them moved a little bit, bin 24 maybe arguably moved and bin 37 went down by a fair amount, but not a huge change in the overall frequency that was -- that should be applied for each of these.

CHAIRMAN STETKAR: Bin 6 changed by about a factor of 3-1/2 which is interesting --

MR. TRUE: Yes, I'm sorry.

CHAIRMAN STETKAR: because of the cause and the location.

MR. TRUE: And I suspect that -- so bin 6 had 12-1/2 events, it's probably that many of those were older and as you did the update for the more recent results, then it dropped down.

CHAIRMAN STETKAR: Okay.

MR. TRUE: So, with a large number of events that wouldn't be too surprising. Okay, so we take this plant-wide frequency, and then we have an allocation process to sort of work our way towards allocating it to each part of the plant.

There's a section of 6850, EPRI 1011989, that addresses this specifically. It's in volume 2. It is done on a compartment basis which is basically in a physically limited area of the plant.

The document identifies three important weighting factors: level of occupancy in the room; the storage of flammable materials; and the type and frequency of maintenance activities. Those are all given equal weighting in the scoring system, so they are each summed together with an equal weight. There is no multiplying factor but they all go into the weighting of each room. And I'll go through a little example of if that illuminates how this works.

The fires were assumed to be able to occur in all areas of the plant unless precluded by design or operation, so if you have administrative controls, you still have to take a fire in an areas even though there is administrative control and at the last meeting, J.S. Hyslop got up and said you know, that stuff does get into those areas and so there could be a fire.

And in fact, 6850, the blue text in there I took right out of 6850. It says, "Administrative controls significantly impact the characteristics and likelihood of transient fires, but they do not preclude their occurrence."

So it acknowledges that both the likelihood and their characteristics could be different, but that you have to take a fire in those administrative controlled areas which is fine.

One of the problems comes in, how do you take credit for those characteristics and likelihood because there is no guidance today really on how to do that, with one exception, which I will get into in a second.

Actually here. So each compartment is weighted in each of those three areas with a weight from zero up to 50. The zero is only for compartments where you can't, you are designed out, you can't have a fire in that area, so those go away.

So it's really one, three, or 10. One is minimal, three is average and 10 is higher than average and then in the maintenance area, if there's a lot of maintenance with the potential for a fire, then you are given a weight of 50, so it gives you a way to really bias up those areas where there is a significant likelihood of a maintenance-related fire.

MEMBER POWERS: These are to say the least peculiar specific numbers. Is there -- are they Fibonacci numbers or something like that, that I don't recognize? I mean, why is very high five times high but high is only three times medium? I mean there must be some rationale behind these numbers.

MR. TRUE: Not being an author of 6850, I'll defer to an author of 6850, Steve Nowlen.

MR. NOWLEN: This is Steve Nowlen.

MEMBER POWERS: Now I understand better where these numbers came from.

MR. NOWLEN: Is that all I need to say?

MEMBER POWERS: No.

MR. NOWLEN: It's my fault the answer is -- I'll go into this in my presentation if you want to let Doug off the hook.

MEMBER POWERS: No, I want to keep Doug on the hook.

MR. NOWLEN: Okay.

MEMBER POWERS: But we will wait for your presentation.

MR. TRUE: Okay, so basically it's a score of one, three or 10 with some outlier areas that get a particularly higher weighting.

Okay. So there's this fancy equation. So basically just think of it as a -- each of -- you get a maintenance weight, you get an operational weight and you get a storage weight. Add them together and you divide by the sum of all of them across the location you are talking about.

So location is a thing that takes a second to think about. What is meant by location is those transient bins relate to particular buildings or locations within the plant. There's a bin for example that addresses control, auxiliary and reactor buildings.

That's a location, so you would look at all the bins across that location. Another one for turbine building. That's a location. So you basically weight it across the area that the frequency applies to.

So your basically, your compartment gets a weight that is based on its number of score points it gets out of the total of that frequency. Okay?

So let's go through just a simple example. I'm doing this just to illustrate how it works. So

I've got an elevation in the building that has got four compartments. It's got three rooms, two pretty good sized, one smaller, and a corridor that goes through that elevation.

Compartment A has a high-level maintenance, got some equipment in it that requires a significant amount of maintenance. So it gets a 10. It's got sort of because of important equipment in there, it's got some medium-level of occupancy so it gets a score of three.

It's got medium level of storage because some materials are stored related to being able to maintain that equipment, so it gets a three. So it's got a total of 16 points associated with that room, okay?

And we can go through that same thing with say B, is just your average, vanilla, it's got average of everything room, it gets a score of 9. Compartment C has low maintenance, low operational but it's really used for storage, so it's basically a storage closet if you will, conceptually it's a storage area. It gets a score of 12.

Our corridor D, because it's a passageway has a little bit of maintenance, sort of average, but high occupancy and some amount of storage or some amount of material kept in that area.

So what we do is we total that category, so we got 16 for compartment A, 9 for compartment B, 12 for compartment C, 16 for compartment D. On this elevation I got 53 points. Okay?

And let's say I have several elevations in that building and they add up to magically 147 which gives me a nice, simple denominator of 200, okay, for the purposes of example, okay? Obviously not a real one, I'm only trying to illustrate the point.

So my fraction for room A is the 16 divided by 200, B is 9 divided by 200, C is 12 divided by 200 and D is 16 divided by 200, okay?

Now, let's say I've got some sort of cable tray or something that runs through that corridor and I decide I need to do something about that area and I want to make it an administratively-controlled region.

So I no longer will store materials in there. I'm still going to have occupancy because people still have to transit the area. I have some amount of maintenance activities, average for the plant in that room, in that compartment, okay?

So, I'm going to say I'm no longer going to store combustible material there. So I'm going to move that severity to low. I got a one now, because I went from average to low. My total is going to go from 16 to 14. That changes my total for my elevation to 51, total to 198 for the building and my fractions change across the rooms and I drop to my fraction for that room from eight percent down to 7.1 percent.

So there is a means to credit it but it doesn't really affect the overall calculation of frequency for that room, even if you have said I am not going to allow transients to be anywhere near that particular cable tray that I felt was important.

CHAIRMAN STETKAR: But that's only because you presumed that the plant level frequency of transient fires remains unchanged, despite the fact that you have now changed your plant.

MR. TRUE: The plant-wide frequency is my plant-wide frequency.

CHAIRMAN STETKAR: That's -- what you have done is you have reallocated that same plant-wide frequency differently among those five locations.

MR. TRUE: Right. Right.

CHAIRMAN STETKAR: You have not reduced the plant-wide frequency by whatever the numbers are --

MR. TRUE: But I would still -- yes, but it's still two out of 200, it's still only a one percent change.

CHAIRMAN STETKAR: It's one percent. In effect you have penalized the other areas because you have allocated --

MR. TRUE: In effect, yes, what's happened is these have gone up.

CHAIRMAN STETKAR: My question is why would a sane person do that?

MEMBER BLEY: Why wouldn't you juts improve --

CHAIRMAN STETKAR: Why wouldn't you just improve the one area and leave the other frequencies the same as they were before you made the improvement?

MR. TRUE: Just applying the rules. I think there is one room to improve this approach and I think that's what the roadmap tried to say is that you probably need to think through some more guidance that will help us address this, both in terms of likelihood and in terms of severity because if I don't have combustibles there, then the distribution of sources that I can have, the trash bags stored in a big pile or the wood planks won't be there anymore and that's going to change the characteristics of my fire also.

MEMBER POWERS: I guess I'm -- I mean, I guess it's okay because you took storage down to low. You didn't take it to zero.

MR. TRUE: I'm not allowed to unless it's precluded by design.

MEMBER POWERS: Yes because the probability is --

MR. TRUE: Even if I made it's zero it's not going to really change this example.

MEMBER POWERS: It won't change your argument or your concern at all.

MR. TRUE: This is me talking, just personal opinion. I am a little bit troubled by this whole occupancy being a dry room. I understand that people can do things but at the same time, just because you are in a corridor that is busily traveled doesn't mean people are walking around causing fires either.

So I think this allocation scheme could be improved. I suspect Steve may even agree with me to some degree that there are some places where we could add some additional guidance to help people evaluate this, but we will see.

MEMBER SHACK: Did the exceptions that people take affect this?

MR. TRUE: The exceptions people took have less -- sometimes deal with the likelihood and sometimes deal with the severity. More commonly the severity is addressed in terms of picking a lower peak heat release rate, but let me get to peak heat release rate and you can see kind of it's set up.

Now what you have got to realize is that the analysts out in the industry are using this document, knowing that they are expected by the NRC to follow this guidance. So when they can, they are going to follow this guidance and they don't have the ability to make the judgment that Steve can make.

CHAIRMAN STETKAR: I hear that and I want to make sure that I understand how the staff, not Steve, not Steve, the staff, the NRC staff who is actually doing the reviews of the submittals, would react to my flip statement that said why would a sane person increase the transient fire frequency in locations A, B and C because you have removed transient combustibles from location D, which is effectively what this is doing.

And that said, when the staff comes up, not Steve, when the staff comes up, I want them to respond to your concern, because you are saying that people out in the industry are simply doing this type of activity because, I am assuming, they fear that the staff would not accept anything other than this.

To me, if that indeed is true, I think we need to understand that. If indeed it's not justified, I don't know why people in the industry are doing this.

MR. TRUE: My personal opinion and observation is that I think there is a concern on the part of the licensees that if they don't just do this the way it's described, then they are going to have a hard time with the staff and so they are trying to follow it.

CHAIRMAN STETKAR: I understand in terms of the initial baseline analysis, but -- well, we'll not discuss it anymore. I'll wait.

MR. TRUE: Okay, we have lots more to talk about on the transients. So okay. So let's look a little bit here at these events, I'm better off moving one way or the other or not. But in the -- in bin 7 there are seven events here and then there are two other events and Steve talked a little bit about this in the FEDB discussion that had basically no description.

They had to be treated as indeterminant events in the evaluation and the weighting.

But the seven with the descriptions that look exactly like this -- I may have changed some punctuation and capitalization but these are basically cut and pasted right out of the fire events database.

So the first one's probably recognizable. Although I didn't include the plant name, this might be a giveaway on it. We got another one with a fire in an oven. We got a regulator on a propane tank that went off. We got an air compressor, portable air compressor caught fire. We had some electrical cables in the laundry trailer heater caught on fire. We had a string of lights that caught on some wood on fire and then we had a water cooler that caught on fire and they unplugged it.

That's the nature of the events that go into our characterization of the frequency. Okay?

I look at bin 37, which is transient building fires, we got a box of ping pong balls that set on fire, we had some wood on a hot steam line, and acetylene line that broke. We had some lubricant that overheated and bubbled out and was smoking. We had a cardboard box with some insulating materials caught on fire, so it's sort of like a trash bin kind of a thing, and then we had a waste receptacle fire.

The other thing is the dates on these are all pretty far back. Many of them pre-Appendix R, pre-awareness of fire protection issues, even some of these arguably might be the earlier phases of Appendix

R implementation.

Up come more here in bin 37. Trash can fire burned plastic liner and some rags. A short in some sort of a portable something or other and then some exhaust fans were running and they had a fire in the ventilation side of that. And then some jumper cables ignited some electrical insulation.

So most of these have to do with some sort of transient ignition source, electrical ignition source that has overheated in one way or another. A couple of them they are related to some sort of container of trash.

So 6850 says to use the heat release rates based on some fire experiments. There's a whole catalogue of fire experiments, including it in the Appendix C isn't it, of 6850.

And then I cut and pasted right out of 6850 here what you are supposed to do about characterizing that fire. So you are supposed to review the transient fires based on -- review the location compartment for maintenance and other activities performed in the area, review past fire plant experience, and if the type and amount of combustible materials is expected or possible to be -- expected or possible, it is bounded by the configurations in Table G-7, then you are supposed to use a recommended heat release rate probability.

So you go out there and look and as long as you can say that the heat release rate proposed in 6850 bounds it then you use it. Otherwise if you find out that you have more combustible materials that are in the second paragraph, then you should come up with a different way of handling it or just take a maximum value and set the severity factor to 1.0.

But you are always, at least by the description in the document, you are bounded by -- you are supposed to use the bounding heat release rates that are provided in the document.

CHAIRMAN STETKAR: For screening.

MR. TRUE: No. This is the distribution, heat release rate distribution. So the screening is the 98th percentile --

CHAIRMAN STETKAR: Yes, okay.

MR. TRUE: but there is a distribution provided with it also. Okay? And this table, from Table G-7, provides the 98th and 75th percentile and the distribution functions for transient combustibles.

As a peak of 317 I think Dan Pace's presentation used that as their example. We'll get a picture of the gal with the bale full of paper or the bucket full of paper, 142 is the 75th percentile.

Okay did you want to ask something John?

CHAIRMAN STETKAR: No, go on.

MR. TRUE: Okay, and there was a note, there's note 9 down here on transient combustibles, it says the distribution is based on the range of tested transient fuel packages summarized in Table G-7.

I took that data and just plotted it on a graph. And so this is every one of the fires on Table G-7, I just sorted it from smallest to largest.

So the 317 is up in here somewhere. It comes out of a fire with basically three airline bags full of cups and paper towels that were burned at Lawrence Berkeley Lab. There was a bag full of straw and grass cuttings with eucalyptus duff in it that had 340.

There was 30 pounds of wood soaked with ethyl alcohol, two airline bags of cups and paper towels, 20 pounds soaked with JP-4, 14 pounds of wood soaked with JP-4 are these upper end ones.

And the concern that we have is that if you anchor your distribution to that 300 and whatever, it will be a fire based on these, but the ignition events that we had, have very little to do with any of these things. We have got this disconnect. It's the simplification of we will calculate a frequency of a bin and then over here we will attach a bounding probability distribution for that particular area.

So we have got events that are characterized by cords overheating and other things. Some of them are more representative and we have then characterized it by these events that are things -- we don't see grass cuttings and eucalyptus duff too much in our auxiliary buildings and control buildings, for example.

So this is where the -- this was the genesis of the industry's concern that there needs to be some better treatment for the way we characterize these transient events, because it doesn't really reflect what we see in the events, or the way we run our plants, and that was Dan's point I think this morning.

CHAIRMAN STETKAR: Doug, I think earlier, the question was asked when -- let's say you do your analysis, and one of those four locations that you showed the example before is a potentially important risk contributor.

Do the refinements of the analysis for that area account for the full probability distribution from NUREG/CR-6850?

MR. TRUE: Every PRA is different, every scenario is different, but if it is significant, then the process would be that you go back and you break it into bins. There is actually a table which I didn't include in 6850 that says this is the probability of this representative heat release rate and this is the probability of a representative heat release rate and you apply that. So flip the --

CHAIRMAN STETKAR: Is that also for transients? I know there is --

MR. TRUE: Transients and electrical fires, yes.

CHAIRMAN STETKAR: Okay. Okay.

MR. TRUE: Yes.

CHAIRMAN STETKAR: Okay.

MR. TRUE: Turns out the mean of this distribution I think is 69 kW.

CHAIRMAN STETKAR: Yes, the mean of the -- if you just use a gamma factor the mean is actually 103 but that's okay.

CHAIRMAN STETKAR: Okay, all right.

MEMBER SHACK: One-oh-three.

CHAIRMAN STETKAR: One-oh-three, that's right.

MR. TRUE: I said 103 didn't I?

MEMBER SHACK: I'm sorry.

CHAIRMAN STETKAR: I'm sorry, 103.

MR. TRUE: I don't speak as precisely as you do.

MEMBER SHACK: I thought you said 100.3. Oh, I'm sorry. One-zero-three.

MR. TRUE: But there's a table that actually gives you bin weighting factors and --

CHAIRMAN STETKAR: And that's a discretized version of the distribution.

MR. TRUE: Yes. Okay. So we don't use the 317, I mean we do for screening but then you'll go back and --

CHAIRMAN STETKAR: The actual mean -- the mean peak heat release rate is three times smaller.

MR. TRUE: Yes. Right. Okay, so that just shows the 98th and 75th. What's interesting in the Rick Wachowiak, he actually did a fit to the gamma distribution and says this fits really well. So, good fit.

So these were the top --

CHAIRMAN STETKAR: But they are all different.

MR. TRUE: If you just give them all equal weight in the process. The --

MEMBER BLEY: You can fit most anything to a gamma distribution.

CHAIRMAN STETKAR: A couple of parameters, you can make it.

MR. TRUE: So these are the description of those top four, five events down here and that are just included for information. I already made my point about that.

FAQ 08-052 gave us growth rates for three different types of transient fires. For trash receptacles it was eight minutes, for trash bags two minutes, spilled liquids like all spilled liquids, it was immediate.

The trash bags and receptacles are based on the same peak heat release rate data as provided in the same table.

But again, these don't really line up with what we are seeing in the events that are driving the frequency, that are driving the PRA.

So just to summarize the description of the method. 6850 acknowledges that the administrative controls can significantly impact the characteristics. This was from some of the discussion we had last time.

But it doesn't really provide much substantive credit for those controls, a 10 percent change in my simple example, and the peak heat release rate guidance really says they are trying to bound the plant practices, because you are not really given the ability to find your distribution, at least in what is written in the document.

Steve may tell me that as an author, there was another path but we didn't see that in the document.

And then there's this lack of connection between the e vents we see and the events -- heat release rate and growth rate in the modeling and then even when you have a stored combustible somewhere, if you look at the events, most of them had some sort of ignition source in conjunction with like the cord that went over the wood or the steam line or whatever, there was something that started on fire, it didn't just spontaneously combust.

So we have sort of lost, even if you have storage there, what's the likelihood you are going to get those things to actually ignite?

And this is my opinion now, this is really a good screening method. I think it's really effective even in the distribution, I think it's still a screening method but it's not really the way we would like to link the data to the consequence and it just needs some more refinement, it needs some more guidance to help the licensees to implement it more realistically.

So in that sense, even though it's not a huge risk contributor right now, it's a good example of some of the challenges that we see when we look at the various pieces of 6850 and how they get brought together in an actual analysis.

Okay? I am going to go on to questions. CDF contribution from transient combustibles, I think it is generally less than 10 percent. It's I think the pilots were down around one percent-ish --

CHAIRMAN STETKAR: It would seem from what you presented this morning that it's probably even less than that.

MR. TRUE: I think there was one plant on that chart that was around 10 percent. I know of one other plant that is around 10 percent.

CHAIRMAN STETKAR: Ten percent after you slice out the cabinets or pre-

MR. TRUE: Oh, on that chart, just to be clear, all I did was make the charts invisible, I mean the cabinets invisible. I didn't actually create -- I didn't reallocate. All I did was make that row and then I changed the scale on the chart so it didn't --

CHAIRMAN STETKAR: Oh, good.

MR. TRUE: I thought that was a more fair way to do it --

CHAIRMAN STETKAR: It didn't make the cabinets perfect --

MR. TRUE: Because they wouldn't go away, I mean they knew they would be in there somewhere so -- but that is a good point you brought that up because I didn't really explain that.

CHAIRMAN STETKAR: I misunderstood that. I thought you'd --

MR. TRUE: Yes, but this number less than 10 percent, let's call it one to 10 percent, often includes some kind of departure from 6850, which we will talk about a little bit in number four.

The second question was what are the problems -- you know there's an emphasis on this maintenance where you get a factor of 50 to give you a bigger number and so it pushes weight towards the places with the most likely thing but there is no way to bring it down when you have administrative controls essentially.

And then my personal opinion is that the occupancy one I think has to be thought through a little bit more. They are all weighted equally and I think there is probably a more refined way that we could come up with the allocation but it's my opinion --

CHAIRMAN STETKAR: Doug, before you go to the next slide, and I don't know whether you have looked at this. For -- granted, the fact that this is relatively small in the overall contribution, of those bullets under number 2, are the current results driven by that factor of 50 or are they driven more by your example, where everything is roughly equal because of the limitations of the one, three and 10? Do you follow me?

In other words, are we seeing a small number of specific locations that are big deal contributors because of the -- they are applied a factor of 50 and essentially get a very high frequency of transient fires, or is it --

MR. TRUE: I think it's the latter, it's not that there is just an area with a lot of maintenance that has, it gets the high weight and therefore causes a big blip, it's the fact we are putting the same weight basically everywhere, and there are some places where you don't want transient fires to occur, I mean that's why we paint the floors and --

MEMBER SHACK: Generally why you put an administrative control in the area.

MR. TRUE: And there are some that aren't administrative controlled that, through the course of doing the fire PRA we have discovered are places you don't want to have it happen also. So it's a good by-product of a screening approach that helps you identify those kinds of things.

CHAIRMAN STETKAR: In that sense a broader, either different guidance for how you account for either newly-applied administrative controls, I'll go back to my why would a sane person do that example, or a broader range instead of one, three and 10 from 10 to the minus two to 10, let's say, could also help that process.

MR. TRUE: Yes, absolutely. I think there are a lot of ways to skin this cat and when I think we should look at --

CHAIRMAN STETKAR: Again, it's not --

MR. TRUE: We have got a wealth of experience now in the industry with all these plants supplying this methodology and I think that there's probably -- we could probably learn a lot from looking at how it might -- different methods might be applied in different plants to see how to best address this.

And I said this last time when I was here, I think that the authors of 6850 did the best they could at the time, but they didn't get to test the method to know how it all turned out, and they could do the mind test and do tests in their mind and say yes, this seems okay, but when you get out there and you've done it and you realize, well, this could use some refinement, we just need to get to the point where we can do that.

CHAIRMAN STETKAR: Okay.

MR. TRUE: So, concerns about the heat release rate was the next question, and this was this disconnect between what we are seeing in the operating experience which is what we are applying in our assumptions about the characteristics of the fire.

And then the section G.5 that says if you got out and look around and there's nothing there, then that's fine, use the bounding value. That's obviously troubling from a trying to be realistic about what the real characteristics might be of a particular area.

Turn to workarounds or departures, I think there are two ways that's been addressed. One is to use a lower peak heat release rate for administratively-controlled areas. Event number has usually been in the range of the mean or lower as sort of the maximum value you'd ever get in that area.

Trying to go to the statement in 6850 that says that you know, you'd expect to have a lower combustible loading in an area with administrative controls. So they have adopted a particular peak heat release rate associated with administratively-controlled areas.

And then another approach has been to apply a severity factor to account for a conditional need for an ignition source if you have something stored there, you might put a garbage -- a trash bag there or you might put a box of stuff there but you wouldn't have an ignition source there at the same time, so you could put a lower additional probability for that occurring.

So those are the two ways that I have seen. There may be other ones out there in the industry, but those are the two -- again there's no guidance on that, and so plant A versus plant B versus plant 7 versus plant 24, there could be some variance in how that's done.

CHAIRMAN STETKAR: Both of those being effectively surrogates for a broader range of distribution of the frequency, I mean, you know, the under four, if I look at it, those are essentially attacking the number kind of in a --

MR. TRUE: The second one is. The first one is how big the fire is you are going to get in that area. So I mean you could do it I guess through a combination of the distribution of peak heat release rate 10 and the frequency both, but --

CHAIRMAN STETKAR: You know in one sense, there's a low conditional probability of having five gallons of gasoline in an administratively-controlled area. That says nothing about the peak heat release rate from that gasoline.

This is sort of attacking the problem from peak heat release rate, it's like -- okay.

MR. TRUE: Yes. So, I don't know if I can -- is that an adequate answer to your question?

MR. KAZARIANS: You answered John's question, sorry.

CHAIRMAN STETKAR: You're looking at him as if he has any influence on this process. Those four questions actually came from me --

MR. TRUE: I blame it on you.

MR. KAZARIANS: That's all right.

CHAIRMAN STETKAR: after reading some preliminary input from Mardy.

MR. KAZARIANS: I am used to it.

CHAIRMAN STETKAR: I don't know how it was transmitted to you, but that's why I said that --

MR. TRUE: Oh in the email I got it said the consultant had questions so --

CHAIRMAN STETKAR: That's fine.

MR. TRUE: I still consider you a consultant, John.

CHAIRMAN STETKAR: Not me, I don't do anything.

MR. TRUE: Okay, I think I am shaping the future.

CHAIRMAN STETKAR: Any other questions for Doug? I guess we will hear from the staff now.

MR. NOWLEN: Well, unfortunately you've got me again.

CHAIRMAN STETKAR: So we are not going to hear from the staff. I actually -- while you are getting set up, Sunil, you are probably not ready to answer this, but I am actually sensitive to this notion that we are hearing a lot from Steve as a contractor consultant.

And a couple of things, the example that Doug walked us through to show how people were treating the allocation of those transient combustibles even after they took credit for applying administrative controls that essentially reallocated the frequency, increased the frequency in some areas, and the response was, well, that's what the industry feels that the staff would require.

So I am actually concerned about understanding during the staff's reviews, whether those concerns are justified or indeed of there's experience to show that the staff indeed would consider other applications of the method.

So you don't need to answer today but if you do find, I'd like to hear from you, but I certainly do want to hear a response tomorrow if you want to have a little time to think about it.

DR. WEERAKKODY: We would speak from our some of our prior experiences, yes.

CHAIRMAN STETKAR: Because that's exactly the type of feedback I'd like to hear because some of the concerns that I am hearing from the industry, I understand the genesis of those concerns because there are numbers, there's guidance, and a path to confidence of acceptability of an analysis is to follow that guidance.

And that might be a bit different from Steve's spin as a contractor or a consultant. So keep that in mind.

MR. NOWLEN: Yes, and I can only answer from the perspective of the methodology, what we were trying to do, why we did the things we did, the problem we were trying to address and I will try and do that but I certainly can't speak to how staff would respond to a deviation from what we had.

MR. NOWLEN: So again, I'm Steve Nowlen, back again.

CHAIRMAN STETKAR: Speaking for yourself.

MR. NOWLEN: Speaking for myself, once again. These are my perspectives as an author, you know, what was it that we had in mind when we did this craziness, and since I think I am referring to myself in craziness, it's okay for me to use that term. You have to be careful.

Transients are really a challenging part of fire PRA. They always have been. They've always been that sort of, you know, thing we wish we didn't have to do but we do. They are very difficult. Not only can they occur at any time and almost anywhere, and we appreciate administrative controls. They have certainly made a difference, you know, the very nice, clean room we saw this morning, I love it, and I've been in many, many rooms that looked just like that.

The difficulty is that people violate the rules. Not everyone follows the rules. Things happen. And so transients are sort of that catchall for things happen.

And like I say, it's always been a very difficult area for fire PRA. We try to make improvements. It may not be real scrutable. I'll try and explain.

But the really unique thing about transients and the reason that they can be important to risk is because the transient is the thing that can bring the fire to a target that is otherwise not exposed. That's what makes them unique.

I can have a pinch point among my cables that has no fixed ignition sources anywhere near it, but if I bring a transient I can now threaten that set, and that's what really makes them different, and makes them difficult to ignore them as well.

Because if I say I can't have a transient, then I'm never going to have any contribution from that cable pinch point and that may not be the right answer either. So somewhere in between you have got to get to the right answer.

So what we try to do is there is an overall, plant-wide frequency of transient fires, just like there is for everything else. Now the question that came up is, well if you put in new administrative controls, wouldn't that reduce the plant-wide fire frequency?

In theory, yes, and hopefully our trends will show that in fact, industry -- this is one actually that surprised me in terms of the FAQ and calculating the fire frequencies post-`90, pre-`90. I expected this one to go down more substantially. I mean, we have much better transient controls in the plant.

And it didn't. But I think part of it is Doug's points about the types of events that go into transient fires, it's everything that doesn't fit in somewhere else and they get dumped into transients.

So we have everything from the two boiling, 55 gallon drums of oil that were bubbling and burbling in a room, to the overheated electrical cord that connected to a portable heater. I mean, it is a grab bag.

But then, the next step was to try and apportion that frequency to locations in the plant. And again, we are talking about the base PRA. So from my perspective, the issue that I start with, a single plant-wide fire frequency and my job is to apportion it amongst the locations in the plant, that's the base PRA.

When we wrote it, we were not thinking about whether I could do a weighting of -- should I enhance my administrative controls or move a cable. I wasn't looking at that, sort of, I wasn't trying to see how the benefit of increasing my administrative controls would impact risk.

I was trying to get a base answer that roughly represented the plant to the best of my ability, and so to do that we wanted to be able to apportion these things to different areas and then at the same time, reflect the nature of the transient fuel that is likely to occur in a given location.

And those words that Doug had in there, that the administrative controls could significantly impact the characteristics and likelihood of fire, we meant those and we hoped that those would get reflected.

So from my perspective, the things that they are talking about, saying I looked at my administrative controls and I am using that to reduce the heat release rate that I might see, or the total heat load I might see and so I am going to truncate the profile for example, I am comfortable those --

again I can't speak to how staff would respond to that piece, but --

CHAIRMAN STETKAR: That again, I do want to hear some feedback from the staff because regardless of how well intentioned the guidance in 6850 is, the fact of the matter is when a particular plant submits an analysis, they will be reviewed by the staff against something.

And you know, we have heard the concerns about, well if I don't do it in a particular interpretation of the guidance in NUREG/CR-6850, regardless of whether that's a misinterpretation or a malinterpretation, people are feeling that their hands are tied.

MEMBER SHACK: Except we seem to have seven PRAs that asked for exceptions and got them.

CHAIRMAN STETKAR: No --

MEMBER SHACK: Only two --

CHAIRMAN STETKAR: remember only one has been reviewed --

MEMBER SHACK: Reviewed, that's true.

CHAIRMAN STETKAR: Only one -- I'm assuming that Harris is one of those seven, they are anonymous so that's just an assumption, but in truth we only have evidence of one.

MR. NOWLEN: And I can speak to personal experience at Oconee because this did come up at Oconee. They had made an argument that the heat release rate was excessively conservative and we reviewed that and I discussed it with the staff who were there and ultimately we said thumbs up, good stuff, like it, let's move on.

So I have seen it but then again I also appreciate that when 6850 is less than crystal clear, for example we made the statement that the administrative controls should significantly impact characteristics, but we didn't follow through with the words saying here is how you incorporate that into your study.

That's the missing piece. I mean, we meant it, we intended for it to be applied and so when Doug has to do it for his plant, he has got to figure well what do they mean by that, okay, I wasn't crystal clear.

But staff has the same problem, because it's not crystal clear to them either what our intent was and I fully appreciate that.

CHAIRMAN STETKAR: And it's a problem that if Doug does it for plant, he does it in a certain way, and if Doug does it for three or four plants, he'll do it the same way for each of those three or four.

On the other hand, if I do it for another three or four plants, I'll do it my way, which is a different way, probably, unless I talk to Doug and that's a bit of the problem also.

MR. NOWLEN: Yes, absolutely.

CHAIRMAN STETKAR: Anyway, let's continue.

MR. NOWLEN: Yes. So the challenge with transients again is that it's a real grab bag, and you know Doug showed some of the examples there. It's everything from faulting portable electrical heaters, spilled liquids, trash, construction materials, packing materials -- when I am staging for an outage things get brought into the plant. You know a lot of things can change just in advance of an outage. How we are going to deal with that?

Storage items, Doug's absolutely right, you've got to be able to ignite them, but the fact that I am storing flammable materials, the little paper suits that we wear when we go in and out of contaminated areas, they are combustible. If they are ignited, we need to be sure that we are not presenting an unpleasant risk profile on that basis.

But it's just a grab bag and I think one thing that does become a little bit of a misnomer is the idea that there is one size fits all and again I think it's part of the guidance in 6850 and the way it was written, you get that impression that it was intended to be a one size fits all.

It really wasn't, but again reading it five years later, I can certainly appreciate the dilemma.

So this is getting to the statement about the assumed peak heat release rate is based on tests performed with trash bags, and Doug showed that. I will say we did not give very much weight to the eucalyptus duff test.

There's actually a discussion of that one in somewhere there. That was an interesting one.

But I think this is a little bit misleading. There's a range of fuel packages that we cited, and again what we were trying to do is say what do we know. So we dumped that table out and said here's all the tests that we can find that have any relevance to this topic at all. Okay, here it is, this is what we found.

And then we said well, so what do we make out of that, and we as a group drew distributions based on the information we had, you know, the eucalyptus dust and all those other big things got pushed out to the 98^{th} percentile. We put a 75^{th} percentile on a large trash can and everything else was smaller.

There are trash bags, there are trash cans, but again we didn't try and draw a distribution through that set that Doug showed for example. We simply used our judgment and tried to give some guidance as to how you should use that.

The other part is that these trash cans, in our view, for most areas, that is going to be the bounding fire, right? I mean this morning we saw the gal standing next to the trash bag full of paper.

MEMBER BLEY: With a gallon of stuff put in it.

MR. NOWLEN: Yes, well experimentally can't wait for it to self-ignite so I do something to ignite it. I put a pint in or whatever. Whatever it is, that's sort of a worst case for most places and so the intent of the passages that Doug cited, accurately by the way, was really aimed at what we call scoping fire modeling.

That is, there's a task before you get to detailed quantification where it's not quite screening, it's sort of the next level and you are wandering around the plant and you need to do something to try and get a handle on whether or not these are going to be scenarios you have to carry forward.

And so the guidance was, you know, if you can bound what you expect to see based on these trash fires, then go ahead, use the trash fires, apply the scoping fire modeling which includes the severity factors. You can bring in the distribution and all of that and if you can now get rid of transients for an area, or if you can focus your transients on specific locations, that was really our goal with that guidance.

And then the idea was that when you go to the detail, you would now get more real, and you would say what have I really got, you would reflect your transient combustible controls programs and whatever.

And again we have seen that in the plants. Personally I don't have a problem with it but I do understand staff's difficulty in trying to decide whether they should have a problem with it.

So, this is another point Doug raised about comparing the events to what we model and it's fair enough, again it's a challenge, it's a grab bag.

We try to just cite all the relevant

sources that we could find for data that people could use in doing their transient fuel assessment. But it doesn't cover everything.

We don't have a single test that involves a wooden transportation crate for a new valve or a motor or whatever. You bring in the valve, it's still in the crate. I now have a new -- I don't know what to tell you about that.

But that's just a fundamental limitation. We weren't running new tests, so we basically gave a laundry list of what's out there from our view of what might be relevant.

The allegation technique, this gets into the one, three, 10, 50, so I'll try and --

MEMBER POWERS: I'm dying to know these things.

MR. NOWLEN: You're going to love my --

MEMBER POWERS: I think they are Fibonacci numbers multiplied by a Hurlwitz zeta function.

(Laughter.)

MEMBER POWERS: It comes out just about right. It's 49.9 or something.

MR. NOWLEN: It may be close to that. Doug has actually one of the best explanations of that method. It's actually -- that's actually what we meant to do, with one slight exception, and he's got it right, you know, we had these ranking numbers.

The whole intent of this was that our peer team, when we were developing the methodology, said we have to get away from this simple area ratio. The way we used to do it, is we would simply take the plant and this is two square feet out of 20,000 square feet of plant so it's two out of 20,000.

They said you know, we have got to do better. We have to do better than that. So, what we were trying to do is to provide the analysts with a tool that would give them a way of ranking within their own plant the relative likelihood of fires in different locations.

Now you -- actually something that is new here is you can eliminate fires for places where it's precluded by design. He's correct about that. We have the zero zero zero. If you can preclude by design, you don't do transients. That's actually -- you weren't allowed to do that in IPEEE space. You had to put a transient everywhere. It didn't matter.

Okay, so that was one thing. We do have an exclusion thing. But it is fairly limited. Now nominally, you can have a ranking of one zero zero for -- if you're not going to exclude it entirely, then you can have 10, 10, 50.

So what this did is it gave us a factor of 70, a little less than two orders of magnitude, between your most likely area and your least likely area. How did we come up with these numbers?

You know we were probably stuck in a blizzard at Millstone and trying to come up with something. This was really a judgmental thing that involved the authors on both sides. We actually started with the one, three, 10.

We said okay, let's rank these things on a scale of one to 10, and we will put in something intermediate -- three. And we tried it out and we said well, you really, when you are adding these up, it's not giving you very much discrimination, it's sort of 30 versus three. That's as far as you can go with these.

So we said well, in our judgment, there ought to be more discrimination in that. And so we kind of asked ourselves, well, how much do we think it is? Is it two orders of magnitude? Yes, maybe. Is it three orders of magnitude? Kind of uncomfortable going that far.

So it really was that sort of a process. It was a debate amongst all of us as to what sort of, how much latitude did we want to allow in allocating these fires at different locations in my plant and when we had our one, three, 10, it just wasn't enough. We wanted more.

So we said well what's probably the most significant factor amongst these three: occupancy, storage and maintenance, and we said maintenance. Let's focus on maintenance. And so we added a 50 for very high maintenance areas.

MEMBER BLEY: Steve, did you have information from your real transient fires that let you somehow evaluate the difference between storage, occupancy and maintenance for these things?

MR. NOWLEN: Not especially, no. These are traditional fire protection concepts.

MEMBER BLEY: Yes.

MR. NOWLEN: You know, I mean, the traditional fire protection engineer in the non-nuclear industry will tell you if I could just get rid of the people, I'd get rid of my fires because people bring fires.

We are not quite so strongly influenced by that. Our people I think are a little better than that. But occupancy, okay we will rank it. If you have more people coming through, more traffic, that's somewhat more likely to have a fire there. Storage, if you have materials there that can be ignited, that would seem to indicate that there is a higher likelihood that they will get ignited.

If I don't have anything there to ignite, then the likelihood of a fire is lower. That's the thought, but maintenance is the one that we really thought was the dominant factor here and so we added a very high category for maintenance.

If you have got people in there doing things, working tools, welding, cutting, whatever it is, moving things around, you are bringing oil in, you are changing it out of the pumps, you are breaking down electrical equipment. That was thought to be the highest one.

And so in the end, we gave it an additional latitude that gets us nearly two orders of magnitude discrimination. And the intent was that people would have, somewhere in their plant there ought to be a 50 maintenance area, the place where they do the maintenance ought to be ranked 50.

And there ought to be a place where it's -- you know we just don't do that. That should be a one. So the idea was that there should be areas at both ends of this spectrum. It wasn't an absolute scale, that is every plant should have a 50 somewhere and every plant should have a one somewhere.

And so in the end you should be able to distribute your fires where you think they are most likely to occur. And this was actually something that we did in conjunction with our peer review team. We had a peer team as a part of the development of 6850, Dennis Henneke and Ching Guay and some others who participated.

And this was actually something that we worked out with them and we asked them, well how far do you think we should go? And that is basically it. I'm not sure it's going to satisfy you --

MEMBER BLEY: This is a question, you haven't had a chance to review most of these PRAs from what you said. And from what Doug said, his example had no big hitter room in it.

MR. NOWLEN: Right.

MEMBER BLEY: So, at least none of the rooms we saw. There might have been one somewhere else that accounted for much of that number in his example.

But he also said that in most of the PRAs they have looked at, everything is kind of distributed, which is kind of like using 3s and 10s for almost everything. I'm just wondering if that's --

if we are -- but you can't answer this. So I just wonder out loud if we are really seeing people use what is provided there to really flag the big hitter rooms as opposed to the other ones, to get real discrimination and I don't know, you can't answer that --

MR. NOWLEN: I can't --

MEMBER BLEY: I want to put it on the table and maybe staff can say something about it, or the industry.

MR. NOWLEN: Yes, because Doug's example is sort of everybody's kind of average and if that is the way you do it then it's not going to discriminate very much.

MEMBER BLEY: And for John's point, even though it is silly for the other rooms to go up, they don't go up a noticeable amount. So --

MR. NOWLEN: Well, but if I -- if for example you had an area where you did a lot of maintenance, and you ranked it as a 50 when you started, and you come back and you realize it's driving my risk. What can I do?

Well, if I preclude -- if I put in an administrative control that says you are not going to do these activities during operations, then you know and I bring it down to a one or a three, now I am going to see a noticeable change.

MEMBER BLEY: But in that room, we will re-spread everything back so we won't see a meaningful change at least in the way it's described the way people are using it.

MR. NOWLEN: Yes, because again this is a base PRA method. It wasn't intended to assess the efficacy of an administrative control. It was simply intended as a tool that would allow the analyst to make this sort of discrimination between this area where I do all this maintenance and this area where --

MEMBER BLEY: When you use it in the other way then --

MEMBER BLEY: For example the cable spreading room ought to be a one, one, one for everybody. Nobody should be storing materials there. We don't do that. There is very limited maintenance and very low occupancy. It's a controlled area.

So the cable spreading room, I would hope, is a one, one, one, whereas I come into the area where my rad techs come in and they set up their instruments and they do a bunch of monitoring, they go collect their samples, they come back and they have got a little -- that's what we were intending to do is to give them a tool to make them discrimination of nearly two orders of magnitude in a base PRA.

It wasn't intended to assess the adequacy of comp measures or administrative controls. Does that make sense?

CHAIRMAN STETKAR: Yes.

MR. NOWLEN: But again, it is largely judgmental.

CHAIRMAN STETKAR: Understand and again, that's -- I think it's important for us to understand from your perspective the original intent of 6850, how it is being applied by the industry and how the staff is reacting to those applications are also important.

We saw from Doug's presentation at least in this allocation of the change to his read numbers how it is being applied in the industry because of concerns about staff review for example, at least that is what is characterized.

MR. NOWLEN: So the last area is allocation within a compartment and this is an area where I reviewed what we have and we don't have much and I think this is another area where improvements would definitely be good. If you go in a plant, and I've been there, you see these painted areas, no combustibles, do not store.

I believe that's legit. Is it always -- is it now zero? A little uncomfortable when you tell me it's zero but clearly I think the likelihood that it's there, I don't know what it is, an order of magnitude, two orders of magnitude less likely to be there? We could use guidance there. So I think that's one that would definitely be helpful.

I actually raise this. Hot work is the same issue by the way, right? Because hot work is the same thing. You bring fire to the source but it doesn't happen everywhere in the plant.

Hot work is actually even more difficult in my mind than transients but so far I don't think we are seeing a lot of hot work. I think you know you have a couple of outliers. There has been five or six reactor building hot work, I don't know, again, I just point out, it's the same issue, so if we are going to fix transients I'd like to see us fix hot work also.

A couple -- this is actually not my last version. I had a couple of suggestions for potential alternatives. I think from my mind, this could be a little bang for the buck thing where we are chasing some low-risk contributors and as authors, I think we were thinking the same thing. So maybe we didn't spend as much time on it as we should have.

We didn't really expect transients to be a huge contributor but there are those exceptions so they will be out there. But I think we might think about some other alternative strategies also.

One of the issues that I had understood was of concern is just the scope. I have to take -- I heard Kiang Zee talk about one time lighting fuzzy on fire and letting him run all over the plant and see what he can do to my plant. That's burdensome you know, having to postulate transients in every single location is a pain, right? And is it really worth it?

I'm kind of thinking that if we develop better screening tools location wise and say if I have got a target set and I'm already threatening it via some bank of electrical cabinets, then if all's I'm doing with my transient is introducing yet one more very low likelihood source of damaging the same target, maybe I should be able to set aside and say it just doesn't contribute.

So you look for those locations where you really do have unique sort of an impact that doesn't have the fixed sources nearby and you assess that, or you come in a room where there are no fixed sources, the only thing you have is transients, you work on that.

I think that could be another way to attack this problem. But again you are not going to see me say transients, oh, easy. It's a very difficult problem.

CHAIRMAN STETKAR: But I think, again, the second bullet there, my own personal opinion, especially after the second slide that we saw this morning about those, you know the next tier of contributors, I think that my sense is that's probably true, that there may not be a large return on investment in this particular area.

Certainly you can always make things better, you can reduce the uncertainties, you can apply more realistic criteria, but this may not be the place to focus the resources at least in the near term.

The only reason, again the only reason both you and Doug are addressing this is something that I raised because I wasn't aware of what that next tier looked at and because transients contribute to a broad spectrum of those fire frequency bins, and we had heard through our interviews feedback from people saying well, gee, we are concerned with transients, we need to do workarounds. That's the reason why we are sort of addressing it today.

So I think the discussions that we have had here sort of elaborates on that issue and --

MR. NOWLEN: Well, I think that the points that both Ken and Biff have made are also well taken. As you drill on some of the heavy hitters, these could pop up and if the results that we are seeing do reflect that they are taking some of these departures from the letter of the methodology, I think those are both very relevant points that we need to consider.

I mean, again, as author of the method I am happy to see that they are in fact taking these departures, looking at their control programs, looking at violations of their control programs, what have they see that has snuck in behind the -- they keep records of that. I am happy to see, from an analyst's perspective, that they are doing that. I don't know how staff will respond.

MEMBER BLEY: And even if it's not a big thing to work on, I hadn't really looked at this thing before, but the maintenance, occupancy and storage, the one thing that jumps out at me is that maintenance and occupancy aren't independent and the kind of people being around that are likely to get things to happen, are probably covered under the maintenance.

If I'm in the control room and got people there, the old argument that gee, there's more people to spot something if it starts may be true, and if it's just an area of passageway that isn't people bringing in stuff and piling it up, so I am just wondering if those -- the dependencies between them are leading to a place where Doug's example does get us kind of in a silly spot, but I wouldn't want to pursue that a whole lot.

MR. NOWLEN: Not real explicitly but there is guidance in there that says what you should be looking at in each of these areas and we do talk a little bit I believe about that one, that occupancy, just the fact that the main control room is 100 percent occupied, well that's not quite what we had in mind, but let's talk about that.

So I think we tried to give them some guidance in this that should be reasonably clear but again, the main objective was to give the analyst a tool they could use to make a discrimination between their high hitter --

MEMBER BLEY: The rooms, yes.

MR. NOWLEN: Yes the rooms where they really expect to see this and the rooms where they really don't expect to see this.

MEMBER BLEY: It would be interesting to

see if people have really done that.

MR. NOWLEN: Two orders of magnitude of flexibility there, roughly, a little less than two orders of magnitude, and so it's all meant to be relative to the plant practices. What's high maintenance for you might be medium for someone else or what is medium for you might be high for -- vice versa. So, but it was intended to be relative within that plant. Some place ought to be high. Some place ought to be very high on maintenance, and if it's not then they are not taking it as far as we hoped. We wanted them to make that discrimination.

CHAIRMAN STETKAR: Mardy?

MR. KAZARIANS: Yes, Mardy Kazarians. I would like to add a note here. The reason I brought up the transient issue from my interviews is because this topic is most important in areas like cable shafts and cable tunnels, where we don't have our typical, fixed ignition sources like pumps and valves and motors, electrical cabinets and so on.

So the frequency of the CDF from those rooms is completely, practically completely dependent on the transient element. So if we make tweak the numbers, we are directly tweaking the CDF and that could make a big difference.

I'm not disagreeing with all the discussions we are having, it's just I'm saying the importance of it is in those specific rooms, and indeed if those rooms are locked, closed, nobody goes in, nothing happens, so then the question is, is this ranking scheme representative of the real world or not?

That's the comment I want.

CHAIRMAN STETKAR: Anything else from the committee? Steve, thank you.

MR. NOWLEN: Thank you.

CHAIRMAN STETKAR: We are going to run over today but that's okay.

MR. NOWLEN: Yes, that's what happens when you --

MEMBER POWERS: It reflects just badly on the chairman, that's all.

CHAIRMAN STETKAR: It does and I'm -- that's fine. I'm incompetent, I'm incapable and inexperienced. I'm becoming more experienced at being incompetent and incapable.

(Laughter.)

MEMBER POWERS: I will point out --

MR. NOWLEN: I learned something today.

MEMBER POWERS: -- that had the authors of

6850 simply made 50 30, then they could argue that it was zero, one half, one, one and a half on a logarithmic scale. But they chose not to do that. They chose 50, which is a Fibonacci number to the -- some power or something like that.

(Laughter.)

MR. NOWLEN: Well, it was five times bigger than one to 10. We started with one to 10 and it wasn't doing the level we wanted, so we said, well, how far will we go? Well, 50. But if I had to defend it in court, I wouldn't be very happy.

MEMBER POWERS: Would 30 have done it for you?

MR. NOWLEN: No, we talked about 30.

MR. KAZARIANS: I am Mardy Kazarians and I am the consultant to ACRS and here is my presentation.

All right, ACRS approached me and asked me to look into the limitations of the NFPA, I'm sorry, limitations of NUREG 6850 application in the NFPA transition process, so basically there were two questions posed.

The first one is could the limitations in current fire PRA analysis methods or data lead to inappropriate conclusions during the NFPA 805 transition? And also are there other issues impeding or discouraging the transition process. So these are the two questions that basically define the scope of my work.

What I did, I contacted different stakeholders of this topic and from the NRC staff and members of the licensees and consultants and the numbers in parentheses represent the number of people I talked to, including other sources, basically NIST and asked questions about the application of 6850 and fire PRA in general.

So the topics that I discussed, first of all I tried to understand their role in the overall scheme of things, meaning that their experience and their involvement with the fire PRA process or NFP transition.

And then if they aren't the ones who are doing the fire PRA, I wanted to know about the current status and the peer review status, and then based on that, then discussions went around the CDF contributors, difficulties in applying the 6850, deviations if they have deviated from it, and then of course the biggest topic was conservatism.

One of the specific topics that I talked about was the multiple spurious operations and the other one was about the quality of the cable information, the circuit information that they used, and also we talked about a peer review process and level of effort.

So one thing I definitely want to stress before I start discussing any of my observations is the fact that all the things I am going to talk about today is based on my verbal discussions with these individuals and I have not made any attempt to do a scientific analysis here and try to gather a very thorough and complete, what I say statistically viable information.

And also I will try to specify if something is my opinion versus what I have heard, so when I speak something that is my opinion, I will start with that statement.

MEMBER BLEY: Fair enough.

MR. KAZARIANS: The CDFs that that are typically found recently are ranging between mid 10 to the minus five to low 10 to the minus four and those that have concluded at mid 10 to the minus five typically have included modifications in their fire PRA. These are modifications that are planned and not existing at this time.

Modifications that are typically considered were changing the routing of a cable, putting wrapping around certain raceways, incipient smoke detectors is probably the most famous one of all in this group and then also providing another source of seal injections for PWR reactor coolant pumps, then controlling the oil spill and also there was some mention about additional operating procedures, or changes in operating procedures or administrative procedures. Those are the mods that were considered in the fire PRAs.

CHAIRMAN STETKAR: Mardy, do you have -- you don't get off just because you are our consultant. Do you have a sense of -- you talked to a number of people. Among these types of modifications, do you have a sense of where people are applying things more or less?

MR. KAZARIANS: I don't have enough information to answer it well. I can tell you that incipient smoke detectors were considered in two of the licensees that I talked to and they had a very significant impact on the final result.

CHAIRMAN STETKAR: We know that they were installed in Shearon Harris. That's available.

MR. KAZARIANS: That's not my understanding. It's not.

CHAIRMAN STETKAR: Is it not?

MR. KAZARIANS: They will clarify, I mean obviously that -- but they can tell us --

CHAIRMAN STETKAR: I thought that they were.

MR. KAZARIANS: But that's, that's quite -- I mean, so there were others that did not go that route and used other methods.

CHAIRMAN STETKAR: So there isn't for example, nine out of the 10 people always did one of these things plus --

MR. KAZARIANS: No, actually, if that was the question, the answer is no. I did not see --

CHAIRMAN STETKAR: You didn't see --

MR. KAZARIANS: a pattern like that.

CHAIRMAN STETKAR: Okay. Okay.

MR. KAZARIANS: Okay, in terms of the dominant contributors, in my opinion there is a general pattern in that, and the ones that I notice is that electrical cabinets, main control room and rooms with high concentration of cables. Those are the typical places that you see at the top of the list.

And one of the things I have also noticed in my discussions that the CDF or the pressurized water reactors is quite sensitive apparently to the reactor coolant pump seal failure timing. That allows for recovery actions I suppose. I don't quite understand that chain of events. But that was one of the messages I got.

Another important thing that I -- another important message in my opinion is that after the first 10 or 20 or some handful of dominant contributors, then we have a very large number of contributors with very small contribution each.

So that in itself is -- in my opinion -- it's an interesting situation because if there is something in the methodology that we want to modify to reduce conservatism, then a large number has to be dealt with at the same time. So it makes it a little, I think it makes it kind of resource-intensive to be able to --

MEMBER BLEY: This was a common thread throughout the utility people and the consultants you talked with?

MR. KAZARIANS: I cannot say everyone shared that opinion, that experience. I cannot say that. But that was something that came out a little more loudly than other comments, you know?

MEMBER BLEY: Okay.

MR. KAZARIANS: Okay. One thing that we keep hearing about, and I want to express my personal opinion about this topic, is that the peak heat release rate distributions and the impact of that, especially in relations with electrical cabinets.

Now, this comment was made to me by several people I talked to, and I am not, by the way, I am not an expert in fire experimentation so I have never burned anything in my career.

MEMBER BLEY: On purpose.

(Laughter.)

MR. KAZARIANS: So I don't know, I haven't measured heat release rates in other words so I went to experts and called them up and asked them what is your opinion about these distributions.

So, the answer is that it is possible to have such high heat release rates given the right conditions. So in other words, the distribution is -- there is a distribution, in other words.

Now if you look at the distribution the way it was done, actually people -- maybe I should clarify one other thing also, is that I was one of the authors of 6850, you know, I think I should clarify that. Okay, so I'm trying not to be biased.

So one of the things that -- you look at the 75^{th} percentile and 98^{th} percentile, one of the things that is being attempted there is to show that those numbers coming from experimentation are at the far end of the distribution so therefore the bulk of the distribution is on the low side.

But then also, when I start digging into this a little more and asking why are these scenarios important, well the reason they are important is because of what is near these electrical cabinets. So in other words separation is a key question here.

So in my opinion, the culprit is really not the peak heat release rate. The culprit is the separation in those rooms.

So, now, if I am allowed to get on the soapbox on this one, is that if we have a separation problem there, then we need to ask that question very carefully and see why the CCDP in that room is so high and I'm presuming those CCDPs were above 0.1.

If that is the case, then the short -- the spurious actuations could be a culprit there also. It's very possible. And so that also by itself brings up another question. Was that analyzed properly or is it conservatively, and the control room response to that is a question there. Is that analyzed properly and conservatively?

So those questions come up. So focusing on peak heat release rate, I personally feel, is not the right focus. That ensemble of elements of the analysis should be looked at, and peak heat release rate most likely is a culprit but is not the only one, okay?

MEMBER BLEY: I don't know how to say this. I don't want to be insulting to anybody doing these analyses, but do the people you have talked to who are involved in these analyses understand that gamma distribution and all the points of it and understand how they could use the whole distribution --

MR. KAZARIANS: I am glad you brought that up because actually I am going to talk about that and I will just talk about it right now, since you brought it up.

Now, we heard from Doug and Jim

Jim Chapman and Dave about that. In their analysis, they have indeed taken into account the entire distribution. Unfortunately, in my discussions with people, that is not what I understood.

Now, granted, when we have a verbal communication, when I hear something I may not have heard correctly or it was not -- I didn't ask the right question and so on and so forth. I mean, I can, I have to paraphrase that, say that.

But my impression, from my discussions is that people have really not understood that well. They are not applying that concept fully because when I do a little bit of math in my head, is let's say, what's the frequency of an electrical cabinet in one room, one electrical cabinet times let's say 0.05, instead of 0.02, let's go 0.05 for the far end of the distribution.

I'm getting in my head something like 10 to the minus five or so, so then if the CCDP is 0.1, then I'm getting 10 to the minus six. So I don't -- I haven't seen the PRAs myself so I have to say that, and then I haven't reviewed them very carefully, so when I am doing that little experimentation in my head, I come up with those numbers, and from my discussions with these people, I am getting the impression that this method is not applied properly. That's my conclusion right now.

MEMBER BLEY: I looked at those and they are -- just the little -- the set that Doug showed us, there are very broad distributions and then I don't know if all, but most of the cases, the mean is well below the 75^{th}, only, you only see those two points on the distribution and if you don't know gamma, although anybody doing a PRA I would think --

CHAIRMAN STETKAR: But you don't see any evidence, other than Doug or Jim, I don't remember who, Dave, there is guidance about discretized versions of those distributions in some appendix of 6850.

MR. KAZARIANS: Yes, there is.

CHAIRMAN STETKAR: But you don't get a sense that people have actually been applying that or eve non a broader sense to subdivide a scenario. For example, Doug's example with the two different sets of cable trays that require two different heat release rates, one could apply different conditional probabilities and subdivide that into two scenarios. You don't --

MR. KAZARIANS: The impression I'm getting --

CHAIRMAN STETKAR: The majority of people that you spoke with are not doing that?

MR. KAZARIANS: Right. Yes, it's not done correctly as point estimates, and the point estimate is at the far end and therefore they are getting very high numbers. That`s the impression. That's my understanding from my discussions.

Again, I want to stress that I may not have understood it correctly, what I have been told, or I have talked to the wrong people, okay? Jim wants to say something.

CHAIRMAN STETKAR: Yes he does Jim? You want to say something?

MR. CHAPMAN: I'm Jim Chapman, ScienTech.

CHAIRMAN STETKAR: There is a magical switch on the back end of that microphone. It's a really small -- no, it's a little slide switch.

MR. CHAPMAN: I wanted to clarify a couple of --

CHAIRMAN STETKAR: The only thing is, Jim, you got to really speak directly into those. Those are sort of funny microphones so sit down. Make yourself comfortable.

MR. CHAPMAN: I wanted to clarify a couple of

comments. I assure you that the PRA teams represented by myself and Doug True and others, know how to implement this.

Number two, we have not implemented it for every potential ignition source because sometimes it doesn't matter.

CHAIRMAN STETKAR: Sure.

MR. CHAPMAN: It's not just a heat release rate, I mean excuse me, it's not just a heat release rate but it's the time for the development, so it doesn't matter. I don't know, Mardy, if you had an opportunity to talk to the fire modeling experts, because on my plants, we are averaging over 1,000 fire damage states, 1,000, not one hundred, one plant 1,500 per unit.

In many cases it's that number of fire damage states because we are doing this, we are discretizing. It's not for everything and it's also one heck of a lot of work and a lot of it is being driven as we have stated in our opinions, by the time to develop the fire and how that impacts not only the time to damage but non-suppression probability.

It's very inter-related. There's no -- I think Doug used the term last time, on silver bullet, or something more eloquent.

CHAIRMAN STETKAR: In that sense, do you think that the 12 minute criterion -- the 12 minute applied timing may be more limiting, because you at least are applying some sort of subdivision of the heat and release rate distributions?

MR. CHAPMAN: Even if I use 103 as a mean value, I can fail important targets before I can detect and suppress.

CHAIRMAN STETKAR: Okay.

MR. KAZARIANS: Okay, that -- okay that is exactly my point, is that you have a separation problem now. You have a separation problem. You don't have a fire modeling problem, you see? You have two trains very close to each other, your CCDP is point something.

MR. CHAPMAN: I'm not commenting on the insights of a PRA, we are talking about the realism in the fire PRA. Insights are different and we can talk about that separately if you like.

CHAIRMAN STETKAR: I am assuming, just looking at the clock a little bit, I'm assuming tomorrow when we talk about heat release rates we are going to see those curves that we saw in November about, I don't know who is talking about heat release rates tomorrow.

MR. TRUE: That would not be a good assumption.

CHAIRMAN STETKAR: That would not be a good assumption, okay.

MR. CANAVAN: That would not be.

MR. TRUE: We can burn a CD.

CHAIRMAN STETKAR: You guys might want to dredge them up.

MR. TRUE: Okay, we can reburn the CD and add those on or if John has the presentations from last time, we can --

CHAIRMAN STETKAR: We'll work through that tomorrow. That's interesting, it's pertinent to that 12 minutes, if that indeed --

MR. TRUE: The 12 minutes is important.

CHAIRMAN STETKAR: And if that's important, juts to make sure, I heard it, Bill heard it, Dennis and Dana did not hear it in November. So --

MR. TRUE: Okay, so this is Doug True, can we have the presentations from last time available on the computer?

CHAIRMAN STETKAR: John Lai.

MR. TRUE: John Lai.

CHAIRMAN STETKAR: The slides on heat release rate. Mardy.

MR. KAZARIANS: Kiang wants to say something, right?

MR. ZEE: I think Jim actually -- Kiang Zee with ERIN Engineering -- I think Jim pretty much said what I was going to say. I guess I just personally reacted a little bit to your characterization of calling it a separation problem. That presupposes that the thermal insult is realistic, so I mean --

MR. KAZARIANS: I'm sorry, what?

MR. ZEE: You have two parameters. You have two parameters going there, for thermal insult and you have some separation distance and the question of what is the problem is an issue of which one do you have more faith in, if you will.

MR. KAZARIANS: Exactly right.

MR. ZEE: So --

MR. KAZARIANS: Exactly right.

MR. ZEE: So, but like I said, we have done the slicing and dicing if you will, and we have carved up the distribution function and in some instances we find out that even at the lowest distribution, lowest number in the distribution function for the very first bin, we are still struggling with the 12 minute, the fact that everything inside the cabinet is presumed to fail instantaneously, and if you do the fire modeling you will find that that first tray directly above it dies very quickly outside the cabinet.

And again, at the back of my mind, if I am thinking in terms if we believe 12 minutes and we believe industry experience, one would think we would have seen one of these fires already. By the time the fire brigade got there, the above cable trays are already on fire, and I don't think we have been seeing as many of those as these numbers would predict.

CHAIRMAN STETKAR: Mardy.

MR. KAZARIANS: Yes.

CHAIRMAN STETKAR: By the way the median for example of the one with the 702, no 702, which is the one that everybody worries about, the mean is 150, the median -- there's 50 percent probability that it's less than or equal to 88, that's starting to get a pretty small amount of heat release rate.

MR. NOWLEN: You may be getting tired of hearing from me, Steve Nowlen, but there is another piece to this and that's the one that I mentioned earlier, which is more realistic modeling of how the cable responds to the thermal insult, because if I get a fire that brings the cable just up to its damage threshold, as I understand it, if the plume gets to the damage threshold, they assume that the cable has then failed.

I don't know for certain, but the fact is, if I bring the cable to an exposure just at its damage threshold, it's going to take an hour before that cable fails, and so that's where I pointed out the THIEF model, the volume three of the CAROLFIRE report, takes that part into consideration.

Now for the 800 kilowatt fire, no, it's not going to help you. But for the 88 kilowatt fire at the median, your plume temperature is probably barely above threshold and you are talking tens of minutes which then will give you plenty of opportunity to put the fire out.

So I think when you balance, you have to build this time line carefully and take advantage of all the pieces and if you let any one fall short, then you are not taking the full advantage and that is something that again, I don't know to what extent it's being applied in the licensee analyses but an 80 kilowatt fire that peaks in 12 minutes should not be causing damage in 12 minutes. An 80 kilowatt fire that peaks in 12 minutes ought to be causing damage out at an hour. So we have to see how that is playing out.

CHAIRMAN STETKAR: Mardy, I've a couple of questions and some of this discussion sort of prompts questions. Let me ask you the first question before I forget it. You said that you talked to people regarding this slide, experts in -- people who run fire experiments, and they concluded that the reported heat release rates are possible if you have the proper conditions.

Did you ask them about whether that is true for the full spectrum of cabinets that are being evaluated with the --

MR. KAZARIANS: No, not really, no.

CHAIRMAN STETKAR: bin 15?

MR. KAZARIANS: No.

CHAIRMAN STETKAR: You know, the example that we saw this morning --

MR. KAZARIANS: Yes.

CHAIRMAN STETKAR: with the small little fire protection cabinet versus a different type of cabinet.

MR. KAZARIANS: No, actually maybe I was a little bit too narrow in my question on that one. I was more interested in that 700 kilowatt --

CHAIRMAN STETKAR: Yes, is that achievable for a certain type of cabinet.

MR. KAZARIANS: Right, because most comments were circling around that, and that's what I asked, okay, is it possible or is it completely an artifact of an experiment because -- the answer is yes, it's possible under specific, certain conditions. Obviously it's an outlier, it's not the main, it's now what you would expect in the majority of the cases, which then, again, in my personal opinion, the distribution sort of reflects it.

CHAIRMAN STETKAR: Okay.

MR. KAZARIANS: All right.

CHAIRMAN STETKAR: Second question, it just came up. And I don't know if you are going to address this. If you are, tell me to be quiet. The folks that you spoke with, did you get a sense of how many are applying fire models? Steve mentioned THIEF, people also talk about other -- CFAST, FDS, more sophisticated models.

Do you have a sense of how -- what fraction of the analyses are actually applying those models?

MR. KAZARIANS: I did not focus on that, however there is one -- you'll see in a few minutes --

CHAIRMAN STETKAR: Okay.

MR. KAZARIANS: I'll talk about one specific case, but the answer is they -- people are using mostly CFAST and NRC's Excel spreadsheets mostly, FDS models in a few cases, in a few cases. All right.

CHAIRMAN STETKAR: Continue. When you say -- I was distracted. People are using them to some extent.

MR. KAZARIANS: Yes, yes, of course they are using, yes.

CHAIRMAN STETKAR: Okay, okay.

MR. KAZARIANS: All right, the next topic is fire ignition frequency. Obviously we had lots of discussion on this and we all know that it has its certain peculiarities, the way 6850 has been set up, and one of them is that the total frequency is the same for all plants and then there are two other assumptions in that.

One of them is that the power level, as for example Dan this morning pointed out very clearly, a pump, it's a huge pump versus a small pump both get the same frequency.

And then the other one that I in our discussions I came across is stand-by equipment get the same frequency as a pump that runs all the time. So actually in one case, and I don't remember exact example case here, in one case people found that the stand-by item was a significant risk contributor.

So clearly these are -- this definitely is a limitation of 6850 that points it out very clearly. So we don't have any, in the 6850 we don't have any guidance on discriminating between stand-by versus normally running or power level.

CHAIRMAN STETKAR: What sense -- I mean if I look at two normally running pumps and one is a really big pump and one is a pretty small pump, it's not clear to me that the frequency of fires depends on the motor rate. After all, they are electrical, they are electrical motors.

Maybe one has got a little more oil in it, but the peak heat release rate, the energy release given a fire might be different.

MR. KAZARIANS: Yes, indeed, however --

CHAIRMAN STETKAR: But it's not clear to me why the frequency should necessarily be different.

MR. KAZARIANS: Well again, without the benefit of statistical analysis, if this was a science fair question for example, the hypothesis will be which one is, you know, and then you will say my gut feeling tells me that the equipment power -- something that has -- runs a higher level of power through it, like a load center let's say, versus an MCC, you would expect more fires in load centers than MCCs because the amp range is much higher.

Or in the case of the motors, I would say the motors that run hotter than are colder, maybe the motors that are hotter are more closer to their break point than the other one, the safety factor in other words is smaller.

So those are basically your hypothetical questions that have to be justified by -- through statistical analysis.

CHAIRMAN STETKAR: Did you find, when you talked to people, you have highlighted these bullets, were these identified as -- I understand the total frequency is the same for all plants, but this issue of the size of the equipment, we could talk about that in terms of electrical cabinets or pumps or other types of hazards, and stand-by versus normally operating. Is there much of a sense that -- are all three of those bullets equally important in terms of people's concerns? Or what is on this slide the largest --

MR. KAZARIANS: No, not really. It's a comment that we hear about the 6850 quite a bit. Obviously it poses some limitations. In one case, a stand-by item was risk significant so that's kind of strange, and that needs to be dealt with somehow.

But when you look at this scheme, you can see that, as like we saw earlier, is it could fall in both sides of the conservatism, in other words it could give us either overly -- too -- well, I can't say overly, but conservative or optimistic depending on if the plant has too many of the same items, so it would be less frequent, if it has too little, it will be more frequent.

CHAIRMAN STETKAR: The reason I asked that, if, for example the third bullet was uniformly identified as a potential problem area, then my next question was going to be to EPRI, when they develop the new and improve fire events database, is one of fields in those database the normal status of the component, for example if there was a pump fire, is it a normally operating pump versus a stand-by pump?

MR. KAZARIANS: Of course, yes.

CHAIRMAN STETKAR: And if it's not a very important issue then maybe I don't need that extra field in the database --

MR. KAZARIANS: I don't have that --

CHAIRMAN STETKAR: have that information.

MR. KAZARIANS: Okay, I -- okay. From the interviews, I can't answer that question. But I can answer sort of from my personal experience, is that stand-by probably is a good idea to have a -- to discriminate between stand-by versus normally running, because it will make a difference in the frequency.

CHAIRMAN STETKAR: Okay, that's -- okay thanks.

MR. KAZARIANS: All right. Transient fires, we just had a long discussion on this so I don't want to add too much to this. The only thing is that if I were to come up with examples, as Doug did, I would have chosen a cable shaft that is normally locked closed, nobody goes in, it's clean and so on, so the discrepancy would be a lot bigger between that and the corridor, let's say and then the true question -- the question that comes up on that one, do we believe that that cable shaft is only 10 times less likely to have a transient fire than the corridor next to it.

So that's an important question in my opinion as I said earlier, that can be a driving factor for the CDFs specifically with those cable tunnels and cable shafts.

CHAIRMAN STETKAR: So in a sense, the variation between the one and 10 is not broad enough to capture --

MR. KAZARIANS: Again, it's our notion because I don't think we have enough statistical evidence to show the difference, but we have a notion that a corridor that is normally traveled through versus a cable shaft next to it, nobody ever opens the door except for once every couple of months somebody checks it, then there should be a huge difference -- and especially they are all control cables in it, let's say, and no high voltage, high power cables in it.

So there should be a much bigger spread perhaps than what is being recommended. So, now, as you saw in the chart that Doug shared with us, is that those are not very prominent contributors, but it is very possible, because of the way the analysis was done, as opposed to sticking to the 6850 to the letter.

MSOs is also an important topic and I sit with -- the use of MSOs in fire PRAs is a recent development. I don't know if that's correct or not but at least that's what I gathered. If you ask me, I tried to do it when I was doing fire PRAs a long time ago, but I don't know how successful I was at that time, but at least I tried it.

However the interesting answer that I got on this one with a question I asked was what was the resources that -- in terms of resources, the impact of the MSO. The answer was mostly minimal impact. Now of course probably in percentage wise it was minimal but in terms of the total amount was probably huge.

I don't know the answer to that, but that was the answer I got. However, my understanding is that MSO has a broad impact in the entire fire PRA and it has also brought up some difficulties in incorporating it into the plant response model.

It has had, in a few cases, I was told that it had opposite effects, in other words, created a problem and at the same time solved another problem, so it was good that it happened that way, just kind of, it's a dilemma for us PRA analysts, usually we don't want an event to help us, right?

So and one of the places that I think has an important impact is the main control room fire analysis, because makes the recovery from that more difficult.

CHAIRMAN STETKAR: When you say difficulty, this is one of the more surprising sort of observations from your exercise, that going in, I would have thought there would have been much more concerns expressed about the effort and the difficulty of evaluating multiple spurious operations, for what you have found --

MR. KAZARIANS: Well, it was, yes, I was surprised too because I was expecting the same thing and what I was hearing is that the number of cables that were added because of the MSO to the analysis were relatively small, and the level of effort was not -- the added level of effort because of it was not huge, okay?

However, the impact of it as a phenomenon is important.

MR. TRUE: I think some of that may be

bookkeeping in terms of resources, because there is a lot of work to go trace all the cables, identify all the potential MSOs and all that. If the PRA analyst isn't handed that information, then it's relatively easy these days to wire it into the database to run the PRA.

So it may be that the minimal part is the wiring in and accommodating the conditional probabilities of the spurious ops.

But there's a tremendous amount of work on the deterministic side that is done to gather all that information and get it all prepared for both deterministic and the probabilistic analyses.

CHAIRMAN STETKAR: Doug, is that -- the level of effort to develop that would be characterized it would be deterministic information, the cable inventories and --

MR. TRUE: Circuit analysis --

CHAIRMAN STETKAR: Circuit analysis, is that required for essentially the whole fire PRA, in other words looking at the effects from open circuits if you will?

So, I think what I am asking is, the amount of resources that are allocated for that input information, do you have a sense of how heavily that is influenced by simply the need to also consider MSOs as opposed to any other failure modes?

MR. TRUE: Well, we started with Appendix R, which had the other failure modes very well addressed.

CHAIRMAN STETKAR: Oh, okay.

MR. TRUE: And so you start with this batch of information, then you are supplementing on the expert panel information on MSO, potential new MSOs, and so it kind of grows. Danny Pace's presentation was really good about the cost but I don't think anybody has done a PRA for $8 million actually.

It's the whole package of the 805 transition that might cost that and a very, very large fraction of that is the deterministic side of it. So not really what you asked, but there's a lot of deterministic work we rely on to do the --

CHAIRMAN STETKAR: That's helpful, yes.

MR. TRUE: the work, so I'd love to get $8 million for PRAs but I haven't seen any of those.

CHAIRMAN STETKAR: Okay. Thanks Doug.

MR. KAZARIANS: All right. The next topic is I think a very important one, which is deviation or adherence to the NUREG/CR-6850. What I gathered from my interviews, there is a very wide variation in adhering to the NUREG 6850 and its FAQs, I mean, the entire package. In other words not just FAQs, also the two joint EPRI/NRC reports that came out after that.

At one end, for example, one licensee chose not to include even the FAQs. They just stick to the original 6850 with the notion that FAQs may be pulled out or pulled back by the NRC. In other words NRC will only stick to the original 6850.

On other case, for example, and this was discussed earlier, the fire decay was not modeled because it was not explicitly mentioned or at least that's the way they read it. It's not explicitly mentioned in the 6850.

So these are -- this is -- and that's a very common by the way sentiment that I heard, that NRC will not allow any deviation from 6850 and it will be very difficult to pass anything that is any, even slightly different --

MEMBER BLEY: That was a stunning sentence or two in the report. It really caught my eye --

MR. KAZARIANS: Yes.

MEMBER BLEY: that people --

MR. KAZARIANS: That's a very common --

MEMBER BLEY: absolutely decided they had to ignore the fuel loading available and just let this burn forever.

MR. KAZARIANS: That's actually -- that was our -- even one comment came from a person who is an expert in fire modeling and fire experimentation and so on and so forth, said the same thing, which I was shocked. I mean, not to include physics and chemistry in the analysis was kind of a surprise to me. But that's the -- so I personally feel this is a message to both sides of the table, that, and this is something that we need to deal with, and for sure in my opinion.

MEMBER BLEY: Did you talk to anybody who had been through an NRC review or is this just what they feared about an NRC review? You have good comments about the peer reviews and the challenges but I didn't see anything about NRC reviews.

MR. KAZARIANS: You included people who -- no, they had not had their NRC review yet.

CHAIRMAN STETKAR: Maybe there's only one --

MEMBER BLEY: Well, there are RAIs out on some.

CHAIRMAN STETKAR: Yes, there's one or two, there's 1.9.

MR. KAZARIANS: So this sentiment I think, this message is in my opinion, in my opinion, I am going to repeat it again, is an important message and if I again express my personal opinion, the FAQ process is a very good process to bring up these issues and deal with it.

I mean I remember the main control board topic came up on that one and the 6850 authors responded to that and it was made a simple case very clear. What was meant in the 6850? And that process is an important one, in my opinion.

So there was one other case that I am not going to go into much detail on it except what is important in there is that one consulting entity chose to go back to the raw data and glean from that new information, or revised information, or information that they needed.

Now, I would like to open -- focus on this for a very important reason. When we were going through the 6850 writing process, and we were looking at the FEDBV at that time, we were going through every event and review them almost -- almost, it feels like every event, but in any case, we were discussing the interpretation of those events very carefully and even at the, I want to say at the 11th hour, even after the first draft was published, we were still being challenged by our peer reviewers about how we interpreted these events.

So the point I am trying to make, these event descriptions, especially the ones we had at -- we have now, not the ones that EPRI is working on, the ones that are actually out there as part of this 6850, we all know they are imperfect, you know? I mean there are only a few of them there that gives you good information.

The majority, there's lots of uncertainty, and as those of you who have done root cause analysis, you know a lot of judgment goes into what you read in an event.

So today, I don't think we can have one entity express, use the raw data and come up with probabilities and so on, and move on with it, because that's just one opinion, and it's not -- it will not be -- I mean, I am not questioning the honesty and so on, no, not at all; actually it's just because of the fact that different groups of people may read the same thing differently and we should definitely have several opinions about the same thing, the same event, before we move forward with it.

So those reevaluations I think we should not -- I want to use as strong a word as not be allowed, until an industry group goes through it and comes up with an interpretation that everybody sort of agrees with.

I am sure they will not agree with all the interpretations, because that's exactly what happened at 6850. And I have it -- well in any case, enough said. That's the important thing I wanted to say about this one.

CHAIRMAN STETKAR: But essentially the four bullets on this slide, they --

MR. KAZARIANS: Oh, the FDS model, I forgot, I'm sorry. I should have talked about that.

CHAIRMAN STETKAR: basically represent the spectrum of things --

MR. KAZARIANS: Yes.

CHAIRMAN STETKAR: that you saw, from essentially no deviation from anything that is printed in the 6850 document to --

MR. KAZARIANS: All the way to reevaluate --

CHAIRMAN STETKAR: We have a creative reevaluation of --

MR. KAZARIANS: The raw data.

CHAIRMAN STETKAR: raw data okay. Another one actually was that FDS model was used. This is fire simulator model, five dynamic simulation model, which is a very sophisticated, very time consuming in terms of even computer time, model to do a fire modeling of a fire inside an electric cabinet.

Now this definitely raises a red flag. The reason is, is that the fire ignition frequencies in 6850 has a notion of severity in it so this changes the interpretation of that.

Now I am not saying that this is a wrong thing to do, but it doesn't match the sort of model that is in the 6850, because the fire propagation part of it and then the suppression and detection part of it all of that is linked somehow to the ignition frequency and so on.

So if you change the interpretation of that, then the interpretation of the entire model changes, not just one element of it. So it's very important for us to understand that all the different parts of 6850 are linked together somehow and there is a compatibility question here and that if we upset one of them, you are basically upsetting the whole chain.

So that was another thing that was brought up and it was actually, I thought it's an important thing to bring up here.

CHAIRMAN STETKAR: Mardy, since you brought it up, I know nothing about running FDS. Is it essentially a consistency of boundary, input boundary conditions? I mean could you run FDS for an initial, whatever you want to call it, pilot fire --

MR. KAZARIANS: Well, yes.

CHAIRMAN STETKAR: that is --

MR. KAZARIANS: incipient fire I guess.

CHAIRMAN STETKAR: Well, but I mean that it satisfies the screening criteria that were applied for the data in 6850. In other words that's a minimal fire size. It's not zero.

MR. KAZARIANS: I don't feel confident to answer that question. I think Steve probably is better experienced than I am to answer that question.

MR. NOWLEN: Okay, I am not an expert in FDS but I know a little bit about it. FDS is a 3D flow code. But it does not do for example fuel spread, or flame spread over a solid fuel.

So the way you would do this is you would have to postulate an ignition point. You would mock up the internals of the cabinet, and then you would also have to specify how the fire grows and spreads.

So my guess would be is I would go to the heat release rate profiles and I would apply the t squared growth and do that internal to the cabinet, theoretically, you can do it.

I think the challenge is how do you probabilistically deal with where the fire starts because it could start anywhere, and then how did they deal with the question of the panel wiring for example.

If what they were trying to do is discriminate for when some component within the cabinet would be damaged by a fire somewhere in the cabinet, what's the relative orientation of the ignition point and the target, which should include its panel wiring and wherever it goes?

You know again in theory, fire models can model that situation, but to fold that into the PRA, I don't know how they would have done that probabilistically and to cover all the bounds, did they do this because they had one particular panel that was a real panel, and so they really worked on characterizing that panel, I could see it.

If they applied it more generically across the plant, I think they might be getting into trouble.

CHAIRMAN STETKAR: Thanks. Try to keep this moving here a little bit.

MR. KAZARIANS: Okay. The next topic is a peer review process and my conclusion from my discussions with people is that this is a very important part of the whole process, and clearly there were difficulties in the early stages, by the way I have not been a part of this process myself so I have to probably mention that.

And in the early stages people went through a learning phase on this and some challenges took place at that time, but overall I would say the peer review teams, they have been able to identify and challenge situations, I mean or analysis, cases that were either unacceptable or erroneous.

So in other words they have, they are serving a very important role in this whole thing. Now, however, one thing is very important for us to understand, is the experience of the members of these teams. This is very critical element of it and from my understanding, is there aren't that many people out there in the industry to do this at the pace that we are going and already I think if -- I'm not, again, this is what I have heard and obviously there are people in this room that probably know much better about this than I do, is that there are difficulties in scheduling these meetings, and that difficulty actually has had an impact on the utility's decision on when to invite them and there have been cases where they have been invited before the fire PRA was completed. I mean obviously there is nothing wrong with that, it's a good check in the mid-course, but still it tells us what is out there, what is happening out there and, which is that there aren't enough people to go around to do this.

And the quality of people, qualifications of people, is a key element of the peer review process and for them to be able to understand PRA, understand what is done, understand places where it was not done right,

or to approve where there's a deviation occurred, okay, to do justice to that, you know?

So this is -- overall my understanding is this has been a success story -- this is a success story with some painful learning curve in the beginning and right now we are at -- it is one of the obstacles in getting these PRAs done.

CHAIRMAN STETKAR: Obstacles in the sense of --

MR. KAZARIANS: Timing.

CHAIRMAN STETKAR: -- timing because the --

MR. KAZARIANS: Yes. Not enough people to go around.

CHAIRMAN STETKAR: -- selection of

unqualified people to do these routines --

MR. KAZARIANS: And people's experience is extremely important in here, okay? You cannot have a person with a few years of experience to go in there without a full understanding of all the different elements of the fire PRA, of the implications of the linkage between the part and so on. All right? Questions?

MEMBER BLEY: I don't know if you can, but you didn't say anything about the people actually doing the PRAs and I am curious from the samples you have talked to, are utility PRA teams doing them? Are consultants doing them all? Are -- the PRA experience people doing them all or is somebody else doing them?

I mean, some of the stories we hear make me wonder about parts of that.

MR. KAZARIANS: I did not focus on that. I have to say that.

MEMBER BLEY: Okay. Fair enough.

MR. KAZARIANS: Okay. And let's just stop there.

MEMBER BLEY: I think you skipped one thing, going through your slides, that jumped out at me, especially given the discussion this afternoon.

On the transient fire frequency --

MR. KAZARIANS: Okay.

MEMBER BLEY: Or is that coming up or did you already do that?

MR. KAZARIANS: No, I went through it.

MEMBER BLEY: Yes, that I thought.

MR. KAZARIANS: No, I did talk about it.

MEMBER BLEY: You have one statement in here that licensees have found the range inadequate to represent the differences among the rooms.

MR. KAZARIANS: Yes, I did say that, I mean for example --

MEMBER BLEY: I missed it. I was looking for it when you said it, but it's kind of --

MR. KAZARIANS: Well, that second --

MEMBER BLEY: Okay that's that last bullet. But that kind of flies in the face of what I guess the intent was, what Steve said, are people not using that factor of 100 or are they not finding the scheme such that if they put in what seems reasonable they aren't getting discrimination. I am just curious about it.

MR. KAZARIANS: Well, okay, I had not fully understood, Actually today's with Doug's discussion, I understood a little better exactly what is happening put in the field. From my interviews I had not understood exactly that.

But what I had understood and I can easily see it, is that what's in NUREG 6850 does not allow that discrimination that we would like, I mean the analysts would like to see.

A simple example of that one is a cable shaft or a cable tunnel that is locked closed and nobody goes in it and it has only control cables in it, versus a corridor that is traveled all the time and all kinds of activities --

MEMBER BLEY: Which might give you a one, one, one --

MR. KAZARIANS: Well, the --

MEMBER BLEY: and some other room could have a --

MR. KAZARIANS: I'm not sure if a factor of 50 is the spread there. It's mostly probably a factor of 10 between the two of them, okay?.

So because the majority of the rooms will be something like 10 and then this will be one or three or something like that, okay?

So that distance does not match the analysts' notion of the distance, so that is the point I'm trying to make.

So 6850 is not flexible enough, at least in its wording, although we do say that you may deviate from it if you would like, but then it has to be fully justified.

MEMBER BLEY: I've got to think about that once more. But go ahead. Thanks for going back to that because I saw that bullet but it didn't quite --

MR. KAZARIANS: All right. Other observations is one of them which I found important is that there were -- I asked about the CCDP and in the majority of cases, they had CCDPs 0.1 and higher. In a handful of cases those were the dominant scenarios and that to me personally is important because that tells me in that room we have something in there that makes it -- we have like train A, train B, the combinations in that room, that makes it more important. So it's a focus of the -- analysts should focus on that.

Human actions is definitely an important part, was not mentioned to me as very important in terms of the difficulty in analyzing or creating problems for people.

Peak heat release rates for pumps. This was another one that came up but nobody could give me an example case that indeed they found like a small pump was a dominant contributor. So obviously, 6850 says use the same heat release rate for both pumps and indeed that should be conservative for small pumps, but nobody gave me an example that that indeed caused any headaches for them.

Now the last one is the level of effort, which I asked about, and as you saw this morning, it's enormous, and even if we take away those other parts that Doug mentioned from Dan's numbers, still it's a huge number from my past experience, and there are reasons behind it.

In a few cases, the licensee had to go back and look at the location of the cables again, because the quality of the information that was being passed on forward was not at the level that they could use.

So those things add up very quickly. Circuit analysis is an important part of it, so one message that came very clear is that this is a very costly process. All right.

CHAIRMAN STETKAR: Mardy?

MR. KAZARIANS: Yes.

CHAIRMAN STETKAR: Did you talk to -- had the numbers, seven licensees and seven consultants. Did you have any sense that the -- I don't know at what stages they were in their PRA development, or when they started the process, for example is there any sense that the efficiency is improving?

In other words, we heard this morning, $15 million, does that mean that over 23 licensees going forward, we expect $15 million per event, because that simply is as much as it costs, or is that $15 million part of a learning curve that --

MR. KAZARIANS: By the way, I didn't hear dollars, I heard man-hours, or person-hours --

CHAIRMAN STETKAR: Okay.

MR. KAZARIANS: which is in the tune of between 10 to 20,000 for the fire PRA, something like that. I cannot comment on that. I don't know the answer to your question. I did not get any sense of any learning --

CHAIRMAN STETKAR: Yes, the sense is, are we simply --

MR. KAZARIANS: basically a learning curve happening, which is --

CHAIRMAN STETKAR: passed through the steep part of a learning curve --

MR. KAZARIANS: Yes. Yes.

CHAIRMAN STETKAR: where it becomes more efficient because now people understand how better to do this?

MEMBER BLEY: We did hear him this morning, I think, I have to check back on the transcript, say he thought he could do the next one for two. But are we doing them all at the same time now? That's what I'm not sure of.

CHAIRMAN STETKAR: Yes, well, that's --

MEMBER BLEY: So nobody is getting the advantage of the learning curve, is what it sounds like.

CHAIRMAN STETKAR: Okay.

MR. KAZARIANS: All right. My conclusion is that I could not find a single source of conservatism that I could talk about and say that is where, that's the reason why we are getting unreasonable or unrealistic results and it is causing people to spend money in the wrong places.

I could not find that. So these are my personal conclusions. One is it seems to me the main control room is generally modeled conservatively, but from my understanding, it's one of the main contributors but it's not one of the important contributors generally speaking.

Then the other one that I -- this is again purely my personal opinion -- is that we have the fire risk model the way we have it is that it has these parts, ignition frequency, then the fire propagation model, then detection and suppression, target damage, the circuit analysis and so on.

These parts are all linked together somehow, and those linkages, there is uncertainty in those linkages, in the compatibility part of it.

For example, what does -- the question came up earlier today, I mean the topic came up, it says, when does the fire start? Okay. What is a fire? Okay. How do you define the fire?

When people were talking about the fire database they said challenging fire. Well, what does the challenging fire represent when we go from there to the heat release rate?

Which heat release rate is it? Okay. So these are the elements that are -- introduce uncertainty that perhaps in those transitions, there are some things in there that perhaps we don't do it right, okay? That's just --

CHAIRMAN STETKAR: That's interesting because there is certainly a strong sense of that in NEI's report, the fact that because the various tasks are presented as almost stand-alone chapters in 6850, they tend to be applied that way, and --

MR. KAZARIANS: Yes, but then you cannot look at them in isolation. You have to look at them in relation with the others. But still, still, when we talk about heat release rate of a device, now, and we talk about the ignition frequency of that device, how are those two related to each other?

In my opinion, there is uncertainty in that. That uncertainty is not explicitly modeled, and I don't think we have a full understanding of it. We have a vague understanding of it, and we tried when we were doing the 6850, we tried to keep that in mind when we went from one stage to the other.

But still, if there were -- if you asked me what are the problems with that model, I will say I think we should focus -- one of the things we should keep in mind are these compatibility questions.

Again, for example, if somebody wants to do an FDS inside an electrical cabinet, this topic comes up in a very loud way, that they cannot do it, even though it's a good thing to do, but they cannot do it, okay?

So that's basically on the conservatism side. Then on, again, one of the observations I want to reiterate here again, is that this thing going back to the raw data even though it's a good idea, I mean, we want to go back and draw more information out of it, but I don't think a single entity doing that, we should have refrained from that. We should do a -- if we want to do something like that, we should do it in a consensus manner rather than one entity doing it.

And the other message that I want to get across which I said earlier, is that the peer review process, the qualifications of the peer reviewers is a very important part of that process and we should keep that in mind that they have -- so that basically it ensures us that we don't have unacceptable methods or data are used in the fire PRAs.

I think that basically is what I have prepared for today.

CHAIRMAN STETKAR: Any questions for Mardy? Just for the record, what I want to make sure that we have stated, is Mardy is a consultant to the ACRS. He has submitted a draft report. The draft report essentially summarizes, provides a little more information on what he summarized today.

His report is by no means either a report from this subcommittee, nor is it, certainly not, an ACRS report. So we are treating that strictly as his input. We will consider that input in the same way that we have considered all other input when we draft our own report, both at the subcommittee level and the full committee level. I just want to make sure that there isn't any misinterpretation, that just because

Mardy is a consultant to us, that certainly any of his personal opinions today would represent necessarily what may come out of our deliberations.

With that, it's late. We are about an hour over but that's not bad for us. Certainly participate --

MEMBER POWERS: It's bad for you.

CHAIRMAN STETKAR: It's not bad for -- well I was using the royal us as you sometimes do.

MEMBER POWERS: Always.

CHAIRMAN STETKAR: I'd like to thank everybody. I think we had good discussions today. I hope they will continue tomorrow and thank you for your patience and presentations and with that, we are adjourned.

(Whereupon the above-entitled matter adjourned for the day at 6:12 p.m.)

Fire PRA and Other Impacts to NPFA 805 Transitions

ACRS Reliability and
PRA Subcommittee Meeting
December 13, 2010

Biff Bradley, NEI
Tom Basso, NEI

Overview of Industry Presentations

- Issues affecting transition – Biff Bradley, NEI
  Tom Basso, NEI
- Utility Management Perspective – Dan Pace, FENOC
- Overview of industry paper “Roadmap for Attaining Realism in Fire PRA” – Doug True, Ken Canavan

Overview of Industry Presentations

- **Technical topics:**
  - Fire Events Database and Ignition Frequencies
  - Incipient Fire Detection
  - Transient Fires
  - Electrical cabinet fires
- **FAQ process**
- **EPRI and NRC research coordination**
- **Interim improvements to support applications**

NFPA 805 Transition

- Initial pilot has received NRC safety evaluation
- Second pilot nearing approval
- 23 units currently would have License Amendment Requests due 6 months from approval of Oconee
- NEI November 15, 2010 letter to NRC requested staggered submittal schedule

NEI

PRA Issues that Complicate NFPA 805 Transition

- Fire PRA results (using NUREG CR/6850 - EPRI 1011989 and FAQs) need additional methods improvements to achieve a reasonable level of realism
  - However, plants are required to justify any deviation from NUREG CR/6850 or approved FAQs, regardless of Reg Guide 1.200 peer review results
  - Unprecedented process for a risk-informed application
  - Pilots plants extensively interacted with NRC on PRA methods to partially address this situation
  - This is not a practical solution for large number of transitioning plants

Issues that complicate transition (cont)

- Regulatory expectations
  - Not clear that pilot process is establishing an efficient, effective process for follow on plants
  - PRA issues remain unclosed by NRC despite pending issuance of NRC safety evaluation
    - NRC states that second pilot needs peer review directly to NUREG CR/6850 and FAQs, after issuance of safety evaluation

Industry Perspective on Path Forward

- Provide additional time for licensees to achieve reasonably realistic Fire PRAs for NFPA 805
- By 4^{th} quarter 2011
  - Develop revised interim methods for key Fire PRA areas
  - Achieve NRC agreement that these methods can be used without each licensee justifying through RAI responses
  - Achieve intended use of fire PRA peer review process
- Continue development of Fire PRA methods such that other applications can efficiently proceed

NEI

Industry Perspective on Path Forward

- Establish an improved process for regulatory interaction on PRA methods
  – June 1, 2009 NRC letter to NEI established revised FAQ process for Fire PRA issues
  – Process is more focused on regulatory clarity versus achieving realism
  – "FAQs must give appropriate consideration of the balance between realism and conservatism in the fire PRA...."
  – This is inconsistent with NRC PRA policy statement
- We believe the revised process should focus on realism

NEI

Regulatory Guide 1.174

- By their nature, risk-informed applications provide for "changes" from deterministic licensing basis
  - Fire protection and NFPA 805 are not unique in this regard
- Other elements of the NRC risk-informed regulatory decision making process (Reg Guide 1.174) were established to provide conservatism as appropriate, and have been effective in application
- Expectation for conservatism in PRA is a new direction for risk-informed applications

NEI

Other NFPA 805 Transition Concerns

- Treatment of “Safe and Stable” (FAQ 08-0054)
- Resolution of pilot issues deferred by issuance of implementation actions and licensing condition
- Compressed post-pilot submittal schedule

Post-pilot Transition Plant Submittals

- 23 LAR submittals (33 units) by July, 2010
- LIC 109 acceptance review extended from 25 to 60 days
- Pilot reviews have taken over 2 years
  - originally estimated as 6 months
- Review and SE issuance for 23 submittals will require multiple review teams to support a 2 year review timeframe

NEI

Benefits of Staggered Submittals

- Allow application of improvements developed in the FPRA methodologies
  - First plants in queue would still need this benefit
- Incorporate lessons learned
  - Pilot information
  - Fleet information
  - RAI's from early submittals
- More consistent reviews by limiting the number of required review teams
- Promotes stable, predictable and efficient transition
  - Ex: License Renewal

Impact of Compressed Post-pilot Submittal Schedule

- Opportunity lost to apply lessons learned or improvements in FPRA methodology
- Multiple review teams increase likelihood of inconsistent reviews
- Review delays will place undue burden on licensees
  - Risk of loosing knowledgeable support
  - Inefficient use of PRA resources

NEI

Conclusion

- Fire PRA issues can be addressed with time and process focused on realism
- Reasonably realistic fire PRAs have many applications and benefits similar to internal events
- Conservative fire PRAs do not
- Staggered submittals are helpful, but all plants need time to improve models

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Management Perspectives on Adequacy of Fire PRAs to Support Licensees Transition to NFPA 805 {10 CFR 50.48 (c)}

Presented to the ACRS Subcommittee on PRA and Reliability
December 13-14, 2010

Sunil D. Weerakkody, Ph. D.
Deputy Director – Fire Protection
Division of Risk Assessment
Office of Nuclear Reactor Regulation

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Commission SRM

"The ACRS should conduct a review and report back to the Commission on the current state of licensee efforts to transition to National Fire Protection Association (NFPA) Standard 805."

Commission SRM (Cntd.)

"The review should include methodological and other issues that may be impeding the transition process, lessons learned from the pilot projects and recommendations to address any issues identified."

Commission SRM (Cntd.)

"The review should determine whether the level of conservatism of the methodology is appropriate and whether any adjustments should be considered."

Forward Focus

- NRC staff looks forward to receiving ACRS's input to help refine its regulatory processes and research priorities.
- NRC staff fully endorses industry initiatives to reduce uncertainties associated with fire PRAs.
- NRC staff continues to invest a significant amount of resources to enhance our understanding of risk attributed to fires.
- NRC\RES staff continues to look forward to work in collaboration with EPRI on areas of common interest.

"The uneven level of conservatism may mask key risk insights and confound and confound decision making"?

- **Over the last two+ decades, fire PRAs have matured sufficiently to enable NRC to make licensing decisions with respect to NFPA 805, primarily because NFPA 805 relies upon fire PRAs to determine whether deviations from deterministic requirements are acceptable.**

- **As set forth in RG 1.200, the licensee should identify the key assumptions for the application and identify appropriate sensitivity studies to support the decision making process (i.e., granting the amendment).**

“The manner in which fires are characterized in NUREG/CR-6850 does not appear to conform with operating experience. The level of quantified risk appears to be overstated, as compared to operating experience.”?

“ROP experience is inconsistent with predictions coming from fire PRAs.”?

“Over two years, some progress was made using the FAQ process, but process was slow and ineffective in achieving realism, even for the topics addressed.”?

“Operating experience has not indicated spurious operations have occurred in real fire events (except Browns Ferry).”?

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

"The Enforcement Discretion timeline for 50.48(c) submittals does not support resolution of all FPRA issues. Industry's November 15 letter to NRC requests consideration of staggered submittal schedule; however this alone does not provide sufficient time to address FPRA issues?"

- The industry letter is being discussed by NRC senior managers.
- NRC can make regulatory decisions with respect NFPA 805 LARs using current fire PRAs
  - Some conservative decisions may occur.
  - Licensing process (ability to commit to modifications and change those commitments) provides some relief.

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FORWARD FOCUS

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FirstEnergy Nuclear Operating Company

FENOC

Post-Pilot Transition To NFPA 805
An Industry Perspective

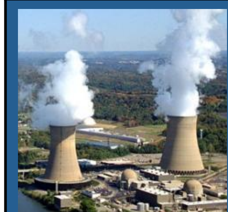
Danny Pace

Senior Vice-President of Engineering

ACRS PRASC

December 13, 2010

FirstEnergy Nuclear Operating Company

	**Beaver Valley 1**	**Westinghouse 911 MWe, 3 Loop PWR, Commercial operation in 1976**
	**Beaver Valley 2**	**Westinghouse 904 MWe, 3 Loop PWR, Commercial operation in 1987**
	**Davis-Besse**	**908 MWe, Babcock and Wilcox PWR, Commercial operation in 1977**
	**Perry**	**1268 MWe, General Electric, BWR 6 – Mark III, Commercial operation in 1986**

FENOC NFPA 805 Transition Decision

- **Opportunity to improve nuclear safety through a risk-informed fire protection program**
- **Potential to resolve industry legacy fire protection issues**
- **Standardize fleet approach to fire protection**
- **Use to leverage improvements in PRA models and PRA staff capability, support other risk applications**

Beaver Valley Transition

- **Initial cost of $7M with projected 2008 submittal**
- **Current cost of $15.4M with projected 2011 submittal**
- **Unit 1 fire PRA model complete; fire area modeling 100% complete**
  - Ongoing refinement
  - Peer Review in Jan 2011
- **Unit 2 fire screening model 30% complete**
  - Unit 1 is pilot for Unit 2
  - Peer Review in June 2011

Davis-Besse Transition

- **Initial transition cost of $3.2M is now projected at $8.9M**
- **Fire screening model complete**
- **Focus on fire area modeling**
- **Peer Review Jan 2012**

Perry transition is scheduled to follow Davis-Besse

Key Industry Transition Issues

- **Conservative methods for Fire PRA**
- **Schedule overlap between pilot plants and post-pilot transition plants**
- **Usability of Fire PRA for other risk applications**
- **Cost benefit of NFPA 805 transition**

Conservative Methods for Fire PRA

Impact

- **Deterministic approach leads to unrealistic modeling outputs**
- **Results are not comparable to experience**

Opportunity

- **Enhanced PRA methods realism would:**
  - Facilitate better safety focus
  - Improve decisions for NFPA 805
  - Enable FPRA to support other risk applications

Summary of Conservatisms Impacting FENOC

- **Heat Release Rates / Zone of Influence**
- **Heat Release Rates and propagation**
- **Fire Ignition Frequencies**
- **Compounding Conservatisms**

Heat Release Rates / Zone of Influence

Example #1

- **Fixed ignition source Heat Release Rates (HRRs) in NUREG 6850 table G-1**
  - Limited to eight bins
  - Overly conservative in many specific situations
    - Small electrical panels ≡ Large electrical cabinets
    - Small pump motors ≡ Large motors
  - Larger HRR

    → Larger Zone of Influence (ZOI)

      → Too many cables / components affected

Small Electrical Cabinet

Fire Protection Electrical Control Cabinet
24" x 24" x 4" height

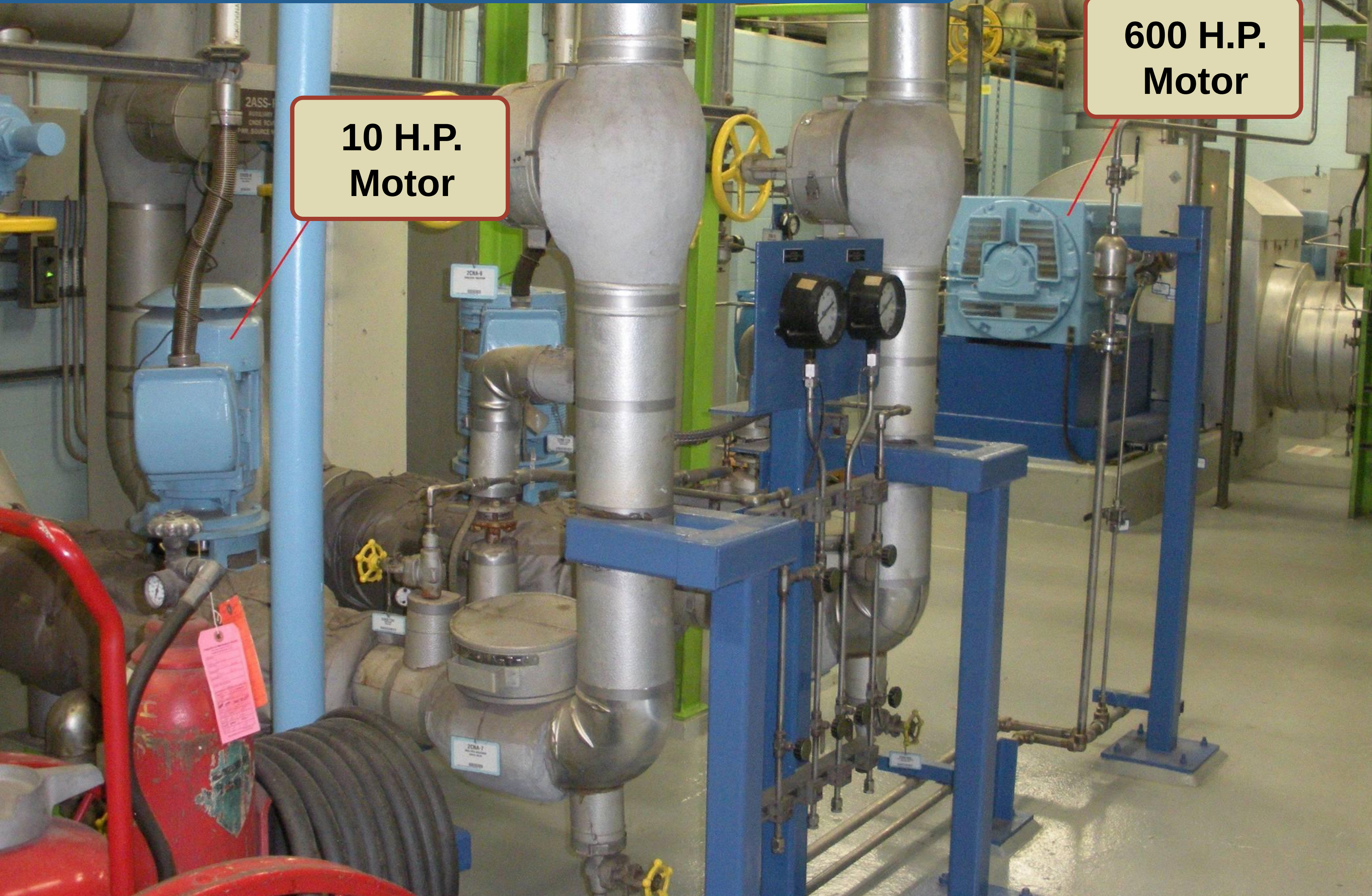
Large Electrical Cabinet

Process Rack

Electrical Cabinet Section

~32” x 32” x 90” height

Small and Large Electric Motors



Heat Release Rates and Propagation

Example #2

- **Transient fire HRR in NUREG 6850 table G-1**
  - 317 kW fire for all transient fires, including small flammable liquid spill with ordinary combustibles
  - Overly conservative for many areas due to transient materials found/allowed in the area
  - Specific case: Process Rack Area
    - No flammable liquids stored or used area
    - Realistic bounding fire size ~142 kW
    - Many cable trays at nine feet above floor level
    - Within ZOI for 317 kW but not for 142 kW
      - Estimate of damage exaggerated

Process Rack Area Cleanliness

Design Transient Combustible

Heat Release Rates and Propagation

- **NUREG/CR 6850 table R-1 HRR data for cable tray fires**
- **Cables binned as thermoplastic or thermoset based on insulation and jacket materials**
- **Thermoplastic cables have significantly higher flame spread rate and lower damage threshold**
  - No guidance for cables that contain thermoplastic (e.g., teflon) that pass flame spread / self extinguishing tests similar or more restrictive than IEEE-383
  - No guidance for flame spread in trays that contain mixture of thermoset and thermoplastic cables

- **Lack of specific guidance results in use of conservative HRRs**
  - Conservative ZOI
    - More cables/components affected for each fire scenario

Fire Ignition Frequencies

- **Beaver Valley uses fire initiating frequencies given in NUREG/CR-6850**
- **Many are significantly greater than fire frequency data provided by EPRI**
- **Example #1: Fire Compartment 1-NS-1, Normal Switchgear**
  - Initial fire PRA screening model CDF = 7.7E-03
  - Initial detailed fire modeling CDF = 2.2E-03
  - Latest detailed fire modeling CDF = 8.6E-06
  - Latest detailed fire modeling + EPRI fire frequency data CDF = 6.02E-06
    - ~30% reduction based on frequency alone

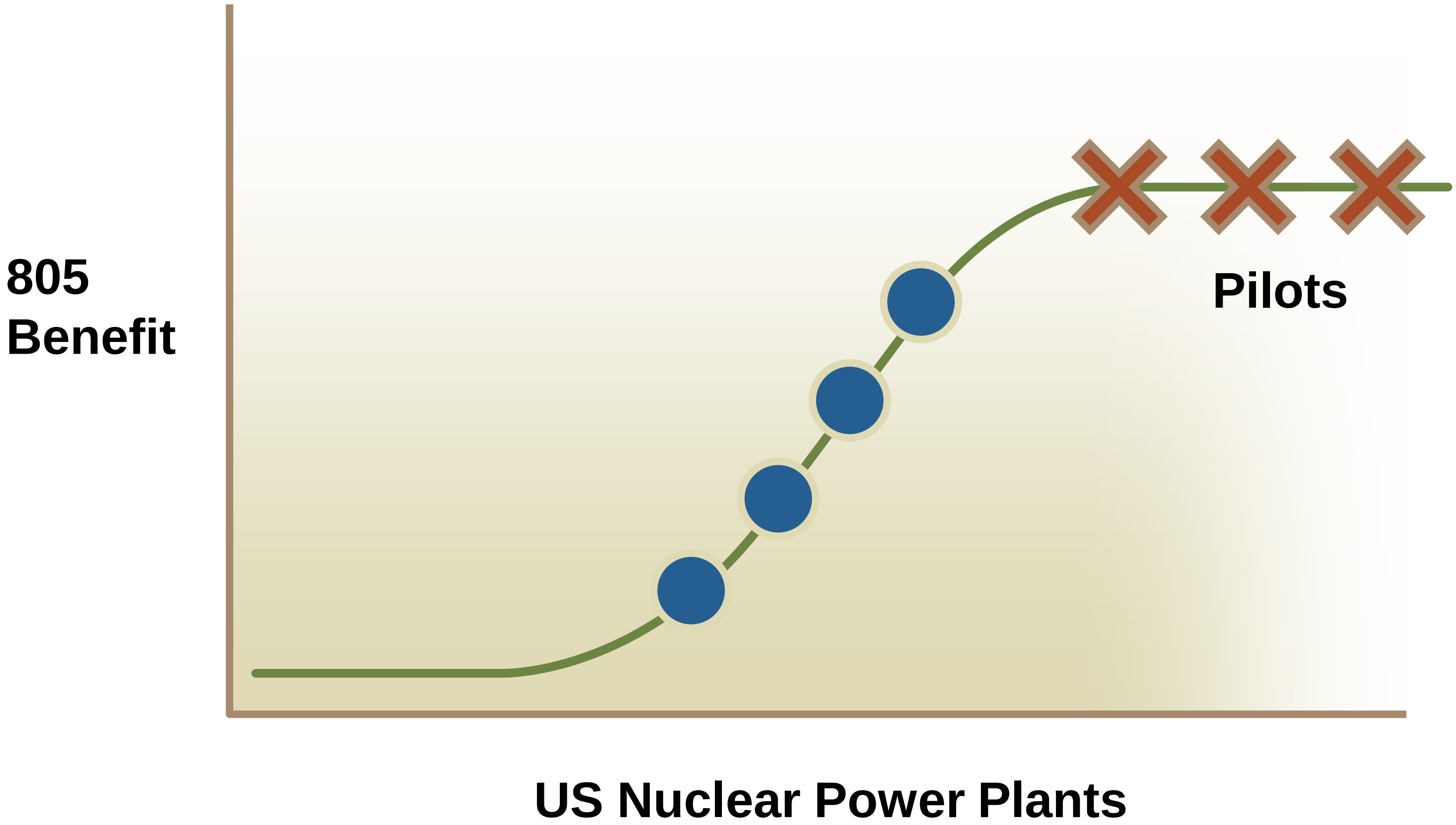
Compounding Conservatisms

- **Conservative Fire Ignition Frequency ↑**
- **Fire Modeling**
  - Conservative HRRs and fire growth ↑
  - (Sf **x** Pns) ↑
  - Conservative HRRs = ZOI ↑ = CCDP ↑

Frequency↑ x (Sf x Pns)↑ x CCDP↑ = CDF ↑↑↑

- **The frequency of the fire event (Fire)**
- **The fire severity characteristics as a function of time (Sf)**
- **The probability of not suppressing the fire event as a function of time (Pns)**
- **The conditional core damage probability given the damage caused by the postulated fire (CCDPdamage)**

Fire Design Impact



Schedule Overlap Between Pilot Plants and Post-pilot Transition Plants

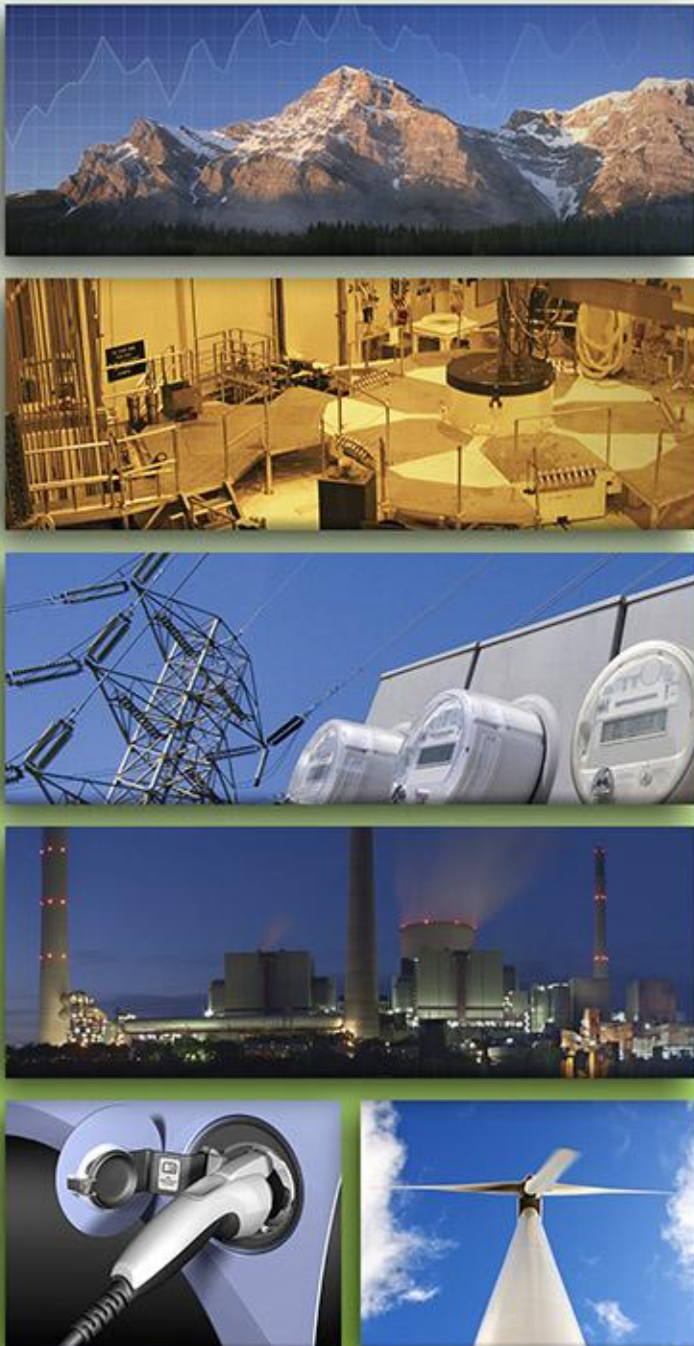
- **Loses benefit of pilot approach**
- **Substantial rework**
- **No fleet benefit**
- **Challenges limited resources**
- **Support November 15 industry letter to NRC requesting staggered submittal approach**

Cost Benefit of NFPA 805 Transition

- **Original assumptions are no longer valid**
- **Deterministic approach (NRC Reg Guide 1.189) provides alternative to resolve longstanding issues**
- **NFPA 805 resources need to be targeted more towards plants improvements versus exhaustive and unrealistic analysis with limited usefulness for other risk applications**

Conclusions

- **Risk-informed approach had good intention**
- **PRA technical issues/fire modeling resolution is critical to industry success**
- **Front end transition plants intend to complete**
- **Follow-on plants are re-evaluating positions**



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Roadmap For Attaining Realism In Fire PRAs

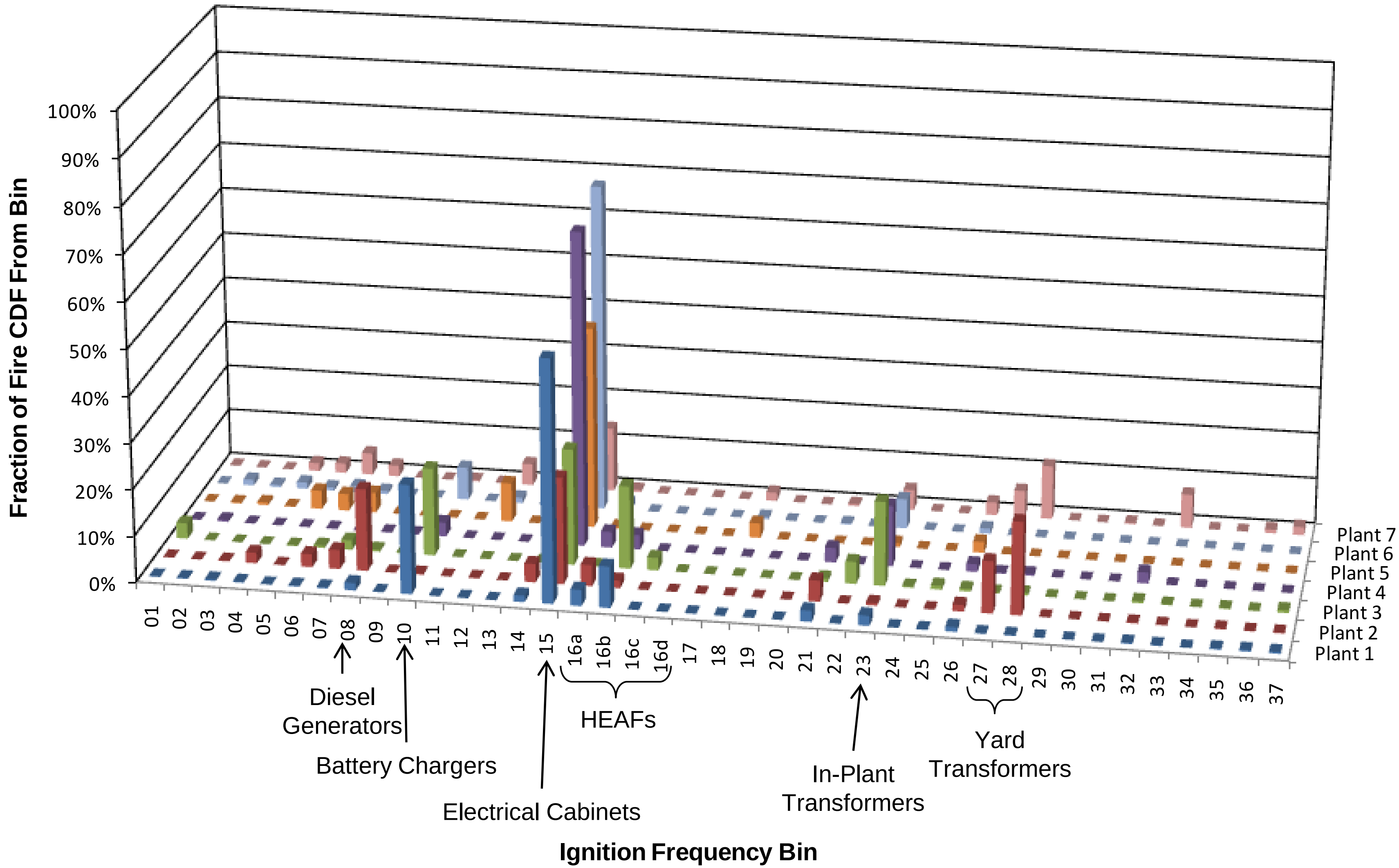
Ken Canavan, EPRI
Doug True, ERIN Engineering & Research

ACRS PRASC
December 13, 2010

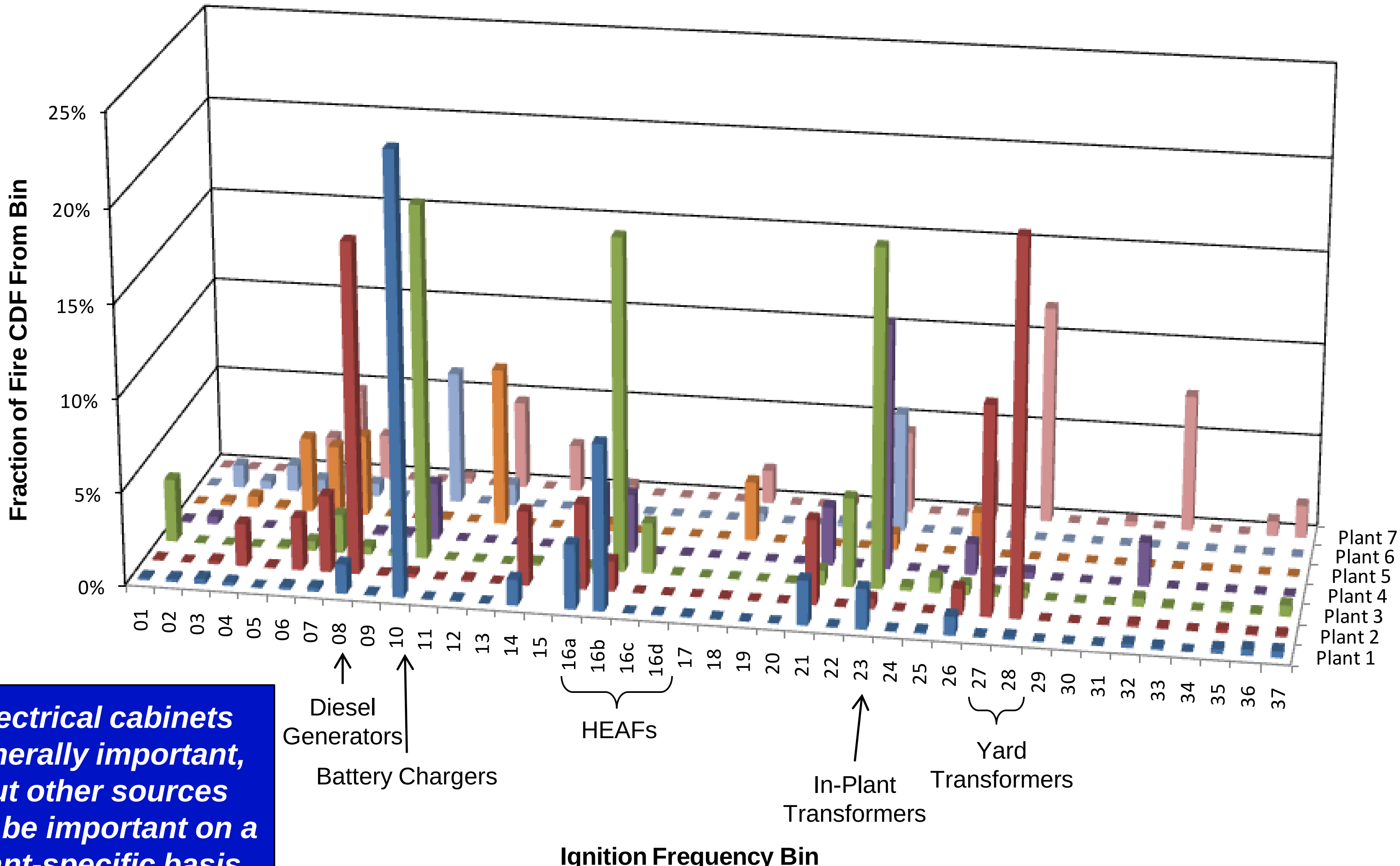
Purpose

- Use insights from industry fire PRAs to identify the important areas of EPRI 1019189/ NUREG/CR-6850 where bounding assumptions/ simplifications are unduly influencing FPRA results
- Objectives of industry report:
  - Provide objective evidence of conservatism in FPRA results
  - Identify key areas needing additional realism
  - Inform & update the EPRI FPRA Action Matrix
  - Provide a vehicle for discussion

Fire CDF Contribution by Ignition Source



Fire CDF Contribution by Ignition Source (without Electrical Cabinets)



Electrical cabinets generally important, but other sources can be important on a plant-specific basis

Conformance with Operating Experience: Spurious Operations

- The FPRA model scenarios include spurious operations (SOs) caused by assumed fires
- Fire scenario damage “vectors” identify those with one or more SOs
- Plant-wide SO frequency (one or more SOs):

$$\Sigma \text{ Frequency of Scenarios involving one or more SOs}$$

- Results:
  – Plant X: 0.0041/yr
  – Plant Y: 0.0043/yr
- If extrapolated to entire U.S. industry (100 plants):
  – Expect to see a fire involving SO every 2 or 3 years
- None observed since Browns Ferry fire in 1975

Likelihood of spurious operations significantly overstated in FPRAs versus operating experience

FPRA Model Prediction of High CCDP Damage Conditions

FPRA Model	Predicted Frequency of "Significant Precursor" Events (CCDP > 1E-3)	Predicted Frequency of High CCDP Events (CCDP > 1E-4)
Plant A	1.0E-3/yr	1.0E-2/yr
Plant B	9.9E-3/yr	2.0E-2/yr
Plant C	3.3E-3/yr	1.4E-2/yr
Plant D	1.3E-3/yr	3.2E-2/yr
Plant E	4.7E-3/yr	3.2E-2/yr
Range	1.0E-3/yr to 9.9E-3/yr	1.0E-2/yr to 3.2E-2/yr
Industry-wide Recurrence Interval	Every 1 to 10 yrs	1 to 3 per year
Actual Experience	None since Browns Ferry (1975)	None from 2001-2009 based on SECY-10-0125

Summary of Insights

Conclusion	Primary Bases
Fire characterization does not conform with operating experience	• Over-prediction of number of severe fires • Assumed rate of fire growth & severity, e.g., 12 mins in electrical cabinets, oil fire severity • No credit for control of fires
The level of quantified risk is overstated	• FPRAs based on NUREG/CR-6850 predict high frequency of fires with high CCDPs, but NRC's ASP & ROP have not demonstrated this • Predicted frequency of spurious operations not consistent with operating experience
Uneven level of conservatism can mask key risk insights and lead to inappropriate decision-making	• Simplifications result in bounding treatment of "bin" • Overstated fire damage can lead to underestimation of risk increases from plant changes • Assumes plant challenge for all fires, e.g., plant trip • No credit for administrative controls

Many areas of expedited research needed to provide enhanced methods

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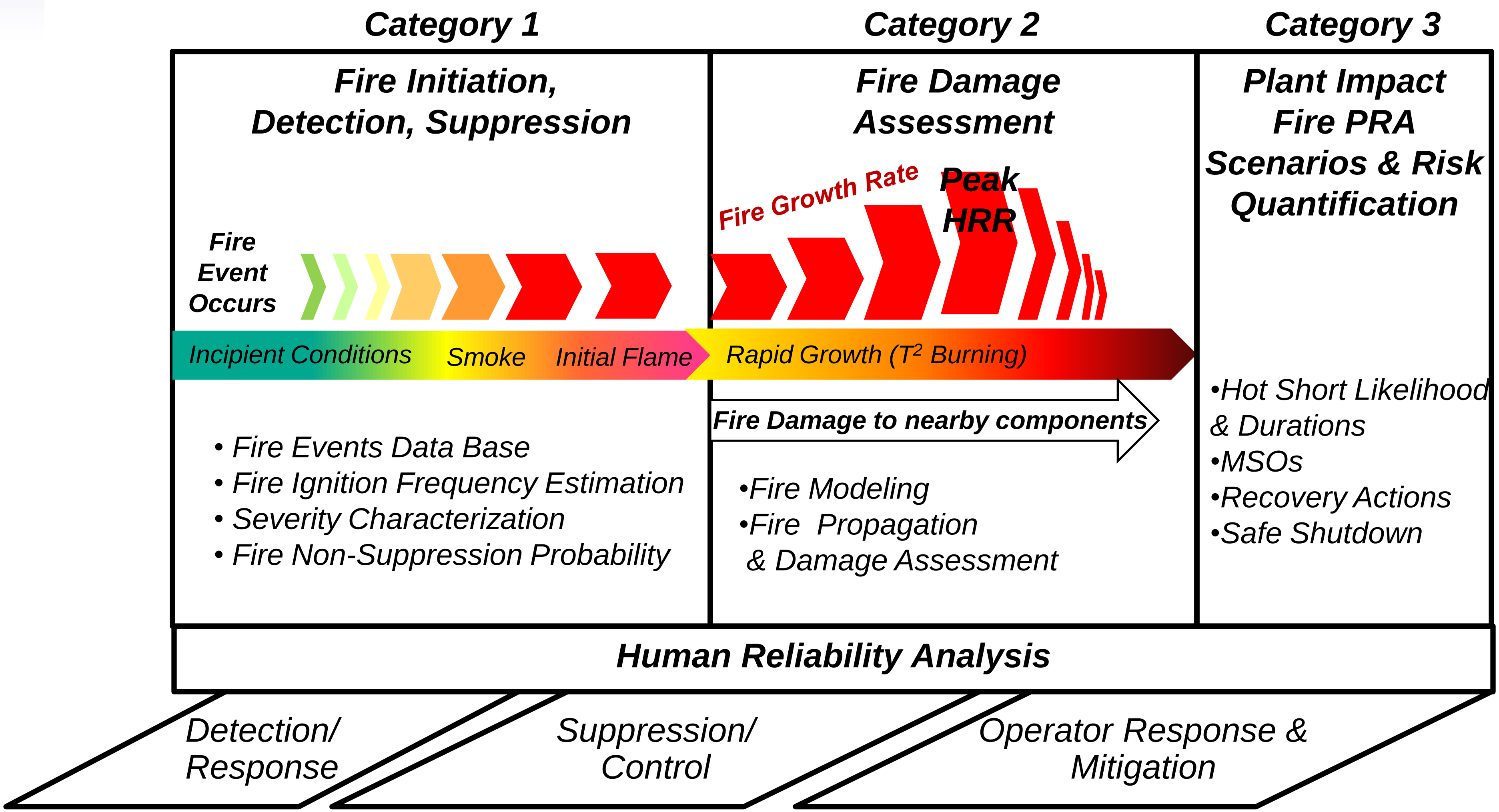
FPRA Issues Framework



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Category 1: Fire Initiation, Detection, Suppression

<u>Areas In Need of Additional Realism</u>:

- Fire Event Data Characterization
  - Fire Events Database
  - Fire Ignition Frequency
- Fire Severity Characterization
  - Incipient Fire Growth in Electrical Cabinets
  - Oil Fire Severity
- Incipient Detection
  - Credit for Incipient Detection
- Fire Suppression & Control
  - Credit for Fire Suppression & Control

Category 2: Fire Damage Assessment

Areas In Need of Additional Realism :

- Fire Growth Assumptions
  - Fire growth and comparison with data
- Peak Heat Release Rates
  - Electrical cabinet peak heat release rate (HRR)
  - Transient Ignition Source HRR
  - Hot Work HRR
  - Other HRRs
- Damage Assessment
  - Switchgear High Energy Arcing Faults
  - Bus Duct High Energy Arcing Faults
  - Damage to Sensitive Electronic Equipment
- Fire Propagation
  - Electrical cabinet propagation
- Fire Modeling
  - Fire Modeling Guidance

Category 3: Plant Impact, Fire PRA Scenarios & Quantification

Areas In Need of Additional Realism:

- Treatment of Hot Shorts
  - AC Circuits Hot Short Probability and Duration
  - DC Circuits Hot Short Probability and Duration
- Human Reliability
  - Human Reliability Methods (HRA) methods and performance shaping factors for fire PRAs
- Modeling of Control Room Fires
  - Control Room Modeling and Treatment in the Fire PRA
- PRA Model Advancement
  - Address unrealistic model simplifications

EPRI Fire PRA Action Plan

- Initiated in late 2009 as a means to clarify and coordinate industry activities related to fire PRA methods
  - Updated as new issues are identified
- Includes activities led by EPRI, NEI, PWROG, BWROG
- Roadmap used to align and help establish priorities
- Reports to NSIAC via an Executive Oversight Group
- Technical tasks coordinated within the NEI FPRATF

QUESTIONS?

Together…Shaping the Future of Electricity

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A ‘6850’ Author’s Perspective on the NEI ‘Roadmap’ Report

Steven P. Nowlen
Sandia National Laboratories

ACRS Reliability and PRA Subcommittee

December 13-14, 2010

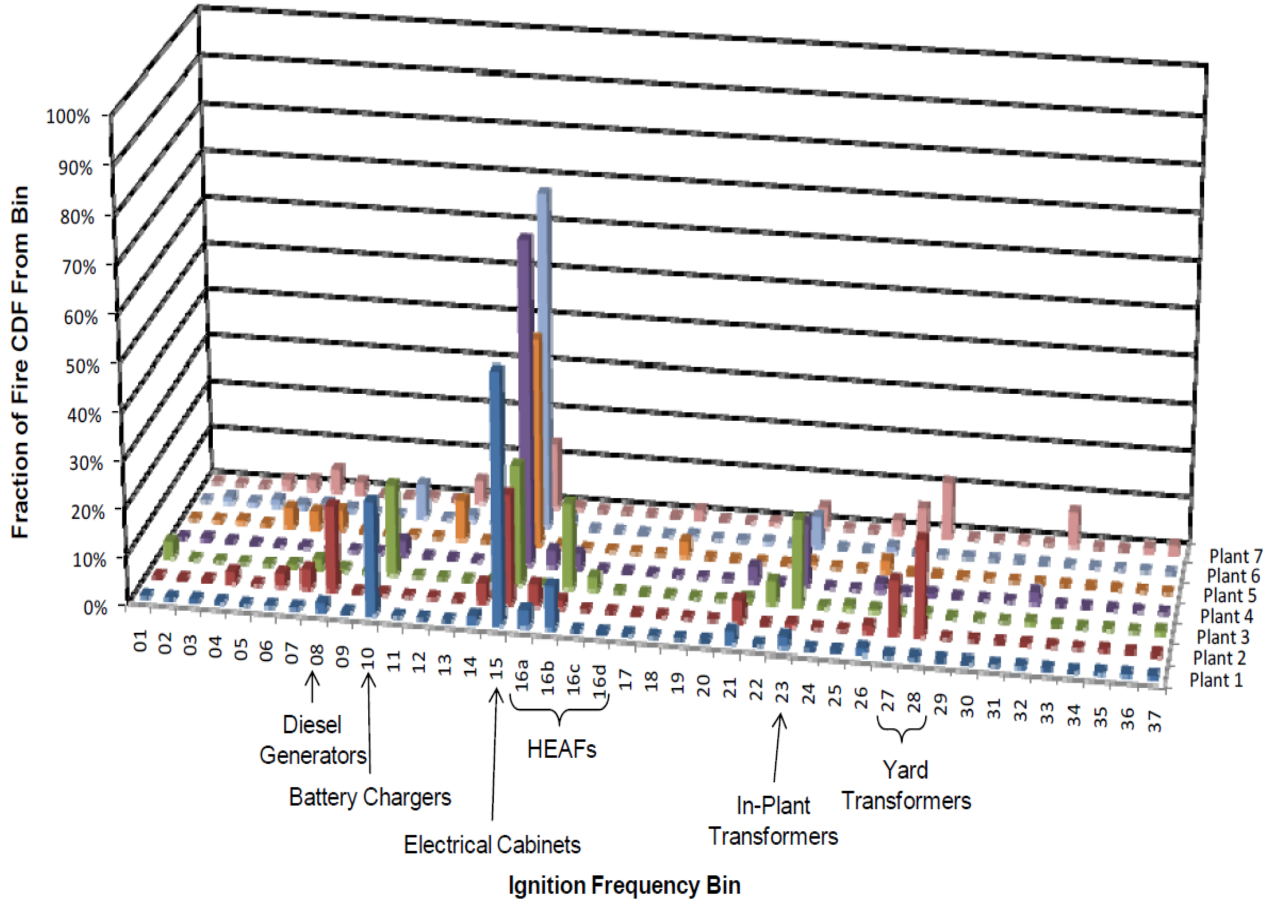
As technical lead of the RES writing team for NUREG/CR-6850, EPRI 1011989…

- I am the first to admit that the consensus fire PRA method is by no means perfect
- Clearly:
  - There are areas where research can lead to improvements
    - Several areas were self-identified by the original authors
  - There are areas of conservatism that can be relaxed given more data and better event insights
  - There are also areas where clarification of the authors' intent would reduce application problems and misunderstandings
- That said, NUREG/CR-6850 is in my view a workable methodology

When I look at this figure…

- **A few outliers but distribution matches my expectations pretty well**

- Cabinet fires dominate fire risk – not a surprise
- How did plant 7 get such a high contribution from TG set exciter fires? (Bin 33)
- Junction boxes visible contributor for two plants – a bit surprising (Bin 18)
- Transients small for most but visible for some – interesting…



Assessing the industry observations is a challenge

- I have no direct access to the industry PRAs
  - Only exception was early access to the pilot plant studies
- Cannot assess licensee implementation/interpretation of method beyond what is in the NEI report
  - Early observation of pilots and FAQs indicated that analysts were mis-interpreting authors intent in various areas
    - One example is the empirical cable fire spread model
  - Misunderstandings are also evident in the NEI ‘Roadmap’ report
- Cannot tell if PRAs are taking full advantage available tools
  - Are they exercising fire models?
  - Are they using the peak HRR distributions as intended?
  - Is anyone using the THIEF cable damage model yet?
    - NUREG/CR-6931V3

A reminder…

- The intent of the consensus method was to work in collaboration with industry to:
  - Consolidate existing methods, tools, and data
  - Address application issues identified in the IPEEE analyses
  - Make incremental improvements where possible within work scope
  - Document the current state-of-the-art and best practices for fire PRA in a single source document
    - At the time, no single source methodology document existed
- In my opinion, all of these goals were met

The areas for improvement identified in NEI's roadmap are all reasonable

- I have no issues with any items on the NEI list
  - All are areas where improvements can be made
  - Some will clearly be more difficult than others
  - Some may have little impact on final answers
- I would add one area identified by the original authors that does not appear on the NEI roadmap:
  - Manual fire fighting effectiveness and timing:
    - '6850' authors recommended development of a method to adjust fire fighting credit to reflect plant-specific conditions and practices
    - Manual fire fighting is a critical element in fire PRA
    - Doing better would add to analysis realism
    - Cannot be done without industry support
- That said, I do not agree with everything in the NEI 'Roadmap' report

One premise of the NEI report is as follows:

"The technical approach described in NUREG/CR-6850/EPRI-1011989 relies upon a set of tasks that subdivides the analysis of the fire scenario into discrete steps in order to make the analysis tractable. When transferring information from task to task, simplifications and bounding assumptions are applied to ensure that the analysis does not become too burdensome and at the same time potentially important sequences are not missed. Conversely, these simplifications and bounding assumptions have the potential (to) overstate the risk." (§2.2)

This statement does not reflect authors' intent (1of2)

- Simplifications are inevitable
  - They have been applied where necessary based on the current state of knowledge
  - Typical of PRA practice for all hazard groups
- Bounding assumptions are only recommended during qualitative and quantitative screening
  - That is, by definition, what screening does
- The need to balance scope is understood and appreciated, but risk quantification is expected to reflect plant-specific realism and detail as fully as possible

This statement does not reflect authors' intent (2of2)

- One challenge is that realism and detail are plant-specific
  - The base method provides generically applicable approaches which will not reflect plant specific detail
  - Also provides guidance for refinement based on plant-specific conditions
    - e.g., examination of electrical cabinet internals and venting
  - Base method cannot address every plant specific condition – that falls to the analyst
- Carrying bounding assumptions forward from task to task and ultimately to quantification is an application problem, not a characteristic of the base methodology
  - Quantification of important contributors should reflect detailed fire scenarios, not bounding assumptions

The report also makes a misleading statement relative to assumed fire impact

"In addition, there is an implicit assumption in most FPRAs that every fire leads to a plant trip." (§3.3.4)

- This was an issue during IPEEE reviews – should all fires be assumed to at least cause a plant trip?
  - The '6850' answer is no
- Fires that do not cause damage to PRA targets are not assumed to cause a plant trip (no contribution to risk)
  - Fire must be in the right location to threaten PRA targets,
  - Must be big enough to create a damaging environment, and
  - Must go un-suppressed long enough to actually damage the exposed targets
- It is true that given fire-induced loss of PRA targets, a trip is generally assumed

Report makes the following observation on spurious actuation experience:

"…the industry operating experience is that spurious operations have not occurred in observed fire events with the exception of the Browns Ferry event in 1975. So, the industry operating experience is one fire involving spurious operations in over 3,000 reactor years of operating experience." (§2.4.2)

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There are spurious actuation cases other than Browns Ferry (1/3)

- **Post-fire investigations typically won't look for spurious actuations**
  - **The NEI report provides no basis for their statement**
    - **e.g., no systematic review of events is cited**
  - **Difficult assertion to prove**
    - **Spurious actuations may occur but unless they directly impact plant shutdown or are caught by event recorders (monitored systems) they would not likely be detected or reported**
- **In the U.S. there is at least one additional case documented in the literature (NUREG/CR-6738):**
  - **Waterford 1995 – switchgear cabinet fire damaging overhead cables**
    - **Event sequence log and operator observations indicate erratic indications on control board**
    - **At least one spurious actuation caused by control cable failure (a breaker trip) was recorded**

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There are spurious actuation cases other than Browns Ferry (2/3)

- **Two additional cases of potential interest :**
  - **Dresden 1990 (LER 90-002-02): condensate charging pump fire**
    - **Three minutes into event, outboard MSIV spuriously closed.**
    - **Caused by fire-induced loss of ac control power coupled with a pre-existing fault on a companion dc circuit.**
    - **Highlights potential complexity of fire-induced failure analysis**
  - **St. Lucie 1994 (LER 94-007-0): Unit 1 switchyard fire**
    - **LER states: "At the time of the *(Unit 1)* event Unit 2 experienced spurious annunciator activity which immediately reset. In addition several radiation monitors spiked causing Shield Building Ventilation Fans HVE 6A & 6B (EIIS:VC) to start. No other significant actuations or abnormalities were observed."**
    - **No root cause analysis for the Unit 2 spurious signals was documented in the LER so the cause/effect relationship is unclear**

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There are spurious actuation cases other than Browns Ferry (3/3)

- **Extrapolation from international experience is tricky, but we ignore that experience at out own peril**
- **Three known international cases (NUREG/CR-6738):**
  - **Armenia 1982: cable gallery fire**
    - **At least three confirmed spurious equipment actuations**
    - **Many control and indication problems on MCB**
  - **Ignalina 1988: cable fire**
    - **False low oil level signal trips main coolant pump**
    - **Spurious actuation (trip) of 6kV bus feeder breaker compounded by an independent spurious trip of backup power supply (transformer) circuit**
  - **Chernobyl 1991: during the course of a plant trip…**
    - **Spurious closure of generator set output breakers re-connects tripped generator set to offsite power and a large fire results**
    - **Not a fire-induced cable failure, but the same mechanism was at work (conductor-to-conductor hot short)**

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One example of conservatism offered involves diesel generator fires

For diesel generator oil fires…

"The HRR computed is based on spread of the specified volume of oil and depending on the degree of confinement. A typical diesel day tank could contain 500 to 1,000 gallons of fuel oil. So, the more likely "small" spill would involve 50 to 100 gallons of fuel oil."

- **§2.4.1**

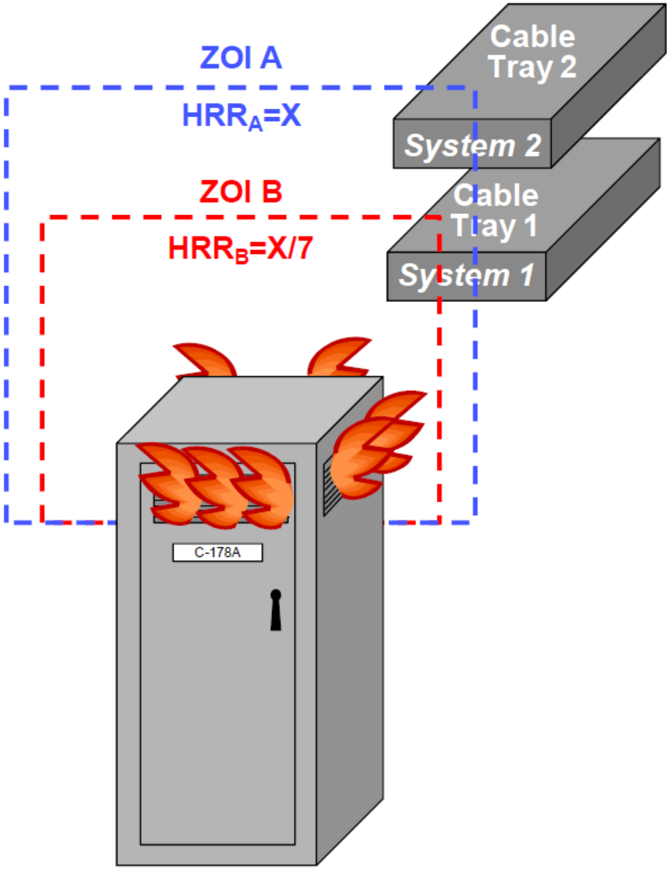
Comments on the diesel generator example

- **On review, one can trace the cited approach to elements of 6850, but this approach was not the authors intent**
  - **It was never intended that diesel generator fires would include large fuel spills from the day tanks**
    - **Similar to MFW pump FAQ case – unintended consequences…**
  - **As NEI report notes, there is no precedence for such fires in the events and certainly not among those included in the diesel generator bin**
  - **There was no intent to suggest PRAs postulate fire scenarios for which there is no precedent in either events or testing**
    - **Fire scenarios <u>should</u> reflect both experience and testing insights**
    - **e.g., for diesels, dominant fire type is flammable material leaking onto the manifold – not a conflagration**
  - **A request for authors to clarify approach could have avoided this misinterpretation of the authors' intent**

A second example deals with a two trays exposed to a cabinet fire (1of2)

- **“Figure 2-3 focuses on the implications of conservative damage assumptions on the baseline risk calculation.” …**

… “This figure depicts two fire damage vectors, Zone of Influence (ZOI) A based on an assumed heat release rate, X, and ZOI B based on a lower assumed heat release rate, X/7. For the case of ZOI A, both Cable Tray 1 and Cable Tray 2 are predicted to be damaged by the fire. For ZOI B, only the closer tray, Cable Tray 1 is predicted to be damaged.” …



A second example deals with a two trays exposed to a cabinet fire (2of2)

- … "The baseline risk calculation for these cases would predict that the CCDP for ZOI A would be greater because damage to Cable Tray 2 results in failure of System 2. For ZOI B, the CCDP would be lower… Thus, in the case where the more conservative fire damage (ZOI A), the resulting CDF would be greater. So, the conservative fire damage assumption results in a conservative estimation of the baseline fire CDF from this scenario."

- Example goes on to consider how carrying conservative (ZOI A) case forward to risk quantification would impact an on-line risk monitor type application:
  - "… the "conservative" assumption of ZOI A actually results in an underestimation of the risk increase from removing System 2 from service."

Example as shown reflects fundamental misunderstanding of 6850 approach (1of2)

- **This is a common situation and must be handled properly**
- **Per ‘6850’ this scenario should be broken into 2 sub-scenarios based on potential expansion of target set over time:**
  - **Sub-scenario 1: fires leading to loss of one tray only (ZOI B)**
    - **More likely because smaller fires/less time needed**
  - **Sub-scenario 2: fires leading to loss of both trays (ZOI A)**
    - **Less likely because larger fire/more time needed**
- **You also need appropriate non-suppression probabilities (P_{ns}):**
  - **Sub-scenario 1: P_{ns} = {cond. prob. that fire lasts long enough to damage first tray, but <u>not</u> long enough to damage second tray}**
  - **Sub-scenarios 2: P_{ns} = {conditional probability that fire lasts long enough to damage both first and second tray}**

Example as shown reflects fundamental misunderstanding of 6850 approach (2of2)

- To get correct baseline risk you carry both sub-scenarios forward to quantification
  - Both sub-scenarios derive from the same overarching fire scenario so CDF/CCDP summation must be done properly but…
  - That is a straight-forward process
- If the two sub-scenarios are properly treated then the risk monitor equipment outage application would work just fine
  - Could readily compute risk change given that either System 1 or System 2 is out of service
  - Out of service train would be appear as failed in cut sets for both sub-scenarios
  - Quantification would be correct

Fire frequency analysis discussion also reflects misunderstanding of approach

- **"An earlier stated premise from NUREG/CR-6850 is that fire ignition frequencies for individual bins are the same at all plants. Yet, NUREG/CR-6850 uses an approach that attempts to account for (or at least assumes) plant-to-plant variability."**
  - **§3.1.1, subsection *Computation of Ignition Frequencies***

- **The plant-to-plant variability analysis reflected the known data problem of under-reporting of fire events that are potentially relevant to risk analysis**
  - **Other than EN/LER reporting, fire event reporting is voluntary**
  - **Many plants do not participate in voluntary reporting**
  - **Plant-to-plant variability analysis had nothing to do with variability in estimated plant-wide fire frequencies**

With respect to sensitive electronics…

"Currently, there is no guidance for the treatment of potentially sensitive electronic equipment. There is not even an adequate definition of the applicable circumstances, equipment, damage, and failure modes. Consequently, it is conservatively assumed that such components fail at t=0. This overstates the contribution from such failures."

- **§3.2.3, subsection *Damage to Sensitive Electronic Equipment***

Sensitive electronics are certainly a challenge, but…

- **The statement is incorrect**
- **6850 discusses sensitive electronics in various sections including:**
  - **Appendix H – gives damage and ignition temperature and heat flux thresholds for solid state control components**
  - **Appendix S – discusses sensitive electronics in cabinet scenarios**
    - **e.g.: with respect to adjacent cabinets "damage to sensitive electronics should not occur for at least 10 minutes after the peak heat release rate."**
  - **Appendix T – *Smoke Damage***
- **6850 recommends that the time to failure for sensitive electronics be calculated based on fire modeling**
  - **e.g., based on exposure temperature or heat flux**
- **Failure modes are highly component specific – little data on this subject exists**

In summary…

- NUREG/CR-6850, EPRI 1011989 can be improved
- Despite it's flaws, I believe it is a workable method
- There are legitimate issues, but:
  - Some "issues" appear to derive more from misinterpretation and misunderstanding that fundamental shortcomings
  - Some conservatism may derive from incomplete application of available tools (e.g., THIEF)
- In some cases, analysts may be using the "easy button," but the price they are paying is conservatism and a lack of realism

United States Nuclear Regulatory Commission

Protecting People and the Environment

Input to Staff Response to NEI PRA Task Force Comments

Jeff Circle

Senior Reliability/Risk Analyst

NRR\DRA\APOB

NEI Fire PRA Task Force ROP Argument

- *"To date, no actual fire events have been considered Red or Yellow (CCDP>1E-5) .. As shown in Tables 2-2 and 2-3, fire PRA models would predict that several of these events should be seen each year across the industry."*

Staff View

- The staff believes that the argument is misleading.
- The entry condition for a finding to be assessed in the ROP is that it needs to be a performance deficiency.
  – A performance deficiency is an issue that is a result of a licensee not meeting a requirement or standard where the cause was reasonably within the licensee's ability to foresee and correct.
  – It could be a self-imposed standard or a standard required by regulation.

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Staff View

- Based on the definition, not all plant fires experienced become performance deficiencies that are processed through the SDP.
- It is true that there haven't been Yellow or Red SDP findings that were the result of an actual severe fire.
  - Most fire findings, e.g., Browns Ferry, Brunswick, Cooper, etc., are programmatic or a predicted plant fire response.

Staff View

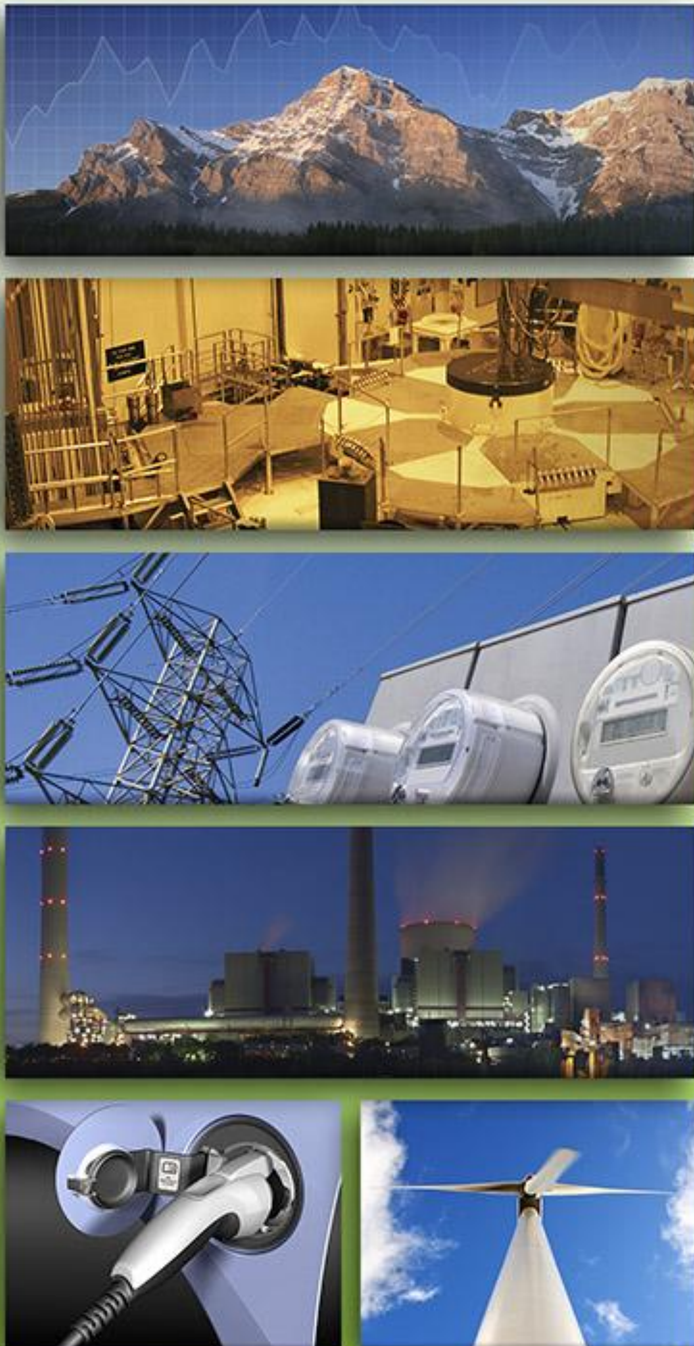
- Other factors limiting the severity of a finding and thus not identified:
  - Exposure time of the existence of the performance deficiency.
    - If vulnerability time was short for a high consequence scenario, the resulting CDF is low.
  - Consequence.
    - A severe fire could occur in a scenario that was modeled having a high base ignition frequency but, a correspondingly low increase in core damage frequency.
    - An example is the June 2004 Vermont Yankee transformer bus duct fire.

Staff View

- Computing the ΔCDP
  - The assessment used in the SDP is typically related to the increase of the CDF derived from the performance deficiency from that of the base case.
  - The result of licensee performance deficiencies are generally not used in developing initiating event frequency data used in base model PRAs.
  - Values are derived mostly from operational occurrences with the assumption is that licensees follow their established programs.

Staff Conclusion

– Based on the nature of the ROP/SDP, the NEI Task Force can not make the valid conclusion that the existence of a relatively low number of high greater-than-green SDP findings (performance deficiencies) is a good argument for why base case frequencies are over predicted.



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Fire Events Database Update and Fire Ignition Frequency Analysis

Patrick Baranowsky
ERIN Engineering and Research, Inc.
Rick Wachowiak
EPRI

ACRS PRA Subcommittee
December 13, 2010

Presentation Content

- Improvements to the Fire Events Data Base (FEDB)
- Fire events data acquisition
- Fire events reanalysis of fire ignition frequency

FEDB Purpose and Objectives

The Electric Power Research Institute's Fire Events Data Base is the principal source of fire incident operational data for use in fire PRAs

This project will improve the FEDB by:

- Including expanded and improved data fields
- Improving consistency and quality of information
- Improved fire event severity classification

These improvements support fire PRA:

- Updated, improved fire frequencies
- Treatment of detection & suppression effectiveness
- Estimates of damaging fire frequencies and their characteristics

Scope and Cooperation with NRC under MOU

- Update data through 2009, and beyond as available
- Principal data sources:
  - Plant records, e.g. condition or corrective action reports supplemented with available
  - LERs, ENs
  - NEIL, EPIX reports
  - Plant specific data collected for FPRAs
- Cooperative effort lead by EPRI with NRC under MOU
  - Database software upgrades
  - Data field content and definitions
  - Fire severity criteria
  - Beta testing
  - QA audit

Description of Updated FEDB

- Microsoft Access based, user friendly software (implemented by INL)
- Plant identifier data (limited availability to users)
- Event descriptive data
- Event severity classification
- QA, traceability

Key Fire Event Data Base Features

- Event summary description
- Location and source characteristics
- Fire duration, growth, and damage descriptive details
- Detection
  - Time(s)
  - Systems & equipment
  - Fire brigade and other personnel role
- Suppression
  - Time(s)
  - Systems & equipment
  - Fire brigade and other personnel role
- Fire severity classification graded, dependent on magnitude and impact details

Fire Event Severity Classifications

- The severity levels used in the updated FEDB are challenging, potentially challenging, and not challenging
- The new “challenging” and “potentially challenging” classifications combined are essentially equivalent to the NUREG/CR-6850 “potentially challenging” classification
- A distinction made between “challenging” fires that did (or could) damage a critical component beyond the ignition source and those “potentially challenging” fires that might evolve into challenging fires in fire PRA model
- Initial classification using fire severity algorithm

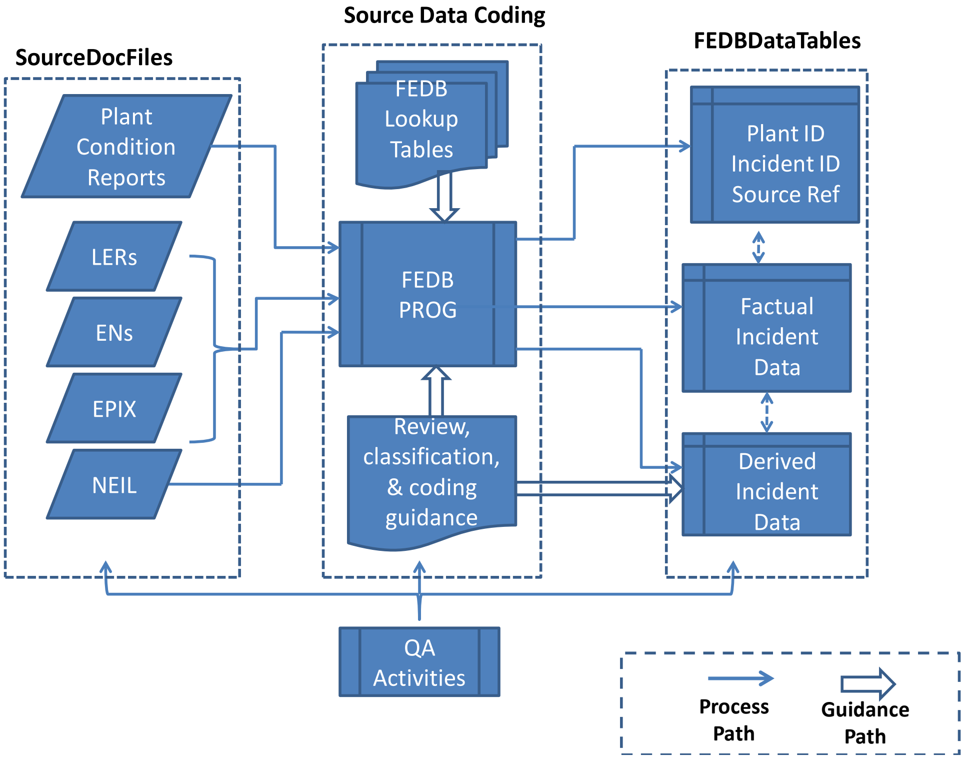
Fire Event Severity Determination

- Applied to new and existing fire event data (1990 forward)
- Fire event severity classification algorithm:
  - Logic model using FEDB data field entries to indicate initial fire severity classification
  - Challenging → Potentially Challenging → Not Challenging
  - Identifies key missing information needed to make classification on “undetermined” events
- Fire event severity classification review & justification for exceptions required
- Resolution of “undetermined” severity classifications incorporated in event data collection and coding process to extent practical

Event Derived/Inferred: Fire Severity

Event Classification	Event Sub-Classification Criteria
CHALLENGING One of the following:	Damage to or ignition of an adjacent object occurred. This includes ignition of secondary combustibles.
	Damage to or ignition of an adjacent object could have occurred if the fire were in a different location.
	Damage to or ignition of an adjacent object or component could have occurred if significant suppression actions had not been taken.
POTENTIALLY CHALLENGING Not "challenging" and one of the following:	Damage to or ignition of an adjacent object could have occurred if minor suppression actions were not taken in a timely manner
	Damage to or ignition of an adjacent object could have occurred if the fire were in a different location and if minor suppression actions were not taken in a timely manner.
NOT CHALLENGING Not "potentially challenging" and one of the following:	Overheat condition only; no smoldering or flaming combustion
	Smoldering fire self-extinguishes without any active intervention.
	Fire involves an ignition source in a location that has no relevance to plant operations or safety.
UNDETERMINED	Any fire event that does not have sufficient information to classify as challenging, potentially challenging, or not challenging.

Software Platform and Design (by INL)



- Microsoft Access
- Source data such as LERs, ENs etc. provide info for the FEDB and are accessible from the SourceDocFiles
- FEDB lookup tables provide supporting info
- FEDB Data tables contain important ID, factual and derived incident information
- FEDBProg provides the user interface and modules for changing or deleting data

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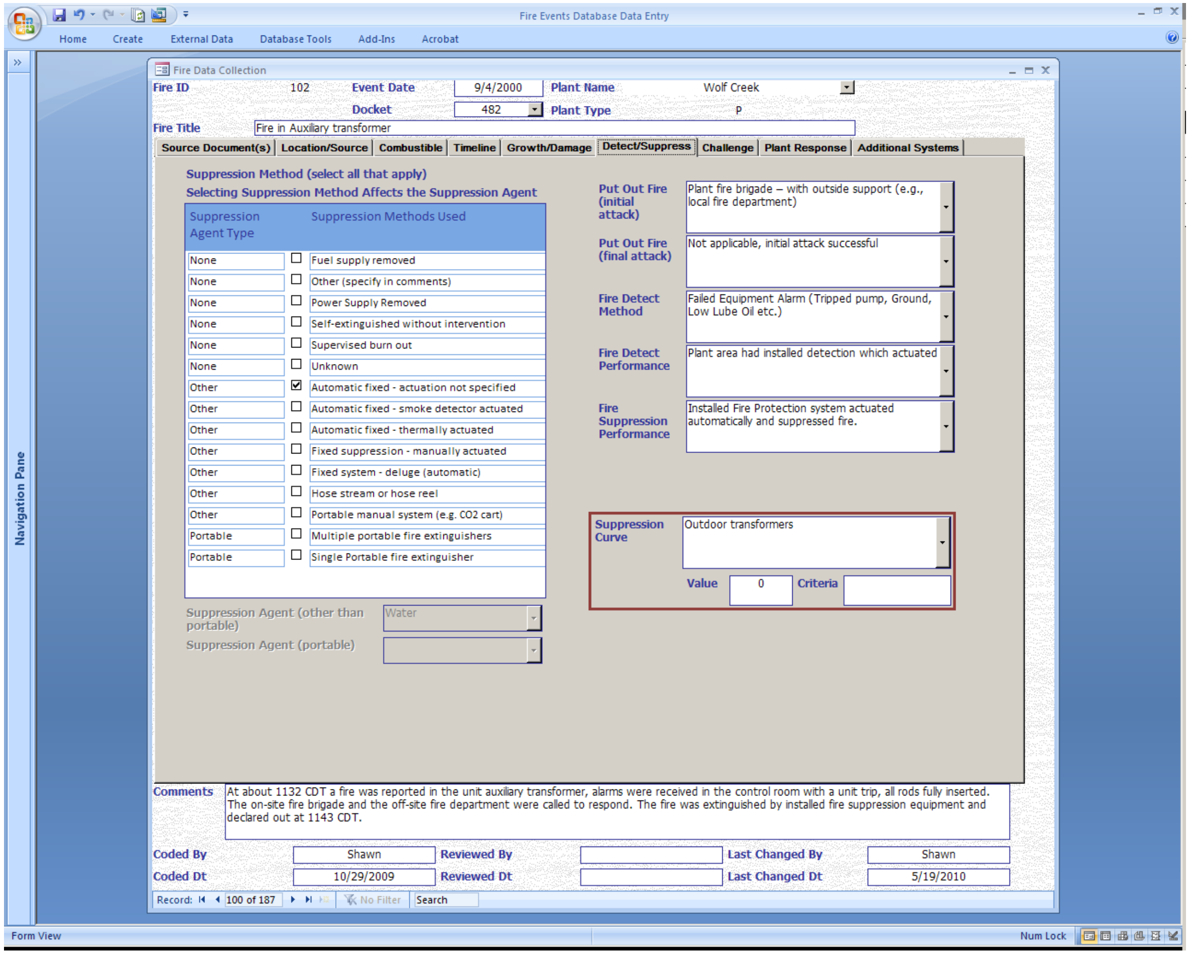
Software Platform and Design (by INL)

- Important data is in easy to use forms
- Lookup tables provide additional information and allow standardization of important data fields



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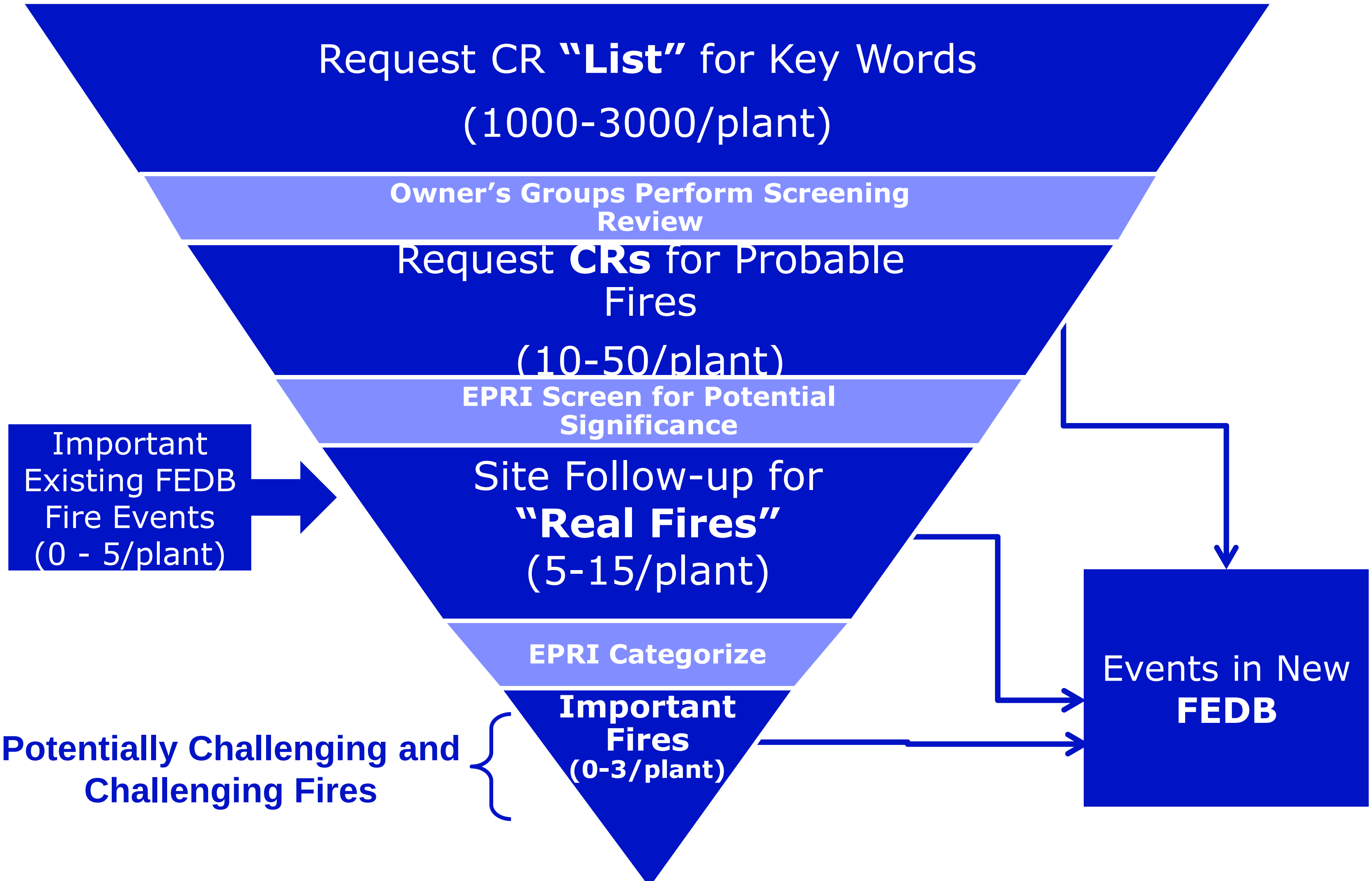
Fire Events Data Collection and Screening



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Fire Event Data Acquisition Status

- Approximately 275,000 events have been screened on short descriptions from the key word search.
- 103 of 104 plants responded to fire event data request
- ~5500 events selected for supplemental review
- Requests for potential fire event CRs sent out to 80 plants to date.
- ~100 events identified as real fires, coded in FEDB
- 70 events have gone through preliminary classification
  – 27 potentially challenging, 2 challenging, 30 not challenging, 11 undetermined (additional information needed)

Summary FEDB Status/Schedule

- FEDB software (INL); full functionality for data loading and fire severity determination, November 2010
- Fire event coding & fire severity determination guidance documents: drafts prepared for project use, October - December 2010
- Complete fire event data collection: 2nd Qtr 2011*, includes follow up information requests
- Complete fire event coding and severity classification: 3dr Qtr 2011*
- Updated/QA'd FEDB ready for distribution via EPRI Technical Report, 4th Qtr 2011*

* Schedules dependent on supplemental data request responses

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Fire Ignition Frequency (Re)Analysis: Purpose, Objective, Scope

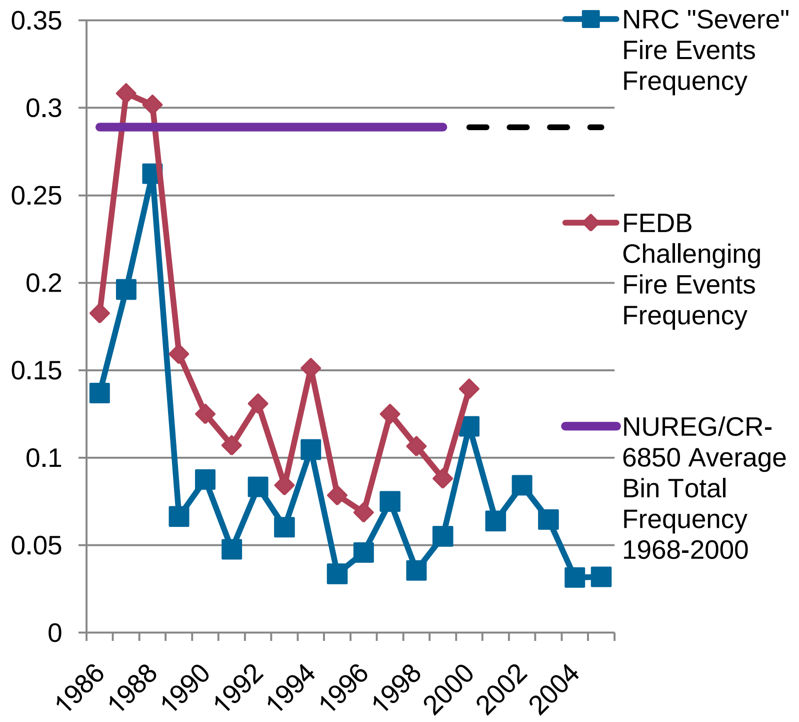
- Update fire event trends and fire ignition frequencies developed in EPRI interim Report 1016735, FAQ 08-48
- Use data from the FEDB updated through 2009
- Improved methods to address statistical issues/concerns for low density fire ignition bins
- Results to be suitable for use in plant specific fire PRA applications
- Includes coordination with the NRC, industry technical review
- Preparation of preliminary and final draft EPRI technical reports

NUREG/CR-6850 and EPRI Interim Report on Fire Ignition frequencies

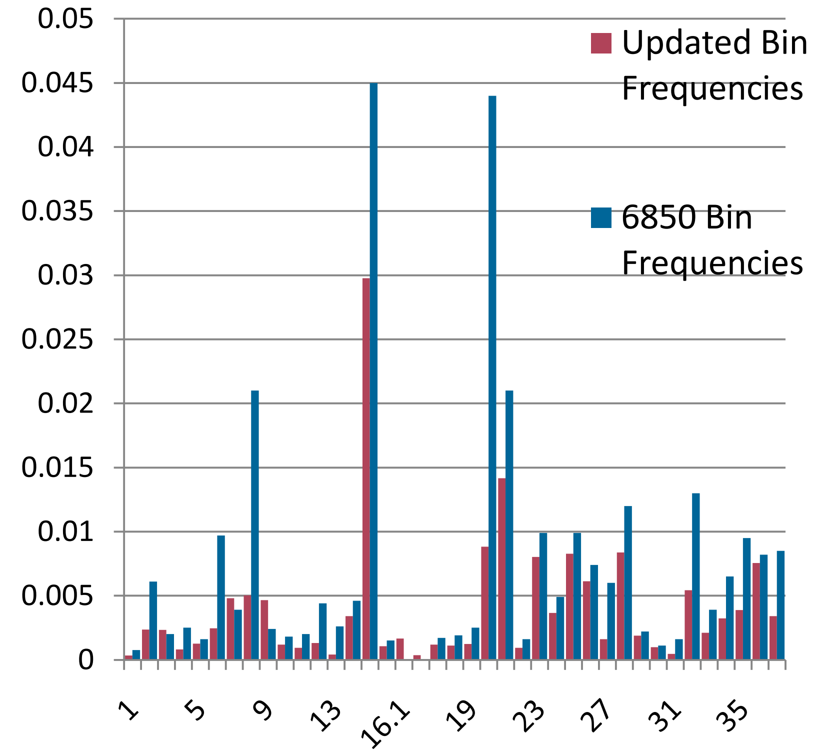
- Issues with NUREG/CR-6850 fire ignition frequencies
  - Outdated data, not representative of current plants (1968-2000)
  - Trending analysis error, erroneous results
  - Bayesian update included some conservative priors based on undocumented expert judgment
- EPRI re-analysis (Interim TR 1016735)
  - Data not updated (thru 2000, now 10 years old)
  - Between plant variability not treated for most bins
  - Methods consistent with current industry and NRC practice, NUREG/CR-6823, NASA/SP-2009-569

Results from EPRI Interim Technical Report, Comparisons with NUREG/CR-6850

Fire Event Trends



Fire Ignition Bin Frequencies



Fire Ignition Frequency (Re)Analysis: Technical Issues and Approach

- Using data from 1990-2000, between plant variability detected
  - strong indication for aggregated data, high density fire ignition bins
  - low density fire ignition bins indeterminate
  - assume between plant variability
- Plan to apply hierarchical Bayes treatment for all fire ignition bins; draft methodology report to be prepared
- Uncertainty bounds & plant specific sensitivity will generally increase while maintaining generic “results” for mean fire ignition frequencies
- Industry wide trends and any implications unknown until new data is available for analysis

Methodology Overview

- Between plant variability modeling
  - Hierarchical Bayes
  - WINBUGS, OPENBUGS
  - Consistent with RDAT used in NUREG/CR-6850
  - Compute plant specific fire ignition frequencies using individual bin data in 2 stage update procedure
- Combined bin model (also a 2 stage update procedure)

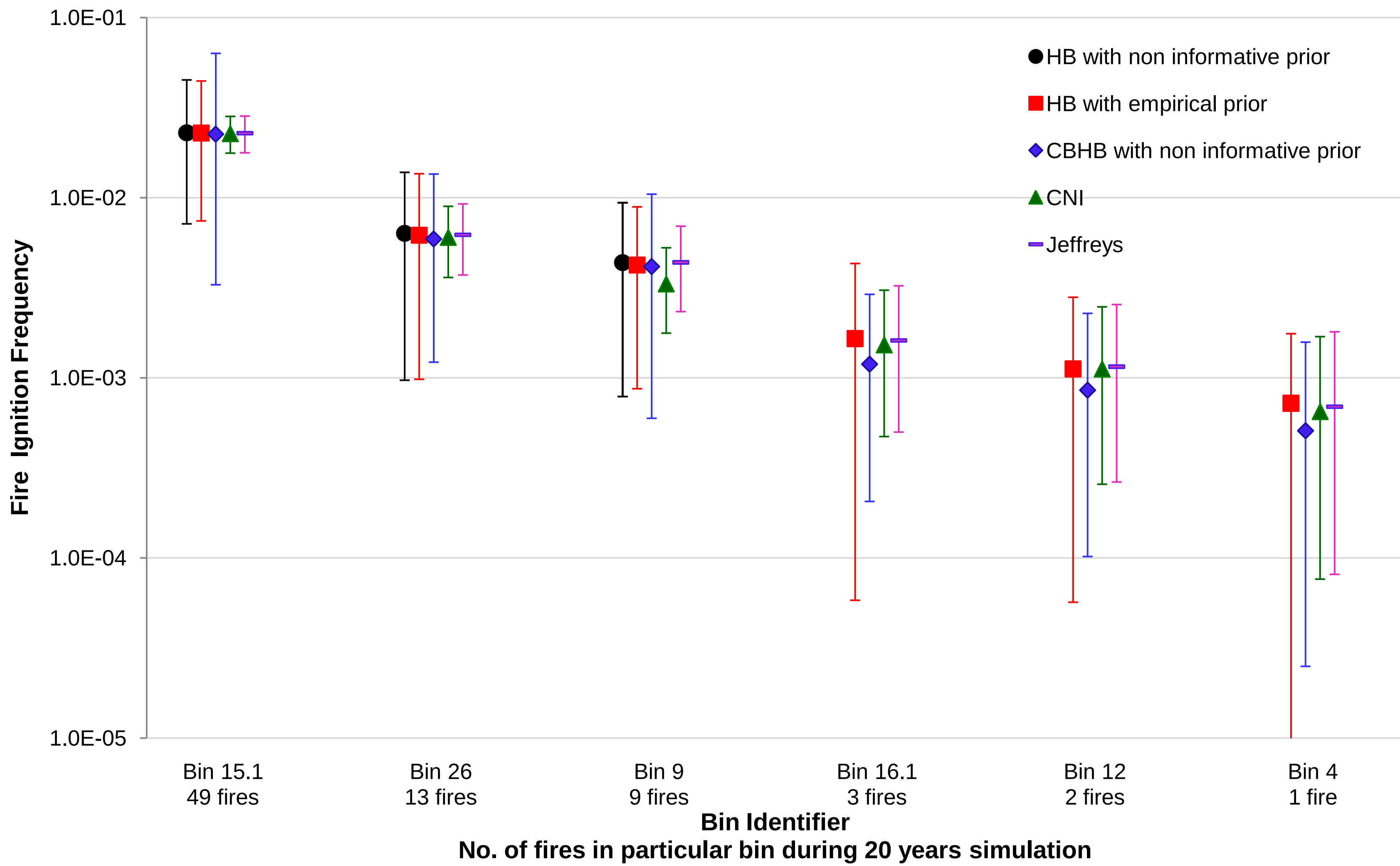
$$\boldsymbol{\lambda_{i,j} = \lambda_{i+} \times p_{j|i}}$$

where $\boldsymbol{\lambda_{i,j}}$ is the bin $\boldsymbol{j}$ fire ignition frequency for plant $\boldsymbol{i}$,

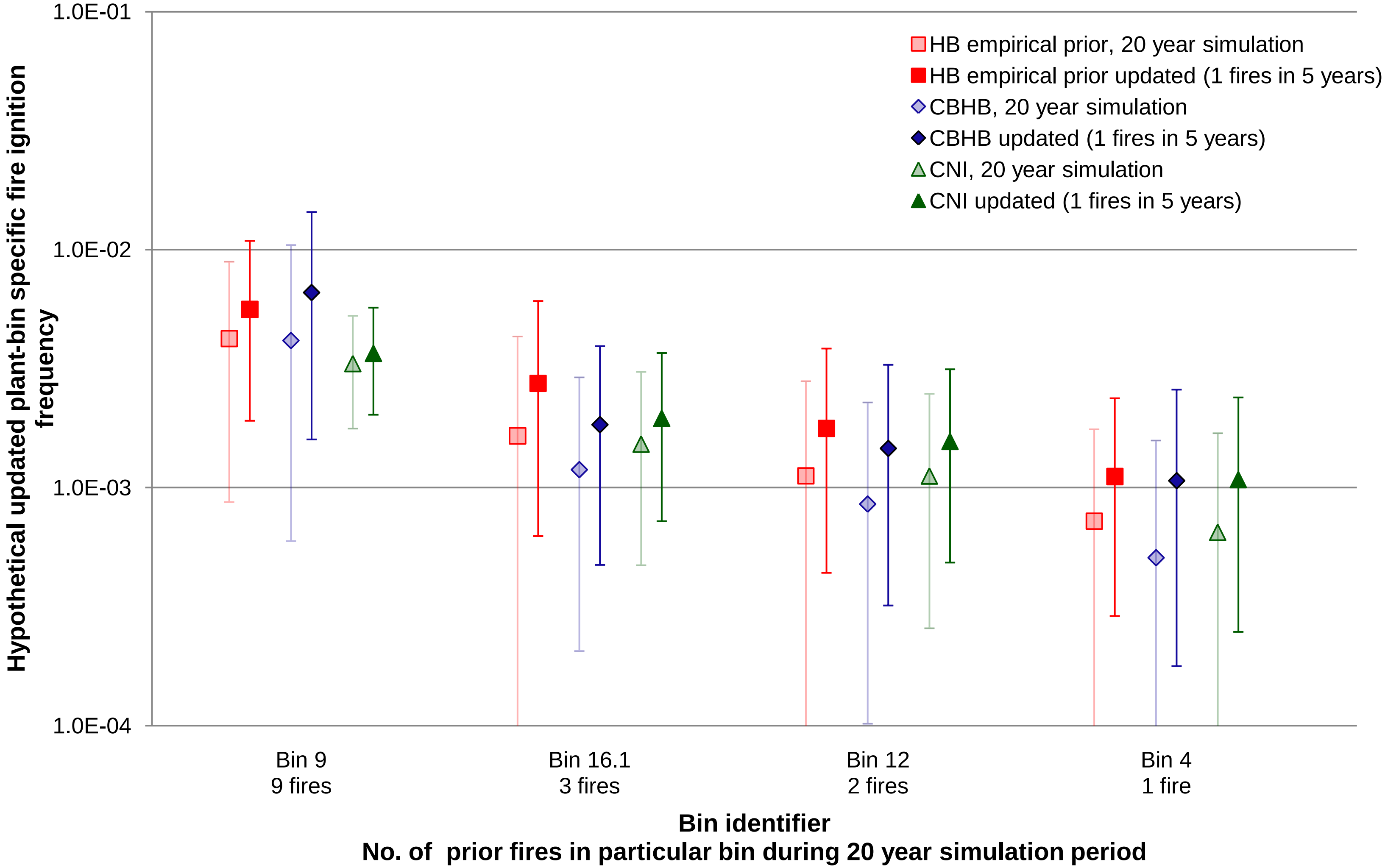
$\boldsymbol{\lambda_{i+}}$ is the plant-specific total fire ignition frequency,

$\boldsymbol{p_{j|i}}$ is the bin-specific fraction of fires for the specific plant

Example Methodology Comparisons of Estimated Fire Ignition Frequency Distributions



Example Methodology Comparisons of Estimated Fire Ignition Frequency Results (cont)



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Fire Ignition Frequency (Re)Analysis: Status and Schedule

- Completing initial methodology enhancements
- Methodology report for technical review with NRC under MOU: 1st Qtr 2011
- Draft EPRI Interim Technical Report on methodology for industry technical review: Mid 2011
- Draft EPRI Technical Report on updated FEDB fire ignition frequency (re)analysis: Late 2011*
- Final EPRI Technical Report (methodology and data analysis): Early 2011*

* Schedules dependent on FEDB data update

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Fire Events Database Enhancement Effort
NRC team perspectives

By:
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Steven P. Nowlen, SNL

ACRS Reliability and PRA Subcommittee

December 13-14, 2010

Background (1of2)

- Efforts to gather NPP fire events ongoing since late 1970's
  - Early efforts included UCLA, individual risk analysts, and consulting firms involved in risk analysis (e.g., PL&G, SAIC…)
  - 1985: NRC sponsored consolidated FEDB under RMIEP
    - SNL, NUREG/CR-4586
  - 1991: RMIEP database updated by SNL under DOE sponsorship
    - Included comprehensive search for events through 1989
  - 1993: EPRI FEDB published (NSAC-178L)
    - Imported <u>original</u> RMIEP data and added events through 1988
      - EPRI fire loss data, Seabrook & Shoreham PRAs, Daily Plant Status rpts…
  - 2000: EPRI update (TR 1000894)
    - Imported 1990 RMIEP update data
    - Utility reports (voluntary survey) covering 1989-1992
    - NEIL data for 1992-1999

Background (2of2)

- **EPRI FEDB has been principal data source since mid-1990's**
  - **NUREG/CR-6850, EPRI 1011989 used the 2000 EPRI update**
- **'6850' included substantive effort to screen out events <u>not</u> relevant to risk when calculating fire frequencies**
  - **The "potentially challenging – not challenging" determination**
    - **Roughly 40% of the events screened as non-challenging**
- **'6850' recommends lower frequencies than were used in IPEEEs**
- **Plant-wide fire frequency values from most common sources:***
  - **EPRI 105929 (1995): 5.7 E-1/ry**
  - **EPRI 1003111 (2001): 6.4 E-1/ry**
  - **NUREG/CR-6850 (2005): 2.8 E-1/ry**
  - **FAQ 08-0048 (2009): 1.5 E-1/ry**

*** Simple sum of recommended at-power mean values for all ignition source bins**

FEDB update – scope and goals

- Collaboration between RES and EPRI
- Effort involves a comprehensive search of licensee and NRC records
- FEDB improvements will:
  - Expand and improve data fields
  - Add credibility by reducing "undetermined" data
  - Improving consistency and quality
    - Both in data entry and data analysis
  - Provide reference source traceability
  - Resolve lingering issues related to reporting consistency

FEDB update – anticipated applications

- **These improvements will provide more current and useable data for Fire PRA applications to support:**
  - **Updated, improved fire frequencies**
    - **Including updates to "challenging, potentially challenging, non-challenging" classification process**
  - **Improved treatment of detection & suppression**
  - **Better insights into fire event timelines**
- **Overall: when applying insights from fire events there will be**
  - **Less uncertainty**
  - **More refinement**

Improving fire frequencies (1)

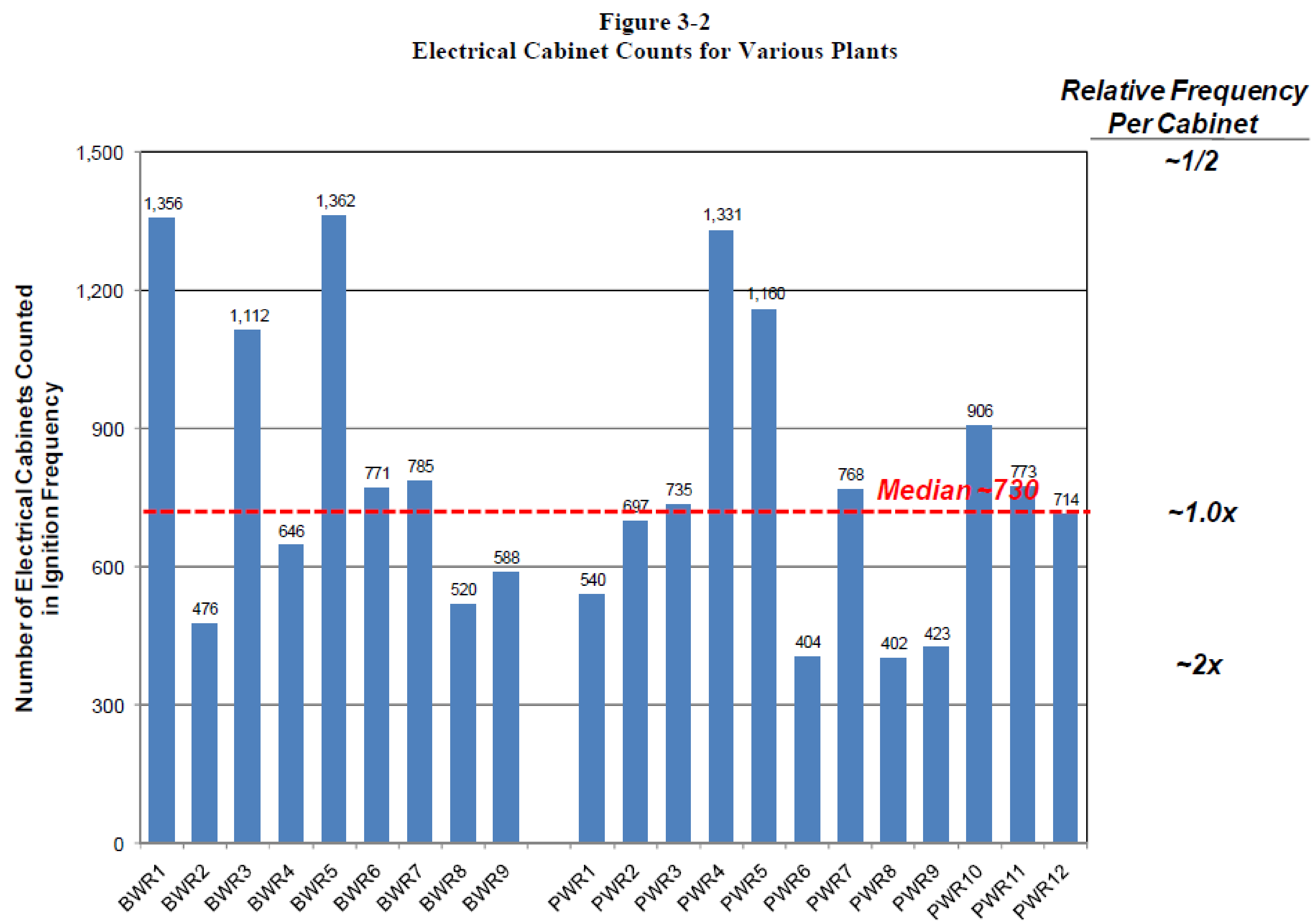
- NEI 'Roadmap' report makes the following statement (§2.4.1)

  "This example points out one of the more problematic aspects of the methodology. The more components in a specific bin, the lower the ignition frequency on a per component basis. This was acknowledged as a limitation …but was felt to be adequate at the time that report was published."

- '6850' went as far it could given information available at the time
  - True component-based approach requires detailed industry-wide ignition source population data not available in 2005
  - 6850 team sought population data but industry did not support effort
  - NEI 'Roadmap' report contains first examples of required data
    - Figures 3-2 through 3-5
- The emerging availability of population data gives us our first opportunity to go to a true component-based frequency model

Sandia National Laboratories

Population data example from NEI report



** Draft information (unverified)*

Improving fire frequencies (2)

- The 'Roadmap' report makes the following statement (§3.1.1*)*

  "An earlier stated premise from NUREG/CR-6850 is that fire ignition frequencies for individual bins are the same at all plants. Yet, NUREG/CR-6850 uses an approach that attempts to account for (or at least assumes) plant-to-plant variability."
- This statement reflects a misunderstanding of the 6850 approach
- Plant-to-plant variability analysis reflected known data problem of under-reporting fire events potentially relevant to risk analysis
  - Other than EN/LER reporting, fire event reporting is voluntary
  - Many plants do not participate in voluntary reporting (e.g., via NEIL)
- The FEDB update should resolve this issue because events from all licensees are being gathered
  - Hopefully this will end the under-reporting debate

One ongoing point of discussion among the FEDB update teams

- The 'Roadmap' report, Table 4-2, item 1.3 indicates:
  - "incipient fire growth in electrical cabinets" will use "information from the FEDB to characterize detection and termination prior to an actual fire event."
- Industry team is proposing to pre-screen (i.e., exclude from FEDB) events associated with, in effect, incipient stage fire events
  - Cases providing evidence of the incipient behaviors would not be included in the FEDB
- NRC team has recommended reversal of this decision
  - We want FEDB to support the incipient fire growth phase and incipient detection applications
- Meetings later this week will examine impact of the screening process and assess impact on data and intended applications
- Final decision on this question is pending

FEDB update – current status

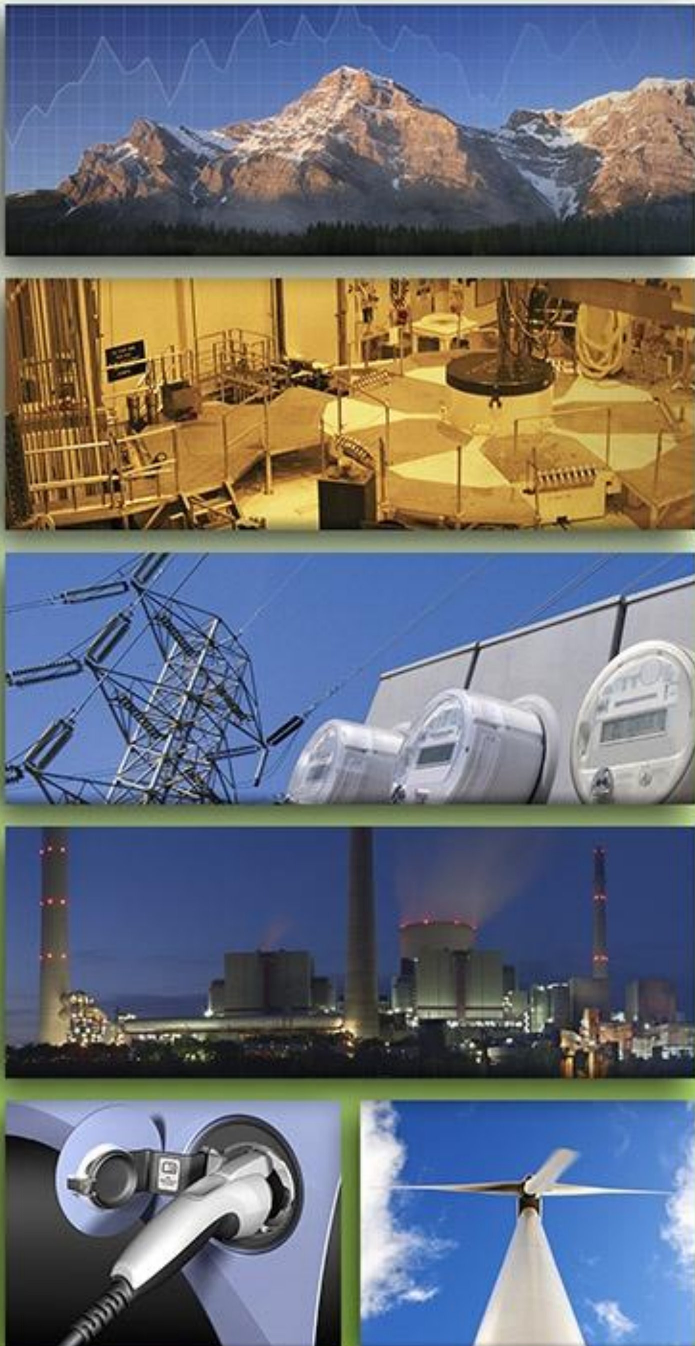
- Beta testing of data entry complete
  - Established data entry fields
- Beta testing of automated preliminary severity classification scheme completed
  - Logical structure for preliminary assignment of “challenging, potential challenging, non-challenging” classification
  - Subject to override by team analysis
  - Initial criteria established, plan to review as more events can be reviewed
- Data entry underway by EPRI counterparts
  - Collection, screening, and entry of plant records
  - Currently looking at 2001-2009 records
  - Output of screening effort was (apparently) approximately 3000 possible fire event records for this 9 year period

FEDB – looking ahead

- **Near-term future (through March) will focus on:**
  - **Continued data entry by EPRI team**
  - **NRC audit of process and data**
  - **Refinement of data fields and event coding process**
  - **Review of severity classification process and results**
- **Longer term (spring/summer):**
  - **Shift focus to applications**
  - **Fire frequency is likely first**
    - **Refinement of ignition source bins**
    - **Recalculate all fire frequencies**
    - **Assess whether FAQ08-0048 trend holds true**

In Summary

- **Fire event data continue to play key roles in many aspects of fire PRA**
- **Limitations to the existing databases have hampered efforts to gain insights and refine methods**
- **The collaborative update effort aims to resolve these issues**
- **Product <u>will be</u> a very complete high quality FEDB designed to suit a range of applications**



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Discussion of NUREG/CR-6850 Treatment of Transient Fires

Doug True, ERIN Engineering & Research
Rick Wachowiak, EPRI

ACRS PRA Subcommittee
December 13, 2010

Topics on Transient Fires

- Transient Ignition Source Bins
- Transient Ignition Source Frequencies
- Allocation of Transient Ignition Frequencies
- Transient Ignition Source Operating Experience
- Characterization of Transient Severity
- Characterization of Transient Fire Growth
- Summary
- Responses to ACRS Consultant's Questions

Transient Ignition Source Bins

Bin	Ignition Component	Location	# of Events Counted
3	Transients and Hotwork	Containment (PWRs)	2.4
6	Transient fires caused by welding and cutting	Control/Aux/Reactor Bldg	12.6
7	Transients	Control/Aux/Reactor Bldg	6.0
24	Transient fires caused by welding and cutting	Plant-wide Components	7.3
25	Transients	Plant-wide Components	12.9
36	Transient fires caused by welding and cutting	Turbine Building	13
37	Transients	Turbine Building	10.5

Ref: NUREG/CR-6850/EPRI 1011989, Table C-3

Transient Ignition Source Frequencies

Bin	Ignition Component	Location	Mean Plant-wide Frequency (/yr)	
			Original	FAQ 048
3	Transients and Hotwork	Containment (PWRs)	2.0E-03	2.3E-03
6	Transient fires caused by welding and cutting	Control/Aux/Reactor Bldg	9.7E-03	2.5E-03
7	Transients	Control/Aux/Reactor Bldg	3.9E-03	4.8E-03
24	Transient fires caused by welding and cutting	Plant-wide Components	4.9E-03	3.7E-03
25	Transients	Plant-wide Components	9.9E-03	8.3E-03
36	Transient fires caused by welding and cutting	Turbine Building	8.2E-03	7.6E-03
37	Transients	Turbine Building	8.5E-03	3.4E-03

Allocation of Transient Ignition Frequencies

- Weighting factor approach described in Section 6.5.7.2 of NUREG/CR-6850, Volume 2
- Allocation done on compartment basis within the Location
- Most important weighting factors:
  - Occupancy level,
  - Storage of flammable materials, and
  - Type and frequency of maintenance activities
- Fires assumed to be able to occur at all areas of a plant unless precluded by design and/or operation, e.g., BWR containment
- "*Administrative controls significantly impact the characteristics and likelihood of transient fires, but they do not preclude their occurrence*"

Allocation of Transient Ignition Frequencies (cont.)

- Compartments weighted based on maintenance , occupancy, and storage:

Rating	Weight	General Description
No	0	Can be used only for those compartments where transients are precluded by design.
Low	1	Reflects minimal level of the factor
Medium	3	Reflects average level of the factor
High	10	Reflects the higher-than-average level of the factor
Very High	50	Reflects the significantly higher-than-average level of the factor (only for "maintenance" influencing factor)

Allocation of Transient Ignition Frequencies (cont.)

$W_{GT,J,L} = (n_{m,J,L} + n_{o,J,L} + n_{s,J,L})/N_{GT,L}$

$N_{GT,L} = \Sigma\ (n_{m,i,L} + n_{o,\ i,L} + n_{s,\ i,L})$
(summed over i, all compartments of location L).

where:

$n_{m,J,L}$ = Maintenance influence factor rating of compartment J of location L,

$n_{o,J,L}$ = Occupancy influence factor rating of compartment J of location L, and

$n_{s,J,L}$ = Storage influence factor rating of compartment J of location L.

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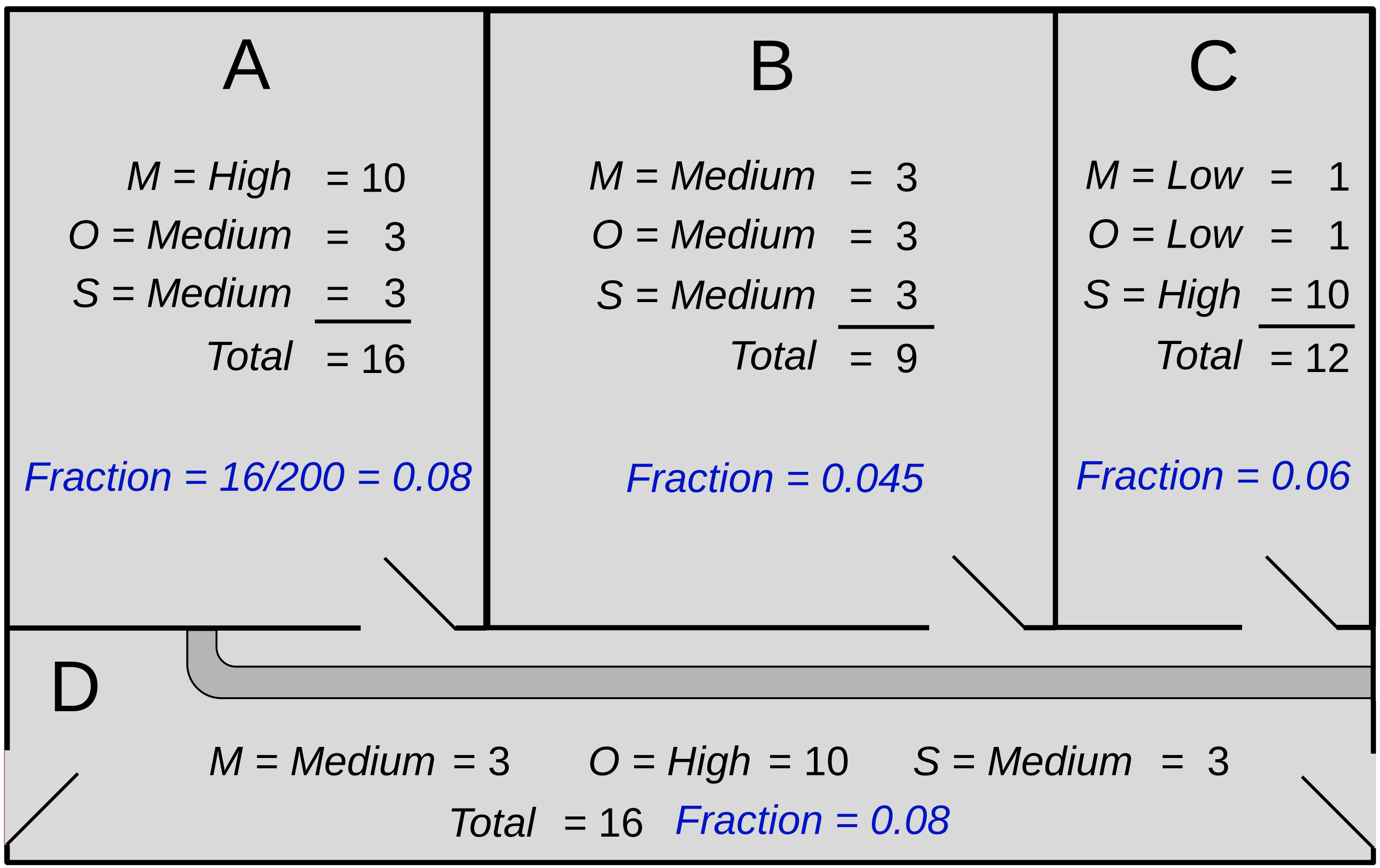
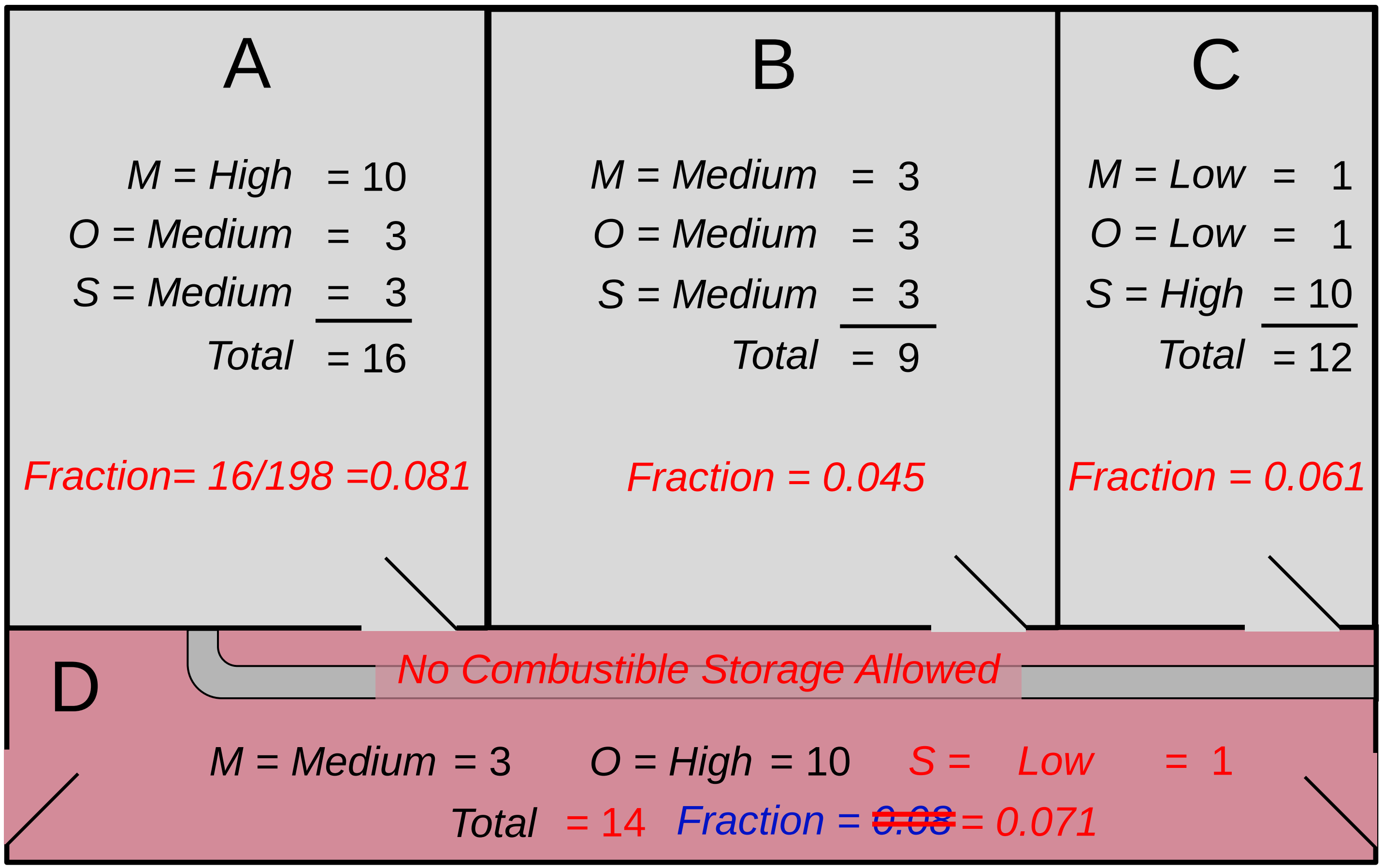
Simple Example



Comp. A = 16
Comp. B = 9
Comp. C = 12
Comp. D = <u>16</u>
Elev. Total = 53
Other Elevs. = <u>147</u>
Location Total = 200

Simple Example – Credit for Admin Controls



Comp. A = 16
Comp. B = 9
Comp. C = 12
Comp. D = 14
Elev. Total = 51
Other Elevs. = 147
Location Total = 198

Admin Control reduces Compartment D frequency by ~10%

Transient Ignition Source Operating Experience

- Bin 7 Events (Transients in Control/Aux/Reactor Bldg)

Event ID	Year	Description
55	1975	A fire occurred in Units 1 and 2 cable spreading room. Containment penetration sealant was ignited by a candle flame being used to check the penetration for leakage. Because of the pressure differential kept between the CSR and the RB, the fire quickly spread to the RB.
464	1985	Excessive grease in bottom of oven ignited and burned inside of oven.
650	1987	A leaking regulator ignited leaking propane.
1164	1992	A portable air compressor caught fire near the control room ventilation west air intake.
857	1992	Over load of electrical cables in Aux. Bldg. laundry trailer portable heater.
2253	1993	Light string laying on top of wood wire reel ignited.
2257	1994	IFO Notified of extinguished electrical fire. IFO responded to report. On arrival found water cooler away from wall and disconnected. Further review revealed a burnt wire connection on the backside of the cooler. The water cooler and a coffee pot were plugged into an extension cord.

Note: Two additional events with no description

Transient Ignition Source Operating Experience

- Bin 37 Events (Transients in Turbine Bldg)

Event ID	Year	Description
46	1974	A fire was discovered in a box of ping-pong balls, which are used to check the two banks in the heat exchanger for leaks. The cause is believed to be careless smoking. The fire was extinguished by an automatic sprinkler system.
1144	1975	Wood laying on hot steam line
1149	1975	Acetylene line broke and ignited the acetylene bottle which over-pressurized and the bottle blow off plugs blew off which prevented isolating the acetylene.
279	1981	Heavy smoke reported in shaft area. A heavy brownish color smoke was present. Fire team found two 55 gallon drums of lubricant being heated. One drum blew off cover and liquid bubbled out, emitting a heavy smoke from drum into area.
577	1987	Reactor at 50% power. Plant had a small fire (cardboard box filled with insulating materials) in the turbine building. Fire caused by discarded cigarette. Heat from the fire was insufficient to set off the sprinkler system.
1128	1988	Dry chem extinguisher and buckets of water were used to extinguish fire in waste receptacle

Transient Ignition Source Operating Experience

- Bin 37 Events (Transients in Turbine Bldg) - continued

Event ID	Year	Description
1050	1989	Trash can fire burned plastic bag liner and rags. No ignition source found, cause undetermined.
1119	1989	Over-current or internal short. Put fire out by tripping breaker and unplugging cord
972	1989	Ref. SOS 93-1905 Auxiliary Boiler had been running a long time. Due to an unusual Turbine Building ventilation lineup of 3 exhaust fans running and no supply fans running a negative pressure was developed in the Turbine Bldg. The hot exhaust gases from the Aux Boiler entered through a small leak in the roof seal.
1195	1990	Overheating of jumper cables ignited electrical insulation.

Note: Four additional events with no description

Characterization of Transient Fire Severity

- HRR for transient combustible fuel packages are recommended based on fire experiments
- Extract from NUREG/CR-6850:

G.5 Technical Basis for Recommended HRR for Transient Ignition Sources

Characteristics of transient fires should be determined by:

- Review of the maintenance and other activities performed in the area, and
- Review of past transient fire experience at the plant.

If the type and amount of combustible material that is expected or possible, based on this review, is bounded by the tested fuel package configurations in Table G-7, use Table G-1 for the recommended HRR probability distribution for transient fires and transient fires caused by hot work activities.

If not bounded by the fuel packages found in Table G-7, the HRR may be estimated using the characteristics of the combustible materials involved and heat of combustion from Table G-8. Note that this will result in a point value for the HRR. In this case the user should develop a representative distribution with adequate justification. An alternative approach is to use a single bounding HRR value with a severity factor of 1.0.

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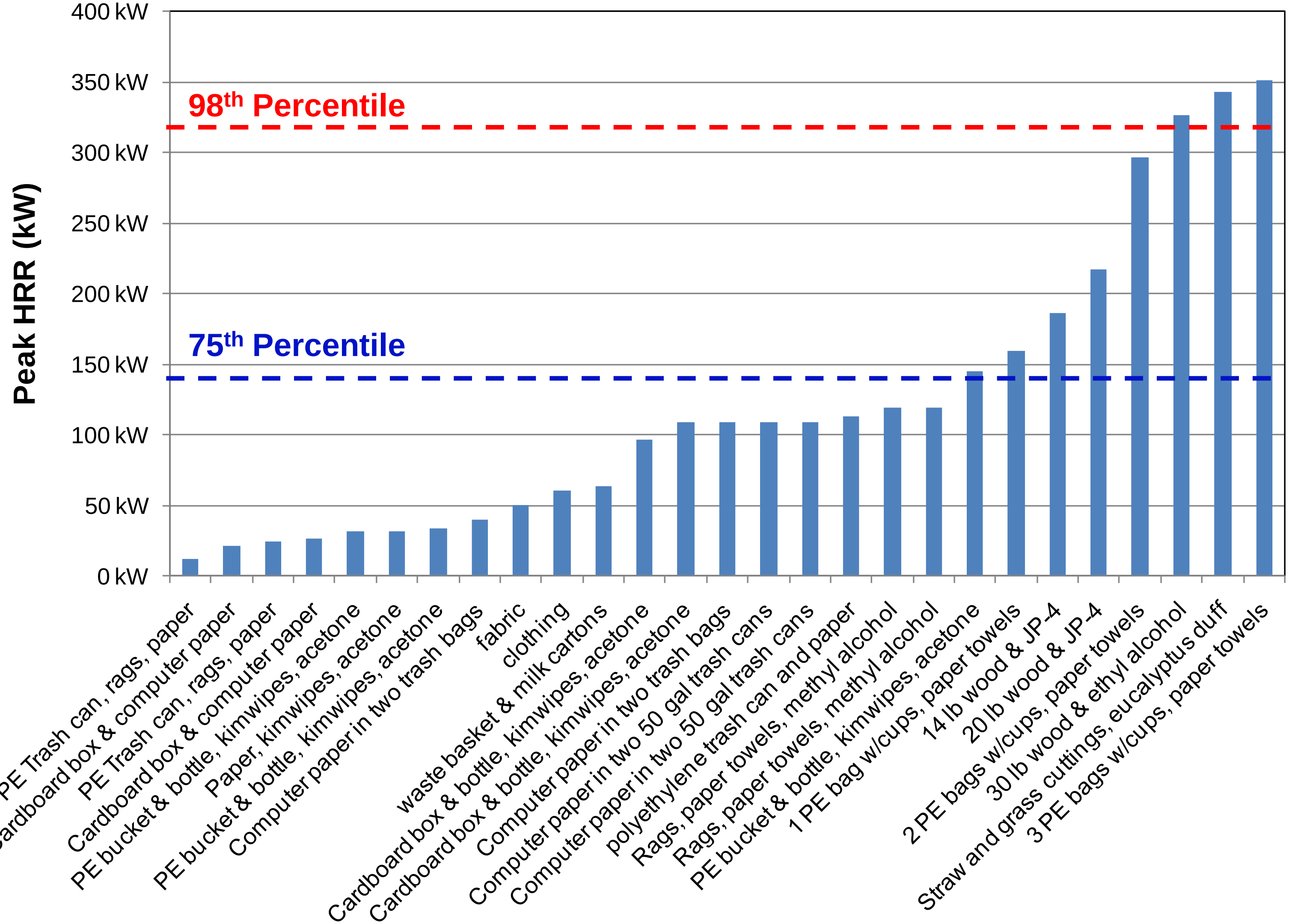
Characterization of Transient Fire Severity (Cont.)

- Transient fires severity characterized in NUREG/CR-6850

Ignition Source	HRR kW (Btu/s)		Gamma Distribution	
	75th	98th	α	β
Vertical cabinets with qualified cable, fire limited to one cable bundle	69 [1] (65)	211 [2] (200)	0.84 (0.83)	59.3 (56.6)
Vertical cabinets with qualified cable, fire in more than one cable bundle	211 [2] (200)	702 [3] (665)	0.7 (0.7)	216 (204)
Vertical cabinets with unqualified cable, fire limited to one cable bundle	90 [4] (85)	211 [2] (200)	1.6 (1.6)	41.5 (39.5)
Vertical cabinets with unqualified cable, fire in more than one cable bundle closed doors	232 [5] (220)	464 [6] (440)	2.6 (2.6)	67.8 (64.3)
Vertical cabinets with unqualified cable, fire in more than one cable bundle open doors	232 [5] (220)	1002 [7] (950)	0.46 (0.45)	386 (366)
Pumps (electrical fires) [8]	69 (65)	211 [2] (200)	0.84 (0.83)	59.3 (56.6)
Motors [8]	32 (30)	69 (65)	2.0 (2.0)	11.7 (11.1)
Transient Combustibles [9]	142 (135)	317 (300)	1.8 (1.9)	57.4 (53.7)

Note 9: Distribution estimated based on the range of the tested transient fuel packages summarized in table G-7.

Catalog of Transient Fire Experimental Results



Ref: NUREG/CR-6850, Table G-7.

Top Transient Ignition Source Fires (Table G-7)

Test ID	Combustibles	Peak HRR
LBL – 3 airline trash bags	• Three 11 gal. polyethylene trash bags (.035 kg, est.) • 36 polystyrene cups (.21 kg, estimated) • 51 paper cups (.45 kg, estimated) • Paper towels (2.73 kg)	351 kW
LBL - Rubbish Bag	• Straw and grass cuttings (1.55 kg) • Eucalyptus duff (2.47 kg) • 32 gal polyethylene trash bag (.04 kg)	343 kW
LBL – 30 lb wood crib	• Wood pieces, White fir (13.65 kg) • Wood excelsior, shredded and fluffed (.45 kg) • Absolute ethyl alcohol (.118 l) (~.75 kg, estimated)	327 kW
LBL – 2 airline trash bags	• Two 11 gal. polyethylene trash bags (07 kg, estimated) • 24 polystyrene cups (.14 kg, estimated) • 38 paper cups (.30 kg, estimated) • Paper towels (1.82 kg)	297 kW
LBL – 20 lb wood crib	• Wood pieces, Douglas fir (9 kg) • 100 cc (.95 qt) JP-4 (~.75 kg, estimated)	217 kW

Transient Fire Growth

- FAQ 08-052 provided transient fire growth rates for three cases:
  - Trash receptacles – 8 minutes
  - Trash bags – 2 minutes
  - Spilled liquids – immediate
- Rates for trash bags and receptacles based on the same experimental data as the peak HRRs

The assigned peak HRRs and fire growth rates do not comport with the operating experience used to define the frequency

Summary

- NUREG/CR-6850 – EPRI 1011989 acknowledges that

  "*Administrative controls significantly impact the characteristics and likelihood of transient fires, but they do not preclude their occurrence*"
  - However, no method provided:
    - Transient ignition source frequency allocation method does provide substantive credit for admin controls
    - Peak HRR guidance prescribes values that bound plant practices

- Other key shortcomings:
  - Lack of connection between transient fire events and fire characterization (i.e., HRR & growth rate)
  - Lack of treatment of need for ignition source for stored combustibles

Current Treatment of Transient Fires is a Screening Method, not a PRA

Response to Consultant's Questions

1. What is the total CDF contribution from transient combustibles
   - Varies, generally <10%
   - However, often includes departures from 6850 (see response to Item 4)
2. Problems with the allocation of transient combustibles among plant compartments
   - Emphasis on high risk areas
   - Lack of credit for admin controls
   - Emphasis on occupancy

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Response to Consultant's Questions

3. Concerns about the transient combustible heat release rates
   – Peak HRR and growth rate do not reflect the operating experience which drives the frequency
   – Intention to be bounding without regard to degree (see G.5)
4. Any "work-arounds" or departures from NUREG/CR-6850 guidance that are prevalent for the analysis of transient combustible fires.
   – Use of lower peak HRR for admin controlled areas
   – Severity factors applied to account for need for ignition source

Together…Shaping the Future of Electricity

Perspectives on the Treatment of Transient Fires

Steven P. Nowlen
Sandia National Laboratories

ACRS Reliability and PRA Subcommittee

December 13-14, 2010

Transient fires are a challenging aspect of fire PRA (1of2)

- **Transients are unique because they can bring a fire to critical PRA targets**
  - **Nominally, transients can occur at anytime and almost anywhere**
  - **The only credible fire exposure source for some target sets may be transients (no fixed sources)**
    - **Most common example is cable pinch points in cable spreading rooms or cable vault and tunnel areas**
- **The '6850' transient fire analysis attempts to reflect**
  - **The overall plant-wide frequency of transient fires**
  - **Apportioning that frequency to any given location based on the location characteristics**
  - **Modeling to reflect the nature of the transient fuel likely to occur in any given location**

Transient fires are a challenging aspect of fire PRA (2of2)

- **Part of the challenge is that the transient fire bins collect the "everything else" events and can be almost anything**
  - **Faulting portable electric heater**
  - **Spilled combustible liquids**
  - **Trash in various forms**
  - **Construction materials**
  - **Packing materials**
  - **Storage items**
  - **Collection bins for rad-protection gear**
  - **and on and on…**
- **There is no "one size fits all" answer when it comes to transients**
  - **One common misnomer is that '6850' recommends such an answer**

NEI 'Roadmap' report promulgates the one-size-fits-all solution myth (1of2)

- **The 'Roadmap' report states (§3.2.2):**

  "In NUREG/CR-6850, transient ignition sources are evaluated in three separate categories with specified frequencies (Bins 7, 25, and 37). The source for the assumed peak HRR is from tests performed on trash bags."

- **This statement is misleading**
- **'6850' cites numerous sources of data for a range fuel packages (e.g., tables G-7 and G-8)**
  - **Sources do include trash bags**
  - **Also includes trash in a trash can, wood, liquid fuels, boxes of paper, clothing, storage commodities…**

NEI ‘Roadmap’ report promulgates the one-size-fits-all solution myth (2of2)

- **6850 does suggest HRR distributions that would bound the tested trash fire configurations**
  - **These are recommended for use as generic profiles suitable to the initial analysis of transient fires in most plant locations**
- **Ultimately, the intent of the ‘6850’ method was to “model what you find”**
  - **Because the range is so wide, this is something analysts have to assess for their applications**
  - **The analyst should assess each location, review combustible control limits, and review plant records (e.g., violations of the control programs)**
  - **Based on review, develop transient fire profiles to suit the scenario-specific conditions**

A second related statement in the 'Roadmap' report

- **From §3.1.1:**

  "Another problem has to do with the nature of the actual events used in each bin and inconsistency with the specifics of the scenario for which the bin frequency is used. This is particularly notable for the transient fire ignition frequency bins where the content of the transient combustible in real events does not compare well with the associated fire experiments."

- **This is somewhat misleading**
  - **'6850' cited all sources of relevant experimental data that could be found**
  - **The available data does not cover all of the sources one might encounter in a plan and are not specifically tied to the actual events**

A third related statement in the 'Roadmap' report (1of2)

- **Following immediately after the prior citation:**

  "In addition, the allocation technique for transient ignition frequencies is relatively simplistic and does not adequately address administrative controls such as transient free zones."

- **While we can always improve, '6850' went further in its transient fire allocation methodology than any prior method**
  - **Prior methods generally applied a simple area ratio method**
    - **Identify 'critical' floor area within a fire compartment**
    - **Apply a 'location factor' based on critical-to-total floor area ratio**
  - **'6850' uses a two-step approach (§6.5.7.2)**
    - **A fraction of the plant-wide frequency is assigned to each compartment based on ranking of various attributes**
    - **Critical locations within a room are identified and potential for a transient to be present in that critical location is assessed**

A third related statement in the 'Roadmap' report (2of2)

- The fire compartment ranking considers:
  - Storage, Occupancy, Maintenance activities
  - Each ranked none/low/med/high (0-1-3-10)
  - Maintenance can be ranked very high (50)
- Allows for exclusion of some compartments
  - 0-0-0 ranking where precluded by design
- Allows a factor 70 difference in compartment frequency
  - 50-10-10 ranking versus 1-0-0 ranking
- Allocation within a compartment not explicitly discussed in '6850'
  - Examples were developed during pilot applications but were never published
  - A good area for enhanced guidance

Issues with hot work are similar

- **Hot work is another challenge for PRA**
- **Substantial credit is given for fire watch – prompt suppression**
- **'Roadmap' report (Figure 2-1) indicates relatively small contribution from various hot work fire bins**
  - **Bins are 3, 5, 6, 11, 24, 31, 36**
  - **The two "outlier" bins should be explored**
    - **i.e., Bins 5 and 6 - Control/Aux/Reactor Buildings**

Summary on transients and hot work

- These are areas ripe for enhanced guidance
- May be low "bang for the buck"
  - Despite the issues raised by NEI, both transients and hot work show up as relatively low risk contributors (NEI Figure 2-1)
- Potential alternative strategies for enhancement would be to develop rule sets that would limit scope of analysis, e.g.:
  - Key to these sources is, again, that they bring the fire to the target
  - Better screening methods might take advantage of that, e.g.:
    - If critical target sets are already threatened by credible fixed sources, transients and hot work are unlikely to change risk numbers or insights
    - A rule set that takes advantage of this perspective could be used to screen locations and thereby limit the number of scenarios that must be developed

Effectiveness of Adopting NFPA 805 in Transition to the Current Fire Protection Program

Presented by

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Presented at

ACRS Subcommittee Meeting

December 13, 2010

Purpose / Key Questions

1. **Could the limitations in current Fire PRA analysis methods or data lead to inappropriate conclusions during the NFPA 805 transition?**

2. **Are there other issues impeding or discouraging the transition process?**

Overall Approach

Information was collected by interviewing interested stakeholders.

- NRC Staff (8)
- Members of Licensees (7)
- Consultants (7)
- Others (e.g., NIST) (1)

Overall Approach

Topics discussed with interviewees:

- Level and type of involvement with Fire PRA and NFPA 805 transition
- Current status of the Fire PRA
- Patterns in CDF contributors
- Difficulties in applying NUREG/CR 6850
- Deviations from NUREG/CR 6850
- Sources of conservatism
- Impact of Multiple Spurious Operations (MSO)
- Peer review process
- Level of effort

Observations

Important notes:

1. **Almost all observations and conclusions are based solely on verbal information obtained from interviewees.**
2. **No attempt was made to gather complete or statistically viable information about a topic.**

Observations / CDF

CDF of Fire PRAs range between mid-10^{-5} to low 10^{-4} per reactor year.

- **Modifications were included in some**
  - – Cable Rerouting
  - – Raceway wrapping
  - – Incipient smoke detectors
  - – Additional seal injection pump train for PWR Reactor Coolant Pumps
  - – Oil drip pans under pumps
  - – Changes in administrative and operational procedures

Observations / Dominant Contributors

There is a general pattern among the dominant risk contributors.

- Common dominant contributors include:
  - Electrical cabinets
  - Main Control Room
  - Rooms with high concentration of cables
- Part of CDF for PWRs is sensitive to time to RCP seal failure
- In some cases, a large number of scenarios are collectively important risk contributors

Observations / Peak HRR

The peak heat release rate (HRR) of electrical cabinets is deemed to be conservative

- **Experts in fire experimentation consider the reported HRRs as possible under proper conditions.**

- **This is consistent with 75 and 98 percentile assignment of peak HRRs**

Observations / Fire Ignition Frequency

Ignition frequency model includes simplifying features that introduces a level of uncertainty not explicitly considered.

- **Total frequency the same for all plants**
- **Equipment power level has no effect**
- **Stand-by equipment same as normally running equipment**

These features certainly have an impact on the final CDF, but the impact could be either conservative or optimistic.

Observations / Transient Fires

Transient fire frequency is prorated to individual rooms based on a qualitative ranking scheme.

- **NUREG/CR 6850 provides values for the ranking scheme**
- **Spread in the ranking values too narrow for certain rooms**

Observations / MSOs

The use of Multiple Spurious Operations (MSOs) in Fire PRAs is a recent development.

- Minimal impact on resources
- Difficulties in incorporating in the plant response model

- Cases with significant impact on dominant scenarios
- Cases with significant impact on Main Control Room fire event recovery

Observations / Adherence to NUREG/CR-6850

There is a wide variation in adhering to NUREG/CR-6850 and the FAQs.

- One licensee chose not to include FAQs
- In another case, FDS was used in modeling fire inside an electrical cabinet
- Some people assume that NUREG/CR-6850 does not allow fire decay
- One consultant re-evaluated the raw data and came up with new probability values.

Observations / Peer Review Process

Peer review process is an important part of the use of Fire PRA in NFPA 805 transition.

- **Difficulties in early stages due to lack of experience**
- **Peer review teams have identified and challenged unacceptable or erroneous analyses**
- **Team members' experience has proven to be an important factor**
- **Difficulties in scheduling qualified peer reviewers has impacted the Fire PRA completion process**

Observations / Other Observations

It is common to find a handful of rooms with CCDP greater than 0.1.

Modeling human actions is an important part of Fire PRA.

The peak heat release rate recommended for pumps is too conservative for small pumps.

Level of effort has proven to be enormous.

Concluding Remarks

No single source of conservatism was brought forward by the interviewees.

- **Main Control Room is generally modeled conservatively.**
- **The fire risk model is based on a chain of inter-related parts (e.g., ignition frequency and fire propagation).**
  - **There is an element of uncertainty in the level of compatibility among different parts of Fire PRA**

Concluding Remarks

Important observations:

- **Analysts should refrain from re-interpreting the raw fire event data.**
- **Use of qualified peer reviewers is essential to ensuring that unacceptable methods are not used.**