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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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TUESDAY

DECEMBER 14, 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:

HAROLD BARRETT, NRR

RAYMOND H.V. GALLUCCI, NRR

DONALD HARRISON, NRR

ANDREW HOWARD, NRR

STEVE LAUR, NRR

CHRISTIANA LUI, RES/DRA

CHARLES MOULTON, NRR

MARK SALLEY, RES/DRA/FRB

SUNIL WEERAKKODY, NRR

JOHN LAI, Designated Federal Official

ALSO PRESENT:

PATRICK BARANOWSKY, ERIN Engineering

BIFF BRADLEY, NEI

KEN CANAVAN, EPRI

PAUL AMICO, SAIC

MARDY KAZARIANS, Kazarians & Associates, ACRS Consultant

DAVID MISKIEWICZ, Progress Energy

STEVEN P. NOWLEN, Sandia National Laboratories

DOUG TRUE, ERIN Engineering

RICK WACHOWIAK, EPRI

KIANG ZEE, ERIN Engineering

C-O-N-T-E-N-T-S

C-O-N-T-E-N-T-S (CONTINUED)

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

8:34 a.m.

CHAIRMAN STETKAR: This is the second day of a meeting of the Reliability and PRA Subcommittee. I'm John Stetkar, Chairman of this Subcommittee meeting.

ACRS members in attendance are Dennis Bley, Dana Powers, and William Shack.

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 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 Committee discussions.

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

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

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in The Federal Register.

A transcript of the meeting is being kept and will be made available, as stated in The Federal Register notice. Therefore, we request that participants in this meeting use the microphones located throughout the meeting room when addressing the Subcommittee. The participants should first identify themselves and speak with sufficient clarity and volume, so that they may be readily heard.

What we are going to do today is we are going to pick up with the agenda as it was published. We skipped one presentation from both EPRI and the staff yesterday on incipient fire detection. We will try to make room for that today. Can't promise. We'll see how the schedule goes.

But I think that the topic of electrical cabinet fires is probably of somewhat more interest to the Subcommittee. So, I want to make sure that we actually get to that topic today.

With that, I guess I will turn it over to Doug True and Rick Wachowiak.

And welcome, Rick. I'm really happy that you made it. It's a heroic effort.

MR. WACHOWIAK: It's good to see you all again.

CHAIRMAN STETKAR: Doug?

MR. TRUE: Okay. I'm Doug True from ERIN Engineering.

I'm going to cover electrical cabinets kind of in a holistic presentation here. Last time, in November, we kind of jumped around between topics and had a little of bit of electrical cabinets in a bunch of different places. This time we are going to try to put it together in one connected discussion. And I'm sure we'll have a lot of dialog on these topics.

Also, at your request, Mr. Chairman, we have the presentation from last time that we will go back to to talk about fire growth --

CHAIRMAN STETKAR: Good.

MR. TRUE: -- because that wasn't explicitly covered in here, or at least in the level of detail that we did last time.

CHAIRMAN STETKAR: Good.

MR. TRUE: So, as we talked about in the last PRA SC presentation, electrical cabinets are a significant contributor to the fire CDFs. There's no surprise there. It was the ridge line sort of on our now infamous skyline graph.

And the purpose here I think is to elaborate on the relationship between the methods from non-electrical cabinets and the large risk contribution, and sort of talk through why we see that happening.

And then, Rick is going to spend a little bit of time talking about some ongoing research activities that target some of these areas and cover what is actually being done with trying to address this.

So, we have our issues framework. I am just going to kind of quickly go through and say that, for electrical cabinet fires, I think there are things to talk about on very large number of our elements of this graphic, beginning with the ignition frequency estimate, talking about the severity, about non-suppression, how that gets handled in non-suppression, about detection and response, and its relationship with non-suppression, about the growth rate, about the heat release dates, about the fire propagation and damage, about suppression and control, about recovery actions, safe shutdown, and the operator response. So, it hits on very many elements of our issues framework, and this presentation tries to put that together in some sort of reasonably concise description.

So, what we are going to do is focus on a handful of the more important aspects of this. First is the fire ignition frequency, and we'll talk about growth rate a little bit. This is where I will probably jump out to the other presentation because I cut it way down in this version; the peak heat release rates, the non-suppression, propagation and damage, and operator response. And they are interrelated, of course, as all these things are.

So, let's start with ignition frequencies. Bin 15, as we know, is the electrical cabinet fires. It was split apart in a FAQ. Sort of the high-energy arcing faults were broken off into Bin 16a and b.

In NUREG CR-6850, EPRI 1011989, there were 109 events. The bin frequency, plantwide bin frequency, was .5 times 10 to the minus 2 per year. That was allocated across the count of cabinets that each plant had. And talked through about how there's some variation from plant to plant in the number of electrical cabinets. But it is the same principle as we talked about with diesel generators. Take that frequency and divide by the number of cabinets that qualify, and that is your cabinet-specific frequency.

In an EPRI Interim Report, EPRI came up with some new ignition frequencies, EPRI 1016735, that kind of split the population the pre-1991 and 1991 through 2000 bins, did a statistical analysis, and came up with a little bit lower frequency that reflected that trend that Pat Baranowsky showed you yesterday of the drop in events that both the Fire Events Database indicates as well as the NRC's tracking of severe fires. So, it was a little bit lower frequency.

In doing that work, EPRI detected that there was plant-to-plant variability in the data that had been involved and went through a hierarchical Bayesian analysis to create a more diffused prior distribution. And the result was a relatively broad uncertainty estimate for Bin 15.

The value of that broader estimate is that, when plants go to do their plant-specific data update, the mean value will move more if the plant has evidence. So, it was done in order to give a little more weight to the plant-specific evidence on electrical cabinet fires because they occur, and it was done because there was plant-to-plant variability. But the result of it is that it will allow plant-specific data to have more influence on the result.

CHAIRMAN STETKAR: Doug, I thought we heard -- nobody has yet done any of these plant-specific updating, is that correct?

MR. TRUE: They do it as part of each fire PRA.

CHAIRMAN STETKAR: Oh, I thought we heard yesterday that they had not done any of that, that they were only using the generic data.

MR. TRUE: I think somebody said, one person said they had only used generic, and, then, I think Kiang got up and said that he uses --

CHAIRMAN STETKAR: Okay, okay. Sorry.

MR. TRUE: -- the data, and Jim I think also is nodding that, too.

CHAIRMAN STETKAR: I misunderstood then. Thank you.

MR. TRUE: There is a little bit of a disconnect in the numbers. The 109 became more like 99, but it had to do with some screening and data cleanup that occurred in the EPRI work. I don't think there's any point of contention over that.

CHAIRMAN STETKAR: Doug, just out of curiosity, were you involved in that rescreening yourself?

MR. TRUE: I was not personally.

CHAIRMAN STETKAR: You were not?

MR. TRUE: But ERIN was.

CHAIRMAN STETKAR: Okay.

MR. TRUE: And the person who was is here, if you want to talk to him.

CHAIRMAN STETKAR: He is? Well, I'm curious whether -- it's, you know, you can talk about factors of two, but it is a fairly dramatic change if you consider also the change in the population over those two time periods, at least for the `68 through `90 time period.

Do you happen to know whether the reduction in events that are retained in the database is due to what I would characterize as a real reduction in the fire frequency or is it only because we have more information in the later events, and therefore, can more easily conclude that a larger number of events were not valid fires?

MR. TRUE: I don't know.

CHAIRMAN STETKAR: You don't know?

MR. TRUE: Pat?

MR. BARANOWSKY: Pat Baranowsky.

For the kinds of events that are counted in the fire ignition frequency, the so-called potentially-challenging ones, they have characteristics that at least I'm pretty confident that we're getting all or almost all of those events identified. It is the ones that were undetermined that were a little problematic where the .5 factor was used that we're not quite sure. Now I guess there's a possibility more than half of them could be real fires, and you would slightly underestimate, but I, frankly, doubt it. Because of the nature of potentially-challenging fire events, everyone would recognize them. But that's my opinion.

CHAIRMAN STETKAR: Okay. Thank you.

MR. TRUE: Okay. There was a FAQ, FAQ 48, that addressed the new EPRI data and the use of that data in the 6850 application for NFPA-805. That FAQ requires the use of both those frequencies for the baseline risk and delta risk calculations.

I pulled the quote right out of the FAQ. It says that "the large uncertainty bin fire frequency is due to the sparsity of data for that bin and, therefore, the potential for significant changes should the post-2000 fire event data differ significantly from the 1991-2000 data."

Basically, what they're saying is that any of the bins that had large uncertainty, you should do the sensitivity study using both values. The problem is that this bin has the most data of all, of all the bins, because it has the highest frequency of all the bins. But because of the plant-to-plant variability and the additional uncertainty that was built in in the hierarchical Bayesian analysis, it was interpreted as being sparse data. So, we aren't allowed to actually use that value, the upper value in these analyses.

And that is one of the reasons why some plants have been loath to sort of jump on to using all this data, is that there is this caginess about whether that is really good data or not to use. So, that is one of our problems, and it is about a factor of two, a little less than a factor of two, on that original line that we like to show in that graphic. So, that's one concern that we have.

Any questions about that?

CHAIRMAN STETKAR: No. I think we'll have questions for the staff.

MR. TRUE: Okay. Fire severity. Fire growth and peak heat release rates, as we talked about in the last meeting, are based on tests investigating large electrical cabinet fires. Many of them used accelerants or some kind of flame source. They were qualified and unqualified data. Data was kind of commingled. There were lots of open cabinets. And there was a relatively small number of sub-bins used to define the peak heat release rates.

The distributions that are used were anchored to this 98th and 75th percentile. And according to 6850, the 98th percentile was used to establish the high-confidence fire intensity that was expected to bound the vast majority of fires involving a given fire source.

Again, this is kind of where we get stuck in this bounding thing, and we've got this ignition, these events that reflect one thing. Now we're anchoring this to a bounding value to make sure we've got everything, the consequences all bounded.

And there's no evidence or little to no evidence that the things that we have in the ignition frequency bin reflect the 98th, much less the 75th -- or 75th, much less the 98th percentile. I mean there have been some serious fires, but most of the really exciting fires have been the high-energy arcing fault ones, not the ones that start in a cabinet and evolve.

So, probably this is the point where it would make sense to go and talk about the 12 minutes. So, I am going to go back to the presentation from November 16th. It was one called "The Roadmap".

CHAIRMAN STETKAR: Do we have paper copies of this, John? Can we get it because Dennis and Dana were not here in November.

MEMBER SHACK: We have electronic ones that John sent to us.

MR. TRUE: So, NUREG/CR-4527 is one of the main sources of data for the fire growth estimates in EPRI 1011989, NUREG-6850. Then, it turns out it is the primary basis for the 12-minute fire growth rate assumptions.

The tests were done in a variety of different forms, and Steve Nowlen can provide a lot of background on this. But most of the tests involved an ignition source that was a polyethylene bucket. They had a pound of kimwipes doused with some acetone. They had a pretty substantial flame height and burned for about 35 minutes.

And according to the report, when they did the first couple of tests, they had difficulty getting the burn to be sustained. So, they would pull the cables physically apart in order to get it a better chance of igniting and burning.

So, this is a graph of a test that is just the heat release rate for the polyethylene bucket with kimwipes and acetone. It shows the heat release rate, and it shows that, after about 35 minutes or so, it starts to tail off, and that it ramps up over a period of just about 12 minutes. And it stays relatively constant. I mean it is pretty impressive how steady-state it actually got to over that 25-or-so-minute period of full burn.

So, I have traced that with a red line here that we will use again here as we compare it to some of the other tests.

So, this is a graph right out of 4527 also that is another set of tests, a different scale, of course, because some of the tests had substantially larger peak heat release rates. It shows a set of five tests.

The first, test 1 and test 2, had no propagation and the bundle didn't burn. So, not surprisingly, if you lay that red line over the top, it looks an awful lot like those first two tests.

And if you, then, also look at these other tests, they all ramp up to about the 12-minute mark, where they're hitting their peak and then tail off.

It appears from this data -- and the report is not particularly clear on this -- but it appears that all of these still include the peak heat release rate from the source. I guess I will be interested to hear if that is the case, but --

MEMBER BLEY: I'm sorry. Say that again. I didn't hear what you said.

MR. TRUE: It appears that all these peaks include the source because tests 1 and 2 are basically the same trace as the source.

MR. NOWLEN: Yes. Steve Nowlen.

Just to be clear, that's absolutely correct. These are total heat release rates -- I'm sorry -- total heat release rate versus time for the fire. So, it includes the source. They're all that way.

MR. TRUE: Thanks, Steve.

Okay. So, if we turn, then, to the data table that represents these tests, ST 1 through ST 5, we will see, for example, ST 5 says the peak heat release rate is 132. Let's see if I can do this this way. And that's ST 5, which is 132. So, it tracks with the data in the report.

Another thing about this data was that many of these open, unventilated cabinets, which that's not totally representative of our electrical cabinets today in plants. Some have certainly grills, but no doors. And the first couple didn't actually have any significant damage involved with them.

So, other tests that were included. These were preliminary cabinet tests. We had one that had 15 gallons of heptane used as its source, and then we had some others involving benchboard cabinets that were also included into this, into these results.

So, this was the table right out of 1650 that has a compilation of all these tests and a handful of others. It shows that the peak heat release rate is all in that relatively short period of time.

It is sort of a mixture of qualified and unqualified cables and the different ignition sources. To be fair, there was one electrically-initiated fire in 4527 and another one down here in another test. So, there were a couple of electrically transient. When they talk about ignition source, it is a term that was used to describe the polyethylene bucket and kimwipes as the ignition source.

CHAIRMAN STETKAR: Doug, on those electrically-initiated fires -- and Steve will probably jump up here --

MR. TRUE: He probably should.

(Laughter.)

CHAIRMAN STETKAR: Just get ready here upfront.

How were those ignited? Because the interesting thing I see in this table is that the time to develop the peak heat release rate for those two particular tests are 12 and 17 minutes. One is pretty close to the magic 12 minutes that we're talking about. One is a little bit longer. How were they ignited?

MR. NOWLEN: Sure. What was simulated is a poor connection at a terminal block. That connection is simulated with a resistive washer placed between the incoming power line and the back side of the terminal block.

The power level for that was 165 watts, so a large lightbulb. The idea was to see if a fault that would not be tripped by a typical circuit breaker would be enough to induce a fire in the wiring. And the answer was, yes, it could be done.

Now the growth times that are reported here are actually from the first observation of when there was a flame that would form.

CHAIRMAN STETKAR: Okay.

MR. NOWLEN: So, there is a period before that where the heating occurs over a relatively long period of time. About a total from when we first turned it on to when the first flame would appear would be about 30 minutes, typically.

During that period, that are actually little wisps of smoke that would come off. And one of the things that we do say is, if you have in-cabinet detectors, those were actually very effective at picking up that early heating behavior. But without the in-cabinet detectors, if there was just a detector on the ceiling, for example, you would not pick that up.

CHAIRMAN STETKAR: Sure. Yes.

MR. NOWLEN: So, these reflect from the point of open flame to the peak heat release rate of the cabinet. And again, there's guidance that, if you have an in-cabinet detector, you take another 15 minutes. So, you know, your detection time, you get to add 15 minutes to it.

CHAIRMAN STETKAR: Okay.

MR. NOWLEN: Does that make sense?

MR. TRUE: Yes. And then, this steady burning, was the electrical source removed at some point or was that --

MR. NOWLEN: Yes.

MR. TRUE: Because they are both zero duration at steady --

MR. NOWLEN: Yes. Well, that's because they peak -- these were some of the largest of the fires. These are the ones where the 98 percentile values tend to come from. These were the full mockup cabinets in the control room mockup. And they tended to grow very rapidly and then burn out. So, there wasn't a growth to a steady-state followed by decay. It came up and then started on its way down.

But these are the fires that were above a megawatt. You know, some of these, especially the benchboard cabinets, and whatnot, these were 1.5 megawatts, 1.8 megawatts. And it's that that tended to drive the 98 percentile.

MR. TRUE: But my recollection is in 6850 -- sorry, I shouldn't be probably asking questions.

CHAIRMAN STETKAR: No, no, go on. Just talk. You're on the record. It doesn't make any difference.

MR. TRUE: It was that you take the 12-minute rampup rate, and then there's a 30-minute duration or some duration that you assign to this also for input to your fire modeling?

MR. NOWLEN: Right. I think the guidance was, if you don't know any better, if you can't examine the internals, you don't know what the total fuel load is, take a 12-minute rampup, 12-minute steady-state, and then let it burn out.

If you know what the fuel load is, then you should follow the rampup, hit the steady-state, and whenever you run out of fuel, you burn out.

MR. TRUE: Okay.

MR. NOWLEN: But there was a generic, if you don't know any better, do this.

MR. TRUE: Yes. Okay.

CHAIRMAN STETKAR: Thank you.

MEMBER BLEY: Thanks.

MR. TRUE: This is more about the qualified cables and ability to continue a fire.

Let's see, there's probably one other thing. This one is actually in the other presentation. So, it is probably worth just a little bit of discussion. And I'm sure this will be a topic for later.

For qualified cable cabinets, there are basically two bins, one with one cable and one with more than one cable. The 98th percentile and the 75th percentile on the two different distributions are anchored to the same test -- it's reference 2 -- which is done by VTTC. It's actually an unqualified cable test.

And our infinite 702 was qualified cables, but it is benchboard, but it is applied to all vertical cabinets. And that is another problem that we are concerned about, is we've got this kind of all vertical cabinets are the same thing. You know, these drive the distribution. If you anchor it at these two points, then you're going to end up with whatever distribution you have.

And I think more refinement to that, and down here in the unqualified cables, there are open -- they have consideration of ventilation, closed doors and open doors. We think there's some of that that could be applied also to the qualified cable cases. That is some of what Rick is going to talk about in terms of the ongoing EPRI research.

MEMBER BLEY: Doug?

MR. TRUE: Yes?

MEMBER BLEY: Would you tell me what it means to anchor it at both of those two points?

MR. TRUE: That's just what they said they did.

MEMBER BLEY: Oh, okay.

(Laughter.)

That's enough.

MR. WACHOWIAK: What that essentially is is you use those points and you fit the distribution. So, that it's of the 75th and 98th pass through those two points.

MEMBER BLEY: Oh, okay. Or you can use the parameters of --

MR. WACHOWIAK: That's how they determine the parameters.

MR. TRUE: And that's how they even set the parameters.

MEMBER BLEY: Oh, that's how they set the parameters.

MR. TRUE: They pick these two points, and then they pick the parameters.

MEMBER BLEY: Well, any two of the four gives you the distribution.

MR. NOWLEN: Yes. This is Steve. That is correct. We used judgment to pick two values, one that we thought was upper-bound for the case and one that was a -- initially, it started out as the 50th percentile. We said, what would be the sort of median value you would expect? And as we looked at the distributions, we said, no, these are just too high.

So, the 50th percentile got moved out to the 75th percentile. Then, we drew the curves and calculated the alpha beta factors, and it was that simple.

MEMBER POWERS: How did you decide it was the 75th? I mean you said it wasn't the 50th.

MR. NOWLEN: Well, again, this was an evolving process involving the writing team, both the EPRI and the NRC team, plus our peer reviewers. We wanted to do something better than what had been in the EPRI fire PRA Implementation Guide. And you will actually notice these numbers are mirrored in the EPRI fire PRA Implementation Guide.

So, what we did is we looked at the numbers that had come out of that work and said, how are we going to deal with these in our approach? And we started out, the first cut was, well, let's take their upper-bound and call it the 95th and let's take their mean value and call it the 50th.

And we looked at how that played out in terms of the distribution, and it was unanimous agreement that that was just too aggressive in terms of the fires, that it didn't reflect the data well because we were looking at the events as well. You know, we were seeing a lot of the cabinet fires that went into the fire frequency were quite small, and they didn't rise to this level.

So, we looked at it, and we said, no, half of the fires that we are counting for frequency are not this big. So we said we want to move these out. So, again, as a team, we worked through and said what's a reasonable representation of the event data that we're seeing. And again, given that we have to consider that, in reality, we put fires out, this is a picture of what happens to a fire if you don't put it out, right? You just stand back and let it burn, because we do the suppression piece separately.

And this was our judgment. We decided to move the median value out to the 75th. The 95th we moved out to the 98th. And we looked at the profiles and said that's better; we like that better.

MEMBER POWERS: But, I mean, you're saying it's just aesthetics, is the only thing that drove you to do this number? I mean you could have made it the 99th percentile, for all I know, or the 97th.

MR. NOWLEN: Yes, I wouldn't say it's just aesthetics. I mean it was judgment. We were trying to match what we felt was representative of both the test data and the events that we were counting in fire frequency, and this seemed to be a reasonable match.

MR. TRUE: We brought up the 211 and 702.

We're going to go back to the other, today's presentation for a minute.

CHAIRMAN STETKAR: One of the things that I think -- maybe you're going to cover it in this one -- that, also, some of those heat release rates are used for other equipment in NUREG CR-6850, in addition to cabinets. Is that correct?

MR. TRUE: Yes. It is not in this presentation because it's a different ignition bin. But pumps and motors use an electrical cabinet value of 69 kW. I mean the report's clear; they didn't have any data. They picked it because it was felt to be conservative.

And I think Dan Pace's presentation yesterday. He talked about that it's the big circ water pump as well as a little sump pump. As long as it's greater than 5 horsepower, it gets counted in the same way.

CHAIRMAN STETKAR: Okay.

MR. TRUE: It looks like Steve wants --

MR. NOWLEN: Yes, I'm getting the feeling maybe I ought to join him up there.

(Laughter.)

But that is correct. I mean, when we went to some of these other sources, we couldn't find any data at all. We couldn't find a single test where anyone had burned a motor.

So, we said, well, we need to say something. So, let's go ahead and tie it to the values we already have.

And again, there are some expectations built into the way we treated some of this. We really didn't think motors were going to turn out to be a really heavy-hitter on risk. I think the distributions bear that out.

So, we felt that if we tie it to these lower-level cabinet fires, that would be conservative. It's likely going to give them the tool they need to screen these out, and that will be the end of the story. That's how it developed.

CHAIRMAN STETKAR: Thank you.

MR. TRUE: This graphic I think was shown to the ACRS once before a couple of years ago by Ken Canavan. It's a compilation of the qualified vertical cabinet tests, the actual tests involving vertical cabinets, excluding the benchboard test. It shows the actual values versus fuel loading. Basically, all the tests came in less than 100 kilowatts. Our distribution has the 98th percentile up here at 702 and the 75th percentile at 211.

So, we first looked at this, and, then, there is the other sort of tertiary issue. I wouldn't say it's a huge issue, but each of these values all still included that ignition source 30 kilowatts. So, those actually coming down a little bit more for that, if you are talking about just the heat-induced by the fire, the electrical cabinet burning itself.

MEMBER BLEY: So, what are you suggesting from this figure?

MR. TRUE: I'm suggesting that qualified cable cabinets, vertical cabinets that have qualified cable probably deserve a different distribution of heat release rates. And there's an EPRI activity going on to look specifically at that topic, whether we can discriminate a little bit more on different types of cabinets, from the test and some other analysis that is being done.

MEMBER BLEY: Just as a subset of --

MR. TRUE: A subset, just subdividing. I know there was some objection yesterday to this consideration, this concern of simplifying and bounding assumptions. Well, this is sort of an example. We have one bin that collects everything into it. Then, it's applied these sorting of bounding cases to it.

We are trying to come up with a technical basis for subdividing, so we can get a little bit more realistic slice put together for that piece of it.

MEMBER POWERS: But you want to use a gamma distribution on this?

MR. TRUE: I am not involved in that project. So, I don't know what they're going to use.

MR. WACHOWIAK: The intent at this point is to stick with the gamma distribution.

MEMBER POWERS: Why?

MR. WACHOWIAK: It's a good question.

(Laughter.)

I don't have the answer to that question.

MEMBER POWERS: Well, it's the maximum entropy distribution for a specified mean. And I could go through a justification that way.

MR. WACHOWIAK: Right. I do know that in the report we're looking, we looked at other types of distributions. And for some of the types of vertical cabinets, especially with the qualified cable, other distributions were suggested. And as I said, that report is still under peer review, and we could look into the cabinet or into the distribution.

MEMBER POWERS: No, you simply don't have enough data to empirically define the distribution.

MR. WACHOWIAK: That's part of the problem.

MEMBER POWERS: So, you've got to have some other theoretical basis for doing the distribution. Maximum entropy distributions at least have the virtue of being maximum entropy.

(Laughter.)

That's about all you can say about them. Now parameterizing them based on hypotheses about which data point corresponds to the 98th or the 75th percentile is probably not that unusual, but I think it's difficult to defend.

I mean I would tend to say, okay, I've got a mean and I'm blatantly going to take a maximum entropy based on a mean and calculate the distribution based on that. And the numbers fall where they may. And if people don't like that, they could define their distribution. Because you just don't have enough data to go out and empirically define the distribution.

MR. WACHOWIAK: That's one of the concerns there, is that there's a few points, and we know that these data points don't necessarily really represent the distribution of what we're trying to model. So, it's a difficult problem.

One of the reasons why during the peer

review we chose to stick with the distributions that were selected in 6850 goes back to part of what was talked about yesterday in the implementation of 6850. If the distribution in 6850 is there, it's easy to get acceptance that it's okay to use that distribution. If we pick some other distribution, we need mounds and mounds of information justifying the different distribution. So, the burden of proof, if you will, is much greater on choosing something that's other than 6850.

CHAIRMAN STETKAR: Rick, are you going to talk about the program at EPRI to address it?

MR. WACHOWIAK: Yes.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: Yes, I've got a couple of slides, and we can elaborate as much as we need. And we've got one of the authors here in the audience with us.

CHAIRMAN STETKAR: One question before you move off this slide. It is somewhat relevant to the path forward.

You're careful to show that these are cabinets that contain qualified cables.

MR. WACHOWIAK: Yes.

CHAIRMAN STETKAR: In a typical plant,

what fraction of the cabinets contain only qualified cables? Do you have any notion of that? I mean, in practice, are we actually restricting this effort to what may be a fairly small fraction of the total number of cabinets? Because some cabinets may have only unqualified cables, depending on their purpose, or some fraction may have a relatively undetermined mix, let's say.

MR. TRUE: Yes, I should say, and Rick should say, that the EPRI work is not limited to qualified cables --

CHAIRMAN STETKAR: Okay. Okay. Good.

MR. TRUE: -- as maybe the poster child sort of this.

CHAIRMAN STETKAR: Yes. I mean, whenever I see these things like this, I start to wonder about what fraction of the real problem is this addressing.

MR. TRUE: Right. I think they are trying to address the whole spectrum of cabinets. Is that right, Rick?

CHAIRMAN STETKAR: We'll get to it later when we talk about the actual program. Thanks.

MR. TRUE: So, the growth rate is based on those same tests used for the peaks that use the accelerants and flame sources, the mix and match of the qualified cables.

And it doesn't appear that these fit what we see in the actual operating experience, and this greatly influences the damage magnitude and the timeline for suppression and/or operator response. So, it carries through into not just what's damaged, but, then, how long do you have for operators to take actions in response? And that affects the PRA response model. So, it's one of those things that has more tentacles into the actual calculation than just how fast does this fire get from zero to that big fire.

The experience in the databases, as best you can interpret from the data we have, the vast majority of them are manually suppressed. That is, there is no automatic suppression that is putting these fires out.

CHAIRMAN STETKAR: Okay. That's a simple -- I'm going to interrupt you a lot.

MR. TRUE: That's fine. Great.

CHAIRMAN STETKAR: This is normal.

MR. TRUE: Yes.

CHAIRMAN STETKAR: In my experience, that's mostly because most of the locations that contain these cabinets do not have automatic suppression systems, is that correct?

MR. TRUE: Right.

CHAIRMAN STETKAR: Okay.

MR. TRUE: Right.

CHAIRMAN STETKAR: I just want to make sure that --

MR. TRUE: I wasn't trying to say that --

CHAIRMAN STETKAR: -- manually suppressed because that's the only way to put --

MR. TRUE: -- people are faster than automatic systems at all.

(Laughter.)

CHAIRMAN STETKAR: Okay.

MR. TRUE: It was mostly the experience as we manually put them out.

CHAIRMAN STETKAR: Because you have to put them out manually?

MR. TRUE: Right.

CHAIRMAN STETKAR: Okay.

MR. TRUE: Either by de-energizing or by actually shooting them with one or more fire extinguishers.

CHAIRMAN STETKAR: Sometimes, you know, the implications of those bullets might be that people are so good, that these fires are so small, that the automatic systems didn't even have a chance to work well.

MR. TRUE: Definitely not the way it was intended to be taken.

If we set aside the HEAFs, then we have very few electrical cabinet fires that have resulted in damage to nearby equipment, even within their own cabinet or array of cabinets, much less cable trays above.

We have a FAQ that provided some improved credit for manual suppression, but this rapid assumed growth rate gets overlaid on that. And so, it affects our ability to suppress.

And, then, I have brought this up a couple of times, that part of the longer-term research -- and, hopefully, we'll get some of this out of the fire database work -- sometimes they don't actually suppress. They will just take some action to control because the fire doesn't look like it's threatening equipment. And we think there's probably some basis to be able to credit control as a sort of interim step before actually extinguishing the fire.

The FAQ 42 talks about propagation outside of well-sealed cabinets. And there was originally in that FAQ the industry has proposed some sort of probabilistic treatment of fire propagation within cabinets that didn't meet this well-sealed definition.

CHAIRMAN STETKAR: I was just thinking. Back to the last slide, the last bullet there, I guess I don't appreciate the difference between control versus suppression. I mean I understand what you're talking about, but in terms of application of the guidance, are the fire suppression curves, the time curves, in 6850 actual extinguishment of the fire or is it simply a combination of control and extinguishment?

MR. TRUE: No, it's just extinguishment.

CHAIRMAN STETKAR: It is full extinguishment?

MR. TRUE: Yes.

CHAIRMAN STETKAR: Okay.

MR. TRUE: Yes.

CHAIRMAN STETKAR: Thanks. Then, I understand.

MR. TRUE: I am actually not convinced the control personally -- this is just me talking now -- is as big an issue for electrical cabinets as it is for some of the other fires, where they may just let them burn out, but make sure that no other equipment is being damaged. But it's an issue we have raised and it should be looked at for this. I don't know that probabilistic we're going to get a whole lot of --

CHAIRMAN STETKAR: It will make a big difference?

MR. TRUE: I wouldn't put it as a high priority for sure.

CHAIRMAN STETKAR: Okay. Okay. Thanks. I just wanted to make sure I understood the subtleties there.

MR. TRUE: Yes, right now, it is only credit, we anchor the non-suppression recovery curve based on actually being extinguished.

CHAIRMAN STETKAR: Extinguished fully, whatever they call it? Extinguished.

MR. TRUE: Yes.

CHAIRMAN STETKAR: Okay. Thank you.

MR. TRUE: So, FAQ 42 talked about propagation outside of well-sealed cabinets. And in the original FAQ, the industry had proposed probabilistic treatment of fire propagation within cabinets that didn't meet this well-sealed definition.

As part of bringing the FAQ process to closure, that piece was taken out of the FAQ and sort of set aside, and we'll get to it later. It's one of those ones that we need to kind of come back to at some point.

The FAQ process, the staff felt they needed to drive it to closure. So, some things got left out. That's one that we think needs to be brought back. Because, right now, we're propagating it everywhere in the cabinets.

So, any MCC fire basically damages the entire cabinet.

CHAIRMAN STETKAR: When you say "the entire cabinet", do you mean the entire cabinet or the entire MCC?

MR. TRUE: Well, this is where it gets a little bit tricky in how you count cabinets and stuff. I probably should have somebody who is an actual --

CHAIRMAN STETKAR: But I'm asking from a practical --

MR. TRUE: It is basically the whole stack goes.

CHAIRMAN STETKAR: I'm asking from a practical implementation how are MCC cabinet fires -- because I understand how cabinets are counted.

MR. TRUE: Right.

CHAIRMAN STETKAR: How are they modeled in a typical fire PRA? Does a fire in any MCC cabinet disable the entire MCC?

MR. TRUE: Yes.

CHAIRMAN STETKAR: The entire MCC --

MR. TRUE: It's assumed to because --

CHAIRMAN STETKAR: Okay.

MR. TRUE: -- there's no other treatment for that beyond that.

CHAIRMAN STETKAR: Okay. And you're saying that there may be some evidence that that actually does not occur in practice?

MR. TRUE: Yes. The industry believed they had I think it was like a .2 probability that it could be justified for that --

CHAIRMAN STETKAR: Okay.

MR. TRUE: -- a .2 probability of propagation, I believe it was. So, 80 percent of the time it doesn't actually get outside of the MCC.

CHAIRMAN STETKAR: Oh, outside of the MCC? I'm talking about damage to the --

MR. TRUE: The initial --

CHAIRMAN STETKAR: I thought you were talking about in-cabinet effects here and refining the level of damage within the MCC. In other words, how many actual motor contacters are disabled by a fire in the cabinet.

MR. TRUE: Kiang, can you help me out here?

CHAIRMAN STETKAR: But what I want to understand, though, is a lot of the experience says that, if I have a fire in a motor contacter, I get combustion products and I tend to trip the supply to the entire MCC. And usually, after a fire, if I'm an operator, I'm not going to go reclose that circuit breaker --

MR. TRUE: Usually.

CHAIRMAN STETKAR: -- unless I'm at certain plants who decide that they like to do that, for example, and the fire is worse.

(Laughter.)

We won't name a plant name.

(Laughter.)

MR. TRUE: Yes.

CHAIRMAN STETKAR: But a prudent thing would be to not do that. So, it's not clear whether you're doing an internal cabinet propagation, whether or not the overall effects are any different.

MR. TRUE: Right.

MR. ZEE: This is Kiang Zee, ERIN Engineering.

You're correct. What's typically done for all MCC fires is every fire that is postulated in an

MCC at a minimum starts with loss of power at that MCC.

CHAIRMAN STETKAR: Okay.

MR. ZEE: Either because of the variable you describe or what could likely happen is the fire brigade may require that the unit be de-energized before they apply suppression.

The issue I think we are dealing with here is the aggression heat release rates and growth times, and when you apply that in fire modeling space and the FAQ 42 will typically result in most MCCs not being considered well-sealed despite the mechanical --

CHAIRMAN STETKAR: Oh, okay. Okay.

MR. ZEE: -- interlocks on the door.

So, consequently, if you pull through the way the data progresses, you could predict virtually every MCC fire will have propagated beyond the enclosure by the time the fire brigade applies suppression.

CHAIRMAN STETKAR: Okay.

MR. ZEE: And that's where you get into a little bit of disconnect.

CHAIRMAN STETKAR: Okay. Thanks. That helps me because I thought the entire context of this slide was really focused on effects within an MCC, trying to focus on how many motor contacters might be damaged, but it is related more to the external effects.

MR. ZEE: Yes.

CHAIRMAN STETKAR: Thank you.

MR. TRUE: I sort of already covered on this, but the rapid growth rate reduces available time for operator actions. So, when we have things like fire damage in a valve that needed to change positions or spuriously operating a valve, because these are growing so rapidly, that response time is shortened, which gives higher human error probabilities, which further exacerbate the quantification.

And, then, in a number of cases, we think that it results in unrealistic human error probabilities coming directly out of these assumptions.

So, back to one of our themes that I think Dan Pace started with yesterday, it is just compounding. We have got, we think, the frequency of the fires is overstated. We think the growth rates are too large. In certain cases, the peaks are too large, and the damage doesn't really comport with our operating experience such that we end up pushing the fire PRA in a direction that departs from reality.

In the FAQs, there have been some places where it they have really helped. But we think they are still short of providing realistic methods in a number of areas.

I think Rick's up.

MR. WACHOWIAK: So, some of the related things that we're doing to alleviate the problems that Doug was talking about are related to the things that are in the research matrix.

You heard yesterday about the fire events database. We are looking at confirming the trend in the ignition frequencies and to provide some better distributions for the plants used as the prior.

We think we can look into the events that are being counted, and because we're collecting more data on the newer events, that we will be able to get a better handle on what was actually going on with the manual suppression and maybe get some insights on the fire growth and the damage from these events. That is mainly a consequence of the way that we are collecting the data to get more information on these.

Another thing that we're looking at is the binning structure for the cabinet fires. And this relates to one of the reports that we are in the middle of reviewing right now that addresses what would the peak heat release rate be. How do you subdivide this bin that Doug was talking about?

Go ahead.

CHAIRMAN STETKAR: I'm kind of intrigued by this because I can hear what you're saying you're planning to do. It's not clear to me how it will actually be accomplished. And yet, we're hearing that the database should be available by the end of next year.

I'm thinking about short-term --

MR. WACHOWIAK: Right.

CHAIRMAN STETKAR: -- not protracted five-year research programs. I'm thinking about what sorts of short-term benefits may be available within the next several months to a year, roughly, timeframe to sort of help at least this hurdle, the cabinet fire hurdle, and perhaps other elements of the process.

How much have you thought about how you're going to use the data to address these issues of fire growth rate and consequential peak heat release rate, given what you know from the fire event reports? Will it be a subjective evaluation that somebody said, well, we had a relay ignite and it was extinguished within 27 minutes; therefore, the peak heat release rate must have been, you know, a kilowatt or 6 watts, or something like that, without any actual measured evidence of heating? Or have you thought much about that?

MR. WACHOWIAK: In terms of what's going on with that particular project, maybe Pat would have a better insight to that piece of it.

From the end that I have been involved in and that we have been looking at, I wouldn't expect the binning to go that way. It is like I mentioned earlier. If we have a lot of things that are subjective like that where we would infer a peak heat release rate from a text description of the fire, I would find that that would be difficult to pass through review scrutiny.

And so, I wouldn't expect that sort of sub-binning to happen, but if you can talk about physical characteristics of the cabinet, what was in there, and how much was available to burn in there, then maybe we could subdivide these things out to something that can be, then, tied back to the experimental evidence and have a reasonable review of that material.

CHAIRMAN STETKAR: Okay. Maybe I'll let you get through your slides here. Because I kind of want to really understand where you're up to. Because you're right, it's not a simple -- I mean, you know, the industry has been very, very critical, at least in the report, of the sort of disjoint nature of some of the tasks in 6850, and the fact that the frequency data are not necessarily coupled to the fire growth rates, coupled to the peak heat release rates, et cetera, et cetera, the things we have been talking about. And therefore, a more integrated focus on understanding the operating experience and the test results is required.

And that sounds very reasonable, but I would like to understand how that's going to be implemented. Because, so far, I'm hearing a little bit more of just the disjoint stuff.

MR. TRUE: Yes. Let me take a little bit of a run on this because I think I may have slides --

CHAIRMAN STETKAR: Go ahead. Because, in particular, that second bullet seems to give me the impression that the fire events database is going to give me information on peak heat release rates for different cabinet types. And I'm curious how it is going to do that.

MR. TRUE: No. The second bullet is a different thing. The first bullet and its sub-bullets relate to the FEDB. And the FEDB will, by the end of next year, have ignition frequencies. The manual suppression data is collected and could also be equally updated in a similar timeframe.

What I meant by the sub-bullets on fire growth and damage is that, because we're getting a lot higher-quality information for these more recent events, and we're going back and collecting data on even the 1991 through 200 data, we should get a better picture of the events that actually occurred than we have right now, looking at those cryptic descriptions in the fire events database.

And that will inform us more, I think, on fire growth and the kinds of damage that we saw from those fires. So, we have an electrical cabinet fire of a certain kind. It lasted 10 minutes, and damage was limited to this. It lasted five minutes and it extended to this point.

That will help us draw the picture of what's really happening out there, I think, because we have a reasonable number of events that we will be able to draw from, probably on the order of 50 to 100 events, I would think.

CHAIRMAN STETKAR: Twenty-four and a half, according to your slide No. 5.

MR. TRUE: Well, 24.5 in the data that we have in hand, plus another 10 years' worth of data.

CHAIRMAN STETKAR: Okay. Okay.

MR. TRUE: You would expect at least another 24.5.

(Laughter.)

Although we're getting rid of halves --

CHAIRMAN STETKAR: Not a thing is getting better every year?

(Laughter.)

MR. TRUE: We're getting rid of halves, I think, though. Maybe we'll only have 24.

(Laughter.)

But I think that the 24.5 is actually more than 24 events, of course.

CHAIRMAN STETKAR: That's fine, but --

MR. TRUE: So, you know, 50ish or something. There will be information, and having higher-quality data, that gives us more of a picture of what happened, maybe even including more photographs -- I know some of the CRs coming in are now including photographs, which is helpful. I think we will be able to inform that. I don't see that in the timeframe you are looking at necessarily informing heat release rates at all.

The second activity is an analytical

activity.

CHAIRMAN STETKAR: Okay.

MR. TRUE: And that's what Rick was talking about.

CHAIRMAN STETKAR: Okay. Okay.

MR. TRUE: So, just to distinguish these two.

CHAIRMAN STETKAR: Okay. Thanks.

MR. TRUE: Sorry, Pat. I didn't mean to cycle you there.

MR. WACHOWIAK: So, I think Doug had this slide earlier, and he was showing some aspects of it. But what we intend to do with the heat release rate report is to provide, if you will, a replacement for this table, so that it could be used in the same methodology as 6850, however, has more discrimination than simply these five rows.

And one of the intents here was to provide something in the near-term that can be used by the current fire PRAs that are out there without having to do a revamp of the entire thing. So, more of a plug-in-type module, if you will.

So, in order to do that, we needed to limit the scope on this to a few things. One, we have data on vertical cabinets. We are only looking at vertical cabinets. We're not trying to expand it outside that.

We're not looking at other external factors such as detection or the suppression probabilities or anything like this. It's just addressing what happens to the peak heat release rate in the cabinet, based on the characteristics of the cabinet itself. It would be a drop-in replacement for these distributions that are in 6850. That was the intent of the report.

So, a couple of things that we end up doing here is, first, we look to see from the experiments. Once again, we basically use the same experimental base that 6850 used. Looking at the experiments that were done, 6850 was able to discriminate between qualified cable fires and unqualified cable fires. We looked for other things that could maybe separate the different characteristics of the fire, and we really didn't find that. So, we ended up retaining the qualified versus non-qualified cable discriminator.

But what we did notice is that, for the qualified cable fires in the experimental basis, we really didn't have anything that propagated outside the cabinet or didn't have anything that propagated outside the cabinet and there really were very few that propagated inside the cabinet.

So, I guess I should back up. There was one of the tests that had outside-the-cabinet effects. So, part of what the report does is it makes the distributions for heat release rate for the qualified cables look more like a distribution that's anchored to the peak heat release rate tests that were done in qualified cables. Make sense?

So, the distribution that comes out of this for the qualified cable-type cabinets would have the upper bound more around the peak heat release rates that Doug showed on the earlier slide. So, that 98th wouldn't be way above the data. It would be closer to where the experimental data was, recognizing that those experiments were done with the intent to try to make the big fire in the qualified cables. Okay?

CHAIRMAN STETKAR: So, all you're doing is going back to the 4527, whatever it is, experiment published results and, essentially, refining the binning?

MR. WACHOWIAK: Refining the binning to include characteristics that we think that the people performing fire PRAs would have, information that people performing fire PRAs would have.

CHAIRMAN STETKAR: Is there no effort to go out and try to find additional data for cabinet fires that might provide more recent information or somewhat relevant information? I don't know where that data may be, but --

MR. AMICO: Paul Amico.

CHAIRMAN STETKAR: Those tests were relatively old and there aren't a lot of them. So, trying to develop more insights from them might be relatively difficult.

MR. AMICO: Yes, Paul Amico from SAIC.

Yes, we actually have data from tests from IRSN which were more recent. So, we ought to add it to the -- you know, we have the VTTC tests, we have IRSN tests. I think it was Carmello was one of the ones. So, we have more information and we have more that we used.

And the key to this is an analytical approach. Quite frankly, we have a model. Okay? It's an analytical model that was actually developed elsewhere.

What we have done is we have looked at that analytical model and plugged in, I guess if you will, plugged in the characteristics of the cabinets that were tested to see if the model reasonably, accurately predicted the results of those tests. And we've been able to show that.

So, now what we are doing is we are saying, okay, what are the important things in the analytical model? And it turns out there's a couple of different things.

The focus really, we are doing the open cabinet fire, but the focus is really on the closed cabinet --

CHAIRMAN STETKAR: Step back from the microphone a little bit.

MR. AMICO: Okay. Sorry. I can't even hear it from here. So, is that working?

CHAIRMAN STETKAR: Yes.

MR. AMICO: The closed cabinet, primarily closed cabinet fires, in looking at the ventilation, what we found is that primary parameter in these fires is the amount of air, the actual amount of air you can get into the cabinet. And it is a function of the total vent area and the ratio between the inlet vent area and the outlet vent area. And also, it relates to the height of the cabinet.

So, what we have been doing is we are looking at the actual test results and what we know about the cabinets, does this model reasonably well predict that? The answer is yes. You do find out, also, that there's really a theoretically upper limit, you know, based on the parameters of the cabinet. No matter how much combustible you have, you can only get so far in heat release rate.

The issue we're dealing with now is we have done some work in turning that into distributions. We have got a lot of comments from peer reviewers, and a couple of the peer reviewers are in the room, about how we turned those into reasonable distributions. So, we're still working on that aspect right now.

What we're comfortable with is that we can get a point estimate based on these parameters that seems to make sense. So, that's where we are right now with that. We have probably got a few more months' worth of work, but, essentially, that is where we are headed with it.

And what we have developed is a series of tables for different cabinet heights, different total ventilation areas, qualified and unqualified cable, whether gap formation occurs or not because that changes the ventilation. So, that's kind of where we are now in this process, and that is the major distinction really that we have been find, is this ventilation.

And the ventilation-limited fires is the major bin, I guess. If you're going to say created a mass of bins, these bins are all related to ventilation-limited fires.

CHAIRMAN STETKAR: Okay. Let me ask you a little bit. So, what we're doing is developing a model, another fire model, what I tend to call fire physics models, that we're trying to benchmark by a few limited data points. What is this model? I mean, what are you using? I don't know if Paul is here.

Where I'm headed is one of the concerns that has been expressed about the entire NFPA-805 transition process is that people are using models; people are not too clear about what that phrase means, but people are using models that have neither been validated nor benchmarked against actual performance. And therefore, how can you rely on models?

I hear good things about, gee, we want to make the fire PRAs consistent with actual operating experience -- that's really good -- actually real test results. That's really good. Now I'm hearing, well, we're going to use another model to develop analytical results. Has that model been validated? Has it been benchmarked against independent test results? Has it been peer-reviewed or now we are going to have new results that are subject to yet more uncertainty about a different modeling method? Is it one of the CFD models that have been, indeed, validated and verified?

MR. AMICO: It's pretty much an equation. When you say, "Is it validated?", I said what we did as best we could is we said, if I take the tests we have, and admittedly, all right, there's not a million tests out there, but if I take the tests we have and look at the information about the cabinets, the description of the tests, and I put in those parameters into this equation, I can show that matches, reasonably well matches the limited test data we have. Okay?

The prediction of the model and the test results are reasonably correlated. That's what I can say.

Admittedly, how many tests we have, you know, closed door, ventilation-limited fires where no gap was formed, I think we had seven or something like that. So, basically, we have done what can be done, I guess is what I can say.

And then, that's the other thing. We are going through a process; EPRI has formed a methodology peer review group for fire PRA methods of very senior experienced people, and we are going through that process right now. It's a new process EPRI has put in place for all the methodology development where we go through an independent peer review, just like a fire PRA would, but this is focused on methodology, and we bring people together and we go through an independent peer review and we address those comments. And that's all documented as part of it.

MR. WACHOWIAK: Right. And one of the objectives of the peer review in this case is to come to a conclusion that, in fact, the model is validated by the test, the experimental test, that we had in hand.

So, this particular one, Paul says it is an equation. Essentially, it is a limited number of parameters that can be used to determine what is the peak heat release rate from a cabinet that has so much fuel, so much ventilation. It is, by no means, a CFD model or anything like that.

CHAIRMAN STETKAR: Okay. You know, when people say all models are equations eventually, but --

MR. WACHOWIAK: Right. So, in essence, what we're trying to do is take information that the fire PRA practitioner would have from going and doing a walkdown in the plant and relating that to what type of experiment could have been done to generate the upper-bound peak heat release rate and what would that peak heat release rate be.

Then, it boils down to a series of tables where you say, what's the cabinet volume? Is it a densely-populated cabinet or a sparsely-populated cabinet? And, then, there are some estimates on what is the fuel loading that are in there, in that cabinet, of that particular volume. That goes into the equation to determine what is the maximum theoretical heat release rate from this cabinet, which relates back into the equation. Then, you look at what is the ventilation on the cabinet, as Paul said, inlet area, outlet area, and the ratio between those. And we think we can fairly accurately represent what the upper-bound peak heat release rate from that type of configured cabinet would be.

CHAIRMAN STETKAR: We're running a little long, but this is something everybody points to, and it's worth discussing, I think.

I might have missed something, but in all of the parameters I heard you talking about I didn't hear anything about energy content of the equipment inside the cabinet. I recall somebody calling me after the San Onofre fire and saying, "Gee, our EPRI models would have never predicted that level of damage because there wasn't enough combustible material inside there," completely disregarding the fact that, for example, when large high-energy switch gear creates an arc, you're not necessarily combustible-limited.

So, for example, I'm not hearing any of that type of thought process. So, how are you accounting for that across the complete spectrum of those elusive cabinets that I have that go anywhere from a little picture of the fire protection cabinet that we had yesterday morning to 6.9-kV switchgear, non-high-energy arcing faults, but still internal flaming?

MR. WACHOWIAK: Right. And I wanted to say that this does not address high-energy arcing faults.

CHAIRMAN STETKAR: No, no. Okay. I'll discount that, but, I mean, the notion of counting up inventory and combustible loading isn't the whole problem, is it, in terms of rate of growth of fire?

MR. WACHOWIAK: You need to have an estimate of what is the combustible load within that cabinet. And the report attempts to make a correlation between the volume of the cabinet and essentially it's a judgment base, but how much -- is there a lot of cable in there or is there not a lot of cable in there? Because we are not going to actually go and measure the mass of things inside of a cabinet. You have to rely on judgment to figure out what that is.

And there is a section in the report that describes how you relate volume versus your judgment of how densely populated the cabinet is to a parameter that actually specifies what is the heat load that is going to be in the cabinet. So, we attempt to do what you're saying there, but it still requires judgment of the user of the model to do that, and we really don't expect people to be going out and actually physically measuring some of these characteristics that you need to put into the equation to get the peak heat release rate.

So, there is an attempt to do that, and that part of it is under peer review right now. The main comments that we have gotten back on that portion, though, is it still looks like it's hard for a PRA, a fire PRA modeler, even to get this type of information. How do we know that it is going to be consistently applied when you go from plant to plant?

So, that is an important part of all these, is usability of these models and making sure that they can be duplicated from plant to plant.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: So, I think in a roundabout way we have covered everything that is on this slide.

MR. TRUE: Yes. We just tried in this or I just tried in this slide to say, okay, we raised a number of issues in this presentation from the ignition frequency to response. I think that the FEDB is going to help us with a couple of these directly. It will give us some information related to growth and damage.

The heat release rate work that Rick and Paul talked about is going to give us some direct information on heat release rates and damage. It may give us some indirect inference on growth rates and indirectly will influence the operator response.

So, it is certainly not a comprehensive way to address every one of them, but we've got something going on that will directly address most of this, and it should improve the overall realism of the electrical cabinet work.

CHAIRMAN STETKAR: Okay. Any other

questions for Rick and Doug? If not --

MEMBER POWERS: Let me ask a question. I guess I have two questions. One, is there anything unique about electrical cabinets in nuclear plants relative to electrical cabinets anyplace else? I mean, you can see, essentially, I'm asking the question, is there another database that you can go tap?

The other one is you're struggling heroically to scale experiments up to specific applications, and I don't see the kind of detailed, let's call it CFD, but I'm sure CFD is not the type of modeling to do that scaling, is there anybody doing that? I mean, do we have faculty members at prestigious universities in America struggling over how you model heat releases and chemical reactions in cabinets? I mean I know they do it for chemical reactors, but those guys have more money than you do. So, maybe they know what it is.

(Laughter.)

But is there anyone doing that kind of stuff that would provide some sort of a framework for -- the problem is your data is sparse and you need some way to know how to take data and extend it to situations that will never get tested. I am just asking, is there anybody doing that kind of stuff?

MR. WACHOWIAK: I'm not aware of that.

MEMBER POWERS: I'm not, either. I mean I plow around that literature, but I never run across anybody doing that, but maybe because I don't get out much or something like that.

MR. WACHOWIAK: What would be very useful for this would be to have something that tests the low-end fires.

MEMBER POWERS: Yes.

MR. WACHOWIAK: Because once you get beyond a certain threshold, we're burning up everything in the room in the theoretical array model anyway. And having a lot of detail at that end --

MEMBER POWERS: It doesn't help.

MR. WACHOWIAK: -- it doesn't help us. But, as we found in the experiments that we have now, those are tricky.

MEMBER POWERS: Yes, and worse than that is that in this kind of -- it almost doesn't go kind of regime, you get a test and it gives you a result, but what you want to know is what's the whole possible range of results there.

CHAIRMAN STETKAR: Yes, have you thought at all about there's greater or lesser support for the notion of expert elicitation in different communities.

MEMBER POWERS: Oh, you and your expert elicitation.

(Laughter.)

CHAIRMAN STETKAR: I said there are greater or lesser support for the notion of expert elicitation. It sort of ranges across the table here.

MEMBER POWERS: Just what I need, more wrong answers.

(Laughter.)

CHAIRMAN STETKAR: Well, we've had a lot of wrong answers.

(Laughter.)

MEMBER POWERS: It's a distribution problem.

CHAIRMAN STETKAR: Now you have a better distribution at least.

Seriously, people have used expert elicitation for focus topical areas in PRA rather extensively. Reactor coolant pump, seal failures, we're all familiar with that; seismic hazard analysis, and in some sense a seismic fragility analysis.

MEMBER POWERS: Don't portray this as a virtue of PRA.

CHAIRMAN STETKAR: Hum?

MEMBER POWERS: Don't portray use of expert opinion elicitation as one of the virtues of PRA. It may be a necessity. It sure brings a lot of details of inapplicable calculations.

(Laughter.)

CHAIRMAN STETKAR: Hold on a second, Ken. Let me just kind of finish the thought here.

Have you thought at all about doing that? I mean in the same sense of convening industry, and I'll include staff; I'll include universities, for example, experts to look at something like a -- I don't know what you want to call it. You could call it a fire hazard set of curves or something like that, in lieu of some of these other approaches you're taking, recognizing that would be informed by what limited actual operating experience we have available and the limited test data available. Have you thought about doing that all?

As I said, there's varying levels of support for it, but --

MR. WACHOWIAK: I'll let Ken answer that, and then I have a little bit to offer there. It won't answer your question, though.

MR. CANAVAN: Yes, I'm chiming in because your question is historical, and Rick is a little newer. This is Ken Canavan.

We had some very detailed discussions about the possibility of expertly elicitating some information. If you look at what Steve and the 6850 crew did in the original study, that is essentially what they did. Their expert elicitation was extremely informal on a smaller group.

But I will say that in this current environment we have discussed the possibility of that being considered an acceptable approach. I'll point out that, even now, when Paul and Rick gave their discussion of heat release rates, right away we start questioning, well, you're using a model; how do I know this is not going to be just another question model? We came to the conclusion that stuff where we have a model and some judgment is much better than a process where we had just judgment to extrapolate the data, even if it was replacing other judgment.

Because the problem was getting that second judgment accepted universally without significant effort. So, I guess I'm going towards Dana's point where expert elicitation replacing an older judgment would come under even more scrutiny as to why that one is right.

So, we were better off where we had models with limited judgment and some experimental data. So, essentially, heat release rates is our first foray into what I would call sort of hybrid, where we are using some judgment, but we have a good model and some points, and that's where we want to use our judgment the best. That was our conclusion of our research dollars spent.

CHAIRMAN STETKAR: Okay.

MEMBER POWERS: Yes, but I mean it is not bad idea. It is that you can use expert judgment on things like heat transfer coefficients where it can be triggered by experiments; whereas, before you had to ask them what's the possibility you will burn up a cabinet that they have never seen before.

MR. CANAVAN: Yes. There's reasonable assurance when there's data points that you can point to that at least you correlate to the existing data, even if it is sparse --

MEMBER POWERS: Yes, much better.

MR. CANAVAN: -- over just judgment. That is changing, and I will give it back to Rick because Rick's driving the future research here. So, he probably has a few points.

MR. WACHOWIAK: Right. One of the things that we are trying to do for things going forward is to introduce more expert judgment, opinion. It depends on what you're actually doing with it.

But when we are reviewing the different methodology reports that are going out or when we are reviewing the newer test data that is out there, we are convening panels of experts. And there's a presentation on this later on, but we should be getting to it.

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: But we are convening the groups of people that have experience in these areas and can do an informed judgment review of things that are based on a model or based on an experiment. So, we are trying to inject that idea into the things that we are doing now and going into the future. I don't know of anything that we have on the matrix right now where it is we are just going to be -- like Ken said, we will just be replacing an older judgment model or an older judgment with a newer judgment in a sense. But we are trying to use the judgment where it looks like it's reasonable. To me right now, that is in the independent review phase of these things.

And for the experiments, I think we can use it some, too. For other experiments, you use it upfront to help design the experiment, to make sure that the experiment itself matches what it is we are trying to get out of the data in the end.

So, there are places where we are trying inject it into there, but not as a wholesale --

CHAIRMAN STETKAR: A formal expert elicitation type --

MR. WACHOWIAK: Yes.

CHAIRMAN STETKAR: Okay. Any other questions? Dana, I think you said two. I don't remember whether you asked --

MEMBER POWERS: I covered both.

CHAIRMAN STETKAR: Okay.

MEMBER POWERS: I got them both out.

CHAIRMAN STETKAR: Anything else for Rick and Doug?

If not, thank you. That was -- oh.

DR. WEERAKKODY: This is clearly now a question for them. Through all the presentation, I know, John, you mentioned at least once that you are going to have some questions for the staff.

CHAIRMAN STETKAR: Sure.

DR. WEERAKKODY: I just hope we'll get that opportunity whenever you want it.

CHAIRMAN STETKAR: Well, according to my agenda here, as soon as the esteemed duo at the front table vacant the process, I have an NRC presentation. And again, I hope this is not just Steve Nowlen as an independent contractor. I really would like to hear from the staff at some time or another. Whenever there's some actual card-carrying staff members upfront, I'm sure we're going to have questions. Anybody at all can sit upfront.

MR. NOWLEN: Okay. I think the caucus is that I will go ahead through my prepared presentation, and then you're going to hear from staff. But what I have prepared is directly relevant to what you have just seen. So, it seems reasonable to take that approach.

Just for the record, my name is Steve Nowlen. I'm from Sandia National Labs. These are my views as an author of the NUREG CR-6850/EPRI TR-1011989. And in this case, I'm also a coauthor of the Sandia electrical cabinet fire test that they have been talking about here, which dates me because that goes back to 1985. I was pretty young then.

CHAIRMAN STETKAR: As we all were.

MR. NOWLEN: Yes.

Okay. So, I'm going to skip a bit of this because a lot of it has already been covered. I think we have talked about this slide. Why do we care about fires? We have talked a lot about that already. I don't need to go into this in detail.

But one of the things to point out is that the variables that we are dealing with here are substantial. You know, we have function, control power distribution, switching, junction boxes. It's all there. We have voltage levels, anything from less than 50, which is instrumentation, to over 100 kV, your offsite power stuff. Physical configuration, size, construction, venting, you know, there's such a range here. The fuel loading, what's in there? What's inside of motor control center is very different from what's inside of a main control board. So, we have to deal with that. We understand it is difficult because the range is very broad.

The event data, I'm not going to go into this very much, either. We talked a lot about this. I think one of the questions that Dr. Powers raised was relative to other industry data. We made an attempt to do that in the early stages of the methods developing work and basically came up empty.

We complain about our data. We should be really grateful that we have the data we have. Because if you go to general data sources, it is much rougher and it is very, very difficult.

We tried to use it to gain sort of qualitative insights of the nature of these fires. That didn't work at all. We gave up very quickly on getting any statistical frequency-type things because there's absolutely no idea what the population is represented by any database. You go to NFPA. Well, how many sites does that represent? It's the whole country nominally on a voluntary reporting basis. So, anyway, there are some real issues there. I don't want to belabor the data too far.

I do want to talk a little bit about this because I think it will give you an idea of what data we do have from the testing. There are really three sources. A lot of focus on the NRC tests. There were more individual tests in that series than any of the others, but there's also testing from VTT in Finland and the IRSN data was mentioned as well.

At the time that we did 6850/1011989, we did not have access to the IRSN data. They wouldn't give it to us yet. I believe they have recently made that available. So, that's an improvement.

But one of the things you have to be a little cautious of is, and this is a theme I'm going to hit on here, is that you have to bring a perspective of understanding fire phenomena and experimentation when you look at these tests. Okay? You can't just -- you know, the slide that shows all the tests down below 100 kilowatts and, also, the 98th percentile, well, there's a reason for that. Okay? And I will try and explain that.

But I will give you an example on the IRSN. The IRSN tests were not real control cabinets, not real cabinets of any type. There are basically welded-up steel boxes with a control side vent in the top and a control side vent in the bottom, and inside of that, for most of the tests, are PMMA, polymethyl methacrylate, slabs with a little acetone to get them started.

What the French were trying to do is develop this chimney model of fires. So, they wanted rigidly-controlled ventilation conditions, right? So, this box is fully welded. And then, they would vary the inlet size, vary the outlet size.

So, when you interpret that and you take that to a real cabinet, what does it mean? Well, it tells you, if you had rigidly-controlled ventilation conditions, this is what would happen, but in real cabinets we don't have rigidly-controlled ventilation conditions. So, when you try to extrapolate from the French data and say, see, my model matches, so, well, fine, you match what happens to a welded steel box, but not necessarily a cabinet. And you have to bring that perspective into your assessment.

The VTT tests are another one that are interesting, in part, for the same reason. This was Olavi Keski-Rahkonan, and I will provide that to the transcriptionist separately.

(Laughter.)

Olavi was an incredibly analytical individual, a college professor. I mean he loved equations that just went on for pages.

And Olavi tried to do the same sort of thing. He was actually burning more realistic cabinets, and he tried to take the ventilation conditions at the inlet and the outlet and do a very detailed analytical model of the chimney flow and what the maximum heat release rate would be. It didn't work because, again, we don't have this rigidly-controlled configuration.

So, again, looking at the data and understanding what you're looking at and how you should interpret it is really, really important.

The other thing you have to recognize is that every single one of these tests was aimed at control panels. I don't have a single test of a load center, switchgear, MCC. So, what we have to do is take the information that we have for the cabinets that we have tested, control cabinets, and try and extrapolate to these other conditions because we know that out in the plant chances are you're going to be far more interested in load centers, motor control centers, switchgear, things of that nature.

CHAIRMAN STETKAR: Steve, let me ask, and you reminded me of something that I wanted to ask EPRI and the industry and I keep forgetting.

We have seen results from, at least in our presentations, from six different fire PRAs --

MR. NOWLEN: Yes.

CHAIRMAN STETKAR: -- all of which show electrical cabinet fires as a measurable contributor. In practice -- and I'm asking folks who are sitting behind me -- in practice, what locations in the plant are driving those results? Are they switchgear rooms? Are they instrumentation and control cabinet rooms? I'm assuming they are not the main control room because that is a separate fire ignition category. So, it is not main control board fires, but are they cabinet fires in main control rooms, electrical cabinet?

So, from the results of those three types of areas, which are the more important?

MR. NOWLEN: I'm absolutely unable to answer your question.

CHAIRMAN STETKAR: That's why I'm asking people sitting behind me.

MR. NOWLEN: Yes.

MR. MISKIEWICZ: David Miskiewicz.

For the early models we have done with Harris, it was pretty much control cabinet-type issues that were driving.

CHAIRMAN STETKAR: Okay. So, I&C cabinet rooms?

MR. MISKIEWICZ: We had some high-energy arcing faults do something --

CHAIRMAN STETKAR: Yes.

MR. MISKIEWICZ: -- but those are limited and they are easier to understand.

CHAIRMAN STETKAR: Right, right. But we're not talking about motor control center or load center fires or --

MR. MISKIEWICZ: In a case-by-case basis, you may, but it is because of the control circuitries associated with some of those, not necessarily -- you know, MCCs may have a lot of wires going to them. If the fire gets out of them, you may have issues.

CHAIRMAN STETKAR: Well, I guess I'm still trying to struggle. In general, when I look at power plants, there are always some exceptions, but there are rooms that are primarily what I call switchgear rooms that have 4-kV switchgear, 40-volt motor control centers, some load centers in them. Those rooms typically don't have I&C cabinets in them.

MR. MISKIEWICZ: Sometimes they have transfer panels.

(Laughter.)

CHAIRMAN STETKAR: Okay. And that's okay. It's a good point. Back to the plant-specific nature of things here, obviously.

(Laughter.)

But other rooms are typically I&C cabinet rooms. You know, protection control cabinets. You typically don't see motor control centers in those rooms. And, of course, the control room has control boards and other primarily I&C cabinets.

And I was more curious from the actual experience from the PRAs, if I can characterize the rooms that way, where are we seeing these problems? You know, what's driving that ridge line?

MR. MISKIEWICZ: It's a mixed bag.

CHAIRMAN STETKAR: Okay.

MR. MISKIEWICZ: In my most severe cases, we're going to involve the control cabinets and those types of things. However, switchgear rooms, depending on your plant's design, they have a lot more cabinets. When you add up the effects of a lot of more cabinets, then those add up.

So, depending on your plant, one plant may have all its switchgear in one room, like Harris. Other plants divide it up with 4160 or -- so, you'll see some variation. But when you have a lot of stuff in one room, that room tends to be a large contributor.

CHAIRMAN STETKAR: Yes, but, look, Kiang is standing. So, I'm assuming he's going to give us other insights. Or are you just standing?

MR. ZEE: I was going to say I think, because of plant design details, I think it is less so an issue of spatial issues. I think it's more in terms of what the ignition sources are.

So, if you think in terms of the I&C cabinets you're describing, I mean what tends to happen is a practical matter of how these plants are all designed because they had to meet the same failure criteria, and they have these logics that are one out of two taken twice. You have a lot of these panels that have to have cross-connected wiring between divisions. Just that was the nature of how the plants were designed.

Now what that means is -- and this is something we touched on a little bit earlier -- when we take an electrical cabinet fire, it is very difficult to distinguish the nature of how the fire progresses within the cabinet. So, once that fire happens within a cabinet, you oftentimes have cases where you have cross-divisional impacts. And from a practical standpoint, there is no way to get out of that.

Now when I get to an MCC, the same issue arises. We talked earlier about, well, we had an MCC fire. Do we take MCC failure? Well, that's correct. But at the same time, what tends to happen is you have a race between valves that are powered from that MCC. Does the fire behave in such a fashion that I cause certain valves on an MCC to spuriously operate before power is lost? And in a lot of instances, single-train divisional upsets create some problems.

CHAIRMAN STETKAR: Okay. Thanks. That helps.

The reason I asked is I was trying to understand a little bit better -- Steve brought up the fact that there is a broad range of cabinet types, different voltages, different applications, for example, and the limited tests that have been performed, their applicability to the broad variety of things that we throw into that generic box that we call an electrical cabinet.

Insights from the completed studies: for example, if the primary concern was cabinet fires in I&C rooms, those cabinets look very different than a motor control center. So, for example, where one might focus the effort to refine heat release rates, refine growth times, for example, rather than just saying we need to understand everything about everything before we can do anything, is there a way to better focus the efforts, based on at least the preliminary results from a spectrum of PRAs that we have been seeing?

And I guess what I am hearing is not necessarily.

MR. MISKIEWICZ: Correct.

CHAIRMAN STETKAR: Okay. Thank.

MR. NOWLEN: I'm a little disappointed to hear that. I was hoping for the same sort of thing. That as we got more risk insights from the applications, we would know where to focus our efforts. It sounds like it's pretty diffused.

CHAIRMAN STETKAR: Okay.

MR. NOWLEN: But, okay. Other things: I've mentioned this before. The tests make no attempt to suppress the fires. So, whenever you go and try to compare a test to reality, you have to keep that in mind. We don't stand around and wait for fires to burn. We put them out.

I think the question came up about control versus suppression. I believe that is a legitimate consideration if you have a fire under control. That, to me, says you have at the least limited subsequent damage. Now, again, you've got to maintain control, and we have fires where we thought we had it under control; we lose that.

The main reason we didn't put that into the suppression model now is that the events don't tell you, you know, the fire was under control at this time. They generally tell you we've got a detector signal; it was out by this time. But that's what you have.

So, again, maybe the new data will help us there. One thing that was stated is, relative to managed burnout sort of situations, if we saw that, we did treat them differently. We would see it. For example, the most common one was hydrogen tank fires. They would just choose to let the fire burn until the fuel was gone because it wasn't going anywhere. It wasn't hurting anything. It was the safest thing to do.

We treated those differently. Those were taken out of the suppression because it is not representative of what happens if you try and aggressively put out a fire. So, they would be removed from the suppression curve, but they would count as fires. It was clearly a fire. So, those are treated differently, but I think the control concept is valid.

Basically, what the tests tell you is what can happen if a fire grows unchecked in an electrical cabinet. And how you interpret that data is really important. The caution that I put forward is that slicing of data too thin is going to lead you to invalid conclusions.

We performed a lot of tests, okay, but these early-phase tests, like all the ST1, ST2, those were very, very limited tests. Like ST1 was a test to see if the ignition source fuel package that we had would ignite the cables from radiant heating. So, the source was here, and the cables were over here. The answer was no. So, it didn't propagate. It didn't even ignite the bundle.

The second one was to take a smaller ignition source and put it under a bundle and see if that would propagate. The answer was we burned a little of the thing, but it didn't propagate at all.

So, you know, again, when you look at these tests, you can't just take them and say, okay, this is the group that represents my cabinet, and that's all I'm going to look at. It's just not the right way to look at data.

What we did in looking at the events, and what is left off of the plot that the industry folks showed are the tests that drove the 98th percentile. The biggest test that we had in these experiments, as I said, were 1.5 to 1.8 megawatts. They were an order of magnitude larger than these fires.

Now they eliminate them from the plot because they are benchboards, right? Oh, I'm interested in vertical cabinets; I'm going to throw away the benchboards.

Well, a benchboard is not a vertical cabinet, obviously. But does a benchboard test tell you something about what might happen in a different type of electrical cabinet, a vertical panel? In my judgment, absolutely yes. You cannot ignore the fact that we had 1.5-megawatt fires in unqualified cables and 1.8-megawatt fires in qualified cables. There are insights that have to be factored in.

What we saw with these tests is that there is truly a threshold sort of behavior with these things. If you get to a certain point, the thing will spread and grow, and it is basically going to burn out the cabinet. That is what the 98th percentile is intended to represent. It is, if we cross that threshold and we burn out the cabinet, what's it going to look like?

Is it real? Absolutely, I think it is real. Did ST1 and ST4 and 7? No, they didn't cross the threshold, for various reasons. Each individual test, there's different reasons. Some of them are just the chaotic nature of fires. You know, that's why we have distributions. I can build the same fire in 10 experiments, and I get 11 data points. It is that sort of a beast.

So, when we drew these curves -- and again, what's missing is what drove the 98th percentile, which is actually approximately 2.5 times the 98th percentile value, which was ultimately picked. I have a 1.8-megawatt qualified cable fire.

I'm not going to use 1.8 megawatts for this case because it was benchboard -- that's a difference -- and that particular test was open cabinet, right, no doors, more of a control panel open back.

And so, we have to take that and say, what would it mean if I had a different configuration? If I had the vertical cabinet, if I had a closed door, but good ventilation through that cabinet, what would it be?

So, again, we extrapolate from the knowledge that we have. We extrapolate from the broader insights that we gain from the experiments, though, as well. You can't just take these one, two, three, eight or nine tests and put a distribution on them because it doesn't reflect the broader insights of the program. It doesn't reflect what might happen if you cross that threshold.

So, that's my biggest problem with those plots that you see. And I think if they are going to go this way, you know, I'm all for it. Revisit the distributions. I don't have a problem with that. But they need to bring in a more experimental, phenomenological expertise when they weigh these data and try and gain the broader insights. I think that's really lacking at this point.

So, I will get off my high horse for a minute. Where I think we could do better, these are important, and I think improvements would be welcome by everyone. A model linking the growth time between the contents of the cabinet and the growth behavior, that would be great.

One of the things that you see from the testing, for example, is that it is easier to burn kindling than logs, right? So, if you can see in your cabinet and what you have is a very tightly-wrapped bundle of large cables in the back corner that come in and feed one large load center, for example, that's going to be an incredibly different fire than what these tests would reflect. It's going to be much smaller. That is going to be a far harder one to burn.

But the other point that comes in is I have a more energetic ignition source there because it is a load center and I have the power; I have the voltage. I can get a pretty good ignition source, right? So, how do we balance that? I'm not too sure.

The other thing that I think is the empiric, and I probably should say semi-empiric model of ventilation effects on peak heat release rate, that was the work that they were referring, Paul Amico referred to.

I saw a paper by Shawn Hunt at the NEI Forum two years ago that was headed down this path. I said at the time I thought this was a good path to follow. Because what Shawn was trying to do was get away from this idealized view of cabinets that the French had in executing their tests and that Keski-Rahkonan had in developing his model, and to try to say what really happens for a more reasonable representation of the cabinet, where the doors warp and I open up new ventilation openings, the side will warp away. Those are all issues. And I thought that was a good approach. So, I am hoping to see more of that.

And again, the idea is we know that the purely idealistic model of the chimney doesn't work. We need something to make the adjustment to reflect the realities of cabinet. We don't have enough data to do that, based on first order of principles, for example. So, I think we have to make some empirical adjustments to try to reflect the data.

But, again, when we match that to the test data, you've got to be real careful about how you do that. If all you can match are these scoping tests, the very first tests in the Sandia matrix, you haven't matched the range yet.

I think these other approaches, the peak heat release rate, are going to be difficult. Again, you have this issue of you have to develop the broader insights from the testing. And I think that is what we did.

I mean I was an author on these reports. I was there when we had this debate. We had other fire experts who understood phenomenology and things. We incorporated that into our judgment of what these heat release rate profiles should be.

So, you can revisit that, but anyone comes back to me and says, "I never have a fire that exceeds 100 kilowatts, so I'm going to call that one 98 percentile," I'm going to have difficulty with that. If my opinion is asked, it is not going to be very favorable. Again, I don't speak for staff, but I don't think that is reasonable. So, I think that particular approach a bit problematic.

The weld seal issue is another one that I think actually could go somewhere. The approach that I have advocated is that we can tie what we mean by a weld seal cabinet, and a weld seal cabinet doesn't propagate fires outside the panel, if we can tie that to, for example, NEMA ratings of cabinets, that would be helpful.

There are certain types of NEMA cabinets that are weatherproof, weather-resistant, weather-tight, waterproof, general panels. Those all have implications for this ventilation issue.

When we were doing 6850, we just didn't really have the expertise to do that. So, we didn't attempt it. I'm not an expert on NEMA cabinet ratings, but I think the people in this room probably are. So, I think that would be a good approach.

The incipient stage timeline that they have talked about, we talked a little about this yesterday. We resetting time zero. There's strong interactions with the other pieces of the method. We have to be careful that that's done right. Again, I'm open to the concept in theory. In practice, it will be a challenge.

And I think the other part, and I emphasized this yesterday, so I won't dwell on it. We have to look at the other potential drivers for risk here. You have to do the cable response part, too.

If you fix the whole problem by fixing heat release rates on cabinets, then you have simply broken it in a different way, right? Now we have what I would consider overly-optimistic cabinet profiles because I didn't do the cable response and cable damage part properly. I am doing that with incredible conservatism, and I try to compensate for that in optimism in another place. I think that is a bad strategy going forward.

We need to fix both pieces, so that together it matches frequency, the heat release rate distributions, the probability that it gets out of the cabinet, and then the likelihood that it damages the fire and the suppression.

I have already mentioned this yesterday. It is this interlocking set of steps, and you can't just pick this one and fix it and make the whole problem right. It is the wrong strategy. All the pieces need to be worked together.

CHAIRMAN STETKAR: Well, although if, indeed, there's evidence that one piece is substantially -- I don't like the word "conservative" -- substantially less justified by test or operational experience than the others, you know, one would quite naturally try to address that issue first.

MR. NOWLEN: Oh, absolutely.

CHAIRMAN STETKAR: You know, in a resource-limited world that we live in --

MR. NOWLEN: Absolutely.

CHAIRMAN STETKAR: -- we can't make everything perfect.

MR. NOWLEN: Absolutely, and I'm not advocating for that. I think risk insights, informed approaches here are appropriate. It is just that we are seeing these comparisons between what the PRA predicts and what reality tells us, and they say it's heat release rate. If that is the approach, then I think that is wrong. You can't fix that problem by attacking heat release rate alone, in my mind. And I think the other piece that is really missing is this cable damage piece.

CHAIRMAN STETKAR: You know, quite honestly, I am not hearing that from the industry. I'm hearing that it's problems across the board, as you said. It is an integrated problem. On the other hand, they seem to have some evidence that the heat release rate estimates in NUREG CR-6850 may be high for certain types of chem. I don't know whether they are.

MR. NOWLEN: Yes.

CHAIRMAN STETKAR: You know, I didn't run the tests. I didn't look at the data. So, it's just a matter of I don't hear them saying they think that the conditional cable damage probabilities, that hasn't been raised as a potential issue.

MR. NOWLEN: Yes, that's my problem, is they're not looking at that and I'm not hearing about it.

CHAIRMAN STETKAR: Well, but, on the other hand --

MR. NOWLEN: And I want to know what's going -- I don't know.

CHAIRMAN STETKAR: -- as a Subcommittee, we have to take the experience of the people who are doing the analyses. I would assume that if the conditional cable damage probabilities were the practitioners felt that they were driving the results, I would assume we would have heard about that. We've heard about an awful lot. That's not one thing we have heard about.

So, therefore, right at the moment, it seems to be less interesting to try to refine that particular issue, recognizing that it, in the sense of trying to estimate --

MEMBER SHACK: Well, it would be interesting to know what they do use for conditional cable failure probabilities.

CHAIRMAN STETKAR: Yes. Yes.

MR. ZEE: Yes, I think we have seen this a couple of times. We have explored it. I mean we have looked into what treatment like THIEF would give us. And what we are generally finding is the types of situations that are giving us problems are not situations that are solvable using THIEF.

I mean what we are generally finding out is that our targets of concern, if you will, are well within the zone of influences for even some of the smallest of the fires in some of the smallest numbers.

When we talk about THIEF, I think Steve made mention of 80 kilowatts. You could potentially withstand that for upwards of an hour. I don't know if that's exactly what THIEF tells you.

But what we do know is, when we do the fire modeling code at a particular heat release rate, we calculate, if you will, a so-called zone of influence. If my target is on the fringe of that zone of influence, we know there's time to damage. But we also know that the target is well within that zone of influence, that time the damage goes away very quickly. And when we get into the flame region, all the guidance we have been given is there's no analytical to predict time to damage. Basically, it dies almost instantaneously. And that becomes the coupling, the coupling with a growth rate and a heat release rate. And you're right, they're all intertwined together.

CHAIRMAN STETKAR: But what I am hearing you say is that the most difficult plant configurations, you are driven by the fact that people built these plants with cable trays located a foot or less above the tops of cabinets, and that within those cable trays there's a lot of really interesting cables. Short of reconfiguring the plant, you are left with that.

MR. ZEE: Well, I mean it makes logical sense. I mean I have a safety-related MCC of lots of very interesting components on it. By its very nature, the cable tray above it is carrying those cables. And once I design a plant that way, that cable tray becomes the route that all the other interesting cables tend to take.

MR. MISKIEWICZ: This is Dave Miskiewicz.

I have two comments responding to what he said. One is we didn't use THIEF, but we actually did use models of time to damage based upon distance from my source and the heat release rate of the source. And we did get some benefits from that. But, like I said, most cases they're close enough in that it is a matter of minutes, not an extreme thing.

The second piece talked about, is the heat release rate the problem or are other things the problems? And it is a combination, but I'm a practitioner, not a researcher. I take the data that is given and I'm trying to apply it.

So, the beginning of my problem is, what's the set of equipment that has failed? That is all driven by the heat release rate of my source and the timing and the growth. So, we have to pick something, whether I pick the first tray or the first two trays, and it's never one tray or very rarely do I get the nicest one tray and another tray. It's trays in different in different directions, curving, bending.

So, what is really happening is almost an impossible thing. So, we'll assume when a tray is impacted, all the cables fail in a tray. We know it is really the outside one -- or, actually, I don't know.

So, we really struggle with that. So, simple concepts like more cables probably means ultimately bigger heat release rate. More oxygen means -- I understand those concepts. Do we have perfect models? That is for others to decide. But there's got to be a model. The one-size-fits-all doesn't work.

Even a template, you know, looking at insides of cabinets and judging cables, you put five people and have them look at it, and you will get five answers. So, as a practitioner, we need more than a 98th percentile. It could be as high as a megawatt or 700 kW. If we use those heat release rates, we have had a time selecting a damage set that we believe is real. Then, we just propagate that through the rest of the model.

Yesterday Danny Pace talked about the set of dominoes. That's a set of dominoes. We build the whole model, and then a fundamental concept changes like, oh, the heat release rate is different, and maybe a whole set of damage targets that are different. And it is a tremendous amount of effort to do that.

So, as a practitioner, we need some tools that can be understood by the PRA people trying to build models, understanding we are not all fire modelers, and even if we were, the uncertainties are huge, based upon what we are hearing.

So, I just wanted to relay that, that heat release rate is the starting point. And if we are not comfortable with that, it is just compounding above that.

CHAIRMAN STETKAR: Thank you.

MR. NOWLEN: Yes, and I will confirm that, of all the parameters that we use to characterize fires, heat release rate is the most important one. There's absolutely no doubt.

And I'm not saying we shouldn't reexamine it, but my caution, again, is I haven't seen what is being done by industry. But when I read the reports, there's such a focus on the heat release rate. I think we have to look at this in an integrated manner and make sure that all the pieces are being done in balance. That is all that I'm saying here.

CHAIRMAN STETKAR: Okay. Thanks.

MR. NOWLEN: This was just a slide to talk about the simple binning. Our intent here was to cover the cases we thought we would see out in the plants. They're predominantly vertical cabinets, the division between qualified and unqualified cable, and open and closed doors.

I believe that the last bin may actually be a typo. I believe that was intended to be either qualified or unqualified cables in an open cabinet. Because what you find is, again, if you can cross the threshold and get the cabinet burning, the qualified and unqualified no longer matters. So, the upper end of the distribution is very similar. In fact, the biggest fires we had were in qualified cables, but you've got to cross the threshold. The threshold is easier to cross for the unqualified. So, I think our intent was to cover qualified/unqualified, open/closed, vertical/others.

But, again, we were focused on what is going to be the application out in the plant. Given the data that we have, how fine can we cut this? Can we cut it between load centers and MCCS? No.

All that we have is control cabinets. We are going to have to use that to extrapolate to what the other cabinets are going to look like. So, let's try and come up with one set that would represent them all. And I agree, revisiting it is totally appropriate. Also, we talked about the control board.

Expert judgment is essentially inscrutable and does not meet the requirements of ASME PRA standard. Well, there was no ASME/PRA standard at the time, but I just tried to go through here and explain a little bit about how we did that particular analysis. And I think the report is pretty clear that the distributions represent the expert judgment of the authors.

Yes, it would never pass the standard

today. We didn't document all our discussions. We didn't have a structured debate. We were a team working to try to come up with a solution. So, take it for what it's worth. It's our judgment.

And again, this is another one that I think we have beat this to death. We were trying to provide sort of generically-applicable methods that you could go around your plant and apply. I see a cabinet and I need to do a model of that. How do I do that? Here's some generic guidance that should bound your cases or reasonably represent your cases. I should be careful about using the "bounding" word. I tend to use bounding a little more liberally than it's being used here.

Our intent was to provide something that would be a reasonable representation across a broad spectrum. So, again, the idea of specializing for particular cases, looking at the total heat load, looking at whether you actually have a single log in the corner versus spaghetti running through a control panel, those things we intended to be considered, and I understand that crystal clarity is lacking there. We have talked about that.

I guess one other point that I should talk about here is that another insight from the cabinet fire testing is that the effects of the cabinet fire on the broader room were relatively minimal. That would address the question about automatic suppression.

In general, the effects of these fires -- and this goes across the board, almost all of our fires -- they are very, very localized. I rarely get the temperatures at a 14-foot concrete ceiling hot enough to set off a sprinkler. You know, these are localized effects, and we see that because the vast majority of fires in the database are manually suppressed. We actually rarely see the automatic suppression systems coming into play. They do show up, gaseous suppression on cabinet fires, and things like that. But, again, these are localized effects.

I'm hoping that the PRAs are reflecting that. Whenever I see a PRA that tells me they burned out a room, "How did you do that?" is my first question. "How did you do that?" And usually, we can track it to some assumption that has been made in growth and damage that just, wow, let's talk about that.

And we had some cases like that that led to FAQs, in fact. The cable fires in the main feedwater pump one were both like that.

This is about the industry experience or the actual experience not matching reality. I think we have talked quite a lot about this. I'm not going to go into it. I'm not sure exactly what is contributing to that, and I think we have to look at all the pieces. I have said that.

So, I think that, whatever we do, cabinet fires are going to remain important to fire risk. They are our most common source. I mean nearly half the fires we get are in electrical cabinets. So, I don't expect them to go away.

I think we can better focus it. Better methods would absolutely be welcome. I think the consistency issues is definitely one that we have to work. We need consistency applied across the analyses. That's important.

I think Mardy mentioned the ideal of going back and reexamining the root data, the event data on your own is dangerous. I would add here that going back and reexamining 20-year-old experimental data on your own is also dangerous. You know, you need the insights from people who understand experimentation, understand fire phenomena. I think that is also a dangerous thing. Again, this over slicing and trying to make too much out of a bin of tests that really aren't representative of what you're trying to cover, and, then, the overlapping issues.

I think one other point that came up before was with respect to MCCs and how you assume damage. There was a question -- Dr. Stetkar, I think you asked it -- how do we do that? The guidance that's in 6850 is you assume a cabinet is lost in the same way that you counted it.

So, for MCCs, it would be a vertical stack. It's not the entire bank of MCCs. It's a vertical stack. So, if you have a fire in the third down, you would assume that it is lost. The idea there is the smoke gets into the back, and it is likely, because the cables usually run and down in the back of these things, it is probably going to trip at least those.

Now what I heard from Kiang is that they will likely assume the upstream breaker is tripped either because of smoke damage or the operators trip it, so they can fight the fire, whatever. That's a little different. 6850 says take the stack out.

CHAIRMAN STETKAR: I understand that, yes.

MR. NOWLEN: So, just a clarification there.

CHAIRMAN STETKAR: On the other hand, not taking out the whole MCC, at least for some measurable period of time, would seem to be grossly optimistic. So, I'm kind of glad to hear they're taking out the MCCs.

MR. NOWLEN: It is an interesting thing. I mean we didn't do anything different for MCCs from any other cabinet because that just goes --

CHAIRMAN STETKAR: I understand. That's where I found the discussion.

(Laughter.)

MR. NOWLEN: Yes. I like it. I think it is a reasonable thing.

I think there was also a statement about propagation out of the cabinets in these tests. None of these tests had fuels outside the cabinets. The only thing that was there is what's in the cabinet. So, you have to be a little careful extrapolating from that.

Again, the overall insights from Sandia was that these things have a relatively minimal impact on the overall environment, the room, but directly above there is clearly plenty of temperature.

Okay. Oh, one last point. In developing our distribution -- and I meant to cover this before -- one of the issues Dr. Powers raised, how we came about this. One of the issues that came out of the IPEEE analyses is that we weren't seeing analyses that covered that low likelihood, severe fire case. So, everything was being based on the mean fire. We think this is the average fire; that's how we are going to do the analysis.

But the thought was that the mean fire may not be what really drives risk. It's the most likely fire, but it could be that low-likelihood, severe fire that actually drives your risk. That's the one that can get you the damage state you need.

So, when we were defining these distributions, one of the reasons that we were pushing the 98th percentile as a characteristic of the curve is we were trying to capture that upper limit. We wanted to say, how far do we think they should push in terms of going after that low-likelihood, high-consequence fire? So, we made an effort in developing our distributions to try to put an upper bound on it. So, that's why we ended up with 98th and 75th.

And that was the end of my notes. Thank you.

CHAIRMAN STETKAR: Thank you.

Any other questions for Steve?

If not, we are going to take a recess.

MR. NOWLEN: Okay. You guys get a reprieve.

CHAIRMAN STETKAR: And, then, Harry and Ray can add, only because we're running a little bit late.

MR. NOWLEN: I almost got you back on time.

CHAIRMAN STETKAR: And I'm the Chairman, and I need a recess.

(Laughter.)

So, we'll recess until 11 o'clock.

(Whereupon, the foregoing matter went off the record at 10:45 a.m. and went back on the record at 11:03 a.m.)

CHAIRMAN STETKAR: Can we come back to session, please?

And I guess we're going to hear from the staff on enhancing fire PRA realism.

Do we have these handouts, John?

MR. LAI: Yes. We have Ray's and Harold's, but I think Harold isn't doing any presentation.

CHAIRMAN STETKAR: Okay. You're going to answer questions.

DR. WEERAKKODY: Yes. For the record, I'm Sunil Weerakkody, Deputy Director, Fire Protection.

Harry Barrett is here. In fact, I asked Harry whether I should introduce him to the Committee because he was our Project Manager for the Harris SC pilot. And he said to me I don't have to because he is in all these pictures, everyone knows him, and that he's famous. And he is. He's is all these pictures.

(Laughter.)

But the point I want to make was Harry was the lead for our first pilot, Harris SC. He is very cognizant of how discuss such a number of issues, PRA or non-PRA, and I understand the Committee had a number of questions that they want to ask with respect to the NRR views with respect to processing these licensing actions.

So, that's why Harry is here. He does not have a prepared presentation, but he's got it all up here.

(Laughter.)

Ray is a fire PRA expert, has been for many, many years. Ray is cognizant with the details of Harris and Oconee. With Oconee, we are a little bit pulling because we have not issued the safety regulation. So, the details that we can give with respect to Harris and the details we can discuss in a forum like this, our comments may be somewhat limited. But, within that construct, he has a lot of insight on both pilots.

CHAIRMAN STETKAR: Okay.

DR. WEERAKKODY: With that, Harry?

MR. BARRETT: Yes. One thing I wanted to talk about directly was how some of the issues that were brought up through the Harris review were resolved in the safety evaluation.

The Progress Energy team ended up having several departures from 6850 because they found issues that either they didn't think were realistic or appropriate. I will give you an example of that as MCCs being treated as closed cabinets. By 6850 rules, looking at an MCC, you would normally end up considering that that was an open cabinet and that you would end up considering that all fires get out of the cabinet essentially every time.

The Progress Energy team looked at the data from the testing and the data from the fire events and basically said, no, I think more than likely you're going to end up having that only happen maybe 20 percent of the time or 10 percent of the time. They came up with a distribution of what the impacts would be, and they ended up doing, essentially, a probabilistic analysis of that and said, well, 80 percent of the time it's not going to do that and it's going to stay within the cabinet.

We looked at their justification and looked at the way they ended up characterizing that, and we essentially said, yes, we agree with that; we don't see a real problem with that.

So, it is in the safety evaluation. It has been recorded that there are several instances where they deviated from 6850 but provided justification. And what I wanted to point out is that I think the staff is pretty reasonable when you give a decent justification. We may end up asking RAIs and ask what impact does that have; maybe you need to do a sensitivity to tell us how important is this.

But in many cases, we looked at what they did, and we ended up saying, all right, we find that to be an acceptable justification, and we ended up going with it.

They also did that looking at MCCs. They happened to be ones that used the FDS model inside an electrical cabinet, as Mardy ended up talking about.

But they did that for a specific reason. They had an issue where they have multiple spurious operations that could happen as a result of the fire in an MCC. What they needed to find out was, they had a proposed resolution, but they wanted to see whether or not that resolution was appropriate. Okay?

If you have, let's say, a fire in one of the lower buckets in one of these vertical sections, the things above that would likely get damaged. What they did was they did an FDS model to look at what the gas flow would be to what's really going to end up getting damaged by that fire.

And they came to the conclusion that if they ended up using fire-rated Meggitt cable to go from the bottom cubicle all the way up through that wireway, and they ended up having the two valves that they were worried about in a multiple spurious combination, or in the low sections of two different vertical section, then they would resolve their multiple spurious concern.

We looked at the FDS model. We looked at the way they justified it. And we said, you know, we agree with that. That's a good use of the tool. They're not calculating a probability of spurious actuation using that. They are using that as a sensitivity to whether or not their modification will really resolve the issue. So, we looked at that and we said, okay, we can go with that.

So, I just wanted to point out that there are cases where people have deviated from 6850. We have looked at what they have done. They have provided a reasonable engineering justification, and we ended up going with it.

So, this idea that the staff is totally rejecting ideas that, when people deviate from 6850, I think is not true. There are instances where you can deviate from 6850, but if you provide a technical basis, you know, the staff would be pretty reasonable with that.

DR. GALLUCCI: Let me add that the place where we're very careful is where what appears to be a deviation from 6850 may have generic implications as opposed to implications just for the specific plant. If that's the case, then we're much more careful about trying to make a judgment on that.

Basically, what we do is we say, for your particular plant, can you justify this deviation? Accepting it or not, we may require sensitivity analysis, but we're careful to say that we are accepting this for your application, but it does not necessarily imply generic implications.

Now just an example of something, early on in the pilot phase, Harris proposed a relaxation on the screening human error probabilities that came out of 6850. And we had a meeting. It was before really they were too far into their PRA, before they had actually submitted.

And we thought it was a good method. Ultimately, it got superseded by the new NUREG-1931, but that was a case there where we probably would have accepted that not only specifically for Harris, but generically. But, ultimately, it was superseded and the fact that the number of human actions that were ultimately left in the PRA diminished significantly, so it wasn't relevant.

But that is an example of the type of thing. But, like I say, where we're careful is where, and just like Mardy said yesterday, is where you have a single entity that has proposed a new method or an alternate method that hasn't really been vetted yet. And the industry recognizes this as well in the peer reviews because the new NEI-0712 has a category called "unreviewed analysis method" where the peer review teams -- and I was an observer on one of the teams where that peer review team didn't feel that it was appropriate to make a decision one way or the other on that.

As Donnie mentioned yesterday, that is being passed on to a task force to resolve, hopefully, in the near-term. So that, if those methods do have generic validity, then they would be used.

MEMBER BLEY: Just to help me understand what's a deviation from 6850, one example that has come up a number of times in the discussions is there is a statement in the NUREG that you can or should account for fuel load availability. Now, if somebody does that, is that considered a deviation or is that just part of the analysis that you would review?

DR. GALLUCCI: That's part of the analysis. I consider it an enhancement.

Or 6850 advocates the use of plant-specific insights, fire modeling, et cetera. What we would consider deviation is where, like the first case, where I have the example is Harris proposed new screening values for the HRA. That could be considered a deviation from 6850. However, they provided a basis, et cetera. And I say, ultimately, this didn't end up in their PRA, and it was superseded by the subsequent work on fire HRA that was done by the industry and NRC together. That would be considered a deviation. That would be something I would consider a deviation.

CHAIRMAN STETKAR: Let me ask -- another one, Dennis?

MEMBER BLEY: No, go ahead.

CHAIRMAN STETKAR: A couple of questions. I'm trying to listen through all of the discussions.

One thing that was brought up this morning, only because I have it in front of me, is -- maybe I'll save this for the FAQ discussion because I know we're having a different discussion on FAQs. So, let me save that one for the moment.

What I want to try to understand, and I know you can't talk too much about the Oconee process. So, our dataset here is limited to a single available staff review of one submittal, which is a --

MR. BARRETT: Well, there may be generic ramifications from the Oconee review that we might be able to talk about. It depends on what it is you're asking.

CHAIRMAN STETKAR: Well, one thing that I wanted to try to get an understanding, the Harris submittal has been approved. Harris has transitioned.

MR. BARRETT: They're still implementing. They're almost done.

CHAIRMAN STETKAR: Okay. Fine. It's process-related. They are not going backwards, I hope.

(Laughter.)

However, I think yesterday we heard that there are still a number of, I don't know whether they're license conditions because I didn't go back and do my homework last night to actually develop the words, license conditions or restrictions on the further use of the fire PRA going forward after transition.

MR. BARRETT: Yes, there is.

CHAIRMAN STETKAR: And I'm curious, and I think what we heard with -- again, we don't know and you probably can't discuss it in detail. There may be a similar process being applied in Oconee. Now yesterday it was characterized as the SER will be issued with open items.

MR. BARRETT: I'm not sure that's an accurate statement.

CHAIRMAN STETKAR: In the sense of a regulatory SER with open items, is that -- I mean, certainly, the Harris SER did not have open items --

DR. WEERAKKODY: Correct.

CHAIRMAN STETKAR: -- in the sense that we understand it.

DR. WEERAKKODY: I think there's a number of things we can speak in general terms when we would do something like that.

I am going to invite Donnie to speak to that.

CHAIRMAN STETKAR: Okay. And as long as I can be assured that the SERs are not, we're not approving something with an SER with open items. In other words, whenever the Oconee SER is issued, whatever that schedule is, that will be an SER with no open items. Is that correct?

MR. HARRISON: Yes, and this is Donnie Harrison of the NRC staff.

That's correct. I think in different types of applications there might be a draft SER that is issued with open items as part of our review process.

CHAIRMAN STETKAR: Yes.

MR. HARRISON: We're at a stage on the Oconee review that, when we issue it, it will be the final SER.

CHAIRMAN STETKAR: Okay.

MR. HARRISON: There will not be a draft with open items.

That being said, I think the confusion is there may be limitations on the ability of the licensee to do self-approval post-transition based upon the current state of their PRA. And that's where there's the confusion, I think, is even within Harris, we had part of the license condition.

There were implementation items related to, and the example would be, incipient detection, where the licensee for the transition application used a model. We developed through a FAQ another type of model. They did a sensitivity study to that other model, but when we said, well, we want to do self-approval in the future post-transition implementation; you need to convert your PRA to the accepted model and not use your model.

And again, you have to understand the staff's perspective on that is we're granting them the ability to approve plant changes without coming to us. So, we want to have assurance that they are using is a model that we agree with.

And so, that's the limitation we put in on Harris in that respect. That's not an open item. We closed it for the application --

CHAIRMAN STETKAR: For the transition?

MR. HARRISON: For the transition. But, then, we said, but before you can do it on your own, you have got to convert over to this accepted model.

And similar thing is happening within the Oconee review as well. It may be broader on Oconee, I'll just admit that.

CHAIRMAN STETKAR: Is the incipient fire detection model the only -- as I said, I have to apologize, I didn't have the opportunity last night to go back and do my homework. Is the incipient fire detection model the only -- I have to be careful in terminology -- I'll call it a license condition. What do you call it?

MR. HARRISON: There's modifications and, then, there's implementation items.

CHAIRMAN STETKAR: Okay.

MR. HARRISON: So, modifications are actual physical plant changes.

CHAIRMAN STETKAR: Yes.

MR. HARRISON: The implementation items may be a list of items, many of which are deterministic, but they need --

MR. BARRETT: Yes. I'm not sure the implementation items made it to the license condition. In the Safety Evaluation, it said they had to be done within the implementation window. But the modifications and the modeling in the PRA of the incipient detection are license conditions.

CHAIRMAN STETKAR: Are license conditions. But from a PRA perspective, I understand the modifications.

MR. BARRETT: Yes.

CHAIRMAN STETKAR: I mean that is they committed to do things; they need to do them. But from a PRA perspective, when we're talking about a risk-informed basis, a risk-informed licensing basis, and the use of that risk-informed licensing basis going forward.

At least in Harris' case, it is only the incipient detection model that is the only kind of --

MR. BARRETT: And making the modifications so that the plant matches --

CHAIRMAN STETKAR: Yes.

MR. BARRETT: Those are the only two.

CHAIRMAN STETKAR: Obviously, the modifications need to be made. But in terms of methods, and what we are discussing primarily in this forum is methods and data --

MR. BARRETT: Yes.

CHAIRMAN STETKAR: -- and that sort of input.

MR. BARRETT: Yes.

CHAIRMAN STETKAR: Input to the PRA

models, and, then, usability of the PRA models going forward.

And I recognize you can't speak about details on Oconee at this time.

MR. HARRISON: Yes. And, John, if I can just -- again, to just understand, when we do our review, there's essentially two parts to it. One is within our guidance is the transition application, is it acceptable? A licensee can do a number of things. They can use conservative models. They can do sensitivity studies to address issues where there might be questions on our RAIs. Those get you through transition.

There may be issues where we say we want some final disposition on issues to allow you to do self-approval. That is a future thing that is part of the application, and again, depending on how comfortable we feel with the applicant, we may or may not grant self-approval until certain things are done.

CHAIRMAN STETKAR: I understand. I understand. Understand.

MEMBER SHACK: Just in the Harris SER there is a statement that they adjusted HRR values for a limited number of ignition sources based on fire modeling insights. Was that the MCC or is this a different issue?

MR. BARRETT: That's a different issue. I think the MCC might be included within that, but there were several different ignition source categories that they adjusted downward slightly that we looked at the way they did it and why they did it, and we agreed with them and didn't have a problem with it, partly because it really didn't make that much difference in the overall result. But we did allow that, and it is clearly stated in the Safety Evaluation that we reviewed that and accepted it.

MEMBER SHACK: And that was based on what? The fuel loading or the arrangement? What was the nature of the --

MR. BARRETT: If I remember right, one of those was transient combustibles.

MEMBER SHACK: Well, yes, transient combustibles is another issue. It said you gave them credit for stricter transient controls.

MR. BARRETT: And Dave can probably give a little more.

MR. MISKIEWICZ: Yes, I can expand on that.

And I don't even know if it's a deviation, based on what we're discussing today. But, yes, we did make some adjustment to transient combustibles, and we had no transient combustible storage areas, no transients allowed. We used a smaller-sized transient, not the giant trash bag as our source. So, the frequency is still there using the method, but we used a smaller transient.

MEMBER SHACK: How about for the cabinets?

MR. MISKIEWICZ: For cabinets, what we did is what we had talked about. You know, we had like a lot of rad monitors, a lot of lighting panels, smaller cabinets. We actually looked at them, what was in them, opened them up. Even some larger cabinets, we opened them and there's nothing in it but some terminations or something.

And we had our fire modeling folks look at them. We took pictures, and we said we don't believe this could be a 702 fire; we are going to limit it to 200 or 69 kW, depending on what it actually looked like.

So, we did that. We justified it with calculations and provided that as part of our packages. So, we used the insights like we had been talking about to try to justify that this is not going to be the megawatt fire.

MR. BARRETT: But, in reality, that is not a deviation from 6850 because you are supposed to look at the combustible loading in the cabinet.

MR. MISKIEWICZ: Right.

MR. BARRETT: So, that is not really a deviation.

MEMBER SHACK: It doesn't call it a deviation; it just says they adjusted the values.

MR. BARRETT: Right.

CHAIRMAN STETKAR: Okay. It's a pity we don't have the Oconee stuff done yet, for a variety of reasons.

MR. BARRETT: Yes, yes.

CHAIRMAN STETKAR: I think that we have seen experience through other types of licensing applications. I think somebody yesterday drew the analogy to the license renewal efforts, where certainly the first two or three --

MR. BARRETT: Yes.

CHAIRMAN STETKAR: -- license renewals, I wasn't around at that time, but in the three years I have been on the Committee I have seen a tremendous improvement, both in the efficiency and quality of the staff reviews and the industry's understanding of what is expected in the submittals and the industry's coordination of their activities to be sure that we don't have repetitive questions raised in every submittal.

MR. BARRETT: Right.

CHAIRMAN STETKAR: It's kind of a poster child for that type of review process. Right now, I think we are dealing with one example. Hopefully, two coming down the pike.

MEMBER SHACK: It is about to double.

(Laughter.)

CHAIRMAN STETKAR: Well, yes. We're going to double our experience base.

Thank you very much.

With that, Ray, you have a prepared presentation.

DR. GALLUCCI: Yes. Let me just say that this is kind of tangential to the cabinet discussion that was before.

CHAIRMAN STETKAR: Okay.

DR. GALLUCCI: And it may very well just be preaching to the choir. So, if at some point you don't think you want me to continue with it, I will be glad to stop.

(Laughter.)

Because, basically, this was my humble attempt as a PRA person, and not a fire modeling person, to --

MEMBER SHACK: A PSA person.

DR. GALLUCCI: PSA.

It's a humble attempt to use pre-FAQ information that's in 6850 to just do some simple enhancements of realism. And like I say, this may be so simplistic to not be of that much interest, but I will go forth and you can let me know.

CHAIRMAN STETKAR: Okay. You're one of the few people who comes up there and says, "You can tell me to be quiet."

(Laughter.)

DR. GALLUCCI: Yes. And to twist the words of Shakespeare from Mark Antony's eulogy of Julius Caesar, I come to praise 6850, not to bury it.

(Laughter.)

Based on the original guidance, the pre-6850 MOU FAQs, which will probably be discussed in more detail later today, from 6850/1011989, I chose to discuss two simple examples, showing how that guidance enables more realistic fire scenarios to be developed, and going from what I would consider the scoping guidance in 6850 to some very basic pre-fire modeling. I don't think it crosses the threshold to really count as fire modeling in the sense of even fire dynamics tools. It uses material directly in 6850.

I don't want to offend the fire protection folks, which I was in that Branch for seven years. So, I don't want to pretend that I am doing any fire modeling here.

My example, Table E.1, which I think you probably saw snippets of earlier, those are the characteristic heat release rates for the selected eight cases. I just took one, the very first one, Case 1, which is a vertical cabinet unqualified bundle.

The listed parameters there, the 75th and 98th percentiles; there's a gamma distribution given. And you can calculate the mean heat release rate from the gamma parameters or by looking at the distribution. And it turns out that the mean heat release rate occurs at the 64th percentile for this distribution. So, even the 75th here is higher than the mean estimate.

Now, for the sake of my example, I am someone did some sort of fire modeling to show that damage will occur at a temperature that corresponds to that for the mean heat release rate. So, that's temperature is T64; the mean heat release rate, Q64, with 64 represents the percentile.

So, basically, I'm saying we're going to have damage at 50 kilowatts. Someone did that calculation.

Temperature varies as the heat release rate to the two-thirds. The ratio of the damage temperature to the temperature corresponding to the 75th percentile heat release rate can be shown to be, it's about 80 percent. So, at the 75th percentile, heat release rate gave you 200 C. Then, the mean percentile, the 64th would have given you about 160.

From the ASME/ANS standard, this is a fire scenario selection, Supporting Requirement C-1. The thing here is that it gives you the three increasing levels of the categories: basically, assigned characteristics at level I that bound potentially risk-contributing fire events, et cetera. At category II, it recommends, well, it requires using the two-point fire intensity model, not necessarily the 75th and 98th percentile, although it is probably in the notes that that's a good choice. And at CC-III, it says talk about a range of fire intensities, which brings in the concept maybe you want to use the gamma distributions.

So, what I did here is, if you assume just the point estimate, the 75th and/or the 98th percentile heat release rate, and you want to deal with category I or II, you would come up with saying the damage probability is 1, since the 75th percentile corresponding temperature exceeds the 64th percentile corresponding temperature.

However, if you want to apply the distributional approach, knowing that the mean occurs at the 64th percentile, the probability of exceeding the mean is .36. So, if you wanted to go from category II to category III, theoretically -- you could obviously do this in category II -- you could say that by just using the distribution I might be able to reduce the damage factor by three.

While this example is only for illustration, it shows how use of more detailed, but straightforward guidance from the 6850/1011989 report can enhance fire PRA realism. So, I really haven't done any fire modeling other than just working with the distribution that's in 6850.

And what I'm saying, people are probably doing this. That's why I may be speaking to the choir.

CHAIRMAN STETKAR: I think what we heard yesterday is that people are doing that.

DR. GALLUCCI: Yes.

CHAIRMAN STETKAR: The mechanics, I'm not quite sure about, but we had --

DR. GALLUCCI: Again, it's an example of what's in 6850.

CHAIRMAN STETKAR: -- pretty positive feedback that people, indeed --

MEMBER BLEY: Or some people.

CHAIRMAN STETKAR: Well, perhaps not all people, but people are doing that. And I would assume that if the people doing it are obtaining reasonable benefits, increased reality, that that would be communicated throughout the industry, and more people would be doing it, I would hope.

DR. GALLUCCI: Okay. My second example, here we are going to talk about fire growth in electrical cabinets. We have 6850 that fire grows to a peak heat release rate in an average of about 12 minutes. There were 20-30 tests, and they are ranging from 4 to 18 minutes of growth. And it suggests use of a T-squared function to represent growth of this peak.

Now let's say someone wanted to be conservative, maybe for bounding, or whatever, and they just wanted to assume the heat release rate peaked at T equal zero, instead of using the T-squared curve. Again, I am not saying people have done this. I am just saying this is one possible bounding approach, and here's how you can relax that from 6850.

What I have here is the scaled heat release rates, scaled time to maximums of 1. The blue curve there is an example of the heat release rate over T-squared time. In the red, I did an equivalent area step function. Basically, I delayed the start of the fire and then shot it up so that the area under the blue curve and the red curve would be equal.

However, talking to the fire protection people, it has been shown -- I don't have the paper, but, apparently, there was a paper given, and this, apparently, is part of the standard teaching in fire protection. It is that, because of the T-squared growth, maybe because of time lag, et cetera, it will actually impart more heat to the target than the equivalent-area step function. Not knowing what the exact ratio is, but suspecting that if I backed off my step function to, instead of the equal area occurring at two-thirds of the timescale, at half the timescale, that would certainly bound that.

So, what I basically did here is saying I don't want to run a fire model for my example. I just want to say, instead of assuming that the heat release rate is instantaneously at its peak the time into zero, I am going to use a surrogate for the T-squared growth where I delay that rise to the peak, as a step function, at the 50th point, the 50th percentile point, or midpoint on the distributions here.

Looking back at the standard fire scenario selection C-2, category I, "characterize ignition source intensity at full peak heat release rate". One could say, well, I'm doing that, even if I do that at time equals zero. One might say, well, I'm doing that if I do it at time equals .5, whatever. I am basically doing a full peak heat release rate.

The second one, categories II and III, "characterize ignition source intensity using a realistic time-dependent fire growth heat release rate". And this would be more analogous to using something like a T-squared curve or a T-squared development.

Now, if you look at CFAST, you will find that there's four categories, slow, average, fast, and very fast, very different rates. And if you use FDS, you can actually input whatever heat release rates you want.

But, for the purposes here, let's just say the T-squared growth profile would be analogous to what I would do for categories II or III. And as a surrogate, I am going to use my step function because I didn't run a fire model and actually put a T-squared heat release rate in.

What might I see as a benefit of this? If I look in Section P.1.3 of 6850, the probability of non-suppression of an electrical cabinet fire before electrical damage occurs, the probability of non-suppression within T minutes is an exponential function. The lambda is minus .12. This has been changed slightly as a result of, I believe it's FAQ 50 on manual suppression, but it didn't change that much. Again, I was trying to use all the pre-FAQ information.

If I have an additional time delay, as opposed to T0, included in this non-suppression probability, I will end up with a reduction by a factor of the exponential of minus lambda times D, this time delay. Thus, if a T-squared heat release rate growth profile -- again, I'm using the surrogate function -- is assumed, instead of an instantaneous, the probability of non-suppression will be reduced by a factor of the exponential of minus 0.12 times half of whatever my actual T development time is. T prime is the unscaled time because what I did in my scale curve is I scaled it to 1.

So, here's just some examples. Let's say that I decided to reach peak heat release rates ranged from 3 to 15 minutes. So, my halfway point time there, you can see, is at 1.5, et cetera. I highlighted the 12 because that is the recommendation or the suggestion from 6850.

And you can see from the third column that that would be the ratio with the time delay to that without the time delay. So, I'm showing decreases. And the reduction factors range from 1.2 to 2.5 by just putting in that 50 percent time delay.

I, then, combine that with what I did from the first example, if I want. And what I end up with is a series of joint reduction factors, if I put the two examples together ranging from 3.4 to 6.9 with an average of around 6, if I was basing it on the 12-minute growth rate.

As it says at the bottom, the first reduction factor shows how much the non-suppression probability will be reduced by use of just the surrogate step function at T scale equals to .50, from 3 to 15 minutes.

The second factor shows the joint effect if distributed heat release rate reduction factor of 3 from example is also applied.

Conclusion: these examples are illustrative only, limited only to two aspects to contribute to fire CDF, but they show how use of more detailed, but straightforward original guidance from 6850 and 1011989 will enable you to enhance realism.

And I am basically going from what I would label the scoping approach to pre-fire modeling. I am not saying that this is not being done. Again, this is just a simple PSA/PRA person's attempt to use this material.

CHAIRMAN STETKAR: Ray, this is good. And I want to see if I can get us somewhat back on schedule here a little bit.

But I wanted to ask you something. The first part of your example, I understand fully. I can derive that completely from the information in NUREG CR-6850 because I know what that distribution looks like, and I can chop that distribution up any way I want to.

The second part, to me, was a bit less clear, the basis for your step function delay at the 50th percentile of the T-squared distribution.

My question is, is that type of approach in NUREG CR-6850 or are you now stepping --

DR. GALLUCCI: No.

CHAIRMAN STETKAR: Okay.

DR. GALLUCCI: 6850 says T-squared.

CHAIRMAN STETKAR: Okay. Right. Now my question is, then, as a practitioner, if I come in, this display is something that I suspect the staff would consider a deviation from 6850. So, I now need to justify why I used a step at 50 percent versus, it looks like, 65 percent versus some other percent, and dredge up the appropriate literature to try to justify that, is that correct?

DR. GALLUCCI: Yes.

CHAIRMAN STETKAR: Whereas, the first --

DR. GALLUCCI: Like I say, this is accurate. I don't have the reference, but my fire protection people say there was a paper that says --

CHAIRMAN STETKAR: Okay.

DR. GALLUCCI: The .5 is an estimate. I know that the two-thirds value, which is the equal integral, is the exact point at which the area under the T-squared and the step function are the same.

And according to the paper, you will transfer more heat using the T-squared distribution. So, the step actually has to occur earlier than that. Where it is, I don't know because I don't have that paper. But, talking to the fire protection people, if I used .5, I would certainly be bounding that.

CHAIRMAN STETKAR: But, again, if I'm an applicant, it is incumbent on me to -- certainly I can find the paper.

DR. GALLUCCI: Right.

CHAIRMAN STETKAR: But I have to defend the paper to staff's scrutiny because that is something that is not in 6850.

The first is certainly, you know, well --

DR. GALLUCCI: Right, right.

CHAIRMAN STETKAR: Those distributions are documented. So, I can at least get that initial factor of, pick a number, 3.

DR. GALLUCCI: And if I was a fire modeler, I wouldn't even have bothered with the step function. I would have just run CFAST and use the actual T-squared.

CHAIRMAN STETKAR: Which is a lot, certainly --

DR. GALLUCCI: Yes.

CHAIRMAN STETKAR: -- a lot. Okay. Thanks.

Kiang, you had something?

MR. ZEE: This is an interesting

presentation. I think I just want to get just a little bit of a clarification.

This is an NRC staff presentation, and I think the context was things that can be done using the existing guidance in 6850. I think we explored a little bit to what extent this represents a deviation. And I'm a little bit confused what they are trying to tell us here, right now.

I mean, is this, but for rationalizing equally, stepping back to half of the time, I mean, are you portraying this as essentially something the staff would accept as meeting capability category II-III for related supporting requirements, simply with respect to the growth rate?

CHAIRMAN STETKAR: Let me stop this discussion for the moment because this is a presentation to an ACRS Subcommittee. We are trying to understand technical issues. I don't want to turn it into a debate between the industry and staff of what might or might not be acceptable in a licensing review. So, I just want to stop that part.

I understand the concern, but let's bring it back to something that we can learn about.

Thank you.

And next up, let's see, it's 11:40. Let's start on the next topic on the agenda. I do want to hear about the FAQs. I think it would be worthwhile. We are going to lose Dr. Powers sometime around noon, as I understand it. Let's start the discussion on the FAQs. The staff is up first. So, see if we can get through the staff presentation, and, then, probably we will break for lunch and have the industry come back after that, if that works. Let's see how the timing works here.

Thank you.

MR. MOULTON: My name is Chuck Moulton. I'm the NFPA-805 mass questions process manager. I have been from the inception of the process.

I have a relatively brief presentation on process. Then, we can get to the more technical discussion.

CHAIRMAN STETKAR: Good. I think we fairly well understand the process. We have had some discussions about it. So, see if you can run through that one pretty quickly and see if we can get to some specifics. Because there have been some discussions about -- I want to learn a little bit more about specific FAQs and why there's discrepancies in terms of --

DR. GALLUCCI: I will follow that up. I

have some material on the specific FAQs.

CHAIRMAN STETKAR: Okay. Good, good. Okay, good.

MR. MOULTON: Do we even want to have this process discussion?

CHAIRMAN STETKAR: My preference is no, but if you think it is important for context --

MR. MOULTON: Well, let's run through it then.

CHAIRMAN STETKAR: Well, run it quickly.

MR. MOULTON: The first slide, you have already seen most of this slide from our presentation in November. It is basically the idea that the FAQ process was to incorporate lessons learned in the pilot process and give them some sort of regulatory weight behind them, get interim staff positions on these issues out to the stakeholders in a timely fashion, with the final regulatory closure of an issue resolution incumbent on a revision of the Reg Guide for 805, just 1.205.

In the most recent revision on that Reg Guide, 18 results FAQs were incorporated into the guidance document.

The next one.

This slide is our bragging slide. It

basically shows our success in resolving issues that have come before us. As you can see, we are almost done with everything we have gotten so far, and we don't have any currently open PRA-related --

MEMBER BLEY: I guess I've lost the thread on this. I wasn't here in November. So, what are these items that are tabulated here?

MR. MOULTON: The top row, the first row is total number of frequently-asked questions --

MEMBER BLEY: Ah, okay.

MR. MOULTON: -- the process, and it moves across the page from the total to the number that were resolved, the number that were withdrawn from the process without resolution, the number that are apparently open or we're working on, and then the number that are in the fast closure process --

MEMBER BLEY: Okay.

MR. MOULTON: -- to achieve output of a publicly-available memorandum, including the staff's position.

MEMBER BLEY: Okay.

MEMBER SHACK: Are you talking about them being incorporated in the NEI, but, I mean, this is also in 6850, Supplement 1, isn't it? Or is that a different set of FAQs?

MEMBER BLEY: Or a subset of these?

MR. MOULTON: That's a subset.

DR. GALLUCCI: A lot of these FAQs are non-PRA-related.

MEMBER SHACK: I just was looking at the 15.

MR. MOULTON: Right. Those PRA-related one are only in the Supplement, I believe.

DR. GALLUCCI: I believe in the last Supplement, they were all in there. Mark Salley may be able to illuminate that, but I think all of those have now been published in the Supplement that came out a couple of months ago.

MEMBER BLEY: Yes. Okay. That's the one we have. Yes. Okay. Thanks.

MR. MOULTON: The initial process was non-PRA issues. So, PRA FAQs, what came to be known as the MOU FAQs.

In mid-2008, a large number of new PRA-related FAQs were introduced into the process. Before then, we had had three or four PRA-related FAQs, counting guidance, binning guidance of miscellaneous things. What if the pump is exactly 5 horsepower, which bin does it go in? Does it go into the less-than-5 horsepower or the greater-than-5 horsepower bin, that sort of detail issue?

MEMBER BLEY: And these are things that were in that table you just showed?

MR. MOULTON: Yes.

MEMBER BLEY: Okay.

MR. MOULTON: Many of these new FAQs were only problem statements. They did not include an initial proposed resolution for discussion. And it was primarily these FAQs that became known as the MOU FAQs after the research EPRI MOU process.

CHAIRMAN STETKAR: Can you, for the other Subcommittee -- I had forgotten that Dennis and Dana weren't here in November. Can you briefly describe that process or do you have another slide coming up that --

MEMBER BLEY: How thing should get added to the list?

CHAIRMAN STETKAR: No. How things, the process, once a FAQ has been raised, the process that was implemented to eventually reach closure on it.

MR. MOULTON: Okay.

CHAIRMAN STETKAR: And who participated in that process and how they participated.

MR. MOULTON: Once a FAQ is introduced to the process, it is presented at a public meeting. The

FAQ process is based on regularly-scheduled public meetings between the NRC and industry stakeholders and the public.

A question is posed, is entered in the process, introduced at a public meeting. It is handout. It is publicly available. The staff, then, considers the proposal. There are substantial comments on it. These comments are provided at another public meeting in writing, and publicly available.

Then the authors go back and consider those comments and incorporate them. And, then, a new revision is introduced again at a public meeting. And this iterative process continues until a technical agreement is reached, in which case, then, the staff takes the agreed-upon resolution and produces a publicly-available memorandum documenting what that resolution is, referencing the final agreed-upon version of the FAQ.

MEMBER BLEY: And 6850 was a joint product with EPRI and the NRC. The FAQ resolution continued that? I know the Supplement is a joint --

MR. MOULTON: The FAQ resolution was separate from that.

MEMBER BLEY: But it still was a joint

effort?

DR. GALLUCCI: The MOU FAQs use an expanded group from both NRC Research and from the industry side and incorporated the original 6850 authors, members of what evolved into the 805 and Fire PRA Task Force for NEI, and an expanded group of participants from NRC Research. So, it included an even larger group and, naturally, when you have more people, consensus could be more difficult.

MEMBER BLEY: Okay.

DR. GALLUCCI: But, specifically for the MOU FAQs, that was the process.

MEMBER BLEY: And as I recall, the Supplement is a joint publication, like the original.

DR. GALLUCCI: It is, yes.

MEMBER BLEY: Okay. That's all.

MR. CANAVAN: For the record -- Ken Canavan -- 1019259 is the number.

MEMBER BLEY: Thank you, sir.

MR. MOULTON: Okay. So, once we had these new type of FAQs in, we continued to have our regular monthly public meetings. Several months, almost a year went by with minimal progress. And NRR management determined that we needed to close out these outstanding PRA-related issues.

So, letter was sent from our management to NEI describing the process that was going to be used to close out these issues. At the same time, a number of fully-developed PRA-related FAQs that we didn't seem close to closure on got subsumed into this alternate resolution process and were closed using it.

That is the process. That is aligned with the FAQ process described in the RIS describing the entire FAQ process.

So, quickly, the steps of our alternate resolution process for these FAQs. The first step is NRR and Research developed an Interim Position. Then, Research engages EPRI under the MOU to obtain comments on that Interim Position.

Step 3 is NRR and Research resolve the subsequent comments. And, then, NRR prepares a position for public comment that is sent into the FAQ process for a public comment period. NRR and Research jointly resolves any comments, and then NRR issues its final position as a publicly-available memorandum.

So, how did this typically go? This is an example timeline from FAQ 46, which is the incipient fire detection question. This was a problem statement FAQ. It was introduced into the FAQ process in April of 2008.

The balance of 2008, we held our regular meetings. Minimal progress was realized from those meetings.

CHAIRMAN STETKAR: Why was that?

MR. MOULTON: It was hard to get consensus from such a large group of sometimes conflicting interests.

CHAIRMAN STETKAR: Okay.

MR. MOULTON: In May of 2009, the NRC Draft Interim Position was sent to the MOU. And on the 19th, we received comments back. This was during the time when the letter to NEI was being developed. So, then, the 1st of June, the alternate resolution process was published. Towards the end of June, we released our Interim Position for public comments, and we received comments at the end of July.

MEMBER BLEY: I'm just a little confused. As you go through the process, this sounds like the product is an NRC product that has responded to comments from the industry rather than a joint?

MR. MOULTON: It is.

MEMBER BLEY: It is?

CHAIRMAN STETKAR: These are alternate --

MR. MOULTON: This is an alternate resolution.

MEMBER BLEY: Oh, 46 is in the Supplement.

MEMBER SHACK: They are all in the Supplement.

CHAIRMAN STETKAR: They are all in the Supplement.

MEMBER BLEY: So, not everything in the Supplement was agreed to by everyone?

MR. CANAVAN: The FAQ 46, incipient detection, was not authored, direct response was not authored by the NRC. That's not accurate. Response 46 for incipient detection for authored by Pat Baranowsky under contract with EPRI.

The solution that is provided from the NRC Draft Interim Position sent to the MOU was actually sent, is our writeup with NRC/RES comments sent back to us.

MEMBER BLEY: So, in fact, you are in agreement?

MR. CANAVAN: We are the author.

CHAIRMAN STETKAR: Well, that is consistent with this process. It is just perhaps not characterized --

MEMBER BLEY: But that was an example that was up here.

CHAIRMAN STETKAR: Yes. Yes.

MEMBER BLEY: So, the example wasn't right.

CHAIRMAN STETKAR: The example is not quite right.

MR. CANAVAN: Just to be clear, FAQ 42, 44, 46, 48, 49, 50, and 51 are all authored by industry.

CHAIRMAN STETKAR: Okay, and we have those on the record, yes.

MR. CANAVAN: All the original authorship is of different people, including Dennis Henneke, Kiang Zee, Pat Baranowsky were the primary authors of those resolutions.

CHAIRMAN STETKAR: Doug?

MR. TRUE: I just want to add a little bit more context to this timeline. So, the NEI letter went in in January of 2008.

Could you go back to the one before?

And, then, there was a public meeting in February. The FAQ process would have got engaged in March.

So, by early April, we had actually decided there were a handful of things we were going to talk about in the FAQ process. This was one of them.

CHAIRMAN STETKAR: Handful in the PRA area?

MR. TRUE: In the PRA area.

CHAIRMAN STETKAR: Okay.

MR. TRUE: And we tried to actually pick kind of the easy ones. Like we didn't go after heat release rates, for example, in that. And incipient protection was important because Harris was pursuing that, and it was a logical one to include.

What's left off of this timeline is that in late 2008 EPRI had proposed the actual solution, and by the end of 2008, had published an interim report that described the solution.

And, then, it was May of the following year before any response to that was given back in a staff resolution.

MR. CANAVAN: Yes, in December of `08 --

MR. TRUE: December of `08 was when the EPRI report was issued.

MR. CANAVAN: Yes, and that's 1016735.

MR. TRUE: So, that's just from a timeline and context impact with this particular EPRI FAQ, I think Ken can go through them one by one, if you want.

CHAIRMAN STETKAR: No, no.

(Laughter.)

MR. TRUE: The other thing is that, while this one was an industry-proposed resolution, I think the point that Dennis was going to make is correct, that many of the FAQs represent NRC positions, not a consensus position. They refer to consensus, but I think that is a consensus within the staff. It is certainly not a consensus within the MOU FAQ group, or whatever the terminology is.

MEMBER BLEY: So, just to get this straight, even though the Supplement is a joint report from both NRC and EPRI, the NRC and EPRI industry haven't completely agreed on all of the resolutions that are in the report?

DR. GALLUCCI: There is agreement on what is in the reports. What there may not have been agreement on is the extent to which some parts of these FAQs were dropped because consensus couldn't be reached.

MEMBER BLEY: Okay.

DR. GALLUCCI: So, there is a limit.

MEMBER BLEY: I didn't understand that.

DR. GALLUCCI: Some of the FAQs were cut and were divided. So, what is in there are agreed upon.

MEMBER BLEY: So, there are still issues?

There are still leftover issues here?

MR. CANAVAN: My presentation actually goes through the technical issues of those FAQs.

MEMBER BLEY: Okay. I was just confused. I'm sorry. That is what we wanted to pursue.

DR. GALLUCCI: Let me just point out one thing. The EPRI report that came out in December 2008 was separate from the FAQ process itself.

MEMBER BLEY: Yes. Okay.

MR. MOULTON: I'm only touching on the FAQ process of stuff here.

MEMBER BLEY: That's fine. I'm not embedded in it.

MR. MOULTON: The MOU thing is opaque to --

MEMBER BLEY: Okay.

MR. HARRISON: This is Donnie Harrison of the staff, just to add some context.

Again, if you go back to what Chuck had a couple of slides before this, it was this was the alternate resolution path because we saw that the PRA FAQs weren't moving towards resolution. So, then, it became an activity of saying what can we do to actually at least get a position out there that says what can you do and let's get that guidance out now.

"Now" takes a year. But that is better than having them sit for three or four years and just be cycling.

So, again, to keep it in context on the PRA FAQs, this was kind of trying to drive towards at least some resolution for an interim bit, so that people could actually move forward, like Harris.

DR. GALLUCCI: And recognize that this example was a very important one because it was part of the licensing process for Harris. It was quite controversial, and it did require longer than some of the other FAQs to finally come to some sort of consensus between the two sides.

MEMBER BLEY: Okay.

MR. MOULTON: And so, the memo for this one went out in December.

This slide just breaks down how many PRA-related FAQs were resolved using the regular FAQ process and how many used this alternate resolution path. Basically, it is seven and nine. So, almost half.

MEMBER BLEY: And if I'm reading this right, five of them have technical issues still that weren't resolved.

MR. MOULTON: No, no.

MEMBER BLEY: No?

MR. MOULTON: Those last two rows are breaking down the alternate resolution path FAQs.

MEMBER BLEY: Yes.

MR. MOULTON: Four of those were introduced with a proposed resolution. Five were just problem statements. There was no proposed resolution.

MEMBER BLEY: Okay.

DR. GALLUCCI: Prior to 2008, there was already a handful of 6850-related FAQs, like a definition of the main control board, counting of cabinets. These were basically clarifications. In some cases, 6850 may have had something that appeared contradictory.

So, four of these were done, and this included the bus duct high-energy arcing fault FAQ, four of these were done prior to or initiated prior to the 2008, what I would call, accelerated process, which dealt with the remaining five. But, ultimately, all that were 6850 PRA-related, it all got rolled up into the Supplement.

MR. MOULTON: This is my last slide I'll go over.

A couple of things I learned from this process was, the first thing is that the FAQ process is very successful when it is used as it was intended to be used.

And the other thing is that an initial proposed resolution is vital for successfully resolving any FAQ in a collaborative or a consensus fashion.

Well, that's my process presentation. Questions?

MEMBER BLEY: I just have two because I hadn't been involved in any of this along the way.

The first one deals with what I thought I finally understood, that what was published in the Supplement are those parts of the FAQs and resolutions that everyone could agree on. So, there's some additional issues that are remaining. Where's the count of those?

DR. GALLUCCI: They are no longer part of the FAQ process. They were removed from the FAQ process. I think some of them are being pursued independently.

MEMBER BLEY: Okay.

DR. GALLUCCI: There was an issue dealing with DC hot short duration. The decision was made, rather than to adopt the proposed industry resolution for FAQ 51, to defer all of that to the completion of the DESIREE cable fire test. And already the expert elicitation, which will provide DC hot short probabilities, durations, and an update to the AC, is ongoing.

One is on, I think Ken mentioned, heat release rates in cabinets. It was just decided that that one was not ready for primetime, and that FAQ was just withdrawn altogether.

Other ones were split. There was one on the 35-degree vertical fire spread model for cable trays. And there was attempt to -- ultimately, there was disagreement as to what were the bounds on that, what could be used. The FAQ eventually got reduced to the only part where there was consensus was to designate the conditions under which that test was run and under which those assumptions were valid.

Trying to expand that to another, to a larger FAQ or a separate FAQ was deferred. And the fact that Research has been running the CHRISTIFIRE cable spreading rate tests, basically, that superseded the reintroduction or continuation of that spinoff FAQ.

MEMBER BLEY: Okay. Thanks.

My other question was, was there anything contentious about items getting onto the FAQ list originally? Or were all the ones that were brought forward added in?

DR. GALLUCCI: The only debate may have been whether the FAQ was the most efficient to deal with this issue or could be handled. It was decided that the FAQ process would be more expeditious than trying to reconvene the MOU expert group on 6850 and doing a complete revision of 6850.

MEMBER BLEY: Okay.

DR. GALLUCCI: So, the FAQ process was kind of a compromise. What could we do in the interim before -- basically, now a Supplement to 6850 has come out, but that's five years after the original 6850. At least these FAQ solutions were coming out in the 2008-2009 period.

MR. MOULTON: The FAQ process also allowed both sides to give a public footprint issues.

MEMBER BLEY: Yes, sur.

MR. MOULTON: This is a public process. MOU is non-public.

CHAIRMAN STETKAR: What I think I would like to -- any other questions for Chuck at the moment?

Because what I would like to do, only because of members' commitments and things like that, I think what I would like to do is recess for lunch now, come back, and after lunch I think we are still interested in hearing specific items that remain under contention, you know, within the FAQ process to give us an idea of what technical sticking points there are remaining.

MR. MOULTON: There are no longer any issues in the FAQ process open.

CHAIRMAN STETKAR: Okay. I understand. I mischaracterized the terminology.

(Laughter.)

I am interested in learning things that were in the FAQ process that have been withdrawn for whatever reason because nobody could reach agreement and what those technical issues are, and why nobody can reach agreement on them. Let me just call them "stuff" instead of calling them "FAQs".

(Laughter.)

So, if we can, after lunch, reconvene with kind of that in mind?

And again, if EPRI has a presentation, we want to go less on process, less on who didn't do what when. I want to understand what it was that wasn't done and why.

MEMBER BLEY: What are the technical issues?

CHAIRMAN STETKAR: Okay? And with that, we will recess until, and I'm only going to give you 54 minutes, until one o'clock.

(Whereupon, the foregoing matter went off the record for lunch at 12:06 p.m. and went back on the record at 1:07 p.m.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

1:07 p.m.

CHAIRMAN STETKAR: Okay, we're back in session.

As I said, there are some folks who have flight constraints. So, I am going to try to keep us as much as possible on schedule and plan to end as close to five o'clock this afternoon as we can, just to accommodate them.

So, what I would like is the presenters to keep that in mind. We may have to forego perhaps some of the topics that are on the agenda.

I think it is important to hear about the FAQs, only, as I said before lunch, from the perspective of I would really like to hear some examples of where there has not been the ability to reach consensus and what those technical issues are, because those are examples that might help our deliberations over what we have been tasked with the SRM.

I am also interested in hearing about the research program. So, I think we want to cover that. Whether we get to the topics on additional support for NFPA-805 and whether we cover the incipient fire detection remains to be seen yet.

So, I want to make sure we get through the FAQs and EPRI's research program and NRC research activities.

With that, Ray, I guess you're up.

DR. GALLUCCI: Okay. This was originally prepared for one of the sessions yesterday. However, much of the material that I have in here was already covered by Steve Nowlen. So, I'm just going to skip to the part that deals with the FAQs. It is only about four slides.

Okay. With regard to the FAQs and fire PRA, contrary to contentions, the FAQ process, while not originally intended as a means to modify NUREG CR-6850, created some significant, what I term, relaxations to the first order guidance to facilitate use of fire PRA in the short-term for NFPA-805 transition.

Could more have been done? Maybe, but there was consensus in most cases where limits were applied.

Here is some of what I would term the significant relaxations:

We find that, as you saw yesterday, in most cases the fire ignition frequencies were reduced for most of the bins. A few selected bins were still subject to sensitivities based on the original `68 frequencies. For example, the electrical cabinets bin, which is a key ignition source.

Probabilities across the spectrum of spill sizes for oil fires, that FAQ eventually was limited to the main feedwater pumps because there was consensus on that, and that was the immediate need. I think further work is being done by the industry now to extend that to other types of pumps.

CHAIRMAN STETKAR: Ray, before you go on, one of the FAQs that was highlighted this morning when we were talking about electrical cabinets --

DR. WEERAKKODY: Forty-eight that would be. It was FAQ 48.

CHAIRMAN STETKAR: -- was 48.

DR. WEERAKKODY: Yes.

CHAIRMAN STETKAR: And if I read that, I am curious about the closeout of that because the closeout basically says use the lower frequencies from the EPRI report, but you also have to do parallel calculations using the original frequencies from the 6850 report.

DR. GALLUCCI: Only on selected bins.

CHAIRMAN STETKAR: This is 50. I'm talking only about cabinet fire frequencies right now.

DR. GALLUCCI: Yes. Well, the original FAQ would have required the sensitivities on all the bins. I was an observer for NRR in the FAQ process, the MOU FAQs, a lot of telecons and things. So, this is coming from my observation.

But my understanding was --

CHAIRMAN STETKAR: Ray, before you go, was 48 an MOU FAQ or --

DR. GALLUCCI: Yes.

CHAIRMAN STETKAR: Okay. Thanks.

DR. GALLUCCI: Yes. My understanding was that, when the 6850 authors originally developed the frequencies from the original fire vent database, they pretty much followed guidance that was in an earlier EPRI report. Steve Nowlen can elaborate on some of this since he was involved, and I bet Mardy could as well.

But at that time there was guidance in there that said it would be inappropriate to do a time trend. And so, the 6850 authors did not do any time-trending, but just treated the `68 to 2000 data as a whole.

Now this FAQ proposed doing a time trend, and the result of the FAQ was that there seemed to be a difference occurring around 1990, for whatever reasons, whether they were physical reasons or reporting reasons, or whatever.

The staff concern was that when the original EPRI recommendation that was adopted by 6850 not to time-trend this, and second, that the data from 2001 to 2009 was yet to be processed. So, this fact was intended to be an interim solution where, yes, these new frequencies could be used, pending final analysis of a 20-year trend from 1990 onward, to see if those reduced frequencies were still being maintained.

So, the sensitivities for the electrical cabinets and a few other bins were retained because this data from 2001 to 2009 was not yet processed, and this was intended as an interim solution.

CHAIRMAN STETKAR: Okay. Well, you have been through one review on the Harris study. Did they apply the reduced frequencies?

DR. GALLUCCI: I don't believe they did. We could check. Dave can verify that.

Do you remember, Harry?

MR. BARRETT: No.

DR. GALLUCCI: I don't think they used it.

CHAIRMAN STETKAR: They just kept the 6850 frequencies?

MR. MISKIEWICZ: This is Dave.

This is real easy. Actually, LAR went in before this FAQ was completed.

CHAIRMAN STETKAR: Say no more. Thank you.

(Laughter.)

So, we really don't have -- I mean, what happens for example if they do the sensitivity study and the frequencies that have been accepted in the FAQ result in measurably different results from the 6850 frequencies? I mean, you know, now we are in a quandary here. What do we do?

DR. GALLUCCI: The purpose for the transition for the frequencies is to show whether any of the variances from deterministic requirements, basically, the delta risks for implementations, et cetera, would cross the Reg Guide 1.174 threshold with the other considerations of defense-in-depth and safety margin.

If by applying the sensitivity for the specific bins of one of the original 6850 caused a variance from deterministic requirement to change disposition from being acceptable to questionable, then we would ask additional questions, what types of defense-in-depth do you have in place to address the possibility that you may be crossing a threshold? What types of safety margins?

I don't believe it happened for Harris. Well, Harris didn't do this --

CHAIRMAN STETKAR: Harris didn't do it.

DR. GALLUCCI: -- but, basically, we would fall back on some of the other provisions of Reg Guide 1.174 for defense-in-depth, safety margins, the other considerations.

CHAIRMAN STETKAR: Okay. I still have to think about that. Thanks. Continue.

DR. GALLUCCI: Okay. The incipient detection, which is more properly termed by the fire protection world Very Early Warning Fire Detection System credit. Up to two orders of magnitude are now attainable for reducing fire ignition frequencies, and it was limited by consensus to low-voltage electrical cabinets. That was the main interest for Harris, and this was being processed in the expedited manner primarily so that Harris could take the credit for installing the system. And their interest at the time was low-voltage electrical cabinets.

Expansion to room-wide, et cetera, was deferred to a later time. And the fact that Research will be conducting experiments to address the possibilities of the actual credit that might be available for these types of systems.

As far as AC hot short durations, we had experimental results from NEI/EPRI and CAROLFIRE were available. Dennis actually used the paper that I developed to come up with the first approximation for AC hot short durations. It got slightly modified in the consensus process between EPRI and Research.

That was pretty much completed and consensed upon. Dennis had proposed an approach for dealing with the DC hot short durations until the DESIREE-FIRE test would be completed and the expert panel. It was decided, basically, to defer that until those tests were completed.

So, that is one aspect of the FAQ. that was cut out from the FAQ. And so, the FAQ that was closed excluded the DC hot short duration material.

In spite of that, there are some contentious limitations due to disagreement between technical experts. Transient fire growth rates was one.

The FAQ clarified, one part of the FAQ was clarifying for the main control room what transient fire frequency curve you should use. Should you use the control room fire frequency or fire non-suppression curve or should you use the transient? And that was clarified for the transient.

Specifications for what were termed trash fires were used, but I think as Steve explained yesterday, if you're getting into other types of transients, then you may not want to use either the 6850, all the 317/142 kilowatts. You may not want to use what was designated for the trash fires. You may want to use something specific, if it is a liquid spill, or whatever.

So, basically, the FAQ was not extended to address things other than the trash fires, trash can, trash bag, and the main control room. So, whether work will continue on that, I don't know. But, as Chuck pointed out, there's no more MOU FAQs being processed right now, and none that I expect. None are slated, to my knowledge.

Another one was the probability of fire spread beyond sealed cabinets. There was a continued debate over what's exactly the meaning of a sealed cabinet and what was the proper way to quantify this. I know there were some models proposed -- again, Dennis Henneke worked on this -- and numbers something like a 10 percent probability of propagation outside the cabinets was proposed, but, again, consensus couldn't be reached.

And one of the reasons was something that Mardy brought up, and I believe Steve brought up. It is because the interface between frequency, non-suppression, propagation, et cetera, had been accounted for to some extent by the original 6850 authors.

If this addition or change was incorporated in there, it might negatively or adversely affect some of those original assumptions. So, consensus couldn't be reached whether or not a quantitative model could be developed. And so, this, basically, the probability aspect was not pursued.

And again, theoretically, the option was discussed whether to split thee into two FAQs. That was an option at some point in time. Eventually, the FAQs disappeared, the split FAQs. So, this one remains unresolved as far as a quantification model.

Continuing, cable tray fire propagation, as I mentioned, 6850 has a vertical spread model that shows, basically, a 35-degree cone as you go up among the trays, based on one fire test from the Sandia tests in the eighties. If I'm wrong, Steve can correct it.

And there was a desire to say, under what conditions do you have to use this? Are there conditions where -- it was hoped to broaden this and apply it to more cases.

There was enough disagreement, again, between the experts as to whether this was a conservative model, whether this was a limiting model, whatever. I know that some other models were proposed during some of the pilot processes, et cetera.

Ultimately, the only agreement that could be reached was to define the conditions under which this model could be modeled, which was basically reiterating the conditions under which the test was conducted. And as far as expanding this, it has basically been deferred to what are the -- which Mark will talk about -- the CHRISTIFIRE series of tests.

And this is my conclusion. Given the accelerated agenda, basically, being driven by 805, for relaxing 6850 guidance and limited test results available at the time, the FAQ process should be viewed as a success.

And that is all I had on this for the FAQs.

CHAIRMAN STETKAR: Any questions for Ray?

We might, you know, depending on what comes up in EPRI's presentation, I'm sure we'll have some discussion. But thank you, and we'll see.

Ken or Rick, or whoever is going to talk to us about the things that I can't call "FAQs".

(Laughter.)

MR. CANAVAN: Good afternoon.

I brought my laptop in case I get in trouble.

CHAIRMAN STETKAR: And again, Ken, if you can, just because of time constraints and sort of our interest, if you can downplay body counts and process and try to emphasize more of the specific issues that remain unresolved that were a fallout of the FAQ process, I think we would appreciate that.

MR. CANAVAN: I will present only the process issues when they have relevance to our discussions on the technical, if that's okay.

CHAIRMAN STETKAR: That's perfect.

MR. CANAVAN: And if I go too far, I am sure that I could be corrected.

CHAIRMAN STETKAR: I will just keep you apprised of the fact that I'm not going anywhere tonight.

(Laughter.)

MR. CANAVAN: That is certainly an encouragement for me to move quickly.

I guess what I will do, I wasn't going to focus on the process at all. Actually, I just have two slides on it. There are some important things that we do need to talk about.

Obviously, you already know we have differing opinions on the efficacy of the FAQ process. A couple of items I did want to mention. It has been discussed a few times that the FAQ process -- so these are the exact words of the FAQ process from the letter sent from NRR to industry.

And I just wanted to point out one thing. If you look through it, you will see two weeks; you will see may disagree, may agree to disagree, or concur with confirmatory research; five weeks. You will see a lot of times in here. So, you go through all the steps, and every step has time. No later than 16 weeks. So, it's finish your research or we'll give you the answer. That's what this says to me, and that's what we did.

I will point out that the last step is industry and public stakeholders send comments that are appropriately considered and finalized in the FAQ resolution. So, you have heard several times the word "consensus" used, and I'm going to have to disagree because, when the final word is left to one person, and not necessarily -- final counts will be appropriately considered, not incorporated dispositions. So, that leads me to the important part, which is its impact on the research.

CHAIRMAN STETKAR: But I think what we saw this morning is that, I don't remember whether it was seven or nine, and which side it was --

MR. CANAVAN: Nine.

CHAIRMAN STETKAR: Roughly half of the FAQs were closed from the MOU process. So, those, indeed, do have consensus, is that right?

MR. CANAVAN: That's what I wanted to clarify. I do not believe they do. I believe that those are the final resolutions as provided by the NRC to the industry which were published in a joint report to provide -- that's the current, it provides a baseline. That is the current thing that everybody has to do. It's the current thing that everybody has do.

We are collecting the methods together back for 6850. We didn't necessarily agree with them. They were interim positions. They were not consensus, but they are the way you have to do it to comply with 6850.

CHAIRMAN STETKAR: I understand that

thought process for what was presented as the alternate FAQ closeout.

MR. CANAVAN: Yes.

CHAIRMAN STETKAR: Again, I don't recall. It doesn't make any difference whether it was seven or nine. Roughly half of what's in that joint report --

MR. CANAVAN: Is all of them.

CHAIRMAN STETKAR: -- is all of them --

MR. CANAVAN: Right.

CHAIRMAN STETKAR: -- all remaining 15.

MR. CANAVAN: And some of them are consensus.

CHAIRMAN STETKAR: But not all that were --

MR. CANAVAN: No.

CHAIRMAN STETKAR: No, I understand, but were all of them that came out of the EPRI/RES MOU process consensus?

MR. CANAVAN: The MOU process was superseded by this process. We were operating under these six steps. Even within the MOU, it says RES will engage EPRI under the MOU to obtain comments on the position within two weeks from the receipt, and the MOU team may agree, disagree, or concur with additional confirmatory research. And so, we could agree, disagree, or concur, but the process moved forward.

The FAQ was going to be issued within 16 weeks of its initial -- and that's step 4, where industry, including EPRI, public stakeholders and comments would be received and appropriately dispositioned. So, those comments were appropriately dispositioned.

There are cases where comments were not considered, and the FAQ solution was put out. The reason why we collected the 16 and published them in a joint report is because they are additions to 6850. There are people in Spain who try to use this that are EPRI members. There are people in other countries, and you can't find this stuff in the ML system, the ADAMS system. It is very difficult unless you have the ML numbers. We just collected together.

CHAIRMAN STETKAR: That's fine. Yes, perhaps it will become more clear if we get to the specifics.

MR. CANAVAN: Well, here's all the FAQs listed similar as before. And I want to be careful. Like I said, the FAQ process is a fine process for a lot of stuff. I agree with the NRC conclusion that previously, you know, when used as intended, it worked great.

When we tried to do research using it, it got difficult. I agree with what the NRC said. You know, teams were large; it got hard to reach consensus sometimes.

Sometimes the issues couldn't be closed in a timely manner. You can't have all that discussion in two weeks. You can't get all the people together; they're not available. What do you do when the key person isn't available for the discussion for the two weeks, he's on vacation?

So, some of the more contentious issues were difficult. The early ones that were closed were more simple. They were more FAQs related to clarifications of the content, and clarifications were easy.

MEMBER BLEY: When you say "closed" on here, can that be considered as consensus?

MR. CANAVAN: Yes.

MEMBER BLEY: Okay. So, any that say "closed" really were consensus?

MR. CANAVAN: Yes.

MEMBER BLEY: Okay. That helps.

MR. CANAVAN: Right. And so, the nine MOU

FAQs that are referred to in the NRC presentation, eight out of the nine are on the Action Plan for further research. Eight out of nine of those, we in some way, shape, or form either had a comment that wasn't dispositioned or we reached consensus with the staff on the interim position, but had an issue or desire to further extend that research. And we had agreed to that.

So, I say non-consensus. There's an awful lot of consensus. You know, it's always tough with this because I really think that some of the issues -- there was a time issue. We wanted to move forward. And that provided a lot of the emphasis for -- you don't see any of the early FAQs, for example. None of the early FAQs have issues with spinning off additional research or punting to a later time. The other ones were handled.

As we get towards the end and time pressure increases, and we're not getting the solutions, there is a tendency to start splitting off the harder parts of it. There is a tendency to defer some of it to later. And then, lastly, there was the last-ditch efforts of, hey, we need to get this out; there's a clock. We don't agree. We got your comments. We're going to take what we can and we are going to move forward.

So, that's where we are. So, let's walk through each. Let's talk about some of them.

The first one that I have here that I wanted to discuss -- and I have some background, and I may refer to that -- we talked about heat release rate from non-vented cabinets. That is in the Action Plan. The Action Plan ID is 2.2.

So, there will be a presentation on the future research plans later this afternoon, and those numbers will correspond. So, we can discuss a lot here or a little bit here.

The next one is the high-energy arcing faults for bus ducts. Again, we consider this to be partially closed. Our issue was with the zone of influence. We went back and forth a whole bunch of times. We think it is a little bit smaller. Staff thinks it's a little bit larger. Back and forth, back and forth, and eventually the larger zone got agreed to in the FAQ, and it is fine for interim, but we believe that it needs further resolution. And there's an issue, 2.7, that we will talk about this afternoon on looking at the zone of influence from high-energy arching faults.

Forty-two, propagation from electrical

cabinets, this one is open. Again, Action Items 2.2 and 2.9. We discussed this a little bit this morning.

Forty-two is the propagation. It is interesting, I always looked at it internally to the cabinet and then outside, but it is also outside. And the real reason is, if you contain it in the -- in the MCC, you're going to de-energize it anyway, as Ken explained this morning, most likely. Most people assume that in their model. Hey, you de-energize. You know, get a fire in an MCC. You de-energize the MCC, then you put it out.

So, the MCC is already gone, but the question is, do you do cabinet-to-cabinet and, then, does the fire get out of the cabinet? And the interesting thing is that it becomes, you know, that whole cabinet becomes the location of the fire, right? You put it at the top, anywhere around, to assume your impacts.

I may just do this. I wasn't going to do this because this is a little confusing the way this is done. This is in your backup material. I included it. I wasn't going to do this because it is a little bit complex, but I will run through them anyway.

So, again, the issue was to allow screening of unvented cabinets that are robustly secured, clarify that fire-sealed doesn't mean fire-rated, and all this other stuff.

The problem was that the likelihood of propagation was not pursued. Heat release rates are different. That wasn't reviewed. Experimental data to generate heat release rates, mixes of types, and we talked about that.

And so this is addressed. The resolutions of these remaining issues are addressed in Action Items 2.2 and 2.9.

Okay, No. 43, location of a fire in an electrical cabinet, this is partially resolved. This is the placement of the cabinet fire for fire modeling purposes. And again, we are going to be very interrelated on a lot of these because this fire modeling is this way. Fire PRA is this way.

And we didn't address configurations where no propagation occurs. And actually, if you look at the data, you find an awful lot of that. You won't find any of -- I think there's only two that propagate outside, out of the ones that we could mine out of the existing database. But, again, our information is sparse in the database. So, it was very difficult for us to make the case.

This was in the original FAQ, but, again, was dropped during the later stages when we were having trouble just in getting agreement. And in a lot of cases, it was better to take it out of the FAQ and see if we could get a resolution with at least partial.

Remember, there's pressure from the regulator in getting these resolved, but there's pressure from the pilots to get an answer.

CHAIRMAN STETKAR: Ken, let me ask a simplistic, naive question on this one. I'm just selecting this one as an example.

As I understand it, why do I care about the location of a fire within an electrical cabinet? I mean, why is this an FAQ? I understand if I'm doing research --

MR. CANAVAN: Right.

CHAIRMAN STETKAR: -- but why do I care as a PRA practitioner about the location of fire in an electrical cabinet?

MR. CANAVAN: Zones of influence, if you have a cable tray right over it, if you have a cable tray and an MCC that are -- you know, all different kinds of geometries. I'm looking at Dave here because he's going to shake his head --

CHAIRMAN STETKAR: But we're talking about the location of fire in the electrical cabinet, not the propagation outside, I don't think, unless, for some reason, that makes a difference. So, I'm asking why I care about the location of the fire inside the electrical cabinet.

MR. NOWLEN: If I could, this is Steve Nowlen. I think I can answer this one for you.

CHAIRMAN STETKAR: No, Steve, actually, I would like the people who are doing the PRAs to --

MR. NOWLEN: Well, but this is an issue of fire modeling and how they interact, and it is a fairly fundamental issue. What we are talking about is, where is the location of the fire origin when I apply a plume correlation? And the plume correlation determines the temperatures above the cabinet, and that temperature above the cabinet determines how far the zone of influence is, and whether I can propagate the fire to the next nearest combustible.

So, this is a fairly fundamental fire modeling concept. And the issue was 6850 didn't give real clear guidance. It said look at what's inside your cabinet and put the fire wherever your combustibles are concentrated. And they said, well, but what do I do if I don't know? The question was asked. We said put it a foot below the top of the cabinet. That's a good generic answer, and then you can fall back on the other.

But this is really not an issue of how a particular analyst is applying it in their plant. We all want to do it the same way, and I think they all are doing it the same way. Dave and Kiang can correct me if I'm wrong.

This is really about the plume correlation. Where do you define the fire origin for the plume correlation?

CHAIRMAN STETKAR: Okay.

MR. NOWLEN: That's where it is.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: This is Rick Wachowiak.

I think also in the slides, when you look at those background slides, the section that says "Issue" is the part of the issue that was resolved, is what that means. So, when the question came up, how do you address where the fire is in the cabinet, for the purpose of modeling the impact on the rest of the room, the closed part of the FAQ was that we agreed that for the interim to put it, I think it says, 1 foot below the top of the cabinet, as long as the cabinet has certain characteristics. That's okay.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: But the part of the FAQ that was not addressed was the operating experience was that most of the time there was no effect outside the cabinet. How do you account for this? And that piece was just not addressed.

CHAIRMAN STETKAR: Okay. What I'm trying to understand is, and the reason for my original question was, I was trying to understand whether that particular, the remaining concern was for modeling fire damage within the cabinet --

MR. WACHOWIAK: No.

CHAIRMAN STETKAR: -- or it is still focused strictly on the fraction of fires that propagate outside?

MR. WACHOWIAK: For that particular FAQ, it was for the ones that propagate outside.

CHAIRMAN STETKAR: Okay. Thank you. Thanks.

MR. CANAVAN: And I think we solved the first part, which was it was assumed, even for cabinets that were sealed at the top, it was on top of the fire. So, this FAQ resolved that part of it, the solution.

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: Okay. Pump oil fires. I

think you will begin to see a trend, again, into further breaking up of bins and looking into those bins and seeing what enveloping characteristics were applied to a bin, and should we be dividing that bin up in some way, shape, or form?

So, you start with this. You know, FAQ 44 looked at the main feedwater pump oil fires. And the original question was, okay, we're dealing with all main feedwater pump oil fires are treated as a very large spill-type model. And that was the original treatment.

This FAQ was partially resolved in that. The actual question on main feedwater was completely resolved in a consensus fashion by looking at the data and agreeing on a model of how much is spilled and what's the frequency of that spill, and smaller spills have a larger frequency and larger spills ignited having a smaller frequency.

The reason why it is partially resolved is, how do we apply this to the others? So, other pumps, standby pumps, diesels, transformers, all that oil that can have these spill-type characteristics, and how do we model those and break up those?

CHAIRMAN STETKAR: I'm sorry, this says pump oil fires. It doesn't say diesel. It doesn't say transformer.

MR. CANAVAN: The pump model is currently being used for the diesels. It is the same spill approach. So, the reason why we call it partial is because of the pumps, and then there is, I guess I would call it, an additional piece of research on other spill-type fires like diesels and transformers.

CHAIRMAN STETKAR: Okay. Transformers are kind of like motor control centers. If they catch fire, a lot of times they explode.

MR. CANAVAN: Yes.

CHAIRMAN STETKAR: A lot of times you de-energize them because nobody wants them to explode. So, it is not at all clear whether, unless specific transformers are located to other very, very risk-sensitive pieces of equipment, I pretty much don't care if I have a transformer out in the yard that blows up.

MR. CANAVAN: Yes, if they are out in the yard, it's no big deal.

CHAIRMAN STETKAR: So, I'm curious.

MR. CANAVAN: There are a few inside, though.

CHAIRMAN STETKAR: My initial reaction is, apparently, some plants had problems with the location of their feedwater pumps that were risk-significant. Okay. Well, that is a plant-specific configuration, but that must have been the genesis of this question.

MR. CANAVAN: Right.

CHAIRMAN STETKAR: Suppose this one is never resolved. Does it affect the overall results of the PRAs?

MR. CANAVAN: It is going to be very important for the boiling water reactors because boiling water reactors will have, many electrical lines will pass through the feedwater pump area, and feedwater pumps can provide a significant mitigative capability, which will go away if we model the fires as large pool fires.

CHAIRMAN STETKAR: But we have resolution on the feedwater pumps.

MR. CANAVAN: We have resolution on the feedwater pumps. Then, we move into the buildings. As you saw Danny Pace's presentation the other day, large and small oil pumps being treated the same.

Also, the standby pumps versus the non-standby pumps, that pool oil fire from a standby pump can significantly impact all the cables in that part of the aux building.

CHAIRMAN STETKAR: It can, but is it? I

mean, you know, what I am trying to get to is, if we try to be infinitely precise and infinitely perfect about everything that could possibly be modeled and quantified in a fire PRA, we might as well just stop doing it today because we will never achieve that. We have never achieved that in internal risk assessment. And yet, we are satisfied that we know enough about the important contributors.

My question is you're highlighting this as something that is still an issue of contention --

MR. CANAVAN: Yes.

CHAIRMAN STETKAR: -- that requires research. My question is, where on the priority list ought it to be in my research program? I know we'll get to that later.

MR. CANAVAN: Good.

CHAIRMAN STETKAR: But just saying that we don't have resolution and we don't know enough yet leaves me really cold.

MR. CANAVAN: Well, let me give you some advance on the next presentation.

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: Priorities aren't strictly selected by what contributes the most. It's a combination of what contributes the most and what can you solve easily. So, if something contributes sort of middle, but it is easier to solve, then maybe that's a little bit higher priority than something that is really hard to solve and very important because that might take time.

So, this is on the list because it contributes. So, there has been at least one plant that has come to us and said, "What are you doing about the feedwater pumps? It's an issue that I think I need resolution to."

CHAIRMAN STETKAR: Feedwater pumps are done, though. I'm not asking about feedwater pumps.

MR. CANAVAN: Pumps.

CHAIRMAN STETKAR: I'm asking about the other ones.

MR. CANAVAN: Standbys was brought up --

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: -- by two separate utilities to EPRI to be put on the list. So, standby oil pumps and their treatments as pool fires and both for standby pumps was brought up.

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: All these items are brought by utilities doing PRAs. Not one of the items on this list is not something somebody is struggling --

CHAIRMAN STETKAR: Are those PRAs finished?

MR. CANAVAN: No.

CHAIRMAN STETKAR: I mean we still have results from several --

MR. CANAVAN: No, they are not.

CHAIRMAN STETKAR: -- PRAs that didn't show any contribution from pump oil fires.

MR. CANAVAN: No, those PRAs aren't complete.

CHAIRMAN STETKAR: Okay. So, they don't really know how important they are going to be? They are just concerned?

MR. CANAVAN: They ran into it. They thought it was going to be a larger one. So, yes.

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: Yes. One is closer to finished. So, I think that they have a handle on it that it might contribute. The other one is earlier.

CHAIRMAN STETKAR: Okay. Okay.

MR. CANAVAN: So, I don't know how to take their concern.

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: Incipient detection, again, partially resolved because I think the particular resolution for incipient detection systems installed within cabinets, similar to he way Harris has done, there is credit. But there a other installations proposed to lower risk that might be different installations than Harris, and the FAQ would not apply.

So, if you are going to look at general area, if you are going to do any significant departure from Harris, the FAQ is pretty clear that it requires you to develop basis. We have had a few utilities come and ask us, "Listen, we would like to take advantage of this technology, but how do we do it?"

CHAIRMAN STETKAR: But it's on a broader area.

MR. CANAVAN: How would we do it? And our real concern is we start having six people doing it six different ways. And then, the staff has six different ways to review, and we have six different ways to try to figure out who did what right. And that's the real concern, is to develop a model that everybody can apply consistently.

So, we are looking for configurations outside the ones specifically described. That is Action Matrix Item No. 1.5. I will point out that during the next presentation we will talk about the matrix. Rick will do most of that.

Spurious operation 47. I am keeping pace in EPRI 1019259, or I don't deviate.

Spurious operation probability, this FAQ is open. This is, obviously, the joint work that is going on in the DESIREE-FIRE program. I think that program is going to be very successful in defining this parameter for us.

CHAIRMAN STETKAR: In this, the issue, now you say "extend lessons learned into AC circuits." So, you're still trying to gain better information about -- is it conditional probabilities of, I'll use the old speak, hot shorts or is it, in particular, durations?

MR. CANAVAN: It's both.

CHAIRMAN STETKAR: It's both?

MR. CANAVAN: It's both.

CHAIRMAN STETKAR: Okay. Thanks.

MR. CANAVAN: And the DC tests, I mean every time you perform a test you learn from how you perform the test. And so, the DC tests were a marked improvement over the way the AC tests were performed, both in protocols, information collected, you know, what phenomena to look for, who is smarter? Specifically, RES and Sandia were smarter, I think.

We came along for the ride.

And we were smart enough to get real equipment, real batteries, all the things needed to perform very realistic testing.

Fire ignition frequencies, FAQ No. 48. You know, we were looking at the data for ignition frequencies, and there appeared to be a change in the data trajectory after 1990. Really, depending on how you read it and how willing you are to accept risk, the statement in the FAQ response actually says almost verbatim what was presented just a short while ago by Ray, which is, if you use the sensitivity cases and they don't work, if you use the data and it provides a different answer such that you might perform a different action, in other words, it changed something that you have to act on, then you need to use traditional fire defense-in-depth and deterministic evaluations to justify that change.

Most utilities that I am aware of have not used this FAQ. They cite that as being the reason. If it provides a change, they have to go back to defense-in-depth and deterministic ways of analyzing it. At least that's what they are reading into it. Maybe I have the wrong interpretation. That's possible.

But they are reading it, well, that's more work than just going with the conservatism. So, that's what they do. So, to my knowledge, nobody is -- I think there might be one plant that is going to use the different frequencies that I am aware of right now.

And again, this was an interim solution. We couldn't come to consensus on a final solution. So, you know, I would look at this as this is not a consensus solution. We believe that we should be using the EPRI numbers. I strongly believe it. I think they represent more how we operate the design as-built, as-operated facilities.

I don't see why we aren't reflecting the good housekeeping practices, the Maintenance Rule, and Appendix R in our current data. And if we were doing internal events, we would never keep this data in the internal events because it doesn't represent what we are looking at today.

CHAIRMAN STETKAR: Provided you've adequately -- you know, I will throw the independent -- provided you've adequately accounted for the uncertainties and the limited dataset that you are using. And it's not clear, reading your report, that you have. And we'll just leave it there.

MR. CANAVAN: Okay. Okay. Yes, I am going a little bit anecdotally from having worked in the nuclear power industry for 25 years at the facilities. And the degree of cleanliness demonstrated by Danny Pace the other day was not apparent 20 years ago.

CHAIRMAN STETKAR: That's certainly true.

(Laughter.)

MR. CANAVAN: I was trying to be very nice.

(Laughter.)

And I also think that some of the other operational programs provide some assurance.

Cable tray propagation, 49, the status of this is open. And again, the current guidance for the two configurations wasn't enough. These open other configurations.

This one is not explicitly included in the Action Matrix. Some of the items are expected to be resolved in CHRISTIFIRE.

CHRISTIFIRE was recently out for public comment. I don't know how many comments the NRC received other than ones from EPRI. We did provide comments on CHRISTIFIRE.

CHRISTIFIRE is very interesting. My

personal opinion, I will make a short mention here because it is something that I'm thinking of requesting Rick add to the Action Matrix.

CHRISTIFIRE comes up with a lot of very interesting observations and conclusions. One of them was, if you remove the source too soon, the cables don't ignite. Too soon is not short minutes. It is tens of minutes. And so, it turns out it is really hard to get cables to ignite.

The other interesting phenomenon in CHRISTIFIRE is the cable trays are separated by about more than a foot and a half. And I think I will be corrected if I get it wrong. I see some of the folks in the room. But about a foot and a half. It's very difficult to get the second tray to ignite. You might damage it over a long period of time, but you can't get it to ignite, even with the pilot in place.

And then, the last one is that the cable trays are very packed, which also leads me to conclude that if they have a solid bottom or they have some kind of deflector plate on the bottom, that they may not ignite because any good Boy Scout knows -- and I'm stealing this metaphor -- you need to separate your wood to allow for air currents to circulate to make a fire.

And the interesting thing I noticed, the future follow-on research might be to look at the efficacy of solid plate cable trays as a modification or deflector plates as a modification that could prevent vertical propagation of fire through cable trays in cases where it is really significant, as opposed to going to wraps or other means. Just a thought that that might be a good follow-on.

Manual suppression probability, partial resolution. Addressed suppression by personnel in fires. I recall this one. I recall all of these vividly in the process.

As a note, each one of the public meetings was preceded by internal team meetings at EPRI, usually phone calls. Then, it was preceded by MOU phone calls. Then the public meeting happened. Some of these were on several public meetings. So, you can only imagine the number of telephone calls and meetings. We did a lot of work. We moved things very far very fast.

I think some of our resolution came down to the data, what values to include and what not to include. It became fairly contentious.

Again, with a database that has entries that aren't always as specific as they need to be, this is going to happen. I'm not going to argue. I have my own opinions about each data point, and our own team didn't always agree on all the data points. However, moving forward, we hope to clear that up.

So, again, a partial resolution. We got what I considered to be part of the way. Action Matrix Item 1.6, again, will take the database, and suppression is one of those things in the new database we think we will get a really good feel for. People accurately track that now. In the seventies and eighties, that really wasn't a priority.

MEMBER BLEY: I don't want to get into the fingerpointing thing, but earlier someone went through how big a process this was when you had your public meetings and tried to work to consensus. But I didn't quite catch it all.

Kind of how many groups were there? The original authors were pretty much part of it. And then, there were several other groups that were mentioned, and I don't remember what they were. Could you just remind me?

MR. CANAVAN: Sure. It really depended on the FAQ.

MEMBER BLEY: Okay.

MR. CANAVAN: So, some of the FAQs were

handled by the NEI. The non-MOU FAQs were handled generally by the NEI Task Force.

MEMBER BLEY: Okay.

MR. CANAVAN: And so, the NEI Task Force met. If there was easy agreement, it was passed up. The resolution was put in the original question. So, the question came with the answer.

MEMBER BLEY: And those we heard worked well. Okay.

MR. CANAVAN: That was really cool, the question coming with the answer. And if the NRC agreed, they went through quick, and there's a few of those, which is why I say the process works well when the FAQ is appropriate. When the FAQ, when it was clarifications of the methodology, that was a fairly quick thing.

The FAQs started progressively getting what I would call more technically-challenging. And so, as they became more technically-challenging, that process wasn't working. Also, now we needed to have meetings of the MOU group, mostly consisting of the authors, to try to agree on how we were going to do.

Now the authors at that particular time consisted of very limited industry participation. Bob Kassawara and Bijon Najafi were the two EPRI personnel on that meeting. And Bob didn't attend all the meetings because he is in California and most of the meetings were held in Washington. Bijon made a lot of them.

At that particular point in time, the questions were pretty substantial. So, we decided to add a few more EPRI people to the team. There was a few more NRC people added to the team as well.

And I don't think that was the source of not being able to consent. I think they are just generally tough issues.

MEMBER BLEY: Tough issues. Okay.

MR. CANAVAN: You know, I respect John a great deal, but I think if me and John were to sit together and look at some of this data, we might have some issues that we needed to work out.

MEMBER BLEY: Yes.

MR. CANAVAN: You add to that calendar pressure. You add to that fact that there are six of these going on in parallel. The numbers of meetings and consensus because very difficult.

The last part is a large part of this was happening in public. The MOU meetings, the "meetings" meetings, were public.

MEMBER BLEY: Were public.

MR. CANAVAN: And so, as soon as research started to be held in public, that was just a really bad idea from every perspective I can think of. Asking people to give their unabashed opinion in a public environment consisting of 60 people, 35 in a room together and 25 on the phone, that was just not -- we probably could have done better is my conclusion on that.

So, I do believe that that process is very difficult. We talked a little bit in the last meeting that I believe that research is best started with a small group of technical experts, gradually expanding out. Once they come to some kernel of, hey, this is the idea we would like to pursue, take that a little broader. And if everybody says, hey, that broader group says this is a good idea to move forward, expanding to the next level, and then continuing that expansion up to socialization among the community.

But we sort of had a middle ground, and in the middle there was too many new ideas, opinions. And when you have that many, you can't pursue them all. Then, you add the time pressure in. It's all a part.

Hot short duration, partially resolved. We resolved it for some AC circuits. We need to post-process all that DC data. I think we will get some more insight on AC as well.

But, again, I think the DC circuits will go a long way. It will be very helpful. A lot of PRAs currently assume that DC shorts go on indefinitely. So, a time period around those shorts would be very nice to have.

And again, this is one of our best examples of cooperation, and we will talk a little bit more about that. But my experience being involved in the DC hot short testing has been a very positive one.

Transient fires, you heard all the issues. I don't think I will go through it again. It is on the Action Matrix.

I will note right away, again, this is probably one that, if we had taken offline and talked a little bit about, maybe we could have been quicker. I do think that we could probably accelerate this one, and that is something that we will talk a little bit about, because I think there is a recognized need for a new model among everyone from the authors to those who were trying to apply it.

And in those cases, there's the incentive that everybody sees a common problem. There is also we have got to be able to come up with a little bit better of a model here, I think, with the collective group.

If I have offended anybody with my rendition of the FAQ process, I apologize, but I was deeply involved. I was on almost all those phone calls. Maybe it is more frustration than anything else and a lack of our collective ability to move these things, these technical issues forward in what I consider to be an expeditious manner.

CHAIRMAN STETKAR: It's certainly a difficult process, especially in the format that you described, to try to reach consensus. I mean that's perhaps a different format or a different charter rather than trying to reach consensus, but recognize differences of opinion and try to quantify those as sources of uncertainty, you know, as an expedited way to come to an interim solution, if you will, recognizing that further research might enhance reducing those uncertainties. But, again, that is past experience. We are where we are today.

And I think it was a good presentation. You know, you highlighted the issues.

As I understand it, and correct me if I'm wrong, I think we spoke about this a bit, and it is highlighted a bit in the NEI report, that the industry has basically abandoned the concept of FAQs sometime in 2009. I don't know precisely when. It probably doesn't make any difference about the precise date, but is that true?

MR. CANAVAN: It is interesting, that concept. No one was ever told to stop submitting FAQs.

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: There was no agreed-upon this is the end of the FAQ process date. I think everybody who participated in the FAQ meetings started realizing, if I put this up, I become the champion of the FAQ, right?

(Laughter.)

Well, I personally volunteer to get my PRA submittal done and be the sacrificial anode for this topic. I think it was really a disincentive. And if you were on some of those meetings, they were difficult and there were many of them. And you are under pressure from your management to get the PRA done. Do you really want to bring up a FAQ?

And I wouldn't let you off the hook because you know the issue, and it is your issue at your plant. We have to work together. So, you're going to be stuck.

So, it was a natural -- nobody has ever been told not to submit a FAQ -- it was a natural stopping because the process stopped itself.

CHAIRMAN STETKAR: And if I can read between the lines and from what we have heard both from the staff and you, it seems as though we, as the PRAs themselves became more developed, the questions, the issues become more difficult from a technical perspective.

MR. CANAVAN: Yes. That's clear.

CHAIRMAN STETKAR: And therefore, from what I have heard, trying to get consensus on the real difficult issues seemed to have been breaking down --

MR. CANAVAN: Yes. Yes.

CHAIRMAN STETKAR: -- let's say in the middle range of difficulty, if you will. So, pragmatically, I sort of understand that.

MR. CANAVAN: And let me caveat my last answer about the process ending for PRA FAQs from the current people who are doing pilots and are active.

CHAIRMAN STETKAR: Yes.

MR. CANAVAN: So, the other processes were clarifications came in. That continued and worked fine. It was the more difficult issues.

The other thing is, if you are doing your study and you come across a question and you are trying to figure out, well, I'm the pilot; how am I going to answer this, maybe I'll just submit a FAQ. And then, you think, well, that process is long and difficult, but I have an answer here that I think I have basis for, which is allowed. Maybe I don't want to be the champion for the world. Maybe I just want to get mine, put it in my study, give my justification, and see how the review goes.

So, that was the other. You know, I need to get done and put up a FAQ. And then, the pressure on what is the resolution requirements; what's the amount of technical rigor required for solving it for the industry versus solving it for you? Is there a little bit less? Well, yes, because the FAQs get all the "What if's". What if the configuration is different? What if, you know --

CHAIRMAN STETKAR: Yes. Yes.

MR. CANAVAN: And so, the scope grows. So, in the interest, I think it was a process that wouldn't, as the pilots matured -- now I don't know; we do have a proposal moving forward about how we think we're going to conduct our research, hopefully, with others. And we will be presenting that in a future trial.

CHAIRMAN STETKAR: Let me ask you one last thing before we go on to the next topic. I think this is a really good summary of the things that I can't call "FAQs" anymore, but are still issues that merit further examination through research, and they provide a basis, part of the basis, for at least the industry's research program.

Are there -- I hate to ask this -- but are there other significant issues that have arisen that, were it not for the difficulty of the FAQ process and the timing, et cetera, that the industry believes still need some level of resolution? And I'm not talking trying to make --

MR. CANAVAN: Right.

CHAIRMAN STETKAR: -- numbers absolutely perfect, precise, well-known. I'm talking about large issues that have come up over the last year, let's say, that are not, for example, in this list, which are effectively derived from the FAQs.

MR. CANAVAN: I think if you look at the next presentation that we give --

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: -- there are no large issues that aren't encapsulated in that list that we're aware of. And I caveat with the "aware of" because I struggle with the lack of BWR PRAs being talked about right now, and I do believe, having worked on both, that there may be some challenges. Now the BWRs, they are a little bit more flexible on the core damage side. So, maybe they will be fine and I'm overstating it, but I think there might be a challenge or two in some of the older BWRs that present themselves in a methodological way, you know, a method that doesn't suit them or needs to be revised to suit them.

So, with that caveat, I will say that we think that is a full list.

MEMBER BLEY: We have heard from various people and in our discussions that Mardy did for us, people doing PRAs who are very concerned about how much effort they need to put in to justifying, if not deviations, special calculations to support their fire PRAs. Is there any effort -- and I know staff is not locked into one once they approve it -- but is there any effort to try to collect the places where people have made arguments and think about building a manual that might eventually work its way into another 6850 revision?

MR. CANAVAN: We don't have that yet as a specific task, but we have an internal EPRI group that is a forum for fire PRA. And right now, that forum for fire PRA has donated their resources to methods. So, they are just go use our money, do methods.

But I have a feeling that in the near future, as more than just the pilot are complete, that that forum will start up and become one of those things that we can collect the technological ones.

I see Biff standing, too.

MR. BRADLEY: I just wanted to add one thing. We do have, as Ken mentioned, the unreviewed method, the new fire PRA peer review process that kicks the methods out of the peer review to our industry process. So, I think that is partially an answer to your question.

MEMBER BLEY: Okay.

MR. CANAVAN: That's the next talk as well.

MEMBER BLEY: I haven't seen it.

CHAIRMAN STETKAR: What?

MEMBER BLEY: Their procedure for looking at these.

CHAIRMAN STETKAR: No.

MEMBER BLEY: Because I hadn't seen it.

CHAIRMAN STETKAR: What fraction of the PRAs -- I hear what you're saying -- what fraction of the PRAs out there today, the end of 2010, have actually had industry peer reviews performed that could start generating this process? I'm thinking about timeliness and processing.

MR. BRADLEY: Well, obviously, we are having a large number of these done rapidly for 805, and quite a number of these were performed before it became clear that we needed to revise the process to accommodate the unrevised methods. Because it was really putting a huge burden on the peer review team to try to come to grips with these methods.

So, since we put that revised guidance into place, there have only been, what, half a dozen or less peer reviews? So, it is sort of just getting going. We have had a handful come out. I wouldn't say we have had a large quantity of methods. We do expect to get methods being fed out of that process once we get this thing up and running.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: This is Rick Wachowiak at EPRI.

I have in my hand one proposal from a vendor that has done multiple PRAs for a set of methods that they would like to have reviewed, and another vendor has contacted me and given me an abstract for a method that he wants to propose for this.

CHAIRMAN STETKAR: So, this is not coming through the peer review process. This is an independent --

MR. WACHOWIAK: I think they were identified through the peer review process.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: And then we are providing this forum or clearinghouse for getting them peer-reviewed.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: So, it has started, but it is in the initial stages. We have turned the key, and we are waiting to see if the "check engine" light is on at this point.

CHAIRMAN STETKAR: Yes. Okay. Good.

Any other questions for Ken, as long as he is sitting up there?

If not, I think you might as well just stay seated, and we will transition into the research program. I don't know; I guess Rick will join you.

MR. CANAVAN: Yes.

CHAIRMAN STETKAR: Actually, let me ask, how long is this presentation realistically, do you think? I'm asking, should we take a break now? If you can get through it in about a half-hour, we'll wait.

MR. CANAVAN: Yes, we can do it. We can do it in a half an hour.

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: Yes, I actually will point out that the original talk was designed to answer your question from the last meeting which was, how are you coordinating? So, I will probably start with slides 1 and 2, and this being one, and then Rick will take the rest, the hard lifting.

And again, I'm here mostly for historical purposes, which is why I get this, because --

CHAIRMAN STETKAR: We don't get to see you much. When do you stop?

MR. CANAVAN: I won't say "stop". I will say I love PRAs, so I'll always try and come back and see you.

(Laughter.)

So, if you extend me an invite, I'll come. But --

CHAIRMAN STETKAR: This may be your swan song --

MR. CANAVAN: This may be it.

CHAIRMAN STETKAR: -- in the PRA field?

MR. CANAVAN: Well, I fear that my usefulness to you is diminishing. So, I will turn it over to Rick.

Our PRA research at EPRI is normally driven through an internal EPRI process where we have advisors at the PRA manager level who help us design a research program that we roll up to -- and this is all risk and safety research -- that we roll up to an executive committee that we then roll up to, I'll say, the C&O-type level. So, we go up to Senior Manager/Director, VP, then to Engineering.

Outside of that process, we have decided to work all of our fire research through this particular organizational chart. I think I will sort of start from the bottom and work my way up.

So, EPRI has a predefined research activity, but anything that comes from either contractors, the PWR, BWR Owners' Group, or EPRI, as a methodology improvement gets given to the Technical Project Manager at EPRI. It used to be me. It is now Rick.

And that is for incorporation into the EPRI research program. That research program already has input from the utilities, which is why they are not listed. They are already putting information into that. Rick adds external input into the mix, and I write "others" because it could be anybody.

There's actually one or two ideas out of this Committee in the last two days that we will take back and figure out, well, how do we work that into our plan? Is it covered? Is it not? So, these ideas come from all kinds of places.

The EPRI Technical Manager works for two different groups. It works with the NEI Fire PRA Task Force, and it works with an oversight and peer review team recently formed. I put the names in because I guess you had asked, is that a real team? So, I went out and got real names. And Donnie Harrison, you're laughing, but you're on the list. Okay?

(Laughter.)

And I asked you if that was okay, and you said you would play.

But what we are trying to do is get the core team together of people who will be technical oversight and overview. Now that group will be supplemented by people who have experience given a different technical area. So, if somebody comes up and we are missing some experience on this, a fire model, we will supplement the group.

But the thought would be that that

technical oversight and peer review helps us get a good, solid review of technical research performed by anybody, whether it is performed by EPRI. As a matter of fact, there are panels being exercised with their first big piece of research. It's the HRR research you heard about earlier today. Paul Amico and SAIC is the primary on that, and along with EPRI.

So, we are submitting that to our own panel and asking these group of people, give us honest feedback. We've gotten our first set of feedback. We are working the kinks out of the process, and then we will start sort of more of a sort of production type of environment.

The purpose of that group is to give feedback to the methods. We will then put them out as interim methods for use. Again, as they are being used, anybody can comment. Anybody can participate in the use, and we will sort of broaden it out, try to get opinions from more folks. Then, anywhere from 60 to 90 days to six months, we will make a final -- maybe it is a year -- we will make a final report, now that we have evidence that it worked or that the method solved what it needed to solve.

We will report up to the Task Force, and we will report up to the NEI Program Manager, which is

Biff Bradley.

I do want to point out there is an executive oversight group. That's why Danny Pace was here. You'll see him. He's on the list.

This is by no means, and nobody should interpret this as a rubberstamp-type group. They're looking at what we're doing. They're asking us, how does it help? They're asking very similar questions to you sometimes. You know, are you working on the important issues? How did you decide importance? How much do you want again? That is a question that comes up a lot.

When are you going to get finished, and can you get that done sooner? Exactly what you would expect. But there is significant pressure to continue to move these methods. Danny says it very nicely: how much have you spent? To me, it's I spent this much and you need to help me, a little bit different of a statement.

So, we are trying to move those methods forward to help these folks who are all in the business of developing PRAs. You notice that Exelon is on there. And Exelon isn't developing PRAs for NFPA-805, the relevant PRAs. And so, their approach is help me get the PRAs get done.

Last is that executive oversight group goes up to the NSIAC. The NSIAC is the Nuclear Strategic Initiatives Advisory Council, and they're all the CNOs from all the plants. This is executive group reports up to them, and they drag formerly me, soon-to-be Rick, to discuss the status, progress, spending, and when they will see the fruits of their money. I didn't say "labor".

So, just so everybody is aware, the Task Force actually does report directly up to the oversight. The dashline is there is actually a separate meeting of the executive oversight group. Every time the Task Force meets, we are required to report up, and we get asked often by that executive group, how can we help?

And that's how Danny got here. He said, how can I help? And I said you can come.

That was all I had. The rest of this is EPRI fire research in the area of fire PRA moving forward.

And I'm going to turn it over to Rick, and he is going to do the rest.

MR. WACHOWIAK: So, let me start out with saying that on the original agenda, the topic here was to address the question, how are we going to do collaboration? I think it eventually morphed into what is the plan? We will try to address both things.

So, the last hour or so we talked about things that happened in the past. And what we want to talk about now is, what do we need to do to move forward with this in an effective, efficient way?

So, when we are going to do fire PRA research, and probably any research, not just fire PRA, but we are looking for ways to come up with our more realistic methods. We have talked about that for three days of meetings now. But we still want to maintain the consistency, which is what 6850 and EPRI -- and I don't have the stamp on my brain yet for that yet.

CHAIRMAN STETKAR: You've got learn that number, Rick.

MR. WACHOWIAK: I know. It looks like everybody else did, and I just didn't quite get with the program.

Anyway, so it brought a consistency of how these are done. We want to maintain the consistency. So, we want to try to bring it into some sort of a central clearinghouse-type process, so that it's available for everyone and you maintain consistence.

When I was looking at this, I'm looking at it in terms of, what have we done for internal events? Now I know internal events evolved over several tens of years to get to where we are now, but there are some lessons that we learned from that process to how to solve a difficult problem. So, I want to draw on that experience.

As Ken said on the last slide, we are going to rely on peer reviews. We will talk about the expert peer reviews for this, different pieces of this.

We would like to participate with the NRC as much as possible in this. One, it allows them to understand what it is we're doing and which ways we're going, understand how we intend to use the methods and how we intend to limit the methods. Because I think some of the contentions in the past, a lot of times around, what's the limitation on this model? And with the participation, you can see what it is we have discussed, and we will get a good understanding of that.

Now if the NRC understands what we are doing, and we understand their positions, I think that fosters a stable regulatory environment for using these methods.

So, in looking at this, I can see three

distinct categories of things we will call research here. The way that we need to collaborate needs to be different based on which one of these you are in.

The first one that we have talked a lot about here is the development of methods or models. They all kind of say, how do you do this fire PRA problem?

Then, there is testing that has to go on. For this, it's testing to support the methods and the models that we want to use. Then there's also tools that come in. What computer codes can you use that propagate the uncertainty of the distributions that are put into the method, and things like that? So, that is a separate sort of area, the development of those tools.

I want to be clear that the methods and models are what we intend to have drive the testing and the tools. You need to have a use for these things before we go off and do a lot of extra testing or start building expensive computer models and things like that. They should be done to solve some problem in this forum here, solve the problem with getting these fire PRAs.

And we want to have coordination between all the different groups, including the owners' groups, the NRC, industry, and all sorts of things we have talked about.

So, let me start with the easy one, the tools research. The way we have done this for internal events is the industry identifies the tools it needs to do its work. Mainly, it is to address how you efficiently do your work, and we go off and we develop our own tools independent of the NRC. And as a matter of fact, the NRC goes off and develops its own tools independent of the industry.

And that's probably a good thing. It helps with independent verification and things like that. We're not looking at a lot of collaboration on this type, but recognize that it's out there.

Go to the next one.

In the experimental area, really it's based on looking at what methods and models we want to implement, but anybody really can identify this. The industry would identify testing for things where it wants to use a method and maybe not enough data is there. The NRC identifies, okay, industry is using this method; we don't know if we can accept it because there might not be enough data there.

So, in that vein, it is to address uncertainties, things where there's large uncertainties in the methods or in the data that supports the methods.

These tend to have a long timeframe for getting done. They are a long timeframe. They are expensive. They are very involved.

But I think here is where we really need to have the highest level of coordination between the industry and the NRC so that we all make sure that we get what we need. So, like I said, we are trying to use methods for making the submittal. The NRC is trying to use methods for approving a submittal. It is a slightly different look at this, and the testing that needs to be needs to be able to suit both needs.

Go to the next slide.

So, the conceptual model that we have here, and I think this is what we're using in the DESIREE-FIRE test, is that we've got a defined scope of what it is we are going to do the testing on, okay, and what parts of the models that we're using are we going to address? What's the applicability going to be? Do we need to use real equipment from plants? You know, all those sorts of things need to be factored in ahead of time.

We want to identify the phenomena that is going to be investigated. We are not just out testing because we like to watch things burn, even though that may be part of it. But we do have a specific thing that we want to look at or that we want to get out of this.

We need to identify what the parameters for the experiments are upfront, so that in the end they can be used in the methods that we think that we want to use.

Then, when we're done, we need to have an expert panel-type review of the results. In the one that is going on right now, there are actually two panels because it is a combination of the application of the testing is for fire modeling and for fire PRA. So, we have two sets of expert panels that cover both of those technical fields that are looking at these experimental results.

One of the things that I think we have learned from the past is that we get the test in; we probably ought to have the experts look at it and provide the interpretation before we start going out and publishing a lot of reports and things like that, so that the results, as interpreted by the experts, are actually the results that are out on the street and are being used. This process works great for the expert panel sort of process.

Then, we get into the methods and model research. The way that the fire PRA Action Matrix is set up, and the new Methods Review Panel is set up, is really that somebody identifies a method, a model that is needed, address realism, address efficiency, address anything that we think we need to have; there needs to be a justification or a reason for why we want to do it.

Typically, they are going to come in as generic, application-specific, plant-specific. We like to move things toward the generic or application-specific because plant-specific it's hard to get a team really interested in resolving just plant-specific issues. And maybe that is better done in the license applications. But if we can make it into a generic or application-specific but industry-generic issue, that would be the type of thing that would be in there.

And the need for coordination on this with the NRC really depends on the topic. If it is something that is really critical in license applications, maybe there needs to be more collaboration. If it is things that are for more how you address how to do a model more efficiently or how to get a PRA done more efficiently, no, maybe not so much in that area.

Go to the next one.

So, basically, what we're trying to do here is anybody proposes something. Our model is that they propose it to EPRI. We have already shown that a couple of things have happened there. We pre-proposed some things that are in the Action Matrix to go through this.

Ken said, you know, one of the downsides for having somebody propose these is that they get to be the champion. They have to be the champion. As much difficulty as that brings or disincentives is that is for people bringing things out, it is the only way for it to work.

They need to define why they need the method. Okay? What is the problem that they are going to solve? We need to have examples of how it is resolved.

Eventually, we would think they would be the one to draft a report in collaboration with EPRI, and there's the expectation that anything that comes through this is going to be public.

I did leave one thing off that list that I realized here in this set of meetings. They really also need to define how they think this method or tool, or this method that they want to use, how it impacts the other areas in 6850, because they are the ones that would best know that from trying to implement it first.

And second, it gives the reviewers, which will come into this later, a little guidance as to where to go and look to see, is it really affecting it? Is it affecting something else? Did we miss something? So, that's important there, too.

My intent is to, when we get these things in, make the abstract, if you will, the description of what we're trying to solve publicly available, mainly because I want to get a sense from the industry out there how generically-applicable is this, who are the right team members to bring in, and if there's a lot of interest or very little interest. So, to help set the priorities for these. It will also help us determine what are the right qualifications for the expert panel that follows up.

Go ahead.

We have an expert review panel. We would upfront define the qualifications needed for the members, the expertise, and knowledge, subject matter knowledge. I really think in that, for these types of things, a small handful of people, six to ten members, is probably the right size to look at these things and make sure that we are on the right track for it.

Once again, NRC would participate. But we still want to make sure that the participation is subject to the qualifications, just like we're going to subject ourselves to the same qualifications.

The intent is to have the deliberation of these expert panels published as part of a method. The exact form of that we're still working on.

CHAIRMAN STETKAR: But that would include some documentation of the arguments?

MR. WACHOWIAK: Documentation of the arguments, absolutely. That's really what I'm looking for there.

MR. CANAVAN: It might be meeting minutes.

MR. WACHOWIAK: Yes.

MR. CANAVAN: It might be meeting minutes. It might be summaries of meeting minutes.

MR. WACHOWIAK: Probably summaries of meeting minutes, but the intent, though, is for the major issues to come out, and especially the things that define the boundaries and limitations of the models we want to have on the record to say, okay, this is what was deliberated; we say it's okay to use it in this area. It's maybe not so okay to use it here. We didn't even consider it over here. And the people who are using these methods and the people who are reviewing models that use these methods need to know that information.

There's probably going to be iterations on these things. I would be extremely surprised if all but the simplest one don't involve some sort of iteration.

I think I talked about boundaries enough.

In the end, we'll publish the method or the model to be used. Joint publication under the MOU is always an option for these things, but I don't know that it's a requirement. In the internal events area, it's almost never done that way. So, you know, it's an option, but I don't think it's a requirement, though.

Go ahead.

So, in doing this, we think we can provide a structured, understandable, and scrutable framework for these methods and to distribute it out for people to use the most latest information.

I think that came up earlier. Where do we get these things? It's got to be informed by the needs of the users. And there is limited research money on everyone's side. We want to make sure that we target it on the things that are going to affect the PRAs the most.

The last thing or the two last bullets on there, we think that this method, this framework is consistent with what's being done now with internal events and where we've gotten to in the end, where the industry develops the methods and models, and in the review phase, so we bring in the NRC.

And finally, the Action Matrix today is actually being run under this at least a reasonable approximation of this framework. As we tighten things up here and try to go faster, we are going to need to have a structured process, so that we can consistently track and make sure we're getting the products that we need.

So, the next part I have on here is the list of the things that we are working on, and I --

MEMBER BLEY: Rick?

MR. WACHOWIAK: Yes, go ahead.

MEMBER BLEY: Because you get to these, and you just said -- I guess we started going faster. On each of the next few slides, because each one is on a topic, could you give us your best thoughts about when some of these will reach fruition?

MR. CANAVAN: There are dates associated

with every activity as well as a budget.

MEMBER BLEY: Okay. I didn't see that in the package.

MR. CANAVAN: We didn't provide you the full matrix.

MEMBER BLEY: Okay.

MR. CANAVAN: We sent it to the staff, I believe, well, RES.

CHAIRMAN STETKAR: It's actually in Appendix B of the NEI report.

MEMBER BLEY: Oh, is it? Oh, I've got that right here.

MR. CANAVAN: It's totally printed out, right?

CHAIRMAN STETKAR: It's actually got color-coded bars on it, color only for --

MEMBER BLEY: I forgot. I've got this sitting right here. Thank you.

MR. WACHOWIAK: So, if you're looking for the approximate timeframes for these, you know, that's listed by quarter. So, you can see today -- this is why the Action Plan is difficult to put into a report like that. That's a snapshot of where we are today with this.

If, for some reason, something has to

change in priority because there is new information, we will have to change it. You know, that's just the nature of these things. But you do have that list, and each of these are number-coded. So, you should be able to see.

On these particular slides, these are the X/Y-level headings. I think on the bar chart it is in the X/Y/Z-level headings. So, there are subtopics to each of these.

MR. CANAVAN: Sorry about the size of the matrix.

MEMBER BLEY: It's all right.

CHAIRMAN STETKAR: That's okay.

MR. CANAVAN: Excellent.

MR. WACHOWIAK: The first part of this is the initiation, detection, suppression focus. We talked a lot this week about the fire events database and how that is really the glue for this first part. We are going to look at fire ignition frequencies, take a look at incipient fire in cabinets, and how well incipient detection can be used for the various fire categories.

We are looking at oil fires. A second topic on incipient detection is, where can it be credited? I think I mentioned that when I did the first bullet.

And also, getting a better characterization of the fire suppression curves that are used to generate the probabilities in the PRAs.

The second area, a lot of things here in terms of damage assessment. We've got the growth, fire growth, and comparing that with the data that is out there.

MEMBER SHACK: Just out of curiosity, Rick --

MR. WACHOWIAK: Yes?

MEMBER SHACK: -- just looking at these priorities, I assume you've got so many highs here that the lows and the mediums are going to be dropping off the chart.

MR. WACHOWIAK: Well, let me say something about the priorities that you have on the list there. The priorities were what we thought we could get done that was substantial work that we had ahead of us in the timeframe one or so years out there. Okay?

But one thing we knew for sure was the database needed to be done. That's the highest priority of everything because it really is the driver for all the rest of these things So, we knew that.

Then, the other ones, we looked at, what can we accomplish in the timeframe coming up right away? Those were marked as high. And, then, we tried to apportion out the mediums and lows to the other things that were there, and the approximate timeframes that are shown on there. And for those that don't have the report in hand, it's about a three-and-a-half year plan.

We don't intend to drop anything off that plan --

MEMBER SHACK: It stretches out?

MR. WACHOWIAK: It stretches out. And we may be adding things to the plan. So, something might come off if other things get added.

MR. CANAVAN: And it might stretch. You know, budget concerns moving into 2011 were our biggest concern. However, we received -- they have been informally approved. I don't know what that actually means, but that's what I was told.

(Laughter.)

And informally approved for our funding for 2011, which was a substantial increase from 2010.

MR. WACHOWIAK: To cover the things that are on that chart that you have in front of you that show in 2011.

MR. CANAVAN: But there's no guarantee for

2012. And informally approved actually doesn't appear to be a guarantee, either.

(Laughter.)

MEMBER BLEY: It doesn't quite sound like it.

MR. WACHOWIAK: I'm going to take it as approved. I'm going to let Ken worry about the informally part.

MR. CANAVAN: Yes, that's my job.

MR. WACHOWIAK: I think we have talked about most of these things here at some point in time today. So, I don't know that I need to go through the complete list, unless somebody wants to stop me on one of them.

CHAIRMAN STETKAR: Yes, I will.

MR. WACHOWIAK: Okay.

CHAIRMAN STETKAR: Only because I'm trying to understand. You know, you address sort of our questions from November about the concepts of coordinated research or collaboration between the industry and NRC in some of these areas. I'm going to pick up on the poster child that we have been discussing, the cabinet peak heat release rates, which is an example, but, again, it's an example that is driven by what we are seeing at least from those nearly-completed PRAs.

We heard this morning that the approach apparently under this program from industry is to have an industry contractor develop a model for estimating heat release rates based on parameter characterization of cabinets. I noticed on the timescale that, for some reason, there's only one of the three subtasks. Review of available data, I'm assuming that is done or, for some reason, we don't look at it for five years.

The second one is treatment for ventilation-limited cabinets. That one shows through the end of about mid-year next year. And, then, there's a gap of about two years, and it picks up again in the mid-2013 to end of the first quarter 2014. And, then, there's something that says testing plan as needed that's blank over the next four years.

My question is that a lot of what we heard this morning was the fact that we are using old test data that may or may not -- the tests may not have been developed specifically for the purposes that the limited data are being used now. There is some other limited test data that may or may not be applicable from VTT and IRSN.

I have heard, and I think we are going to hear from the staff a little bit about the staff's research program, which I know does include some amount of cabinet heat release rate testing.

My question is, do I now, as a third-party interested observer, have confidence that the efforts that are being undertaken by the industry and the staff are the most efficient and productive use of the available collective resources to answer this question?

And basically, in a sense, you're headed in somewhat different directions.

MR. WACHOWIAK: I'm not sure that that is really the case.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: Let me try, and you picked a great example of one to look at here because we will be able to touch on a lot of different things with this one.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: Now the first topic, it doesn't have a bar here because it's done.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: We're done with that piece of this.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: It fell off before this snapshot was taken. Okay. So, maybe that's something for me to say, how do I identify on these summaries when things are done?

CHAIRMAN STETKAR: No, that's fine. It starts December -- no, it's fine.

MR. WACHOWIAK: So, the next piece is the report that we're generating now, and in all these cases we have the intent of generating the report, getting it out into the field, and being used in pilot manner, if we need to. In the initial phase, maybe we put a pilot as part of the initial report, maybe not. This has aspects of a pilot based on who the contractor was.

But we want to pilot these things. We want to get them out in use. We want to get the feedback back into how it was used, what are the problems with it, what else needs to be done with it. And, then, our intent is about every year and a half to go back and look at these things, at least in the foreseeable future. Maybe we have to do it again or do an update.

CHAIRMAN STETKAR: That's why it's pickup --

MR. WACHOWIAK: That's the other one. So, you will see in a lot of these reports there is a year-and-a-half-or-so gap, and, then, there's another phase to it.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: Now the testing as needed part, we touched on something in here. We recognize that there are limited tests that are out there, and we are basing this report on the tests that were already done.

CHAIRMAN STETKAR: Right.

MR. WACHOWIAK: Okay?

CHAIRMAN STETKAR: Yes.

MR. WACHOWIAK: To get something out now, that is what we can do. But we have in the matrix identified that, if we realize during either the peer review process that we put too many constraints on the use of this method because of the sparseness of test data or the uncertainty is much too large because of the sparseness of test data, then it is our intent to identify what further testing needs to be done to address that. Then, we will factor that in as we go forward.

But, once again, I think you said it. We don't want to solve the world here. We want to solve things in pieces that can get out and be used and have trial periods now, so we can get the feedback in a timely manner, and recognizing where those things might come in.

So, this is one where we recognized that there is this additional testing task. We don't have the testing identified today, but we know that there's probably going to be something in that line eventually.

CHAIRMAN STETKAR: It's your program, but I'm mostly concerned about timeliness and collective resources.

MR. WACHOWIAK: Right.

CHAIRMAN STETKAR: And, for example, obviously, there's a lot of thought that goes into this. You have selected the modeling approach. Perhaps if the resources required to develop that are relatively small, and you can generate something and get it out for comments, that's fine. I sort of understand that.

MR. WACHOWIAK: Yes.

CHAIRMAN STETKAR: If it's a reasonable amount of resources, I don't know how long the program -- and I don't care because it's your resources. But, for example, if there's a high risk that when the report is published, that there will be so many questions by either the staff or your own internal review committees, the question is, are those resources well-spent? Is it the most productive way to get to eventual resolution on some of these issues, such that the people doing the PRAs can have some confidence that over the next period --

MR. WACHOWIAK: And you're bringing up excellent questions.

CHAIRMAN STETKAR: -- there will be a staff and industry perspective.

MR. WACHOWIAK: Right. Now I think the way that we are trying to address this is, at first, when we got into this, it didn't look like that we were going to have difficulty with the sparseness of data here. It looked like, at least in the initial way through it, it looked like it was a pretty, I wouldn't say easy, but a doable thing.

And we got through the first round with it, through the initial development of the paper, and it was reviewed internally with the contractor. And it looked like everything was going to work out okay.

We got it to the industry portion of the peer review group first, and I think we have mentioned this before. I wanted to work the bugs out of the peer review before we started bringing in the additional people.

We did find something that, granted, if we had given this presentation last October, this line would be done now -- but it's extended -- or at least close to done now. But it is extended out there because it's not quite as easy as what we thought.

Okay, that doesn't mean that it is not correct. It just means it wasn't as straightforward as we thought. So, we will get through that part of the process.

And as we get to the revision of the report that incorporates the first peer review comments, this is where we will bring in Donnie and his group to identify who are the right experts that they have to look at this. And I'm sure they will have someone that wants to look at, are you interpreting the data right?

CHAIRMAN STETKAR: And this one, in particular, though, that would occur, if I look at this timeline, roughly, soon or six months from now?

MR. WACHOWIAK: No, soon.

CHAIRMAN STETKAR: Soon? Okay.

MR. CANAVAN: Soon, very soon.

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: Just another comment, taking it one level up, back to what you asked, which was you started off with the confidence part. And I think we will provide the schedule on a regular basis to anybody who wants it. So, we are providing the plan to anybody to add to it and to be aware of when they can participate. We are going to update on a regular basis and make it available.

The other part is you see this method in a lot of your other questions related to resources. Your questions are great because we did the exact same exercise. So, we could go back through suppression curves again. It's partial, right? It's a partial response. If we go back to the FAQ, we could say these are the data points we don't like. What happens when we take them out? Try and convince the staff again. There's a whole bunch of things we could do now, or we can wait for the database, where we think we will have much better evidence.

So, the question is, if it could be done really quick, and it would benefit people right now, then we might put it on the list. But if it is going to bring up more questions, if it is not going to get a resolution, if it is going to be wasted time and effort, we ask ourselves those questions very early in the process. And, then, we say it's not worth doing it early; we're just going to do it late. We're just going to wait for the database. We are going to do it right after the database.

So, I think we make those decisions in this on a regular basis. You will see a few loops in here where we choose to do early and late as well. And you will see ones, like in this case, or you will see ones where we chose not to do anything early --

CHAIRMAN STETKAR: Okay.

MR. CANAVAN: -- and we just stuck with what we had.

CHAIRMAN STETKAR: Okay. Thanks.

MR. WACHOWIAK: Okay. In the area of the fire impact scenarios, we talked about the AC and DC hot short probability and duration. That is being addressed probably as we speak.

The human reliability; there's some issues on control room modeling, and what I titled in the matrix as unrealistic model simplifications, but these are those things that are out there that we have talked about before, like always assuming there's a plant trip if you have a fire and always assuming that things like ventilation fail at time zero, when it may take a long time for the fire to develop to where the ventilation ultimately fails and, then, the things supported by the ventilation fail down the road. So, there are a handful of those things that are out there that are kind of grouped into this one bin.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: And, then, finally, we have our support of other activities. So, you can see what we are doing with those, but there's a lot of ongoing things that we intend to continue doing.

CHAIRMAN STETKAR: Good. Any other questions?

Good. Thanks.

MR. WACHOWIAK: So, one of the things that I think maybe in terms of time we had later is, what is it that we have high priority now and what is it that we are doing right now? What are the interim things that we are trying to get out? It might be just easiest for me to go through those right here.

CHAIRMAN STETKAR: Yes, if --

MR. WACHOWIAK: It will only take a few minutes. I don't have slides for these things, but all the activities you have just seen. They are all listed there already. So, it is a subset of those activities.

The high-priority things that we are doing in 2011, obviously, is the fire events database and getting the plant-level frequencies out of the fire events database with the new batch of data. That's a high priority.

Also, addressing the non-suppression curves based on the information that we get from gathering all that data from the plants for the database.

The heat release rate report that we just talked about a minute ago, that is a high priority, mainly because we think we are close to doing that and we think we can get something out this year that people could actually use in the fire PRAs that they have developed now because it's a drop-in piece for a part of 6850.

The transients, including hot work, to really identify what's the right heat release rate to match what the experience of the transient fires that we have seen, that has got to be done. There is just a disconnect there that I think we all agree that that can probably be cleared up, once we have the information from the database.

Also, something in terms of the likelihood of the different type of fires that we have out there, that's all tied into that.

On the oil fires, we think that we can get that, the heat release rate on the oil fires resolved for the pumps, as an extension, diesel generators, and the indoor oil-fueled transformers, the big ones in the yard that's not part of this. It is the things that have a potential to impact other equipment in the room located next to them.

That's actually one that the PWR Owners' Group is working on, and they are getting to a state where it is ready to be reviewed here soon.

And, then, finally, another owners' group activity that is going on that is tied into the matrix is the propagation of fires within the electrical cabinets, not the one we talked about before as to how does it get out, but what actually is going on inside the cabinets for different industry standard cabinet types?

They want to look at, what's the potential for propagation within the cabinet of something like a relay cabinet versus MCC versus a switchgear, and things like that.

CHAIRMAN STETKAR: Okay. I understand that. But, as a practitioner, it is not at all clear to me, if I plant with 1330 cabinets, that that's going to be awfully useful to me, or even if I have 50 different cabinets, because I have never seen a generic cabinet in my life, except in the new standard plant designs they tend to look a little more standard.

MR. WACHOWIAK: Yes.

CHAIRMAN STETKAR: I'm assuming --

MR. WACHOWIAK: They have the luxury that they don't have to worry about other people's decisions.

I haven't seen the report yet. So, I can't tell you specifically how that's going to be addressed, but the intent here is to identify things that the PRA practitioners can use. We don't want to put out a method that is out there that somebody goes --

CHAIRMAN STETKAR: That's good. I certainly hope so.

MR. WACHOWIAK: -- you know, "I can't do this." It's intended to be used by people who can identify that their cabinet is configured like this thing that we have analyzed.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: So, those are our interim priorities.

CHAIRMAN STETKAR: Good. Questions?

If not, thank you.

And I think it is time for a recess. So, we will recess now until 3:10. We are doing okay on time. We had time built in at the end for open discussion. So, I think we are doing fine.

We will recess until 3:10.

(Whereupon, the foregoing matter went off the record at 2:54 p.m. and went back on the record at 3:15 p.m.)

CHAIRMAN STETKAR: Okay, we're back on the record.

I guess we'll hear about the NRC fire research. For the benefit of the members who weren't here in November who are not here now, we heard quite a bit about the research plan. So, I don't think we need to go over what we have heard before. Let's see if we can focus a little bit more on some of the topics that came up in the November meeting.

And with that, I will turn it over to, Christiana, I guess you or Mark, one or the other.

MS. LUI: Yes, thank you.

Good afternoon.

Well, in my own interest, I will keep this short, too, because I am about to lose my voice. So, five to ten minutes.

MR. SALLEY: Yes, it won't be so much.

MS. LUI: These are the results I've gotten so far, anyway.

Before we go into the different activities the Office of Nuclear Regulatory Research is doing to support NRR, just a few very quick remarks about how we focus our work and the ways that we actually get a job done.

So, what we do is that we really focus on NRC's regulatory needs. We establish a technical basis, defensible technical basis, to support the regulatory product development. And in particular, we are aiming for clarity in the guidance documents.

And although everybody likes to go into as much detail as possible, our first order of business is really to focus on safety-significant and generally-applicable situations.

Although we do have different roles and responsibilities compared to our licensing offices, we work very, very closely to establish the regulatory research priority in terms of shaping our programs. So, the three noticeable criteria that we use is the agency one, the agency-mandated program, any short-term needs, and also longer-term outlook.

And how do we actually get there? Clearly, we have in-house analyses. We also have contractual support. We clearly leverage on our domestic and international collaborative efforts. And in terms of how do we pursue that, we identify common development interests, and we also build on strength offered by different participants.

Some of the programs that you have heard about that I didn't talk about in these two days is the DC circuit testing. That is one particular success example that we can really cite where the industry comes up with the actual operational equipment that we can use while our strength is in the test protocols. And our goal is to continue to be transparent, traceable, and be open.

One slight clarification, I really want to offer that some of the statements that we have heard in these two days referring to the MOU process, some people say that it is too public; some people say that it is not public enough.

What we do is that, in general, whenever we develop joint products with the industry, we do put our product out for public comments. And very often, if we are jointly conducting a test program, where should we put all the test protocol for public comment once that we have a technical team work together to actually build our strawman?

So, we continue to look for opportunities to get all stakeholder involvements. That's in the past; we are not doing that now, and the in future we will continue to do that.

In terms of priority, we do meet with NRR on a quarterly basis to go over the status and also the priority of the program. As needed, we do adjust the priority.

So, what Mark is going to talk about in the next couple of slides are our current research program and how these activities stack up in terms of priority.

MR. SALLEY: Okay. Thanks, Chris.

Last time we met, John, I gave you a pretty detailed presentation about a lot of the different programs. I will be happy to answer any questions on that, but, again, I don't want to repeat the presentation we gave you.

What Chris and I discussed when we put this together for you this time was the message we got was priorities. What are our priorities? So, I focused, quite simply, on our priorities.

And these priorities, again, as Chris stated, are worked out with NRR. Of course, we will start out with the high-priority items, and they are in no particular order. Okay? Once they fall into the high-priority bin, they're in the high-priority bin. So, this is just a random ordering.

One of the first key things is the PRA training. Again, this is something we work with EPRI in the partnership of training the methods on CR-6850. We hold two sessions a year. We are now up to four sessions. We have added the HRA piece. Next year we are looking at adding a fire modeling class. So, that continues to grow. It continues to get very good turnout.

We take turns holding it. So, it is truly collaborative. This year it was the NRC. So, they were both held in the Washington area. And next year EPRI will sponsor it, and it will be, again, free to the public. It is held as a public meeting forum.

Updating CR-6850, that continues to be a challenge. We did issue Supplement 1. So, the FAQs that affected it have all been collected, catalogued, and that is issued as Supplement 1.

As I discussed to you last time, the big challenge is going to be, how do we advance the state-of-the-art, and I would really appreciate your feedback. You know, if you think a modular approach would be something that we could go for or do we need to try to do a whole full revision of the document?

Again, part of our mission is the long-term support. As the new challenges come up with 50.48(c) for NRR, we are there to support them in any way we can, answer questions, find things for them. Whatever support they need, that is one that is a high priority for us.

The fire modeling applications guide, as I discussed last time, the joint project with EPRI and NIST, the V&V was a challenge to do. That was a hard project. And I thought the fun part, being an old fire modeler, was going to be to write the applications guide. But, boy, I'll tell you what. You get about half a dozen good fire modelers in a room, and I think they can rival the PRA on this.

But that program, it's moving along. A lot of good ideas. It was done last January, went out for public comment. It got a lot of comments. The team is back reworking through the comments. They are close to having it completed again, and discussions with Ken was that, because there was so much industry interest in it, that when this draft is completed, we will put it out again for 30 days public comment again, to let the commenters see how we resolve their comments and make sure that everyone is happy with it, and we have a good applications guide.

So, I am really expecting next month to be getting that real close to being on the street; if not, for sure in January. But that program should finish up this summer as a completed document.

As a note, too, I would like to keep that team together, and we've got a lot more for the V&V as we progress. So, I think we can actually roll into the fire model V&V, which is NUREG-1824, and start expanding that a little bit. That is something Rick and I will talk about as we do our future planning.

DC circuit testing, the DC circuit testing is complete. The draft report has been written. We have moved around a little on our priorities. We are not in a hurry to get that draft report out. The testing is done; the data is there. It is really now fed into the expert panel.

We have the two panels that you have heard mentioned. The first panel was a PIRT panel that we are running. It is a nice group. We've got eight members on it, four from the regulatory side, four that EPRI has supplied from the industry side. Brookhaven is running the PIRT.

They have had their first meeting. So, they are started off. I sat in on the meeting, and it was a very good meeting. You could feel the interest of the people in there and the expertise. So, Rick, I think you would say the same thing. You say in on the first meeting, too.

So, that program is started. When that completes, which will be in the spring with the electrical portion, we will go into the PRA applications, and that will answer the questions about the DC circuits, as well as any updating to the spurious actuations for the AC.

And again, this program, it's in play right now. We're really looking at the final two reports being issued by Brookhaven, which will probably be in the summer or early fall of next year. So, that program is working away. And that covers the next one.

The fire events database, again, that is really an EPRI program. They hold the data. So, we are there to support them. I believe talking with Steve and J.S. that, while they are here, they are actually going to do a little audit, I guess, and work with the folks from EPRI and see how the data is coming together and to make sure that we are all in alignment with that. So, that program, it's EPRI-controlled, and it's moving along.

One that we had from NRR directed by the Commission is the fire protection metrics. John, I think I sent you an email with that one.

CHAIRMAN STETKAR: Probably.

MR. SALLEY: Yes, and this is the one where we capture three things. We capture the fire vents that were sent in versus via the LER program.

CHAIRMAN STETKAR: Yes.

MR. SALLEY: And the second thing we would look at is the inspection findings, where we will catalog the inspection findings.

And the third is the long-term comp measures. So, that is one, again, we work with EPRI and NEI to get especially the long-term comp measure information. And every six months, we update that and we send it over to NRR. That is one that the Commission asked us, so that they could kind of see a tracking of how fire protection is for them. Again, there will be another update of that, and it will be on a rolling six months.

We are also trying to go back in time. I think we are back currently to 1990. We want to go back and see if we can find the LERs, the 5072s and 73s, to try to get it. Ideally, I would love to go back to the `75 timeframe.

And I heard comments earlier about the reporting requirements. And, yes, the reporting requirements are different, and they have evolved. It is actually interesting. The report, if you read it, we spent some time laying out how those reporting requirements are. But, you know, the key was that, whether you have to report an LER fire, whether it is 10 minutes or 15 minutes, there doesn't seem to be a whole bunch of 13-minute fires. They either tend to be longer or very short. So, even though, yes, there are different requirements, I think they are close enough that we are not seeing that 13-minute fire that one reports and the other doesn't.

Next slide.

Coming along with the high-priority items, the cable tray testing, you heard mention of CHRISTIFIRE. This is where we are looking at the heat release rate and the flame spread.

The first report is drafted. It has been out for public comment. We've got the public comments. Dr. McGratten from NIST is working on that with us. That testing is being performed at NIST. He is working with our staff, David Stroup, right now. They are resolving comments. And we expect that first volume to be issued in the spring.

We will, then, look on to the second phase. We will consider this successful, and we will look on to the second phase, where we will start introducing some more of the variables, vertical trays, covers, fire retardant coating, and we will start that second phase.

I know talking with Kevin that we have got the contracts in place. Procurement is started, and they are procuring the cable.

An interesting side note, maybe because I'm a fire protection engineer, not an electrical engineer, but it was interesting the amount of lead that was in the jackets of those cables. It surprised me, but I know one of the challenges with NIST is, when they have gone and cleaned their hoods and their filters, is, yes, oops. So, I find ways to stick NIST all the time, but unintentionally.

(Laughter.)

So, anyhow, part of the procurement is that the cable manufacturers are moving to, I guess, lead-free cables, not that I ever knew there was that much lead in there in the first place. So, that is an interesting little side note that we had as we procure new cable.

One of the FAQs that fell out was the

kerite testing. Again --

MEMBER BLEY: I didn't hear the word.

MR. SALLEY: Kerite.

MEMBER BLEY: Oh, okay.

MR. SALLEY: Kerite is an odd cable. Dennis, you know, I want the whole world to be hammered into two nice camps, thermoset and thermoplastic, and from there, we can bin them, and once you are in that family, you tend to be close enough that you are splitting hairs, whether you are cross-linked polyethylene or polypropylene, or whatever specific chemical type.

The one cable that does want to be a bit of an outlier, it is supposed to be a thermoset that wants to play like a thermoplastic, is the kerite cable. And again, this is one where you can see the benefit. You will notice I put a lot of parentheses with EPRI here, where you can't buy this kerite table anymore, but EPRI was able to, you know, with the contacts through the industry, to marshal some cables that had been left over from construction or people had spares in the warehouses. And we were able to get enough samples and get them out to Steve.

And again, an economy of testing, because we had just figured, completed, the DC testing, Sandia was still geared up. What I am saying is the Penlight facility was still hooked up. The technicians were there. The instrumentation was there.

So, it was all in timing that we could get the cables from industry through EPRI and we could run those cables through the testing, and we will come up with an answer for kerite.

MEMBER BLEY: Is there a lot of kerite out there? I'm not familiar with it.

MR. SALLEY: Well, yes, see, that is the whole thing of this. When we started out, there was a couple of plants. But, as we started talking more and more, all of a sudden, kerite started popping up all over the place. So, there is a fair amount.

Now, in fairness, you know, kerite was a big player in medium-voltage power, which is something we are not too interested in. We are interested more in the instrument and control circuits, which is a smaller population.

But, again, I think one of the things you saw from the presentations, that if I'm a licensee, I mean, what is my problem that is slowing me down? That is what I am interested in, and everybody has their problem.

Duke, for example, it was the armored

cable. You know, they had to use so much armored cable that they really needed armored cable. And, of course, when they did their first testing, nobody else used it. So, basically, Duke had to go it alone.

Kerite, there is a handful out there. The interest to them is, hey, do I treat this as a thermoset or a thermoplastic; what's my temperature; what's my threshold? So, to them, that was probably one of their most important things.

Again, just the fact that we want to close the issue, too. And it was an FAQ. We have had the opportunity. Testing is done. Sandia is writing a report. This spring we will issue the report. We will feed it to the expert panel, which is where I really need to get it, and, hopefully, we will close that. So, that will close up this spring.

The effects of the fire-retardant coatings and cable tray covers, I had mentioned that. That is on the plate, and that looks to be about next year at this time completing up there, and that will be the effects of the covers and the coatings.

And the last one of the high priorities, and again, these were not in any particular order, is the incipient fire detection. This one we have scheduled to complete in the summer of this year, hopefully. We just got the contract in place. We had some contractual stuff. You know, nothing is ever simple, you think, between the government agencies. But the lawyers looked at everything and we had to go through the clauses in our contracts.

We awarded the contract to NIST. We have just gotten it in place, and we will be working with NIST on this. And again, we hope to, when we lay the program, I have started laying the program out with my project manager. Again, we will talk to EPRI through Rick and say, "Here's what our plan looks like. If you are interested in joining it, here's how we intend to proceed with the incipient detection."

CHAIRMAN STETKAR: Right now, Mark, on the incipient detection, is that only in cabinet with different types of cabinets or are you looking, also, at ex-cabinet area?

MR. SALLEY: My project manager Gabriel Taylor, he's been here before, and I have discussed this. We are basically looking at four steps in this process.

The first thing we want to look at is, just what is incipient detection? You know, what are the systems out there that are listed, rated, that have some quality, some pedigree? And what is the family of them? So, we need to establish that.

The second thing we need to look at is, what is the technology that they are using? This is how these systems are designed. This is how underwriters' laboratories test them. These are how they are calibrated.

And to a point, you know, educate everyone onto what we are calling incipient detection and how the technology is regulated, how it basically works. So, that phase will come in.

The next thing we look at, of course, is the third phase, would be the literature survey. I had known that in the past with the Candu reactors, I can remember years ago going to a conference when I really wasn't interested in this, but I can remember a female engineer from Canada coming down and really singing the praises of incipient detection that they installed post-shutdown on the Candu reactors, I guess, about 10 years ago. So, we need to go back and see what people have done to this point.

The fourth phase of that will, then, be to look at it. And believe it or not, these are in use in quite a few places. As I mentioned before, NASA loves the stuff. DOE did not have that good of experience. The Candu reactors is one definitely that we talked about, you know, that I want to get the folks to look at.

But I think we really need to do the research to go to talk to these people, to see how well they are working, how many years of experience they've got, and look at it that way. And, then, if the next phase is needed, then we will move into a testing phase.

CHAIRMAN STETKAR: Okay, but this initial is no testing? It's simply --

MR. SALLEY: We need to establish a baseline before we just blindly go out and test.

CHAIRMAN STETKAR: Okay.

MR. SALLEY: And I think one of the things, you know, beyond testing is going to be how reliable in that are these systems, and what kind of operating experience? Operating experience, as Chris mentioned, is usually valuable. So, we need to get that from other industries. And there is a bit out there that we can pull from. Like I said, NASA, DOE, the Candu's. So, we have a lot of communications to make, a lot of meetings to happen with the folks to get that, and we have started that.

CHAIRMAN STETKAR: Have you looked at others? You mentioned Candu's. Have you looked at other international experience. I have seen cabinets. I've been up close and personal with cabinets in nuclear power plants in other countries that have them.

MR. SALLEY: That have used the incipient? So, that would be international? Where would I be looking, John?

CHAIRMAN STETKAR: You would be looking -- I don't know how prevalent -- I'm familiar with the Swiss plant, but it's a German plant design. So, I would contact Siemens, you know, or people in Germany. I mean I actually don't know if they use them in France.

MR. SALLEY: Okay. I appreciate that, and we'll take that --

CHAIRMAN STETKAR: They may have some operating experience.

MR. SALLEY: Yes, we will take that with our OECD work. That is something that, as a matter of fact, the OECD is here next year. I'll go to that meeting and I'll ask for the people we can get. Then you can send me over to Switzerland for a month or so, boss; what do you think?

CHAIRMAN STETKAR: Well, it is one plant. You know, it is a Siemens plant and they come in

Siemens sort of supplied cabinets. I don't know whether it's a Siemens product. I don't actually recall. It is several years ago that I ran into these.

MR. SALLEY: Okay, but that's a place I'll look. And we have got a number of other different leads --

CHAIRMAN STETKAR: Okay.

MR. SALLEY: -- that we will also run down. And again, we want that operating experience.

So, those are all our high-priority items. The next thing we would move into would be a medium priority.

This one, the human reliability analysis, you have separate meetings coming up on this. And the only reason this one is down to medium now is because the main product is pretty much complete. The team has completed the NUREG. The NUREG has gone out for comments. The comments are in. The team is walking through and resolving the comments. They hope to have this published this summer.

So, again, this one has kind of gotten off the high-radar screen. It's gotten down to medium because now they are just in a closeout portion.

It is interesting, too, that we do have a full track in the training, that is, a whole class that is dedicated to the fire HRA that looks to be a continual part of the training.

Electrical cabinet heat release rate, again, this was one that we did have at a higher priority, but with discussions with NRR, when we learned industry's plans and that they were out there doing the work on the cabinet heat release rate, discussions then are we kind of backed that down to medium because we don't really want to reproduce work that other people are doing.

MEMBER BLEY: When you say "medium" here, this means you are not going to do anything until you see what goes on out there or are you doing something at a low level?

MR. SALLEY: We have something at a low level. I mean we are doing our versions of literature surveys. Where we were at with this, and you have heard mention, was we looked at what testing had been done, primarily by Sandia, and we were looking at, okay, where is there holes in the data; what's missing?

And we were saying, okay, if we were going to go and start filling these data parts that are missing, how would we start setting it up. And that's where we were in the project when we learned through conversations with EPRI that they had a project ongoing based on some work that come out of some earlier research about two years ago.

So, in essence, we were going to let them run through their course. I believe, Rick, the agreement is that when you guys get the report drafted, you will send it over to us for comment on the heat release rate?

MR. WACHOWIAK: Yes. Actually, what we had talked about with Donnie was that, when we have the initial set of review comments done, then we will bring you guys in to be part of the review team, official review team.

MR. SALLEY: So, that's how we moved it from a high to a medium, to allow industry to do their portion before we go and pick it up.

CHAIRMAN STETKAR: Okay. And we know industry is approaching it, trying to develop parametric models based on the same set of limited test data that you're looking at. So, we are not creating anything new here. We are just simply looking at the same old stuff differently perhaps.

The question is, again, the reason we are here is NFPA 805 transition. If it is identified as a key issue, and we have a sparsity of test information or in some cases perhaps questionable test information because the tests weren't designed to produce the information that we are trying to glean from those tests.

Is this an area where additional testing should be done? Now the industry has decided apparently no. You've decided apparently no. I understand tests are expensive. It is hard to find cabinets. The last I checked, there's a nuclear power plant that I used to work at being dismantled right now on the northern shore of Lake Michigan that I guarantee didn't have many solid-state cabinets in it, but it had a heck of a lot of switchgear and electrical cabinets with relays and wire bundles and things like that that probably shouldn't be contaminated. You know, there might be stuff available.

MR. SALLEY: I wouldn't rule out testing, John, but, like any research project, before you just run out there and test, there's steps we like to take. One of the things is we like to do a really good, solid literature survey to see who has done what and to try to learn from their experience. And from that, we, then, go and frame our testing. I fully expect a test. It's just when.

The other thing is with this that I did have money budgeted, and we were starting to move forward, but there's always more research projects than there are funds and resources, okay? And Chris has six different branches, and we sit down and the six branches basically compete where she has to balance out that all the areas we have covered.

Again, this was one where we were getting ready to start it, but we knew that industry had an effort. I didn't want to duplicate theirs or go out and test things and find out that they had data that I had missed.

So, we had diverted funds to other high-priority work and decided to be patient here and let industry take the first bite at the apple, if you will, and then we'll pick it up, look at where they are at, where we were going, and see where we need to go.

And again, this may well develop into discussions with industry where we say, hey, we need to run "X" number of tests and here's what we're thinking of doing. And do you want to come up with some equipment; you want to come up with some expertise, and we will work with you? We will have those discussions under the MOU. And that's how we try to do business.

MR. WACHOWIAK: This is Rick from EPRI.

The other thing that, as I mentioned earlier, we want to make sure we do is we are trying to come up with a tool, a model, or an equation, like we said before. Then, if that turns out to be a useful model, then we can tailor the test to fill in the gaps for addressing that model.

So, I think the way this is being sequenced right now is probably the right way for this.

CHAIRMAN STETKAR: Okay.

MR. WACHOWIAK: We need to figure out where the gaps are and target the test to fill the gaps.

CHAIRMAN STETKAR: Rick, in practice, this is just information. I know Mark in our November meeting was very, very appreciative of the batteries that, I will use the term "scrounged", that EPRI scrounged up from a plant that was replacing their batteries because that allowed them to use a legitimate power source to support the DESIREE tests.

If there's any indication that prior testing of electrical cabinets -- and, you know, I will run the spectrum of electrical cabinets -- may be done, has there been any thought? I was not necessarily facetious about scrounging equipment from Zion. You know, if you wait too long, it's going to be in a dump out in Utah someplace, I think.

(Laughter.)

MR. WACHOWIAK: That's something to consider.

CHAIRMAN STETKAR: Warehouse space is cheap if, indeed, there is an indication that tests might be performed. You know, granted, the test program isn't designed yet. But if you want to use prototypical equipment, that might be hard to come by.

MR. WACHOWIAK: Right.

MR. SALLEY: And there's one facet that is not on the priority list that we are dealing with the international. And again, we will get it with EPRI for the U.S. utilities. And that is the high-energy arcing faults one that we have been working for about three or four years now in discussions with an OECD project.

And it's interesting that Korea, I believe, emailed me and sent me some nice pictures that they have already started getting surplus switchgear, that they are ready to commit to the project.

So, hopefully, yes, it was really surprising that the guy basically emailed me. I love these emails.

CHAIRMAN STETKAR: Those are the tests I want to see.

MR. SALLEY: Right. Where I got the email and it said, "See attached photos." I looked at it. It was a bunch of switchgear and says, "Give me an address where I can send this." And I was slow down a minute; we're getting this together. This spring we will get the agreements in place.

But some people were interested. And again, that's one where we will look to EPRI, if they can contribute also.

And the last in the medium priorities is in the meeting support. Again, anytime NRR would like our assistance at an ACRS meeting, NEI fire protection forum, any public meetings, any of that, then we are there to assist them. That's a smaller activity.

Moving from that is into the low-priority items. Sometimes low priority is just because there's nothing much going on or there's very little.

The first one, for example, observing industry fire tests, there's nothing going on right now. There was some aluminum conduit penetration seal testing that was done by VEPCO, and we went and witnessed that, and we will write an internal report for NRR and for the Regions. So, that is kind of when something is going on.

Low-power shutdown, I talked about that last time. As a matter of fact, my PM and Steve have completed that. Again, Ken said it wasn't a peer review, but EPRI did give it a read and give us some comments.

We have incorporated those and that draft NUREG CR we looked to have out the first of the year. So, we will give NRR the two-week look-ahead on that. That will be coming over and we will get this thing straight.

A longer-term research project -- so the low-power shutdown we would hope to complete this summer, the summer of `11. Again, it is a low priority, but it has been going for a long time. It has almost been a little fill-in-the-blank-type kind of project.

A long-term research project for us is the smoke damage on the I&C circuits. That is one that we have thought about long-term. And it gets more into digital I&C systems. Again, we are still in the planning stages, but this is something right now that we would be looking at for, say, June of 2012. So, it is a year or two out in the distance.

Another one that is in the June 2012 timeframe is the gaseous fire extinguishing agents. We need to go back. It has been a while since we have looked at that. And also, there's some newer technologies with things like the water mist systems and that which didn't exist when Sandia did the original work that we need to take a look at.

CHAIRMAN STETKAR: Do you actually see those being installed in -- I'm thinking of new plant designs. I haven't seen any of the new plants that have talked about those types of systems.

MR. SALLEY: I haven't seen anything. I would defer to industry if there is anything going on. But there's also the things like the halon replacements. Halon is outrageously expensive if you had a system that you have those clean agents in that now.

And again, part of it is you know with the deep-seated fires that we see in cables, you know, what concentrations and soak times would you need with these newer agents. That may be an area where some research needs to be performed. And again, this is something that we are looking at in two years out getting into.

The documentation of the circuits and manual operator action closure, again, these programs have pretty much run their course, I think, and they are being implemented now, but we still need to establish a regulatory footprint and capture that. So, this is a project that we are looking at in about 2014, actually, where we can really bring things to closure.

I think a funny story, just a side anecdote on this, is we had the whole issue of thermal lag and HEMAC and 3M and the whole fire barrier issue. We wrote a NUREG where we captured the whole history. I believe this was one that we did for you guys when we had the GAO audit where they couldn't follow the full closure of it. So, we packaged it all, and we put the whole regulatory history and the full final closure. It's got it all there.

And we figured, okay, that's nice, and the next time GAO comes in and says, "What did you do about this?", the NRC has a real nice response.

But, as a side byproduct, as people were looking at multiple spurious, I ran into a contractor and he called me up and said, "You know, that's really coming in handy now because we are going to go install fire barriers again, and you've cataloged all the testing; you've got everything cataloged."

So, we had meant it as a historical closure thing. And as people may want to add some fire barriers to resolve their multiple spurious, we now have this nice handbook, if you will, where it has changed its mission and they can say, okay, here's all the tests you've got; here's the configurations; here's where you need to go. And it has become a nice source document. So, I thought that was quite interesting.

In follow-on to that project, actually, it wasn't as big an issue, but the radiant energy shields that are used in containment. Typically, you have a thermal lag, get people doing a lot of different things.

And the unique qualifications on things like the fire-resistant cables, those were done under 50.12 in the exemptions. Again, we want to capture a footprint in the essence of future questions from the GAO that, okay, you did fire barriers; what about in containment? And again, this is one that we are looking at scheduled for the summer of 2013. So, those are our low priority.

And with that, that is pretty much the matrix of where we are working in research as of today. And again, with this, as Chris mentioned, is the big user here for us right now is NRR. We do have quarterly meetings. So, in those quarterly meetings, it is not uncommon -- for example, you saw the HRA go from a high to a medium. That is because so much progress had been made. It is ahead of all the other HRA projects. So, it lowered that down for completion.

And new projects will come in, and projects will close. We keep this pretty much as an active running dialog quarterly with NRR.

And also, when we talk to EPRI, one of the things we will do, typically, in the spring is we will exchange our notes. Okay, here's what we are looking at; here's what you're looking. Where do we see possible fits to work together? Or, in the case of the heat release rate on cabinets, where don't we want to duplicate efforts because there's just so much?

So, those discussions, like I said, typically happen at least once a year, if not more. There's always talk at things like meetings like this, NEI fire forums, and that, where we discuss this.

That's all we had prepared. And again,

like I said, we wanted to focus on priorities.

CHAIRMAN STETKAR: Anything else?

Thank you very much.

Now the process, looking at the time, it has been a long two days also. On our agenda, I think what we will do, as much as some people probably would really like to talk about incipient fire detection, I think we will probably forego those presentations. I think we have heard a lot about it.

I think we are sort of familiar with some of the concerns. Going into the details of the two different approaches, I don't think would necessarily add anything to sort of our understanding of what at a higher level some of the issues are.

There are two presentations, one by NEI and EPRI that is entitled "Interim improvement to support NFPA-805 and other important risk applications". I am not sure what --

MR. WACHOWIAK: I covered that in this last presentation.

MR. SALLEY: Rick covered that at the end of the last one.

CHAIRMAN STETKAR: Thank you.

And, then, there is kind of a closeout from the staff that says, "NRC perspective on fire

PRA". Have we covered that or is that something that, Sunil, you would like to kind of get some closeout?

DR. WEERAKKODY: You had a couple of questions yesterday, John. One was with respect to the fire PRA results and, then, the lack of compatibility --

CHAIRMAN STETKAR: Okay.

DR. WEERAKKODY: So, I would like to speak, comment on that.

CHAIRMAN STETKAR: Okay. Good.

DR. WEERAKKODY: And, then, you had a question, also, with respect to the implications of these issues on the other PRA applications.

CHAIRMAN STETKAR: Yes.

DR. WEERAKKODY: And I'm prepared to speak to that.

CHAIRMAN STETKAR: Okay. Good. Good. Let's do that because those are relevant. I didn't want to put you on the spot necessarily and make you say, no, you didn't have anything. So, I'm glad you did some homework.

MEMBER SHACK: He's born ready. He doesn't need to do homework.

(Laughter.)

DR. WEERAKKODY: I want to find my

presentation.

CHAIRMAN STETKAR: Go ahead.

Harold said he just arrived at Dulles. That's probably from Germany.

MEMBER SHACK: No, no, that's true; he always flies into Dulles.

CHAIRMAN STETKAR: He flies into Dulles nonstop LAX-Dulles.

DR. WEERAKKODY: I'm Sunil Weerakkody. I'm the Deputy Director, Fire Protection, NRR.

The purpose of this presentation is to try to answer one of the questions based on the information that industry presented with respect to some of the insights that they got from some fire PRAs and how they don't really comport with what we see in the experience.

I recall very well in November I made a commitment to John to come back and address it at this meeting. Then, we tried to do that yesterday, but I don't think we did really try. I went home and I didn't feel comfortable that we answered your question.

So, I kept challenging the staff, and when I kept challenging the staff, they basically said to me that one of the hardest things they have is without just having the results, without knowing the degree of use of the plant-specific insights that went into the six or seven plants, they had the hardest time trying to address that specific question.

And, then, I understood, when I listened to Danny Pace yesterday, where he had some information which was how this initial fire PRA was 70 minus 3 for the compartment, and then he applied the detailed fire modeling, it dropped down like almost three orders of magnitude.

Even though we have access to the licensee's PRAs when we need to, we can't tell with those seven plants where on the spectrum these are. But, still, the question that you ask is a very legitimate one and we have to try to come up with some kind perspective.

Go to the next slide.

So, what I said was, you know, let's try to answer these questions with the knowledge we have, the facts we have, and try to shed some light.

Go to the next slide.

So, basically, I had to rely on a paper that my colleague, Ray Gallucci, put together to present at a forum many years ago. Was it like a couple of years ago, Ray?

DR. GALLUCCI: 2006.

DR. WEERAKKODY: Yes, 2006. He had done some analysis using some of the precursor data, the Browns Ferry, and some of the analyses he has done.

And I wanted to be careful in terms of how I presented that information. And when I looked at that, the results that he produced, and then he has to presentation to the staff, if the ACRS is interested.

If I include Browns Ferry and the other accident sequence precursors and some of the other key events, I'm getting a number. Use that as a prediction like 6E -5 per year.

But we all know that, since Browns Ferry in 1975, you know, we have made many changes to the plans. Okay?

And so, if I, then, go to the other extreme and say the industry has fixed anything and everything, the lessons learned from Browns Ferry, and as a result, if I just throw away the precursor, the conditional, or the contributions from Browns Ferry, what is the order of magnitude I get? I get like 1E -7 per year.

What is interesting about the lower number is, when I look at these new plants where they have complete separation, the new generation of plants where the only place where the two things come together is in the cable control room and the containment, that's the order of magnitude you get.

So, with these two bounds, then, I said, okay, you know, we know that a large number of plants have made a lot of modifications to the plants out there. The number is like something that may be lower, 6E -5, I mean minus 7, but that is the average number. I may have a plant out there today that's higher than 6E -5 even. It all depends on the risk reductions associated with the post-Browns Ferry actions, and that varies among the plants.

For example, if I take one of the plants that I am very familiar with now, say Shearon Harris, not only did they do a number of modifications with respect to the lessons learned from Browns Ferry, they did more modifications such as rerouting cables, putting in incipient detection systems. That has to be towards the lower end.

However, I want to be very candid about this. When they submitted their pilot Harris SC, their core damage frequency was, I recall, 3 minus 5 per year. I can't remember the exact number.

And if you recall what Progress Energy said, what they did was in their analysis they did enough sharpening the pencil to a point where they could just get the staff to approve to complete the transition. So, I wouldn't be surprised if they are today at 3 minus 5, and, then, when they sharpen the pencil some more, they fall into much lower values. Okay? That wouldn't surprise me.

Now I do want to make a comment with respect to what I have there. Risk reductions associated with post-Browns Ferry actions vary among plants. One example is Browns Ferry, okay? That I know.

And, then, there is another plant that I know about is Browns Ferry, okay? Just last year, we issued them for each of their plants a yellow finding. And as you know, a yellow finding is their CCDP is greater than 1E-5 per year. That is going to be in the ASP program.

And one of the things when I spoke to Gary DeMoss, who is the Branch Chief of the ASP program, and I should have known this yesterday because I used to be an ASP analyst, that in the ASP program, even if a performance deficiency lasted for 20 or 30 years, you truncate it at one year. Okay?

So, that yellow finding, it is a yellow only if you assume that the condition that we found at

Browns Ferry lasted, stayed only one year. And to give you some context, what they had was they had about over 100 operator manual actions. And when the inspectors went in, and I'm sharing this and these are all publicly available. You know, there is an inspection finding. Everything is well-documented.

But what is interesting there was that they had about over 100 operator manual actions. And some of the operator manual actions, the time required was like 20 minutes. And when they did the walkdown, they already closed three.

So, when you put all this information together and did the quantification, you had this one plant. You know, Browns Ferry, actually, they had three units. Each of those units we had yellows.

So, to me, I am very comfortable in sharing in this forum, and I give you the 6E -5. That may be an upper bound. And, then, you have the E -7, which is more like the new plants where they have totally separated.

And we know in the operating fleet they have just a lot of barrier issues. They have addressed a lot of issues. But, still, some of the fundamental separation issues are still there. And that's okay. They do provide adequate protection, but

I cannot say that they have just separated everything and gotten to that other point.

So, that is the perspective I wanted to leave with. And with that kind of perspective, depending on the plant, and depending on the conservatism that plant has used in their fire PRA, I am not surprised with some of the results that NEI and EPRI presented with respect to the operating experience that was actual.

My main point is each plant is different. Depending on how much separation they have, how much modifications they have, how much lessons learned from Browns Ferry they have internalized in their plant, I might be at a different part of the spectrum.

And I just put Oconee there as another example. With Oconee, the staff told me the number is around 6E -5. Now Oconee has a very unique configuration. They have their switchgear in the turbine building and a lot of stuff. And they are 6E -5 after crediting a very expensive system they will install at the plant over the next couple of years. So, I'm not surprised by that number, too.

I just want to share that perspective and answer any questions the staff or the industry has on that.

CHAIRMAN STETKAR: I guess I'm not quite sure what to say. I'm not sure this has answered the questions that I had. I will come back to it is certainly true that there is variability in plant to plant on the plant configuration, the locations of hazards versus potentially risk-significant cables or equipment. So, you expect to see variability plant to plant.

Also, because certainly I haven't had the opportunity to look at any of the fire PRA studies that were referenced in the presentation yesterday and as a continuation of the presentation that we saw in November. But I'm not sure the level of maturity, for example, of those analyses, what refinements have been made to the particular studies that were used as a basis for comparison with operating experience, how much of the pencil-sharpening has been done, has much credit has been taken for, whether credit has been taken for newly-installed detection systems, et cetera. I just don't know that.

And that's why I'm not too interested in numerical precision. I'm interested in sort of ballpark accuracy, and the ballpark accuracy that was presented by the industry was that we should be seeing something on the order of a fire that induces some sort of spurious operation roughly once every couple of years.

And I will be as accurate as "a couple of". That might be every five or so-ish. It is probably not once every 100,000. It is probably not 10 times a year. But it should be across the industry somewhere in that ballpark of once every two to five to eight years. We are apparently not seeing that.

We should be seeing the frequency of fires that are estimated just looking at the damage of having a condition core damage probability on the order of 10 to the minus 4, and I will probably get these numbers wrong because I didn't look them up, but I'm not trying to be precise anyway. Sort of around kind of one a year or so maybe. It might be once every three or four years. It might be a couple of times a year, but in that sort of range.

In other words, if I look back over the industry operating experience over 20 years, for example, I would expect to see countable numbers of these events. I don't care whether it's one or three or eight. I ought to be seeing some numbers, not zero.

And the fact that we don't seem to have that operating experience, either countable numbers of events or, in the case of the ROP and ASP processes, events that are coming up above the regulatory radar to say, gee, here was a fire, and if I look at the damage from that fire, it is a potentially-challenging fire from a risk perspective because the conditional core damage probability for this particular plant is 10 to the minus 4 or perhaps higher. And again, 10 to the minus 4 ballpark, you know. We're not seeing that.

So, that was the genesis of the question of why aren't we seeing that. And it is a sense of, are we all in agreement now -- and this is something we are trying to get our hands on. It is, given the results of the fire PRAs -- and, granted, you have seen two now; ACRS has seen zero -- that are being developed to support the NFPA-805 transition, is there general agreement among the staff and the industry that the results of those fire PRAs are numerically conservative compared to the available operating experience that we have? Or is there a contention that, indeed, they are numerically-realistic? And what evidence do we have to support that?

I'm not trying to be very, very precise. And obviously, we can't use core damage frequency as a metric because I'm not going to hang around for another million years to wait for one or two of these things.

MR. WACHOWIAK: Well, John, if I may, you're the Chairman, and I'm just presenting facts. But if I go, you know, after the level of discussion on this topic, if I have tomorrow an event where the CCDP is .05 or .005, I hope it doesn't happen, but it can happen. With Browns Ferry, it has happened.

I think if you seem to look at the last 10 years, and say just because I didn't have these precursors operating over the last 10 years, therefore, my number just can't be anywhere near realistic, then I'm kind of saying I'm confident that it is in that 1E -7 per year.

I think what I am conveying to the Committee is that, if I look at the new generation where I have perfect separation, you may be there. And based on the last 10 years of experience that I have seen, and I am not limiting to the CCDPs or the ASPs, I'm using my personal knowledge of the licensing actions that come forward, the other events that get reported. There may be these numbers like, for example, Harry's. I think the number they reported is conservative, but I can't make a general statement and say everything out there is conservative.

I think when we get amendments after looking at how much they have sharpened the pencil, we can make a judgment. But I, sitting here, using my academic hat, I will not agree that just because we didn't see any events that are like Browns Ferry over the last 10 years, the number has to be in the -- you know, that's over-conservatism.

So, as a regulator, I am in a quagmire. I hear the industry's pleas that they are conservatisms and all that, but when I make that regulatory decision where I tell the plant, okay, you can use your fire PRA to self-approve changes, I am inclined to be a little bit more conservative than otherwise.

So, again, I apologize for being argumentative --

CHAIRMAN STETKAR: No, no, no.

DR. WEERAKKODY: -- but I think there's a flaw in that fundamental thinking where we jump in and look at a few concepts and say, hey, you know, this just can't be that high. That is all I am trying to convey.

MR. HARRISON: And I think, if I can step in and just say, back up to again the information that was presented in regards to Beaver Valley, the staff has not looked at all the seven plants that were used to derive the estimated frequency of events. I would say, if they are using the initial fire PRA screening model that Browns Ferry or Beaver Valley used to come up with 7.7 to the minus 3 for an area, I would expect the number to be higher.

If I do refine modeling and I drop it by nearly three orders of magnitude, then I would expect those numbers to be lower. So, it is somewhere in between those.

CHAIRMAN STETKAR: That is why I prefaced mine --

MR. HARRISON: Yes.

CHAIRMAN STETKAR: -- because I don't know. I only know what I hear orally in these meetings because we don't see and we haven't been presented with very many details from either the staff or the industry, quite honestly.

MEMBER BLEY: On actual PRAs.

CHAIRMAN STETKAR: On actual PRAs with actual contributors. Every time we ask people, we get genericized. And that's fine. If that's the available information that we have for us to write our report, that is the available information that we have. I hate to say that, but --

DR. WEERAKKODY: Well, we could speak to

this adding on, with Harris and Oconee we could be specific. We don't have any more data.

MR. HARRISON: Yes. And again, the variability is also within the licensee's modeling of their plant because, if it is a high-risk area, they are going to do more refined modeling. That will bring those down.

There's variability across how the analysis is done. I guess from our perspective, we can't really give you an answer, but we believe the numbers are not --

CHAIRMAN STETKAR: But again, talking -- and Doug is standing up; he will get his chance -- the industry I think, as I understand the information that was presented to us, tried in a sense to normalize out a bit of that. Certainly took away the notion of core damage frequency because that is obviously something that you can't measure from operating experience yet.

It was my understanding -- and I think Doug probably wants to add some information -- that the results that we were seeing were probably not the initial fire screening model. They may be, it's my impression they are probably a mixed bag of some fairly detailed in some locations and less detailed in other locations, but they led to some amount of refinement.

But we don't know how much that is. We certainly don't. You do on Harris and Oconee.

DR. WEERAKKODY: We do not have --

CHAIRMAN STETKAR: We don't know that on Harris and Oconee because we haven't seen, either from the industry or from the staff, Harris or Oconee.

MEMBER BLEY: Have you seen any of the other PRAs yet or just those two?

MR. HARRISON: Just those two.

MEMBER BLEY: Okay.

CHAIRMAN STETKAR: So, we are going to have to leave it there, I think.

Doug, now it's your turn.

MR. TRUE: Okay. I just wanted to add a few things for clarity's sake.

One was we stay away from talking about total CDFs entirely in the report.

CHAIRMAN STETKAR: Yes. Sure.

MR. TRUE: We made some general references to the fact that risks were higher than we expected, but we tried to get to things we could actually look at that were traceable to operating experience. Because it is very difficult to make extrapolations --

CHAIRMAN STETKAR: Right.

MR. TRUE: -- at the CDF level.

And the second thing is that I used, in one figure I used plant 1 through 7. In one table, I used plant A, B, C, D. And in other plants I used X and Y. That was intentional, so there wasn't any trackability between those.

CHAIRMAN STETKAR: Sure. Sure.

MR. TRUE: In terms of relevance to operating experience, all of the five CCDP examples we provided were PRAs that were very well along the path, basically done.

And both of the pilots were included in that table. I didn't identify them, but they were both included in the table.

CHAIRMAN STETKAR: That is important Okay.

MR. TRUE: The second thing is, or maybe I don't know, the end thing is, that they were done by different vendors. We had some input from ScienTech. We had some interim studies. We had the pilot studies. So, we were trying to make sure we were getting a reasonable sampling of these reasonably-complete PRAs.

The one place where I have somewhat of a regret is that there is a little bit of a mixture in that list that some of the plants, like the pilot results, were all based on post-mod CDFs. So, they reflect the post-transition CDFs, not pre-transition. And if you are going to compare it to the operating experience, you really have to be looking at pre-transition.

So, if anything, by taking credit for those mods in those models -- and it wasn't only the pilots in the list of five; there was one other plant that had the mods incorporated in the model -- those CCDPs would be expected to be lower. The frequency of the high CCDPs would be expected to be lower because they have made modifications.

So, I think we tried to be really, really fair in what we provided in that operating experience comparison and, if anything, err on the side of giving the benefit of the doubt to the post-mods and well-developed PRAs.

Probably I didn't articulate, I certainly didn't articulate all that in the model or in the report, but just for the record, it is worth knowing those facts because it does maybe flavor the way you look at those.

CHAIRMAN STETKAR: Yes, and I appreciate that, those insights. Also, my own personal observation is I think we have heard -- I don't remember whether it was Dave or Dan yesterday who made the statement that, well, you do enough analysis refinement in your PRA for your particular purpose.

Certainly, for the Harris and Oconee purpose right now, that is to justify transition to the new licensing basis. That may not be to develop a perfect estimate of core damage frequency for every location. So, therefore, you know, there may be residual conservatisms even in those analyses and the analyses that include credit for the incipient detection system, at least at Harris. That is the only one I know about.

But other parts of the plant may have not refined the analyses that far. So, you know, there's pluses and minuses in any case. And I think, until you actually look at some of the details of the studies objectively, it is difficult to be very, very precise about those numbers. You certainly cannot be very precise about the numbers without a lot of work.

That being said, the numbers that are being presented, at least in this forum, are not in the 10 to the minus 2 event per year kind of range where you could argue that, well, we certainly shouldn't have seen any, or in the last 10 years we wouldn't expect to see one. They are in the couple of events per year, depending on how you cut that data.

And even within 10 years, you would expect to see a few of them, maybe a couple of them. And I guess we will just leave it at that.

MR. TRUE: Yes.

CHAIRMAN STETKAR: I don't see us coming to any -- I think the discussion has helped. I don't think we have a clear-cut answer from our perspective.

MEMBER SHACK: Which you're not particularly shocked to find that the fire PRA, the current state-of-the-art, when you are not explicitly considering uncertainties, you come up with somewhat conservative answers.

CHAIRMAN STETKAR: No. I mean I am personally not shocked to hear that. I actually personally are more concerned about what the implication, if that's true, if everyone agrees that the results are conservative, I am more concerned about what the implications of that conservatism are going forward.

I mean recognizing that people who have committed or announced their intention to transition to NFPA-805 have done that for a variety of reasons that we don't need to go into as an ACRS Subcommittee, they will probably do enough analyses to justify acceptability of the PRA for that transition.

A lot of the concerns that I hear about conservatism seem to be based on what's done with that PRA going forward after that fact. So, I am not quite sure yet how to think about this snapshot that we have of the PRAs and what might be numerical conservatism in those results.

Dennis?

MEMBER BLEY: Is this our final one?

CHAIRMAN STETKAR: No, no, no. No, it isn't.

MEMBER BLEY: Nothing especially convincing has crossed my way here.

CHAIRMAN STETKAR: I think this transitions a bit into, I think, probably --

DR. WEERAKKODY: The next topic?

CHAIRMAN STETKAR: Yes.

DR. WEERAKKODY: This was your request because I stated in my opening remark that, I made the statement that, with respect to the Commission SRM, I geared my opening or the management remarks to say that the current state of five PRAs are adequate for NRR to do its job, which is to receive and issue the SCs with respect to the 805.

And, then, John mentioned, hey, you know, let's talk about some of the other implications. So, I kind of did a little bit of different setup because this is kind of like more, I suppose, some of the presentations we give where we think a lot, prepare a lot.

I said to Donnie here, "Let's create a slide that has all these other implications." And I said to Donnie, "Let's have in the audience his staff who are most cognizant of these different implications." And I told the staff members, "Let's not argue whether or not five PRAs are conservative. Let's agree that they are conservative by a factor of two or three, and then let's tell John and this Committee what is the implication of that kind of conservatism on other applications."

So, it is basically let's go to the next slide.

I listed some of the applications or use of PRA here. We may have a case here where -- you know, hopefully, all the staff is here, but the 50.65 Maintenance Rule, Donnie, did you want to say anything? Or I can follow that. Or do you want to have one of your staff?

MR. HARRISON: Yes. Under the Maintenance

Rule, right now, to do the A-4 analysis for the Maintenance Rule, that can be done qualitatively. So, you can look at the configuration of your plant and address it using either the onsite tools, the licensee can do that, and make qualitative considerations.

I know there's ongoing discussions on the use of fire risk in the Maintenance Rule. And that is an ongoing activity, ongoing discussion topic.

But, again, with the Maintenance Rule, you can make those assessments qualitatively. So, conservatism in your fire PRA may inform a licensee. It may result in them potentially taking additional compensatory measures in response to a maintenance activity. I don't see that as something driving them to drastic changes as far as addressing the fire risk associated with 50.65 Maintenance Rule.

DR. WEERAKKODY: Yes, if I may add, Biff has a lot of knowledge in this area of where the NRC, the Commission, and the industry had deliberation over several years with respect to what is the regulatory requirement with respect to fire risk and in the Maintenance Rule. We came to a place where we said the regulatory requirement, well, we basically said -- Biff, why don't you? You are as knowledgeable as I am on the resolution.

MR. BRADLEY: We are about to submit a revision to NUMARC-9301 that will include fire risk consideration into A4. It is explicitly qualitative. It does give you the option to use PRA, but it is qualitative guidance.

Our initial indications are the staff accepts that concept. As always, these things are more complicated than they sound, and we could spend all day just discussing how this could impact 50.65, and we are running out of time.

But I would just note that the NRC's inspection procedure does quantify the delta, and I suspect having a fire PRA lurking at your plant would certainly beg the question. Whether you have done this quantitatively or not, if there is an inspection issue, someone is going to ask the question, run the number, and let's use that to inform the outcome of the inspection.

So, it is more of an ROP issue, I think, to me than a 60.65 issue. We have gone to great lengths to make that qualitative because of the very things we have been talking about here. And this is a comparative evaluation where you are looking at internal events versus fire. You have a finite number of risk management actions, and if your fire number dwarfs out internal events, you are not going to be doing internal events risk management actions anymore. That is the concern we have there and why we went to lengths to make it qualitative.

MR. HARRISON: Yes, and addressing that particular one, and that applies also to 10 CFR, like what's done on 10 CFR 50.69, which is lower on this list. Instead of looking at it as an "either/or", if fire risk gets too big, and I don't do anything for my internal events hazards because the fire risk is so big, that is an "either/or" approach. It is really a "both/and".

You look at what's driving the risk in a certain area. You address it if it is a fire risk. If it has still got internal event impacts, you address those, too.

So, you may end up with, again, additional fire compensatory measures on top of what you do already right now for the internal events considerations. So, a slightly different perspective, but, again, that plays out also in how we approach 50.69, where it explicitly addresses it that way. You have an integrated assessment of the importance, and, then, you have the individual hazard assessments of importance.

DR. WEERAKKODY: Let me just introduce Steve Dinsmore, and, then, let's ask him to talk about the next topic. Steve Dinsmore has been the champion or the key staff member in NRR on the risk-informed ISI.

One of the things I do want to say is that, when I look at these applications, John, I ask the question, if the five PRAs are conservative, am I causing the licensees to take actions adverse to safety? That's my threshold.

With that, Steve, can you speak about whatever you know about fire PRA implications?

MR. DINSMORE: Yes, this is Steve Dinsmore from the NRR staff.

Well, the short answer is risk ISI looks at weld failures, and weld failures don't cause fires. They cause floods. Fires don't usually cause weld failures.

There's some transients that could be induced by fire, which could indirectly cause loads on welds, which could cause the weld to fail, but those are not any specific differences between the internal events and the external events.

As long as you are doing an absolute change in risk estimate, I think the conservative fire calculations will never push you in the wrong direction. They might not give you as much relief as you would like, but they won't give you an unsafe answer.

It is only when you do relative types of calculations that the fire thing could really perturb. So, ISIs, it doesn't have any effect on the ISI.

DR. WEERAKKODY: Is Andy Howard in the audience?

MR. HOWARD: Yes.

DR. WEERAKKODY: All right. Andy, could you come up here and speak to tech spec 5(b) initiative and tech spec 4(b) initiative, and share your --

MR. HOWARD: Yes.

DR. WEERAKKODY: Okay. I'm taking a risk here by asking Andy to come and speak here, but --

(Laughter.)

MR. HOWARD: I guess you're ignoring NOEDs? That was next on your list.

Risk-informed tech spec initiative 5(b) is the surveillance frequency extension licensee control. It specifically provides for the use of a high-quality internal events PRA, but fire, seismic, other external events, shutdown risk, other hazard groups, can be handled by IPEEE-level analyses and insights or even qualitative insights. So, that has been specifically carved that.

You can use a fire PRA for surveillance frequency extensions under this program. If you have one and you so choose, that is perfectly acceptable, but it is not a mandate. So, conservative fire PRAs would have no impact on 5(b), as far as I can tell.

DR. WEERAKKODY: And how many are under review or have we issued on 5(b), Andy?

MR. HOWARD: How many have we issued?

DR. WEERAKKODY: Issued or under review right now?

MR. HOWARD: About 33 plants, so about a third of the industry is submitted or it is in the pipeline. We expect pretty close to 100 percent within a decade or so.

Tech spec initiative 4(b) is the flexible AOT program. There a fire, a quantitative treatment of fire is required since the standard has now been issued and is in effect, a PRA has been assessed against the standard and meets category II as required.

So, a conservative fire PRA will impact the allowed outage times. And I have given this a little thought since I was told I might be asked to speak about this.

And I don't want to seem hesitant, but I think I have to be a little careful what I say here. In the limiting case of a conservative fire PRA, where I say I'll assume, if I have a fire in the plant, it goes straight to core damage, it would be very non-conservative because the AOT would not be affected. The baseline and any delta would not be affected by out-of-service equipment.

Obviously, we don't have fire PRAs that are quite that conservative. I am sure even Biff Bradley would agree that we're not quite that bad, I think.

(Laughter.)

On the other hand, if you have a perfect fire PRA, whatever "perfect" means, then you get an accurate AOT calculation. We are somewhere in between.

I really don't have any knowledge to know whether the shape of that, if you go to the level of conservatism on one axes and what my delta CDF would be on the other, I don't know if initially conservatism is good because it makes things more conservative, and, then, right at the very end it becomes, you know, non-conservative or what it does. So, I really don't know.

That will be part when and if 4(b) applications come in prior to us correcting this problem that we are dealing with today. That will be the subject of a licensing action. We will explore that. We will look at it. And if it is non-conservative, we will make appropriate adjustments before we approve the amendment. So, it will be a challenge.

MR. BRADLEY: I just wanted to add a quick note on that, since Andy invoked my name.

I think for the calculation of the completion time, you know, conservatism is just going to limit the duration. So, where you might have a 30-day, it might be less.

Again, 4(b) is like 50.65 in that there's a risk management action component. It is not just in the AOT. It is also establish actions to compensate for the risk. So, again, that is where I would have a little more concern with the use of a conservative fire PRA. I think you would have to temper that judgment that, well, I can't really have 95 percent of all my risk management is fire-related. It is sort of like what Danny said yesterday, you know. So, you have to take that into consideration.

I do believe that I am a big 4(b) fan, and I think we can make this work. This is one that would greatly benefit from our interim improvements in our next year's worth of work to start closing the gap toward realism.

Plants, other than STP, which has minimal fire risk to start with, aren't going to be implementing this for another couple of years. We have one pilot in the pipeline. So, we have some time to try to address this.

This is an issue for 4(b). It is a real issue for 4(b) that I don't want to downplay that.

CHAIRMAN STETKAR: Yes, yes. Okay.

MR. HOWARD: Just in closing, though, I should identify myself. I'm Andrew Howard with the NRR staff, just for the transcript.

CHAIRMAN STETKAR: Thank you.

MR. HOWARD: But, in the event we do get licensing actions on 4(b) again before the fire PRAs are considered accurate, that will be part of the consideration that we make as far as the licensing review. We are not going to license it and say, you know, the fire risk swamps it all. We are going to do something to make sure those insights can come through for the internal events there. I feel like we can handle it.

DR. WEERAKKODY: Can one of your staff speak to NOEDs? I can't think of --

MR. HARRISON: Yes. You want to speak to NOEDs?

DR. WEERAKKODY: Yes, yes.

MR. HARRISON: Well, you volunteered when you walked up. Actually, the staff is not here that typically does NOEDs, but go ahead.

CHAIRMAN STETKAR: That's okay. We can probably skip that.

MR. HARRISON: Okay.

CHAIRMAN STETKAR: You can explain to me what it is.

(Laughter.)

MR. HARRISON: Notice of Enforcement Discretion. So, a licensee finds itself in a place where it's going to violate the tech spec --

CHAIRMAN STETKAR: Okay. Yes, we know.

DR. WEERAKKODY: Again, I don't want to go through the whole list.

CHAIRMAN STETKAR: No, no, no, no.

DR. WEERAKKODY: If you have any questions, we can speak to them. Now, with respect to

ROP, Biff --

MR. BRADLEY: You are going to get to the same thing I was. I would say, by far and away, my biggest concern with that list is ROP.

CHAIRMAN STETKAR: Okay.

MR. BRADLEY: You are not dealing -- you know, you have SRAs; you've got some great PRA people in the Regions, but you are dealing with a lot of inspectors out there. This is going to be viewed as a target-rich area to color your findings.

And let's not kid ourselves. I mean we do need -- that is one that is really a concern for me.

CHAIRMAN STETKAR: Okay.

MR. HARRISON: And I would agree, if you have an overly-conservative fire PRA and you have a finding, you could exaggerate the finding to make it bigger than it really was. So, realism is needed there. I think if we stepped back and went to the actual purpose of the ROP and the SEP process, it would lessen the effect of that. But the intent of that program and its actual impact are two different things. So, it is worth consideration.

CHAIRMAN STETKAR: Okay.

DR. WEERAKKODY: Yes, the one note there I would add is based on what I have seen in the ROP experience. When a licensee is about to get a yellow or a red, at that time a lot of resources are applied to address that plant-specific -- you know, here we are discussing, what is the plant-specific concern? And the resources do flow into address the plant-specific concerns in that area.

But I do agree with Biff and Donnie; that is an area that you need to watch if we have highly-conservative fire PRAs.

MR. HARRISON: And I would say it is even important for white findings. So, the resources to start to go exponentially.

CHAIRMAN STETKAR: Yes, I think the message is pretty clear there, yes.

MR. WACHOWIAK: And just to amplify, this is Rick Wachowiak from EPRI.

There are also some things in the guidance, like in the FAQs, that sometimes it was the right thing to do for the FAQ. Because I am writing this interim position to get transition to 805. So, for the frequencies, the staff wasn't quite sure about the trend in frequencies. So, for transition, they said let's go ahead and look at other fire compensatory measures, if they make a difference.

I have heard at least one piece of

anecdotal evidence where in the field it is being said, if you do that sensitivity on an STP, then that FAQ says you have to bump it to the next color.

MR. HARRISON: And that's where maybe the staff needs to provide additional guidance, where the FAQ process was an NFPA-805 FAQ process. It was not a generic fire PRA methodology piece.

So, some things were done in the context of enabling 805 applications.

CHAIRMAN STETKAR: Yes, I think that came across relatively clear in the discussion earlier this afternoon.

MR. HARRISON: And it may have been clear here. It is just I think the point you are making is, if you get into an STP or an ROP process, that may not be clear to everyone that is involved in that process. So, we need to make that clear.

CHAIRMAN STETKAR: Sure.

MR. HARRISON: Steve Laur?

MR. LAUR: Steve Laur, NRC staff.

I just want to make one observation. I am not an ROP expert in any sense of the word. But if you had a performance deficiency involving, for instance, a barrier or separation, a variance from the deterministic requirements that you somehow missed during your transition, those are likely from the fire PRA, even the potentially conservative fire PRAs, to be felt to be negligible delta risk.

And I say that based on two pilots that identified a number of variances from deterministic requirements that they wanted to keep by using the performance-based methods, and they were able to show delta risk numbers that were well within the Reg Guide 1.174 numbers and allow the staff to approve the Harris one and still review the Oconee one.

CHAIRMAN STETKAR: Okay. Thank you.

DR. WEERAKKODY: I put that bullet on the last bullet there because it is an issue that is of interest. I'm not going to speak to that. I'm not a licensee. But to the extent the licensee's senior executives are driven by PRAs with respect to resource allocation, that can have an implication. I do acknowledge that.

So, it is just an acknowledgment, and I don't know what the plants do today. I know what they did 20 years ago.

MR. HARRISON: Well, and in the context of the two pilots, modifications were proposed and are being implemented as a result of having fire risk numbers that were too high for certain areas. So, to offset that fire risk, they have implemented modifications.

So, I mean, at least from the two pilots, that comes into play as the resources for making safety improvements. From a regulator's standpoint, the plant got safer. It is hard for us to argue against that.

But it is an issue that the industry -- and we have heard this a number of times from the industry -- of allocating resources and making the right fixes. An overly-conservative fire PRA would potentially drive you to make modifications that make the plant better, but maybe not be the best modifications you could make.

CHAIRMAN STETKAR: Yes, the most optimal mix.

MR. DINSMORE: This is Steve Dinsmore from the staff.

Could I just add that we have discussed, when we were looking at Oconee, we discussed whether these conservatisms could inappropriately perturb the results, the conclusions. We went through and we were looking at, well, conservatisms don't affect the change in risk calculations, and those that do, we came to the conclusion that any conservatisms that are in there would be conservative in the change of risk calculation.

I guess if industry doesn't think that is the case, we would be very interested in knowing that because we would need that information to go further on the upcoming submittal.

CHAIRMAN STETKAR: Okay.

DR. WEERAKKODY: Okay?

CHAIRMAN STETKAR: Good.

It is 4:42, and I think we have just about run our course on the presentations.

First of all, I would like to thank everybody. This has been a rather grueling two-day session. I think everyone has been very, very responsive, both to the issues that were raised from the November Subcommittee meeting. I think we understand much more about some of the topics that were raised at that.

I really thank all the effort that was put in, both from the industry, everybody involved, and the staff, to be responsive, and, also, the work that you have done over the last couple of days to kind of respond to questions on the fly. We really, really appreciate that because, as you understand, we also are under some time pressure.

So, again, thanks to everyone for your presentations and your responsiveness.

I don't know if we have any members of the public here. I don't see any, but I always have to ask whether anyone --

MEMBER SHACK: There are members of the public.

CHAIRMAN STETKAR: -- wants to add any comments.

John, I don't know if there is anyone on the phone. If we can open up the bridge line just in case there is someone listening who would like to make a comment?

This is always a somewhat curious activity because we don't really know whether there's anyone out there.

(Laughter.)

Okay. Are there any members of the public who would like to make a comment or have anything to add to the proceedings here?

Hearing nothing, I'm assuming the answer is no. So, thank you.

And as a last item, what I would like to do is, for the remaining Members who are here, is there anything else that you need, questions you would like to add?

No? Okay, thank you.

Just for the record, before we close out the meeting, the process going forward here is that we are a Subcommittee. We are not the ACRS. The Subcommittee will write a report sometime during the next three weeks or so, submit that report to the full Committee, basically, summarizing the process that we have gone through, perhaps some draft conclusions and recommendations.

The full Committee will have somewhere on the order of three or four weeks to consider that report. We will have a full Committee meeting in February, where we are expecting to have some input from both the industry and staff on highlights of some of the most important issues. Because, again, we are limited in time in the full Committee meetings to probably an hour and a half or two hours. I don't know whether we have the agenda yet.

But what I would like to hear is a synopsis of only the most important issues from both the staff and the industry at that full Committee meeting. I don't want to presuppose what those are. I think we have had adequate discussion over the last couple of days. Perhaps we might have more dialog through John over the next two months or month and a half to identify those.

And, then, in the February full Committee meeting, the Committee will, then, draft a letter report to the full Commission in response to the SRM that will have the full Committee's conclusions and any recommendations that we might make to the Commission.

So, that is sort of the process and the time schedule. The SRM calls for our report to be submitted by the end of February. That's why we need to close out that process in our full Committee meeting in February.

MR. BRADLEY: Is there a date set for that? A date set?

CHAIRMAN STETKAR: For our submittal of --

MR. BRADLEY: The full Committee?

CHAIRMAN STETKAR: Yes, it is.

MEMBER SHACK: The agenda -- I mean we know the dates of the meeting.

CHAIRMAN STETKAR: We know the dates of the meeting. We don't know the specific -- we don't have the agenda for a specific day, but it is, most probably, the first day of the meeting, which would be Wednesday of what looks like the second week in

February. I can't remember. It would be about the --

MEMBER BLEY: The 10th.

CHAIRMAN STETKAR: The 10th or so? Yes.

MEMBER BLEY: The 10th is a Thursday. So, it would be either Thursday or Friday.

CHAIRMAN STETKAR: It would be either Thursday or Friday of that week. And typically, we like to get the important things in on the first day. So, I would guess it will be on the 10th.

Anyway, with that, unless there are other comments by anyone?

MEMBER BLEY: I would just like to reiterate what you said and thank everybody. The presentations were exceptionally good and I learned a lot. My questions have narrowed a lot.

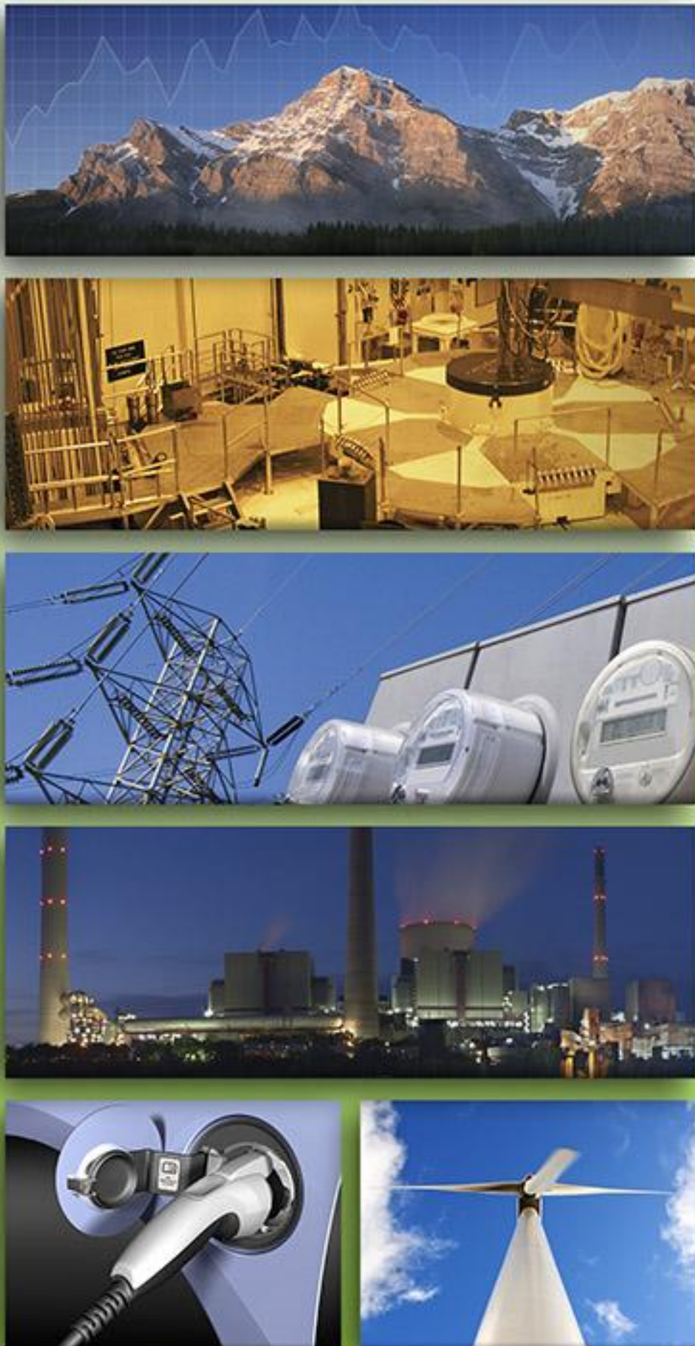
CHAIRMAN STETKAR: Good.

MEMBER SHACK: I'll echo that. I mean it was a tremendous presentation from everybody.

CHAIRMAN STETKAR: And again, thank you all.

And we are adjourned.

(Whereupon, at 4:48 p.m., the proceedings in the above-entitled matter were adjourned.)



Electrical Cabinet Fires

Rick Wachowiak, EPRI
Doug True, ERIN Engineering & Research

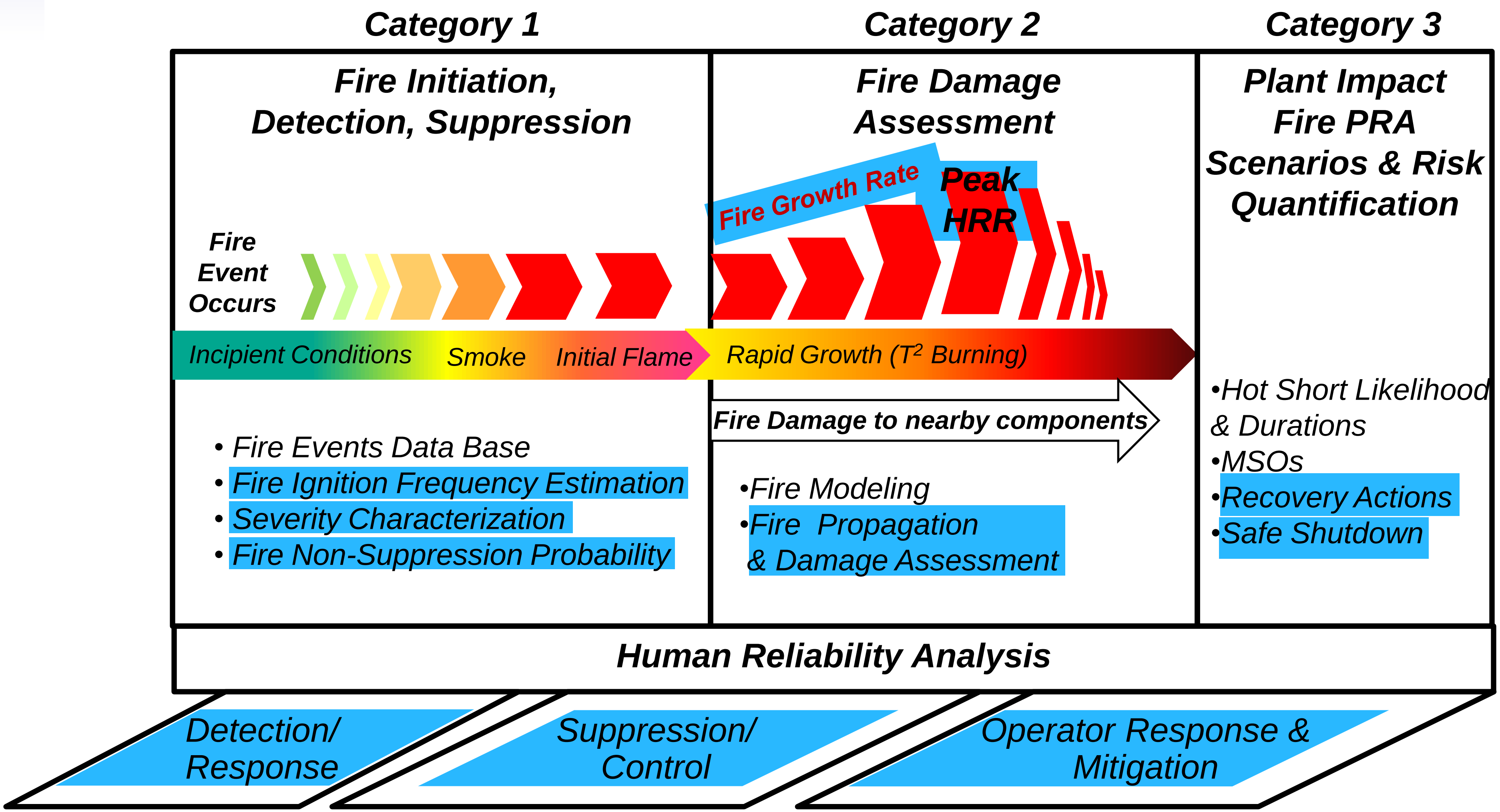
ACRS PRASC
December 14, 2010

Background

- As described in Nov. 16, 2011 ACRS PRASC presentation, electrical cabinet fires are a significant contributor to fire CDFs computed using NUREG/CR-6850/EPRI 1011989

- Purpose:
  - Elaborate on the relationship of the prescribed methods for modeling electrical cabinet fires to large risk contribution
  - Describe how EPRI's near term research activities target some of these areas

FPRA Issues Framework



Technical Areas to be Discussed

- Fire Ignition Frequency Estimation
- Fire Growth Rate
- Peak Heat Release Rate
- Fire Non-Suppression Probability
- Fire Propagation & Damage Assessment
- Operator Response Actions

Fire Ignition Frequency Estimation

- Ignition Source Bin 15 addresses electrical cabinet fires
  - Excludes high energy arcing faults (Bin 16a & 16b)

Source	Number of Events	Bin 15 Plant-wide Ignition Frequency
NUREG/CR-6850	109	4.5E-2/yr
EPRI 1016735	1968-1990: 74[1] 1991-2000: 24.5	2.4E-2/yr

- EPRI detected plant-to-plant variability in Bin 15
- A more diffuse prior distribution consistent with those from NUREG/CR-6850 was used and a hierarchical Bayesian analysis was performed. The result was a more broad uncertainty in the Bin 15 estimate.

1 - Excluded some pre-operational events and other data cleanup

Fire Ignition Frequency Estimation (Cont.)

- FAQ 08-0048 requires use of <u>both</u> frequencies for baseline risk and delta risk calculations because of:

  "…*the large uncertainty in the bin fire frequency due to the sparsity of data for that bin and, therefore, the potential for significant changes should the post-2000 fire event data differ significantly from the 1991-2000 data.*"
  (See note 1, pg 2 of FAQ 08-0048; note 10, page 10-2 of NUREG/CR-6850, Supplement 1)
- Bin 15 actually has the most data of any ignition source bin
- The larger uncertainty exists to support a more appropriate plant-specific Bayesian update of the frequency

A factor of 2 increase in CDF for Bin 15

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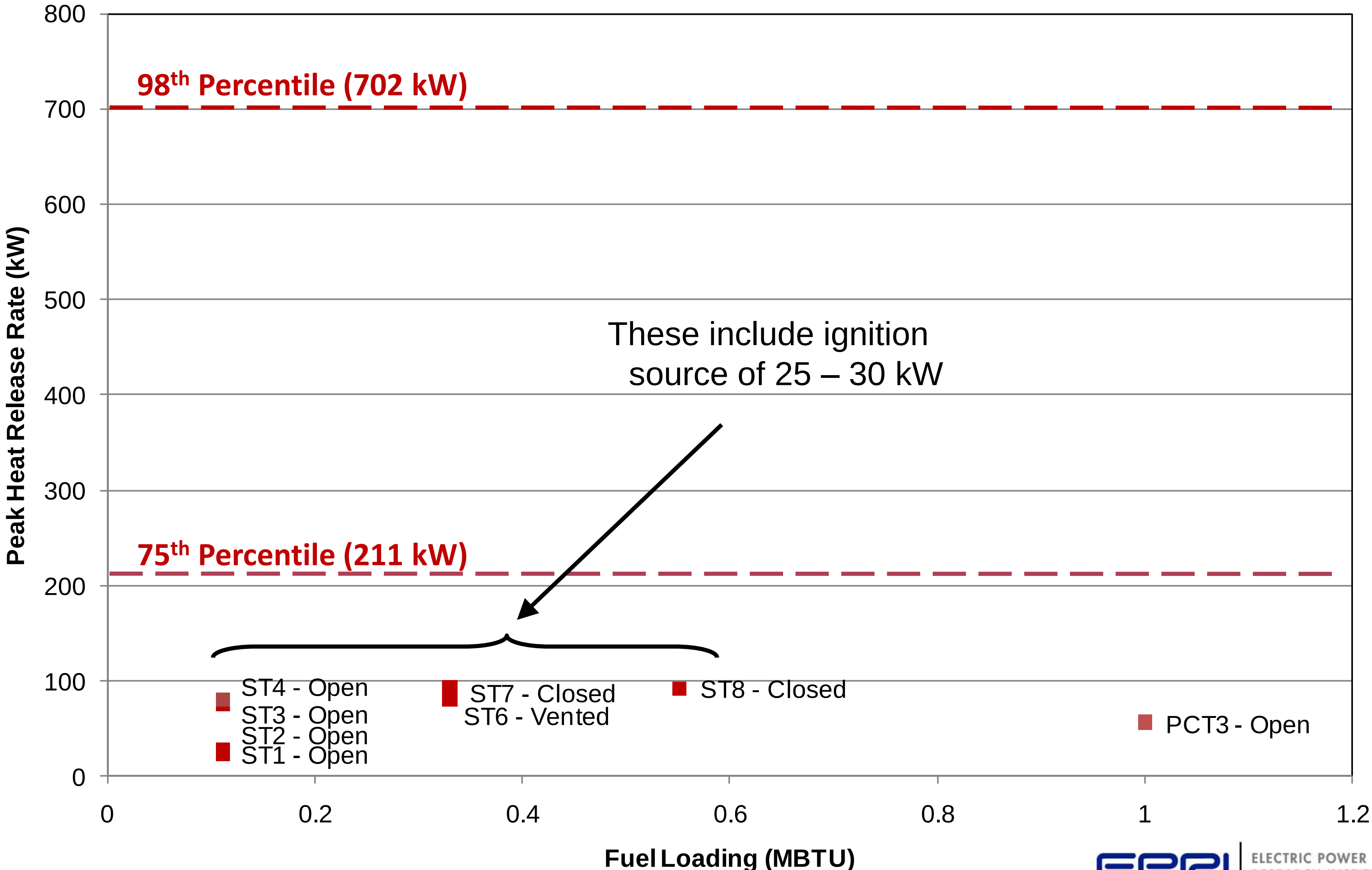
Severity Characterization

- Fire growth and peak heat release rate (HRR) based on tests investigating large electrical cabinet fires
  - Many used accelerants or flame sources
  - Qualified and unqualified cable data comingled
  - Open cabinets
- A small number of “sub-bins” used to define peak HRR
- HRR distribution anchored to two key percentiles to characterize HRR distributions: 75th and 98th percentile
  - 98% selected to “*establish an anticipated “high-confidence” fire intensity value expected to bound the vast majority of fires involving a given fire source.*”
- No evidence that these postulated fires, even at the 75th percentile, are consistent with operating experience

Vertical Cabinet Test Results (NUREG/CR-4527)
(Qualified Cable)



Severity Characterization (Cont.)

- Fire growth rate based on same tests and are influenced by the same factors:
  - Use of accelerants or flame sources
  - Qualified and unqualified cable data comingled
  - Open cabinets
- No evidence that these growth rates fires are consistent with operating experience
- Greatly influences damage magnitude and the timeline for damage/operator response

Result is faster and greater damage due to inability to suppress fire and exaggerated zone of influence

Fire Non-Suppression Probability

- The vast majority of electrical cabinet fires in the FEDB are manually suppressed, i.e., no automatic suppression occurs
- Very few (non-HEAF) electrical cabinet fires result in damage to nearby SSCs
- FAQ 08-0050 provided improved credit for manual suppression
- Combination of assumed rapid fire growth rate (12 min) and limited suppression credit leads to higher probability of damage
- No consideration of control vs. suppression

Fire Propagation & Damage Assessment

- FAQ 08-0042 addressed fire propagation outside of "well sealed" cabinets
- Probabilistic treatment of fire propagation within cabinets, e.g., MCCs, removed from originally submitted FAQ 08-0042 in order to expedite closure
- Thus, all MCC fires are treated as damaging entire cabinet
- This increases the level of damage and adds to the fires causing spurious operations

Operator Response Actions

- Rapid growth of large fires propagating within and outside of electrical cabinets reduces the available time for operator response actions
- Examples include response to failure to operate due to assume fire damage (e.g., valves fail to open/close) and spuriously operated valves
- These damage timelines can result in unrealistic human error probabilities driven by the unrealistic fire damage assumptions

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The Bottom Line

- Compounding of conservatisms leads to unrealistic estimates of risk from electrical cabinet fires
  - Frequency of fires artificially overstated by continued reliance on original values
  - Assumed fire growth rates do not comport with operating experience
  - Damage does not comport with operating experience
- FAQs helped in some areas, but fell short in providing realistic methods and inputs

Related Near-term EPRI Research

- Update of FEDB will provide improved basis for:
  - Ignition frequencies
  - Manual suppression
  - Fire growth
  - Fire damage
- Refined binning structure for electrical cabinet peak HRRs will provide improved basis for:
  - Peak HHRs for different cabinet types
  - Allow more realistic fire damage zones

Vertical Electrical Cabinet Heat Release Rate

- Purpose of study: Re-evaluate the heat release rates (HRRs) of cabinet fires recommended for use in NUREG/CR-6850 (Table G-1)

Ignition Source	HRR kW (Btu/s)		Gamma Distribution	
	75th	98th	α	β
Vertical cabinets with qualified cable, fire limited to one cable bundle	69 (65)	211 (200)	0.84 (0.83)	59.3 (56.6)
Vertical cabinets with qualified cable, fire in more than one cable bundle	211 (200)	702 (665)	0.7 (0.7)	216 (204)
Vertical cabinets with unqualified cable, fire limited to one cable bundle	90 (85)	211 (200)	1.6 (1.6)	41.5 (39.5)
Vertical cabinets with unqualified cable, fire in more than one cable bundle closed doors	232 (220)	464 (440)	2.6 (2.6)	67.8 (64.3)
Vertical cabinets with unqualified cable, fire in more than one cable bundle open doors	232 (220)	1002 (950)	0.46 (0.45)	386 (366)

- Scope limited to:
  - Vertical cabinets
  - No consideration of external influences, or of fire propagation to other cabinets
  - No consideration of fire duration

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Vertical Electrical Cabinet Heat Release rate *Comparison with NUREG/CR-6850*

- Model maintains distinction between qualified-initiated fires and other fires: Qualified-initiated fires account for probability that fire may stay localized
- Model adds refinements and thus more inputs needed than in NUREG/CR-6850:
  - If not ventilation-limited: HRR dependent on combustible loading. Combustible loading estimated based on:
    - Cabinet volume
    - Estimate of cabinet fullness (low/high loading).
  - If ventilation-limited: HRR controlled by amount of air available for combustion.
    - Determination on whether cabinet is cooled by forced or natural ventilation
    - Assessment of robustness regarding gap potential
    - Need to know vent area and position of vents (top, bottom, or vents at intermediate level)
  - EPRI model uses a flowchart to guide fire analyst to proper ventilation model
    - Open-door cabinet fires are not ventilation-limited
    - Closed-door cabinet fires may or not be ventilation-limited based on air flow within cabinet

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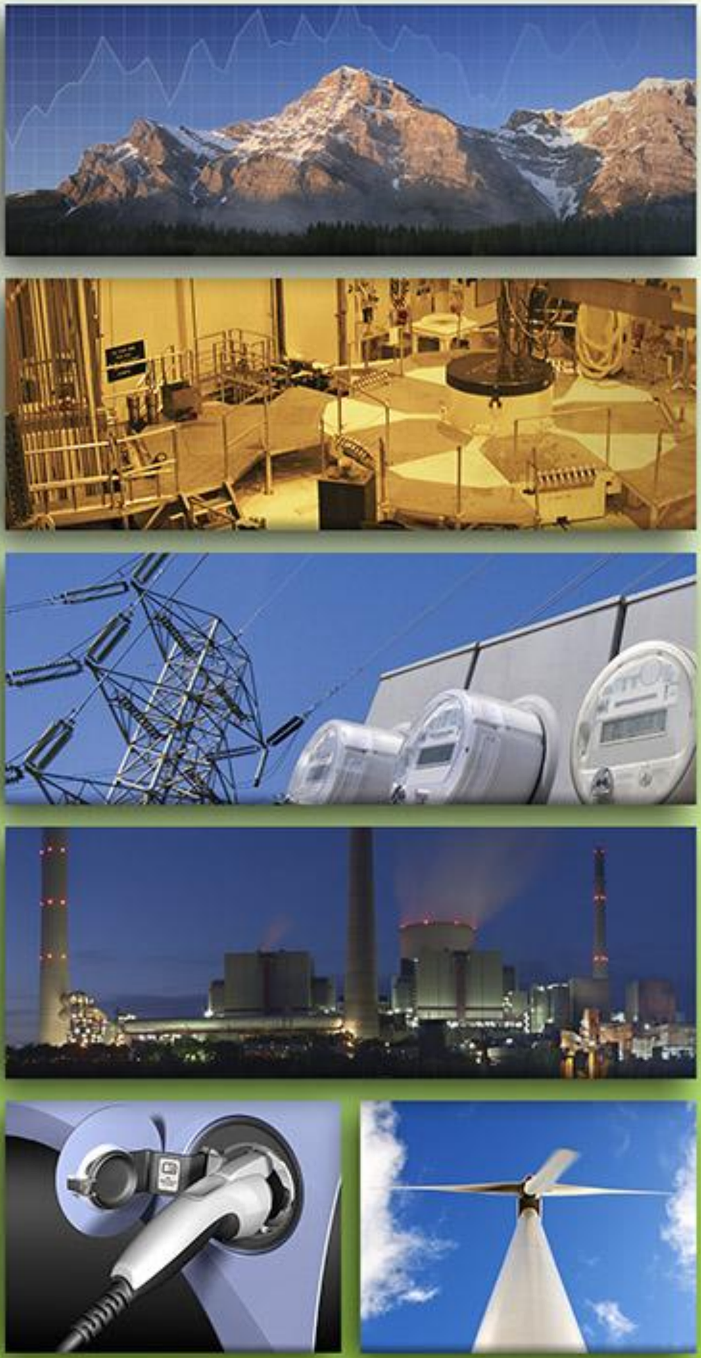
Summary: Near-term EPRI Work to Address Electrical Cabinet Issues

Technical Area	FEDB	HRR
Fire Ignition Frequency Estimation	Directly	---
Fire Growth Rate	Indirectly	Indirectly
Peak Heat Release Rates	---	Directly
Fire Non-Suppression Probability	Directly	---
Fire Propagation & Damage Assessment	Indirectly	Directly
Operator Response Actions	---	Indirectly

Together…Shaping the Future of Electricity



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Roadmap For Attaining Realism In Fire PRAs

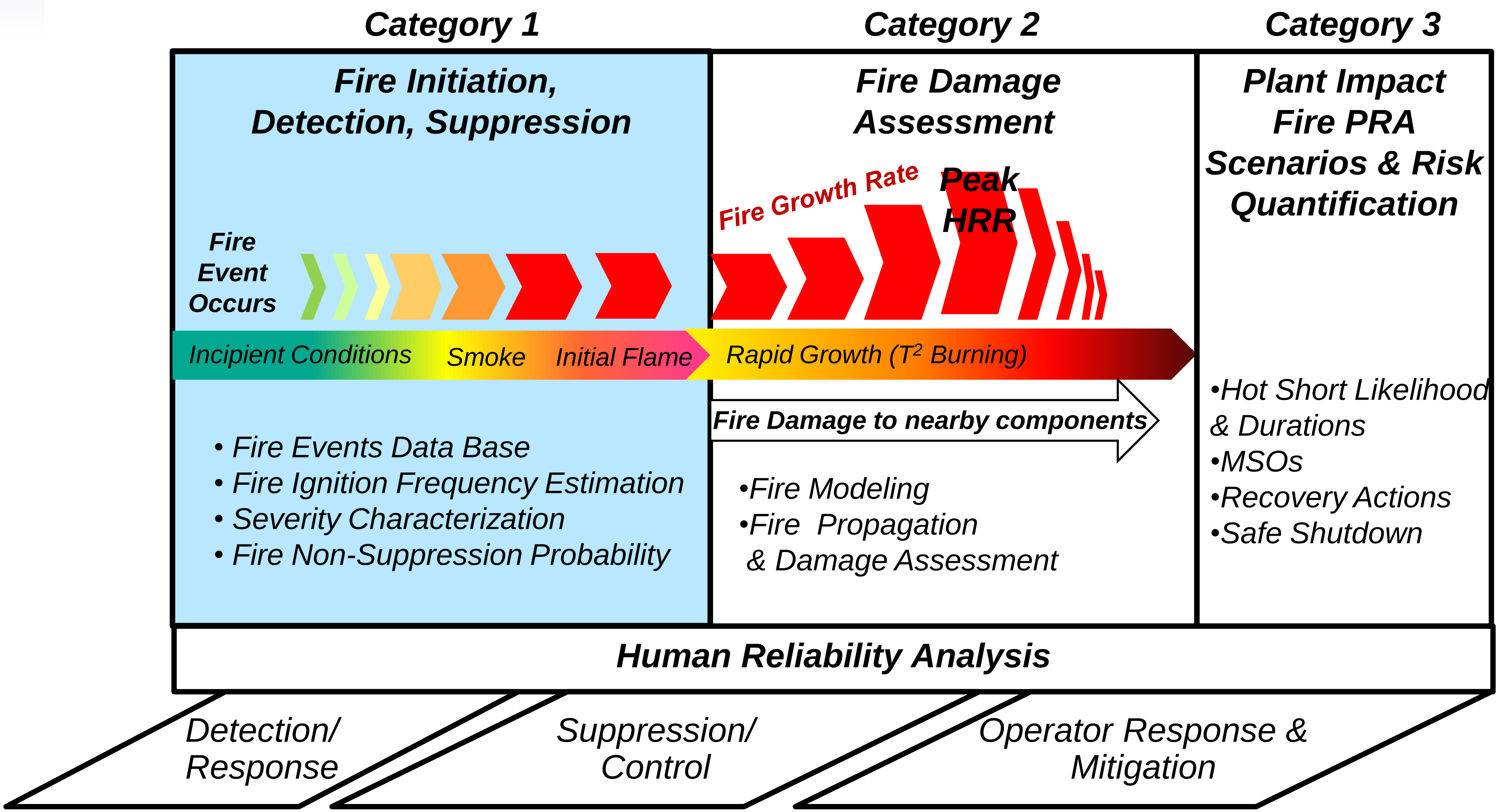
Doug True, ERIN Engineering & Research

ACRS PRASC
November 16, 2010

Purpose

- Develop a report that uses 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
- Report Objectives:
  - Identify key areas needing additional realism
  - Illuminate causes
  - Identify and organize a set of reasonable near-term research activities (next ~3 years)
  - Inform & update the EPRI FPRA Action Matrix

FPRA Issues Framework



Category 1: Fire Initiation, Detection, Suppression

Areas In Need of Additional Realism:

- 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

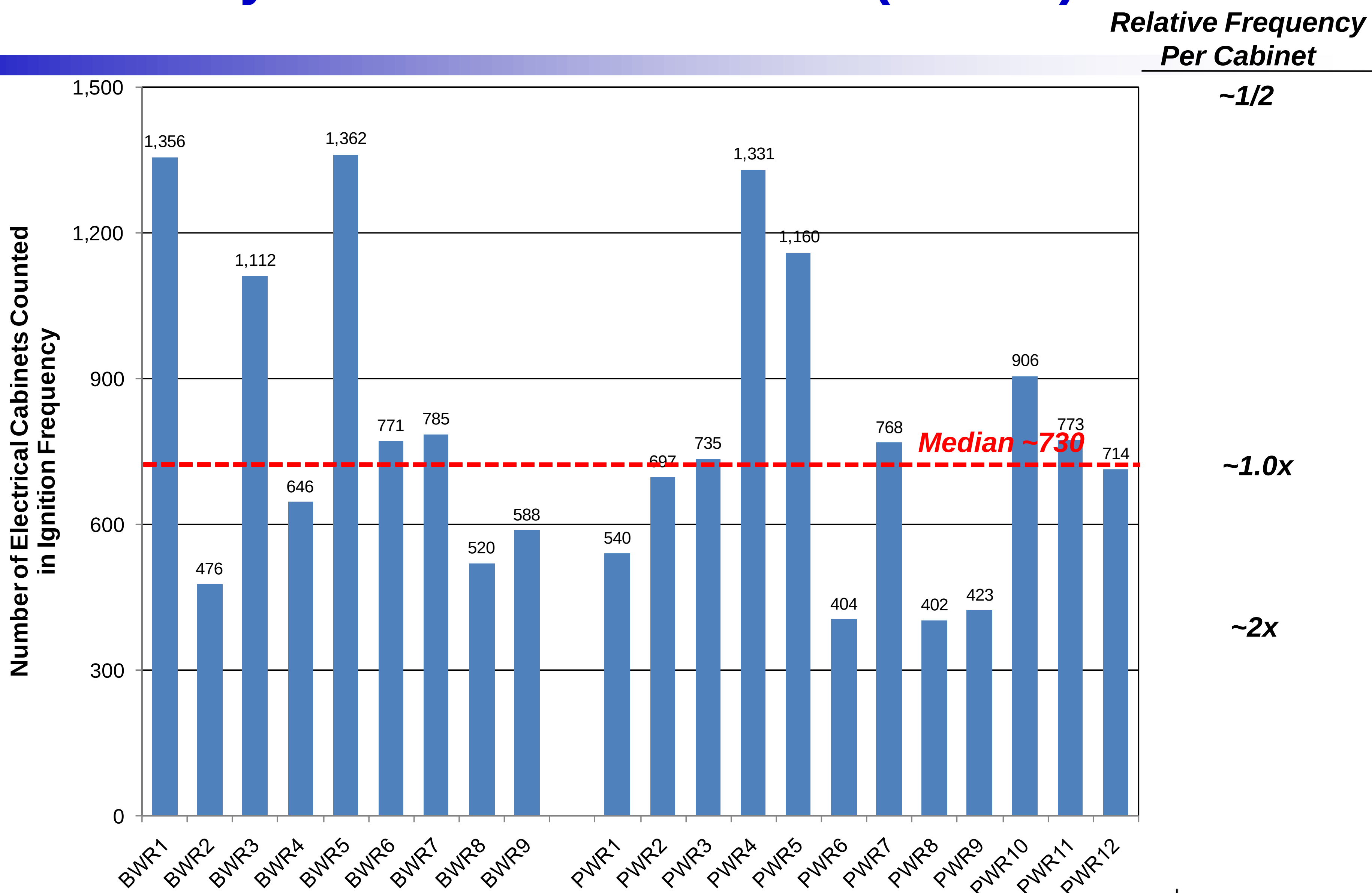
Fire Event Data Characterization

- Fire Events Database
  - The events in the current FEDB do not align well with the manner in which they are used.
    - Assumptions are used to make links that could be supported by data
  - The current FEDB only includes data through 2000
  - The current FEDB relies on weak event descriptions and a less than traceable categorization scheme
  - Risk-informed, Performance-based Fire Protection will require a long-term fire event data collection & analysis program

Fire Event Data Characterization

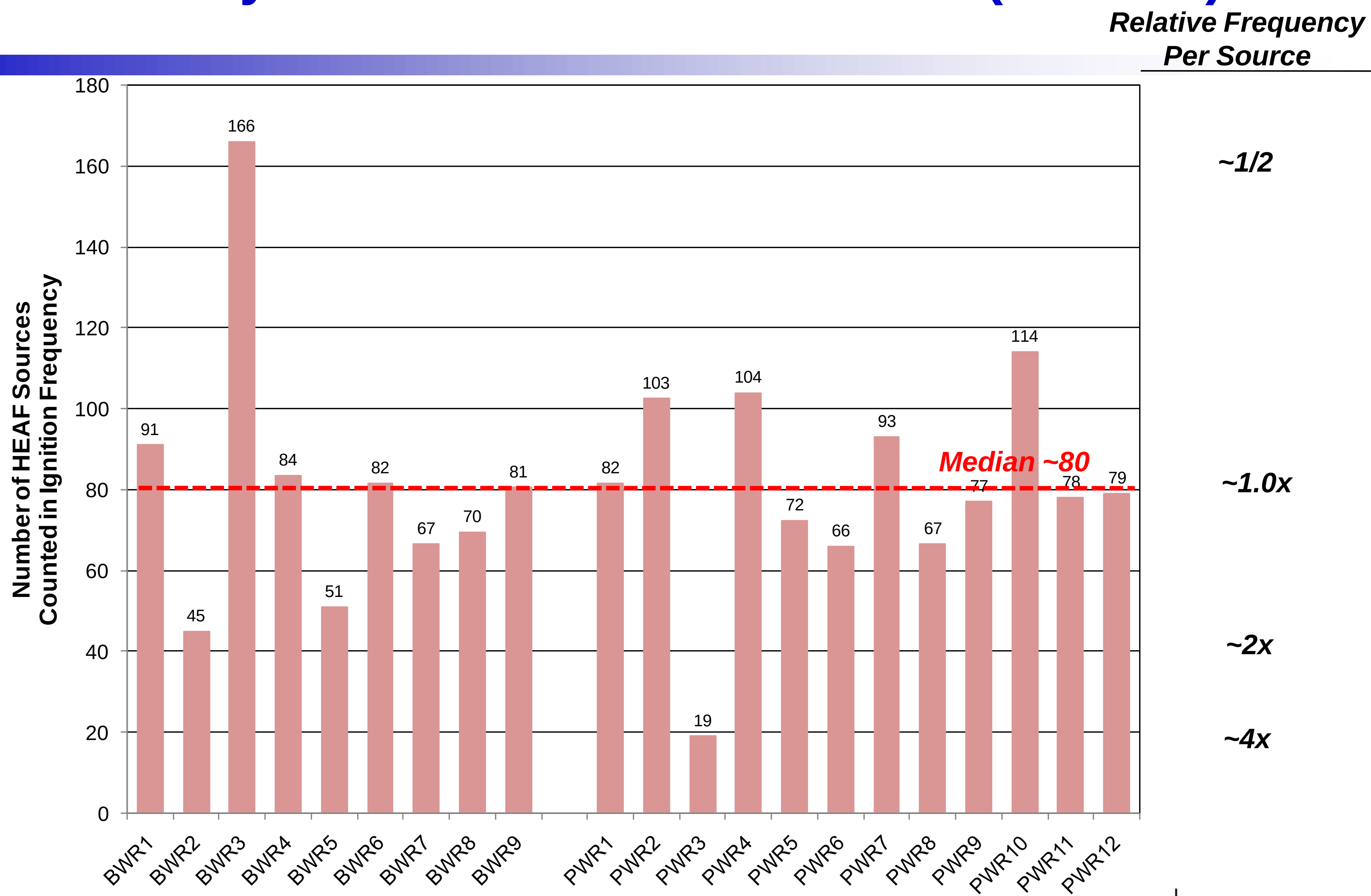
- Fire Ignition Frequency
  - Current approach to component-based ignition frequencies relies upon an allocation technique rather than component-specific ignition frequencies
  - Current approach to the calculation of ignition frequencies is simplistic, does not comport with current data analysis techniques, and does not account well for plant-to-plant variability
  - Treatment of transient ignition frequencies does not address administrative controls
    - No credit for control of transient combustibles

Inventory of Electrical Cabinets (Bin 15)



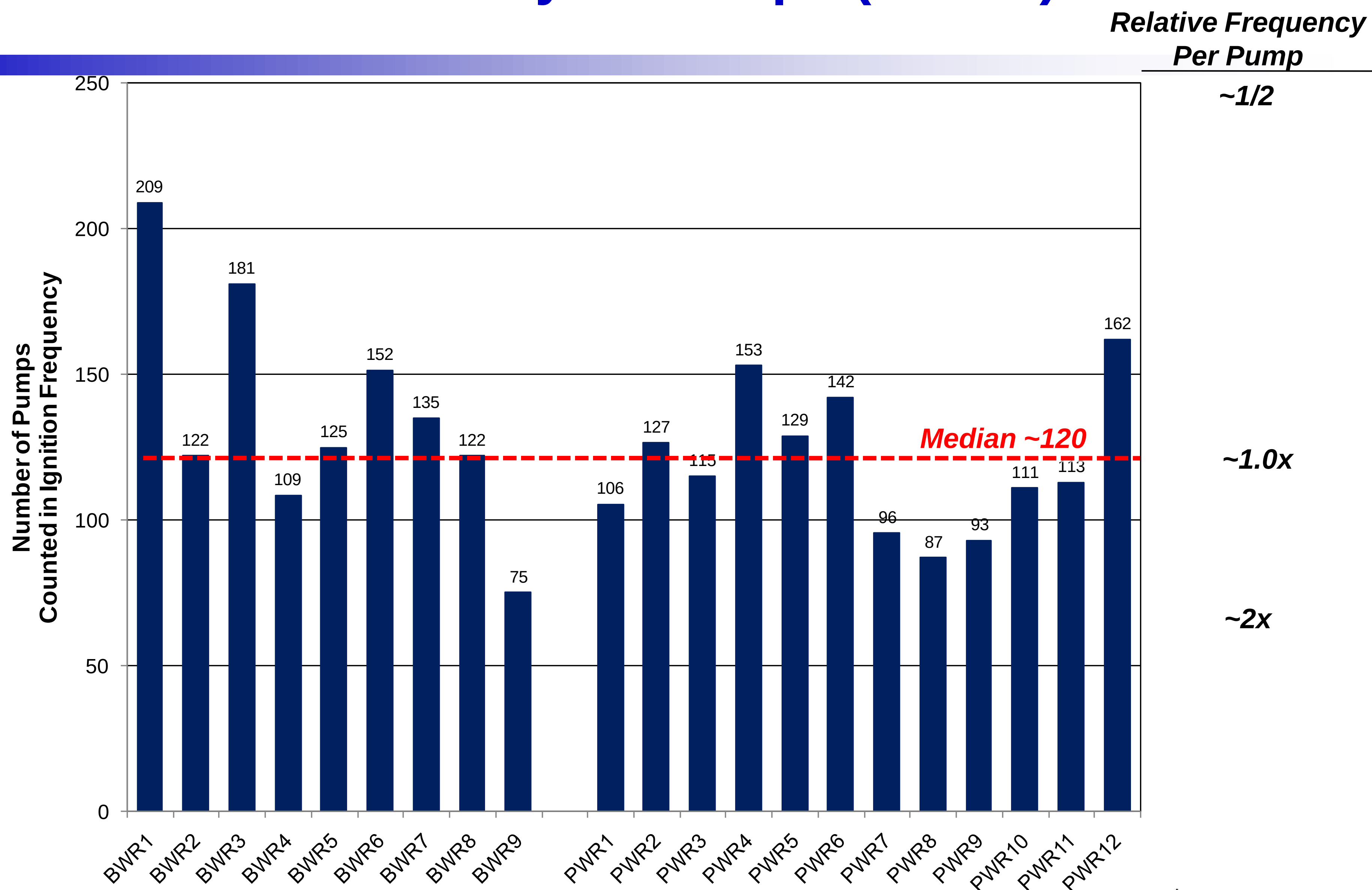
** Draft information (unverified)*

Inventory of HEAF Sources > 1000V (Bin 16b)



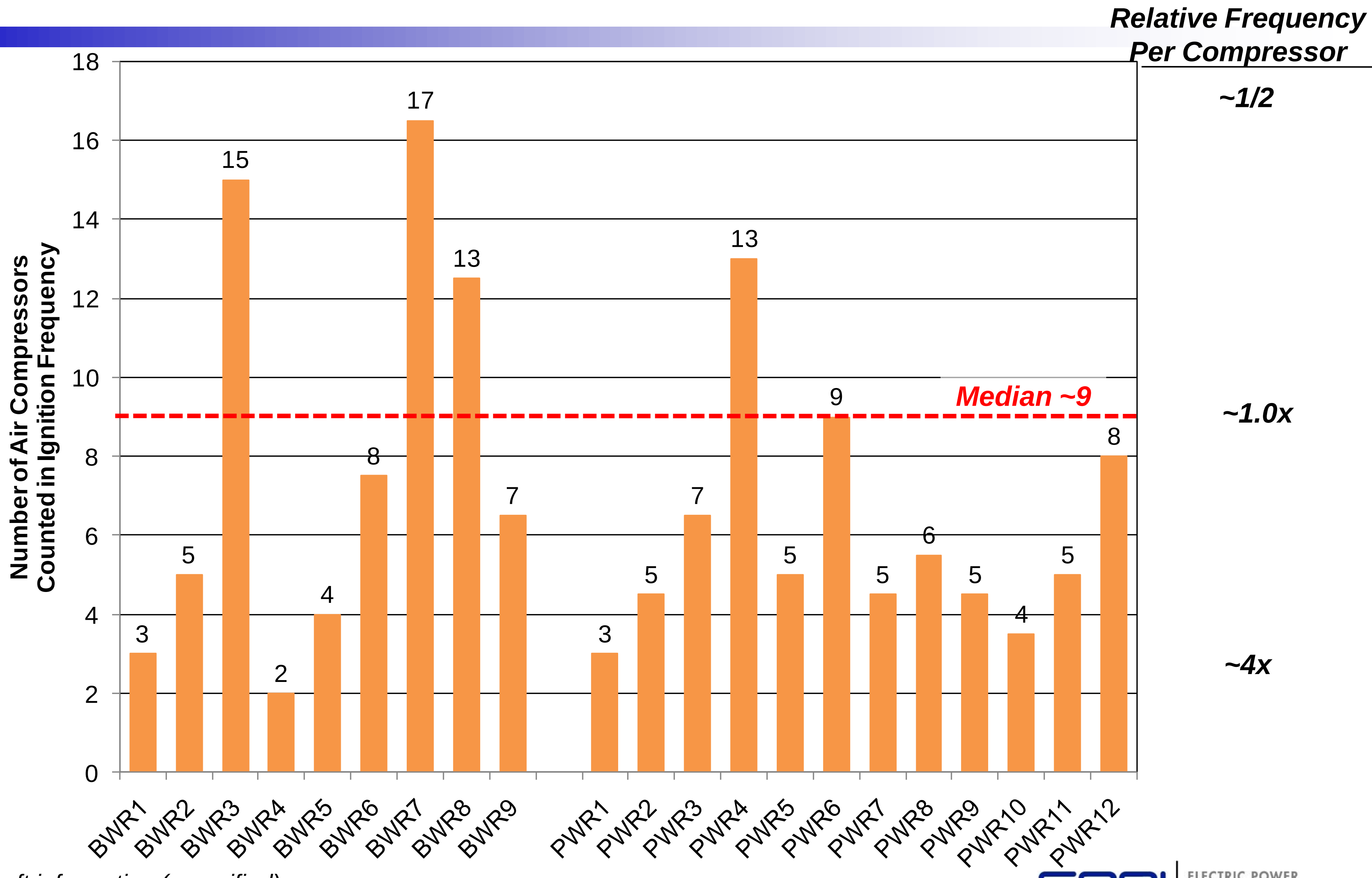
* *Draft information (unverified)*

Plant-wide Inventory of Pumps (Bin 21)



* *Draft information (unverified)*

Plant-wide Inventory of Air Compressors (Bin 9)



** Draft information (unverified)*

Database & Ignition Frequencies

- Implications for FPRA
  - Current FAQ requires reliance on old data
  - Current database has non-negligible frequency contribution from “indeterminate” events
  - All fire events treated as entering the t^2 growth phase
    - Experience does not support this

Could easily overstate likelihood of true fires by a factor of 2-5 for key bins

Insights from enhanced database will provide valuable input to other tasks

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Fire Severity Characterization

- Incipient Fire Growth in Electrical Cabinets
  - Events from Fire Events Database (FEDB) are treated as in the t^2 growth phase even though vast majority are suppressed or controlled before external damage occurs
- Oil Fire Severity
  - Treatment of oil fires severity is simplistic and over-predicts fire severity vs. events in current FEDB
  - FAQ-44 adjusted treatment for MFW pump oil fires, but other components need a similar update:
    - Pumps
    - Transformers
    - Diesel generators

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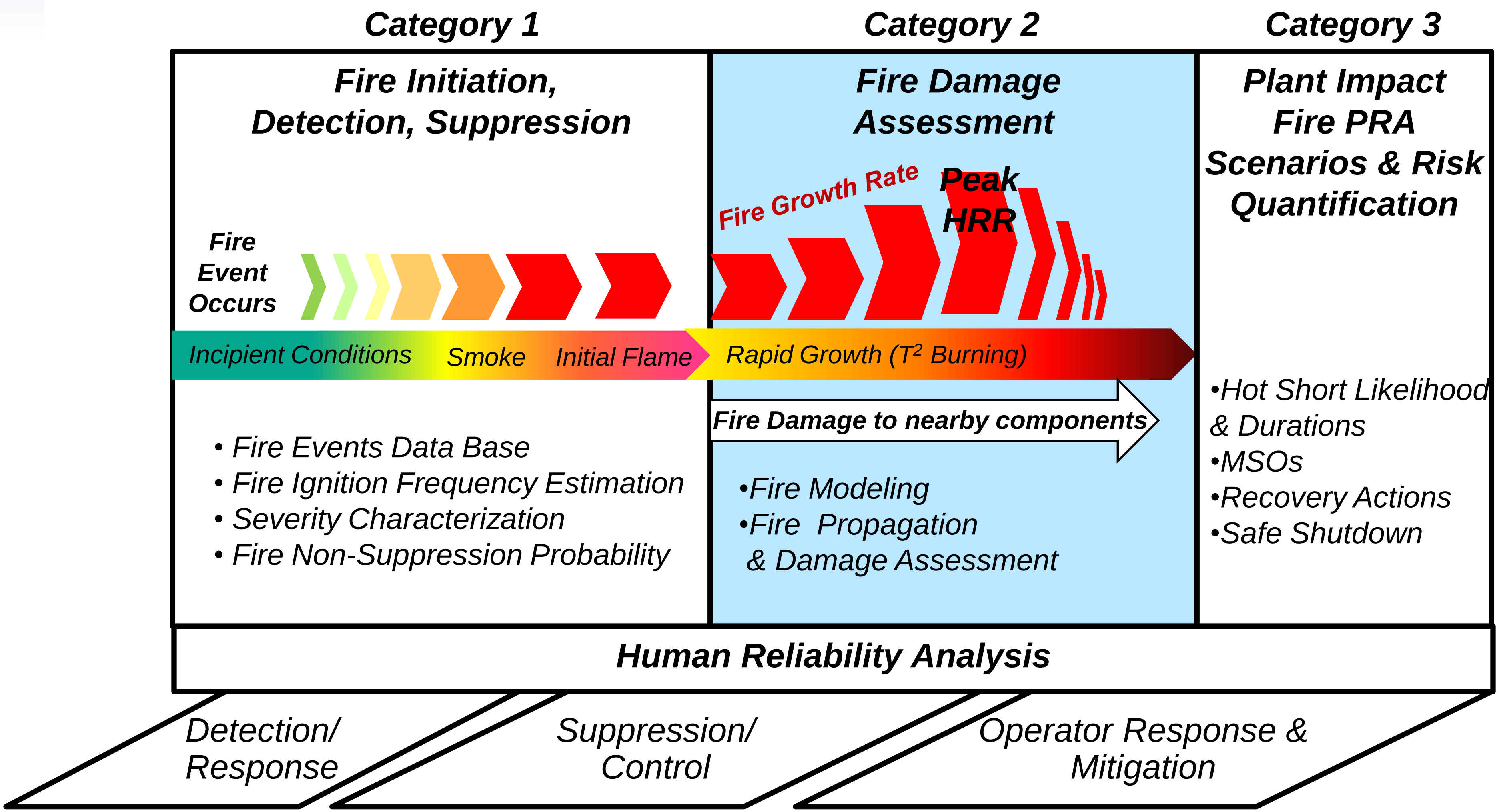
FPRA Issues Framework



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

Fire Growth Assumptions

- Fire growth and comparison with data
  - The treatment of electrical fire growth rates is very coarse and does not address condition-specific factors
    - Ventilation-limited conditions
- Fires in the database do not appear to evolve in the t^2 development phase for some time
- Current assumptions has artificially assigned fire growth rates
  - e.g., 12 minute fire growth timing for electrical cabinets
- Artificially limits benefit of intervention actions
- Improved database should provide better basis for fire growth assumptions

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NUREG/CR-4527

- Primary basis for 12 minute fire growth rate assumption
- To ignite cables, utilized ignition source comprised of a polyethylene bucket containing:
  - 1 quart of acetone
  - 1 lb of kimwipes
- Flame height of ~3ft
- Duration of source burn ~35 min

- Source insufficient to sustain burn unless cable bundles were physically separated

NUREG/CR-4527 – HRR of ignition source only

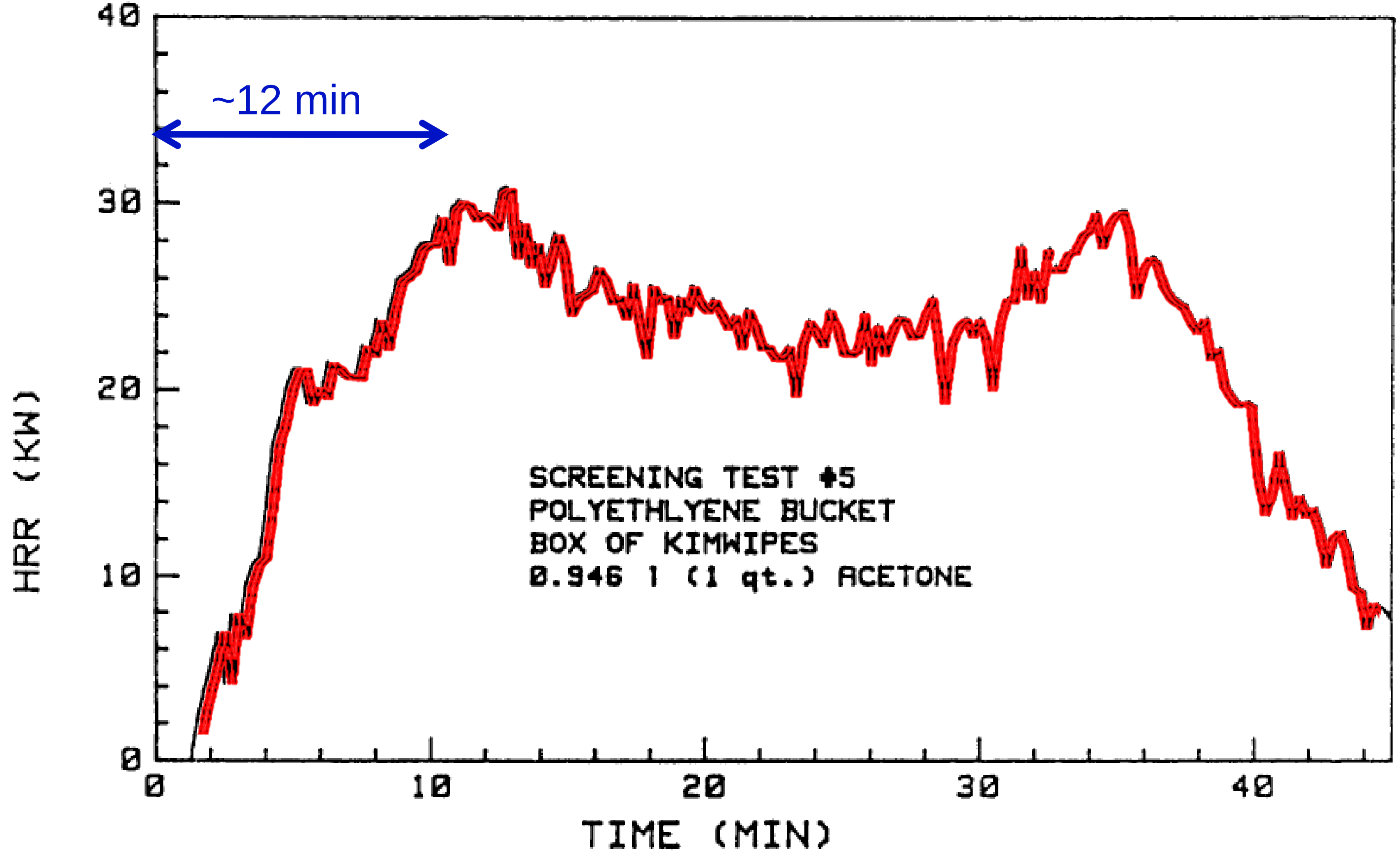

Figure 6. Heat Release Rate for the Transient Ignition Source; Screening Test #5

NUREG/CR-4527 – Screening Test Results

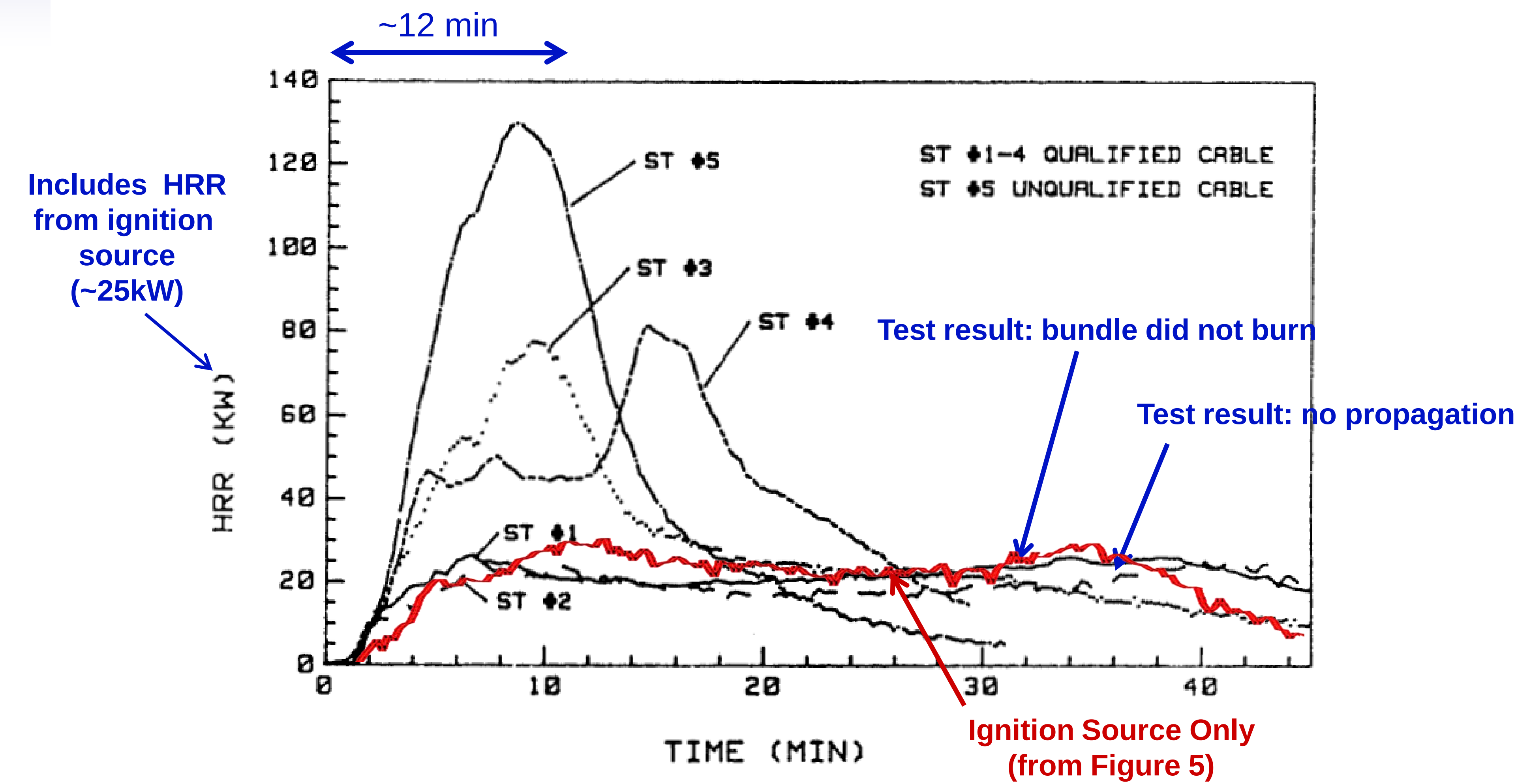

Figure 8. Heat Release Rate Plots for Scoping Tests #1 through 5

-22-

NUREG/CR-4527 Scoping Test Results

Test #[a]	Cable Type	Amount of In Situ Fuels[b,c] (KJ)	Cabinet[d] Ventilation Method	Peak HRR (KW)	Intense Burn Duration (min)	Test Result
ST1	Q	117,000	No doors	24	15	Bundle did not burn
ST2	Q	117,000	No doors	27	17	No propagation
ST3	Q	117,000	No doors	77	18	Entire bundle consumed
ST4	Q	117,000	No doors	82	17	Almost entire bundle consumed
ST5	UQ	117,000	No doors	132	17	Entire bundle consumed
ST6	Q	348,500	No doors	82	25	No propagation
ST7	Q	348,500	Doors closed	95	25	No propagation
ST8	Q	582,875	Doors closed	93	30	No propagation
ST9 barriers	Q	234,990	Doors open	74	20	No propagation
ST10	UQ	611,530	Doors closed	280	30	Propagated All burned
ST11	UQ	611,530	Door open	506	20	Propagated All burned

No significant damage

NUREG/CR-4527 – "Preliminary Cabinet Tests"

Table 4

Matrix of Preliminary Cabinet Tests

TEST #	IGNITION FUEL	CABINET TYPE	CABINET VENTILATION	IN SITU FUEL TYPE	IN SITU FUEL AMOUNT (KJ) [BTU]
PCT 1	Transient	Vertical	Vent Grills on Doors	UQ	7.283×10^5 [6.90×10^5]
PCT 2	Transient	Vertical	Doors Open	UQ	1.051×10^6 [1×10^6]
PCT 3	Transient	Vertical	Doors Open	Q	1.055×10^6 [1×10^6]
PCT 4	Heptane	Vertical	Doors Open	Heptane	56.78 ℓ (.929 m^2 pan) [15 gal (10 ft^2 pan)]
PCT 5	Electrical	Benchboard	Door Open Front Grill	UQ	1.519×10^6 [1.44×10^6]
PCT 6	Transient	Benchboard	Door Open Front Grill	Q	1.551×10^6 [1.47×10^6]

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Fire Growth Rate Data – Electrical Cabinets

Test	Time to Peak	Steady Burning	Time to Decay	Ignition Source	Cable	Ventilation
ST1	7	8	15	Transient	Qualified	Open
ST2	6	11	17	Transient	Qualified	Open
ST3	10	8	18	Transient	Qualified	Open
ST4	14	3	17	Transient	Qualified	Open
ST5	8	9	17	Transient	Unqualified	Open
ST6	8	17	25	Transient	Qualified	Open
ST7	18	7	25	Transient	Qualified	Closed
ST8	10	20	30	Transient	Qualified	Closed
ST9	10	10	20	Transient	Qualified	Open
ST10	10	20	30	Transient	Unqualified	Closed
ST11	18	2	20	Transient	Unqualified	Open
PCT1	11	10	21	Transient	Unqualified	Closed
PCT2	12	2	14	Transient	Unqualified	Open
PCT3	13	14	27	Transient	Qualified	Open
PCT4a	16	0	16	Heptane Pool	Unqualified	Open
PCT4c	16	0	16	Heptane Pool	Unqualified	Open
PCT5	17	0	17	Electrical	Unqualified	Open
PCT6	11	0	11	Transient	Qualified	Open
Test 21	4	14	18	Gas Burner	Unqualified	Open
Test 22	9	2	11	Gas Burner	Unqualified	Open
Test 23	10	0	10	Transient	Qualified	Open
Test 24	12	0	12	Electrical	Qualified	Open
Average	**11.4**	**7.1**	**19**			

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NUREG/CR-4527 – Scoping Test Conclusions

- “A number of conclusions can be made as a result of the Scoping Tasks that give insight into cabinet fire development and input into the Preliminary Cabinet Tests. The conclusions are as follows:
  - There is a “critical” amount of “ignition source fuel” that is necessary to ignite a cable bundle, particularly qualified cable.
  - Qualified cable fires (with the selected cable and ignition source) in vertical cabinets do not spread throughout the cabinet.
  - Unqualified cable in vertical cabinets will easily ignite (with the selected ignition source) and propagate a fire in a single cabinet.
  - Burning rate (as measured by the HRR) is affected by the ventilation method (i.e., closed or open cabinet door) in tests using unqualified cable. Closed cabinet doors appear to result in higher cabinet temperature but also cause oxygen deprivation that appears to limit the burning rate.
  - Smoke obscuration in the test enclosure occurs within eight minutes in unqualified cable cabinet fires in the configurations tested.
  - The thermal environment in the enclosure does not become severe enough to cause melting of components or result in flashover.

- Furthermore, an important observation made during the tests was that when comparing the test cabinets loaded with in situ fuel (loadings are based on survey information) to pictures of actual nuclear power plant cabinets, the fuel load appears to be small. As a result of the Scoping Tests, it appears that cabinet fires with qualified cable do not propagate significantly. However, cabinet fires with unqualified cable may be a real threat to the safety of a nuclear power plant, from the standpoint of fire spread, and control room habitability, given the “critical” conditions and configurations.”

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Ramifications for FPRA

- Simplification in NUREG/CR-6850 leads to potential overstatement of fire growth rate and heat release rate (HRR):
  - Tests designed to cause damage
  - All fires treated as if propagation is possible
  - Fire growth rate set by “transient” ignition source (acetone & kimwipes)
  - Included tests with 10-15 gal of heptane as ignition source
  - Most tests were with open or no doors
  - Many tests were with unqualified cables
  - Benchboard and vertical cabinets treated the same

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Ramifications for FPRA (Cont.)

- Damage rate and damage potential appears overstated
- Short time reduces potential for intervention by plant personnel, e.g., operations or brigade
- Needs to be informed by better experience data & more mechanistic treatment of cabinet parameters, e.g., ventilation limited fires

Could easily overstate likelihood of fully involved fire by a factor of 2-5

Peak Heat Release Rates – Electrical Cabinets

- Electrical cabinet peak heat release rate (HRR)
  - HRRs for electrical cabinets are binned very simply
  - Mix and match of test results to assign peak HRRs
  - Assignment of distribution appears to have little connection to experience
  - Expert judgment inscrutable – does not meet PRA Standard requirements
- Simplified scheme for designating peak HRR
  - Qualified/unqualified & number of bundles
  - Ignores ventilation limited cases
  - Applies test results that may not be applicable

Peak Heat Release Rates – Electrical Cabinets (Cont.)

- Major contributor to all current FPRAs
- Not aligned with actual operating experience
- Overstates effects of fires
- Has potential to confound risk-informed decision-making:
  - Assumption of damage that may not occur is not always “conservative”
    - Could mask risk increases from plant changes/ conditions, out-of-service equipment, etc.

Could lead to identification of wrong dominant contributors and misguided decision-making

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Fixed Ignition Source HRRs

Tests of Cabinets with Unqualified Cables

Average of Benchboard Tests with Open Doors

Table G-1
Recommended HRR Values for Electrical Fires

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)

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Peak Heat Release Rates - Transient Ignition Sources

- Transient ignition sources, e.g., Bins 7, 25, 37
- Source peak HRR data from tests performed on trash bags
- FEDB events are primarily events involving transient ignition sources:
  - Space heaters, extension cords, scaffolding, etc.
  - Only one FEDB event involved a trash receptacle

Overstatement of threat from transient combustibles could skew results and mask important contributors

Quantitative impact on PRA is very plant/ scenario-specific, but could be significant

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Peak Heat Release Rates – Hot Work

- Majority of events in FEDB are pre-Appendix R
- New FEDB needs to inform with the type of events that actually occur
- HRR should be tied to the types of hot work that has involved fires, rather than an arbitrary HRR from a transient source

Peak Heat Release Rates – Other Sources

- As other refinements are made to FPRA methods, it is expected that additional simplifications/assumptions on peak HRRs will be identified for improvement
- One example involves electrical fires from pumps and fans
- NUREG/CR-6850, Table G-1 says that the data used is from electrical cabinet fire tests and it is “considered conservative”

Fixed Ignition Source HRRs

Table G-1
Recommended HRR Values for Electrical Fires

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)
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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)

See Note 8: No basis

Note 2: Vertical Cabinet Test

Fixed Ignition Source HRRs (Cont.)

Notes for Table G-2

1. Ref. G.2: Sandia experiments, average of vertical cabinet fire intensities with qualified cable.
2. Ref. G.3: VTT experiments with control cabinets.
3. Ref. G.2: Sandia experiments, average of two bench-board cabinet experiments with qualified cable.
4. The value is based on expert judgment. The expert panel assumes that the type of cable will only affect the ability of the cable to ignite. Therefore, once ignited, a single cable bundle is assumed to burn with similar intensity regardless of the cable qualification. A value of 85 BTU/s was selected as a conservative estimate for unqualified cables to represent a higher intensity at the 75th percentile when compared to qualified cable.
5. Ref. G.2: Sandia experiments, average of two vertical cabinet experiments with unqualified cable and closed doors.
6. Twice the intensity selected for the 75th percentile.
7. Ref. G.2: Sandia experiments, the highest heat release rate observed in cabinets with open door and unqualified cable.
8. No experimental evidence is available for assessing fire intensities for electrical fires in equipment other than electrical cabinets (or panels). Recommended values are considered conservative and are based on electrical cabinet (panel) fires experiments.
9. Distribution estimated based on the range of the tested transient fuel packages summarized in table G-7.

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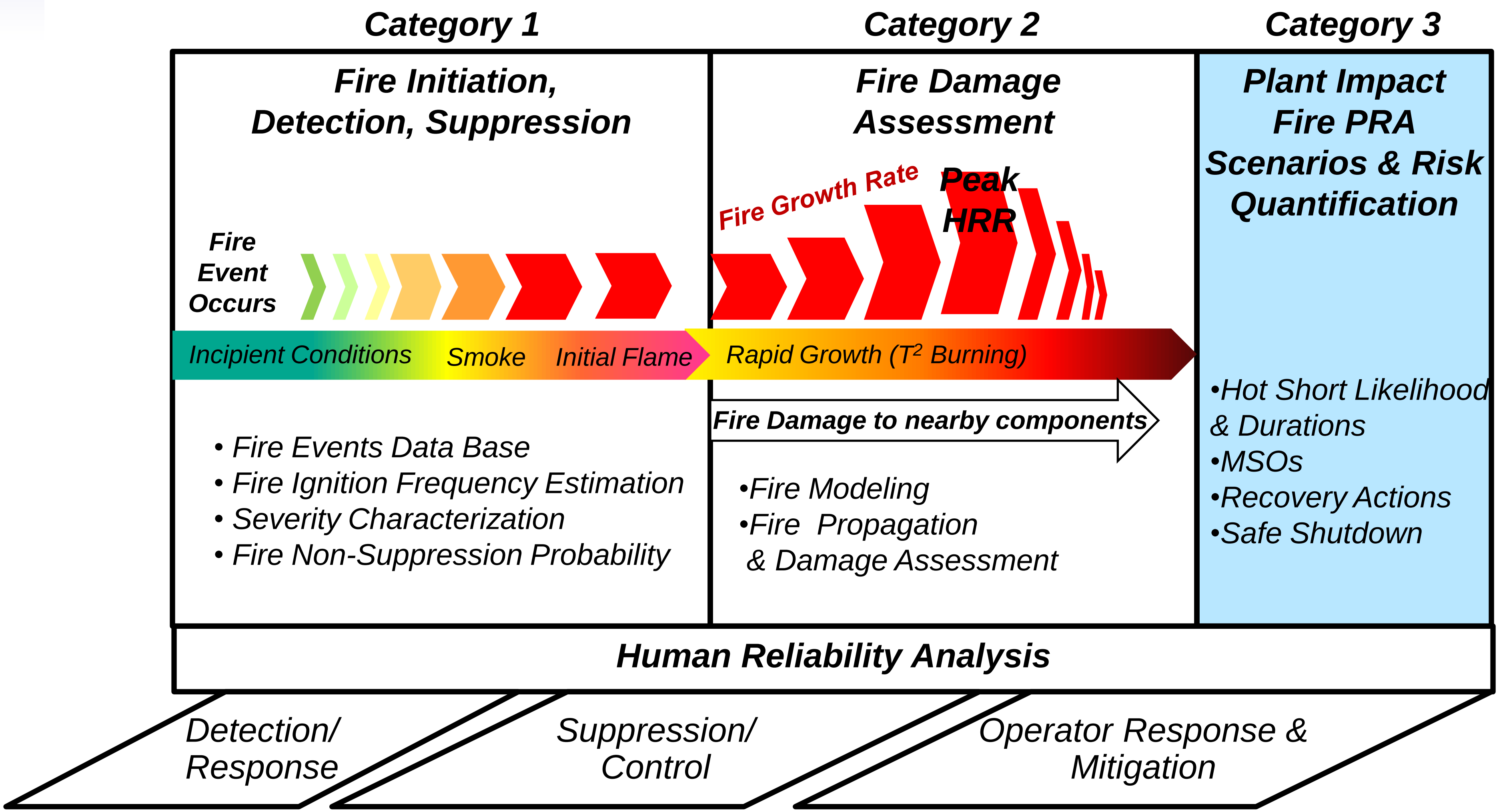
FPRA Issues Framework



Category 3: Plant Impact, Fire PRA Scenarios & Quantification

<u>Areas In Need of Additional Realism</u>:

- 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

Summary of Roadmap Conclusions

Conclusion	Primary Bases
Fire characterization does not appear to 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 appears to be overstated	• FPRAs predict high frequency of fires with high CCDPs, but NRC's ASP &ROP have not observed • Predicted frequency of spurious operations not consistent with operating experience
Uneven level of conservatism may 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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Perspectives on the Treatment of Cabinet Fires

Steven P. Nowlen
Sandia National Laboratories

ACRS Reliability and PRA Subcommittee

December 13-14, 2010

Cabinet fires are likely to remain important risk contributors

- The electrical cabinet fire ignition source bin (15) contains more risk-relevant fire events than to any other bin
  - Cabinets are the single most common source of plant fires
- One substantial challenge is the wide range of cabinets that exist in plants – variables include:
  - Function – control, power distribution, switching, junction boxes…)
  - Voltage levels – can range from <50 to >100kV
  - Physical characteristics – including size, construction and venting
  - Fuel loading – type, distribution, and quantities
- Reflecting the range of potential configurations is difficult

Limitations to the event data

- While there are a relatively large number of cabinet fire events in the database, the information on each is rather sparse
- Very difficult to parse events into groups
  - Many events are explicit as to cabinet type based on function
  - Many events are not
- Attempts to parse the data consistently run into the same problem – what do you do with the large number of 'unknown' cases?
  - '6850' did attempt to parse cabinet fire events
  - Too many were left as unknown
  - The set was eventually collapsed back into a single frequency bin
- Hopefully the FEDB update effort will provide better data on this important ignition source

What we know from test data (1of2)

- Three major sources of cabinet fire test data
  - NRC/SNL – NUREG/CR-5546
  - VTT Finland
  - IRSN France
- All have focused on control cabinets
  - No known investigation of other cabinet types (e.g., power distribution and switching equipment)
- Tests have covered a relatively narrow range of fuel loading
  - IRSN used surrogate fuel packages (not cables/components)
  - NRC used qualified and unqualified cables in various loading arrangements and densities
  - VTT did both cables and some tests with components (e.g., circuit cards)

What we know from test data (2of2)

- The tests make no attempt to suppress these fires
  - In reality, plant personnel put most fires out quickly
  - Comparisons between what happens in testing and what happens in an actual event rarely consider what might have happened if the fire had not been suppressed…
  - But that is what fire PRA asks – what might have happened?
- The tests tell us what can happen if a fire grows unchecked in an electrical cabinet
- One caution: slicing the data 'too thin' will likely lead to invalid conclusions
  - SNL performed many tests but early phase tests involved limited fuel loads, were designed to explore fundamental fire spread behaviors, and probably don't match in-plant conditions
  - Parsing of the data set into small bins is risky at best

Cabinet fires – areas for improvement (1of2)

- Given the importance of cabinet fires any improvements to method would be welcomed by all
- A model linking growth time to cabinet contents would be desirable
  - Challenge will be application – rarely allowed to inspect cabinets
- Empirical model of ventilation effects on peak HRR is desirable
  - Prior efforts to model deterministically (e.g., VTT) were not successful
  - Validation should be reasonable achieve give available data
  - Readily implemented because you may only need external inspection
- Other approaches to peak HRR will be difficult given available data
  - Again we need inspection of internals to really do better
  - Data will be problematic

Cabinet fires – areas for improvement (2of2)

- The "well-sealed" issue (non-propagating cabinets)
  - If we can tie to cabinet rating that would help (e.g., NEMA)
- Incipient stage timeline implies resetting "time-0"- a real challenge
  - Strong interaction with how we do fire frequency
  - Would require re-examination of fire events relevant to risk
- Need to look at other potential drivers for risk results, e.g.:
  - PRAs do not appear to be taking advantage of THIEF cable damage model
  - Use of conservative cable damage assumptions could overwhelm other issues
  - Need to ensure balance is maintained – Not appropriate to 'fix' conservatism driven by cable damage assumptions by making optimistic assumptions about cabinet fire characteristics

Assessing cabinet fire heat release rates (1of3)

- **From §3.2.2:**

  "The peak HRRs assumed for electrical cabinets are binned very simply. As shown in Figure 3-10, there are only 5 bins for electrical cabinets and these do not align well with the test conditions."

- **'6850' parsed the data in an attempt to cover a range of in-plant cabinet configurations and within limits of the available data**
  - **e.g., "single bundle" versus "multiple bundles"; qualified versus unqualified…**
- **The values cited by NEI only cover vertical cabinets - closed doors**
  - **This is the predominate case in general plant areas**
  - **Very few open-door cabinets outside the main control room and control room annex areas**
  - **There is a separate treatment provided for the Main Control Board (Appendix L)**

Assessing cabinet fire heat release rates (2of3)

- **From §3.2.2:**

  "The expert judgment applied is essentially inscrutable and does not meet the requirements of the ASME/ANS PRA Standard."

- **'6850' approach may not meet ASME/ANS standard for an expert panel, but it was never meant to**
  - **In fact, the standard didn't exist when this work was done (2002)**
- **The approach was pretty simple:**
  - **HRR profiles represent the potential peak intensity of a cabinet fire *given no efforts to suppress the fire***
  - **The tests were generally assumed to reflect worst case conditions**
    - **Worst case peak HRRs were generally taken as 98th percentile**
    - **Average values were generally taken as the 75th percentile**
- **The distributions represent the expert judgment of the authors**

Assessing cabinet fire heat release rates (3of3)

- **As in other areas, the intent of the cabinet peak HRR distributions was to provide a generically applicable approach for application to the initial analysis of general plant applications**
- **'6850' recommends that analysts review their specific cases and incorporate insights**
  - **Cabinet internals for representative cabinets should be examined**
  - **Fire duration should reflect total fuel load within the cabinet**
    - **Fires don't burn forever even if there is no intervention**
  - **Fire location within the cabinet should reflect where fuels within the cabinet are actually concentrated**
  - **Fire exposure to external targets should reflect venting conditions and locations**

Comparisons between PRA models and events

- **From §3.2.2:**

  “The observed damage from operating experience does not align with the damage computed using fire models based on the assumed peak HRR inputs and the damage does not align with actual operating experience.”

- **Many possible explanations – root of this problem is not clear**
  - **Timing is certainly an issue, but we have to be careful**
    - **If we incorporate the concept of incipient growth stages, we have to re-think fire frequencies as well**
    - **‘6850’ generally called incipient stage fires “non-challenging”**
    - **The FEDB update effort may not capture incipient events either**
  - **Analysts still appear to be applying very conservative cable damage time assumptions**
    - **e.g., The THIEF model can add many minutes to the damage time but industry does not seem to be using that tool (NUREG/CR-6931V3)**

In Summary…

- **Cabinet fires will likely remain important to plant risk no matter what we do**
- **Better methods would be welcome but we need to maintain consistency between analysis elements**
- **Efforts need to consider other overlapping modeling issues that could drive results – e.g., cable damage assumptions**

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Enhancing Fire PRA Realism Using Original Guidance from NUREG/CR-6850 (EPRI 1011989)

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Senior Fire PSA Engineer
NRC Office of Nuclear Reactor Regulation

Purpose

- To twist the words of Shakespeare from Marc Antony's eulogy of Julius Caesar:

"I come to praise 6850, not to bury it."

Outline

- Based on the original guidance (i.e., pre-6850 MOU FAQs) in NUREG/CR-6850 (EPRI 1011989), discuss two simple examples showing how that guidance enables more realistic fire scenarios to be developed when going from scoping to very basic (pre-)fire modeling

Example 1

- Table E.1 Characteristic HRR (Case 1 - Vertical Cabinet, One Qualified Bundle):
  - 69 kW (75^{th} %ile) and 211 kW (98^{th} %ile)
  - Gamma distribution with $\alpha = 0.84$ and $\beta = 59.3$
    - Mean HRR = $\alpha \cdot \beta$ = 50 kW (64^{th} %ile)
- Assume damage occurs at temperature (T_{64}) corresponding to mean HRR (Q_{64} = 50 kW)
  - Since $T \leftrightarrow Q^{2/3}$, ratio of damage temperature to temperature corresponding to 75^{th} %ile HRR is $T_{64}/T_{75} = (Q_{64}/Q_{75})^{2/3} = (50\ \text{kW}/69\ \text{kW})^{2/3} = 0.81$

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ASME/ANS RA-Sa-2009, Part 4 ("Fire")

- Supporting Requirement FSS-C1
  - CC-I: "... ASSIGN characteristics ... that bound potentially risk contributing fire events in the context of both fire intensity and duration ..."
  - CC-II: "... ASSIGN characteristics ... using a two-point fire intensity model that encompass low likelihood, but potentially risk contributing, fire events in the context of both fire intensity and duration ..."
  - CC-III: "... ASSIGN characteristics ... that reflect a range of fire intensities and durations and that encompass low likelihood, but potentially risk contributing fire events ..."

ASME/ANS RA-Sa-2009, Part 4 (cont.)

- Assuming point-estimate(s) 75th (and/or 98th) %ile HRRs for CC-I or CC-II yields damage probability = 1 since actual threshold is at the 64th %ile HRR
- Assuming a distributed HRR for CC-III yields damage probability = 1 – 0.64 = 0.36
  - This corresponds to a reduction by a factor of 1/0.36 ≈ 3
- While this example is <u>illustrative only</u>, it shows how use of more detailed, but straightforward, guidance from 6850/1011989 can enhance fire PRA realism

Example 2

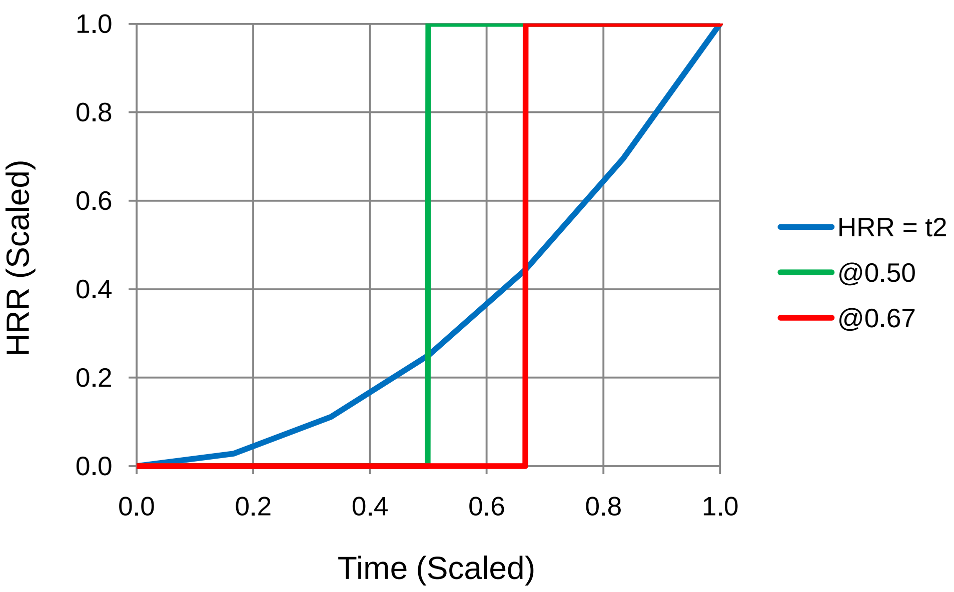
- Section G.3.1 on Fire Growth in Electrical Cabinets
  - Fire grows to peak HRR in ~12 minutes
    - Experiments show range from 4 to 18 min
  - A t^2 function can be used to represent growth to this peak
- Compare conservative “instantaneous” HRR peaking ($t = 0$) to t^2 peaking

Simplified HRR Growth Profiles

Blue curve shows t^2 growth

Red shows equivalent-area step function $[{}_0\int^1(t^2)dt = {}_t\int^1 dt \rightarrow t = 2/3\ (0.67)]$

Green shows step function allowing for phenomenology that accounts for more heat being transferred to target by t^2 curve than equivalent-area step function



ASME/ANS RA-Sa-2009, Part 4 ("Fire")

- Supporting Requirement FSS-C2
  - CC-I: "CHARACTERIZE ignition source intensity ... at full peak ... HRR ..."
    - E.g., "instantaneous" ($t = 0$) peak
  - CC-II/III: "CHARACTERIZE ignition source intensity using a realistic time-dependent fire growth ... HRR for significant contributors ..."
    - E.g., t^2 growth profile (for illustrative purposes, assume surrogate step function including delay)

Non-Suppression Probability

- Section P.1.3 on Fire Detection-Suppression
  - Probability of non-suppression of an electrical cabinet fire before electrical damage occurs (P_{NS}) within t minutes = exp(-0.12t), where t includes time from ignition to damage
    - If there is any additional delay (d) included in this time, P_{NS} will be reduced by a factor of {exp(-0.12[t + d])}/{exp(-0.12t)} = exp(-0.12d)
      - Thus, if a t^2 HRR growth profile (using the surrogate step function at t [scaled] = 0.50) is assumed instead of an "instantaneous" peak HRR (t = 0), the P_{NS} will be reduced by a factor of exp(-0.12[0.50t']), where t' is the unscaled time

Reduction in P_{NS}

Time (min)		exp(-0.12 [0.50t'])	P_{NS} Reduction Factor	exp(-0.12[0.50t']) * 0.36 (from Ex. 1)	Joint Reduction Factor
t'	0.50t'				
3	1.5	0.84	1.2	0.30	3.4
6	3	0.70	1.4	0.25	4.0
9	4.5	0.58	1.7	0.21	4.8
12	6	0.49	2.0	0.17	5.8
15	7.5	0.41	2.5	0.15	6.9

The first reduction factor shows how much P_{NS} will be reduced by use of just the surrogate step function at t (scaled) = 0.50 for t^2 growth profiles ranging from 3 to 15 min (with the 12-min profile being the average estimated in 6850/1011989).

The second reduction factor shows the joint effect if the distributed HRR reduction factor of ~3 from Example 1 is also applied.

Conclusion

- While these examples are <u>illustrative only</u> and limited to only two aspects that contribute to fire CDF, they show how use of more detailed, but straightforward, original guidance (i.e., pre-6850 MOU FAQs) from NUREG/CR-6850 (EPRI 1011989) enables more realistic fire scenarios to be developed when going from scoping to very basic (pre-) fire modeling

NRC Review of NEI "Roadmap for Attaining Realism in Fire PRAs"

Dr. Raymond HV Gallucci, PE

Senior Fire PSA Engineer

US NRC

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Outline

- NRC Review Comments on NEI "Roadmap" Report
  - Fire PRA History
  - Scope and Role of NUREG/CR-6850
  - NFPA-805 FAQ Process and Fire PRA
  - NRC "Expectations"

Comments on NEI "Roadmap" Report

- The report appears to misrepresent, or at least try to present in a negative light, aspects of fire PRA history and the more recent activities related to the role of NUREG/CR-6850 and the NFPA-805 FAQ process, particularly in light of their roles in NFPA-805 transition

Fire PRA History

- Plant-specific Fire PRAs originated after WASH-1400's assessment of the Browns Ferry fire in 1975, e.g.,
  - Studies at universities (e.g., UCLA, RPI) ~ 1980
  - General Atomic Fire PRA for an HTGR ~ 1980
  - Early to mid-1980s plant-specific Fire PRAs by PLG

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Scope and Role of NUREG/CR-6850

- Specific “first-order” guidance intended for refinement/supplementation by plant-specific analysis, especially for fire modeling
  - Plant-specific guidance necessarily “high level” due to unique aspects at each plant

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Scope and Role of NUREG/CR-6850

- Individual tasks (analytic modules) intended to be worked as concurrently as possible with as much integration and iteration among analysts as appropriate
  - No "requirement" that each task create standalone work products to be passed from one task to the next

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Scope and Role of NUREG/CR-6850

- Contrary to contentions, 6850 provides guidance for treatment of
  - Sensitive electronics (Attachments H and S)
    - Significant "back-and-forth" between NRC reviewers and Oconee pilot based on 6850
  - "Incipient detection systems" (Attachment P)
    - "Prompt detection" may be credited for "high-sensitivity smoke detection system"
      - Could there be more? Yes (FAQ 08-0046)

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NFPA-805 FAQ Process and Fire PRA

- Contrary to contentions, the FAQ process, while not originally intended as a means to modify NUREG/CR-6850, granted some significant “relaxations” to the first-order guidance to facilitate use of Fire PRA in the short-term for NFPA-805 transition
  - Could more have been done? Maybe, but there was consensus in most cases where limits were applied

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NFPA-805 FAQ Process and Fire PRA

- Significant “relaxations:”
  - Refined (mostly reduced) fire ignition frequencies
    - A few selected “bins” still subject to sensitivities based on original 6850 frequencies (e.g., electrical cabinets, a key ignition source)
  - Probabilities across spectrum of spill sizes for oil fires
    - Limited by consensus to MFWPs for now

NFPA-805 FAQ Process and Fire PRA

- Significant “relaxations:”
  - “Incipient detection” (Very Early Warning Fire Detection System) credit
    - Up to two orders of magnitude attainable for reducing fire ignition frequencies
      - Limited by consensus to low-V electrical cabinets for now
  - AC “Hot short” durations
    - Experimental results (NEI/EPRI and CAROLFIRE) available; DC deferred by consensus pending completion of DESIREE-FIRE tests

NFPA-805 FAQ Process and Fire PRA

- Some “contentious” limitations due to disagreement between technical experts
  - Transient fire growth rates – clarified for MCR and “trash” fires, but not extended to “other” types of transients
  - Probability of fire spread beyond “sealed” cabinets – continued debate over meaning and proper quantification

NFPA-805 FAQ Process and Fire PRA

- Some “contentious” limitations due to disagreement between technical experts
  - Cable tray fire propagation – defined limits for use of 6850 approach, but expansion deferred pending completion of CHRISTI-FIRE tests
- Given the accelerated agenda (805) for “relaxing” 6850 guidance and limited test results available at the time, the FAQ process should be viewed as a success

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NRC "Expectations"

- NRC has "very high" expectations to justify treatment beyond the methods in 6850?
  - NRC "expectations" are set forth in RG 1.200
    - – NRC "requires" a high quality fire PRA, whether based in whole, in part, or not at all on 6850
    - – E.g., Oconee cited 6850 for their fire PRA. NRC reviews revealed deviations or exceptions, prompting the obvious RAIs: where and why?
  - – NEI 07-12 Fire PRA Peer Review guidance itself recognizes need to justify "Unreviewed Analysis Methods" beyond the 6850 methods

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Summary

- The report appears to misrepresent, or at least negatively reflect, fire PRA history and the more recent activities related to the role of NUREG/CR-6850 and the NFPA-805 FAQ process
  - Fire PRA History
  - Scope and Role of NUREG/CR-6850
  - NFPA-805 FAQ Process and Fire PRA
  - NRC “Expectations”

Total Fire CDFs (Backup Slide)

- Five plant-specific Fire PRA results presented to show misalignment between prediction and experience can be extrapolated to estimate total Fire CDFs ranging from ~1E-5/yr to ~1E-4/yr
  - Compatible with historic fire CDF estimates (e.g., IPEEEs, early plant-specific studies)
  - Extent to which plant-specific insights (e.g., fire modeling) are included is unknown

Total Fire CDFs (Backup Calculation)

CCDP		Frequency (1/yr)		CDF (1/yr)	
Threshold	Assumed*	Cumulative	Per Decade**	Per Decade	Sum
≥1E-2	3.2E-2	9.9E-4	9.9E-4	3.2E-5	3.2E-5
≥1E-3	3.2E-3	3.2E-3	2.2E-3	7.1E-6	3.9E-5
≥1E-4	3.2E-4	1.4E-2	1.1E-2	3.5E-6	4.2E-5
≥1E-5	3.2E-5	6.3E-2	4.9E-2	1.6E-6	4.4E-5
≥1E-6	3.2E-6	1.7E-1	1.1E-1	3.4E-7	4.4E-5
*Geometric mean of decade (e.g., $[0.1 \times 0.01]^{1/2} = 0.032$)		**Difference between cumulative frequencies for consecutive decades (e.g, 3.2E-3 – 9.9E-4 = 2.2E-3)			

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NRC Perspective on the NFPA 805 Frequently Asked Question Process

Charles Moulton

Fire Protection Engineer

Division of Risk Assessment

Office of Nuclear Reactor Regulation

December 14, 2010

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Frequently Asked Question (FAQ) Process History

- As lessons were learned through the pilot process, licensees asked for a semi-formal process to address guidance document changes
- FAQ process established to provide interim staff approval of changes to NEI 04-02 guidance
- Final closure of a FAQ comes with the approval of a new revision of Regulatory Guide 1.205 incorporating the changes
  - Approximately 18 FAQs were incorporated in NEI 04-02 Revision 2, which was endorsed by RG 1.205, Revision 1

FAQ Status Overview

	Total	Res-olved	With-drawn	Open	In Closure Process
Total	49	35	9	2	3
Non-PRA	33	20	8	2	3
PRA	16	15	1	0	0

“MOU” FAQs

- In mid 2008, a large number of new PRA-related FAQs were introduced into the process
- Many of these FAQs were only problem statements. That is, they were incomplete and did not contain proposed resolutions.
- These FAQs became known as the “MOU” FAQs after the RES/EPRI Memorandum of Understanding.

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Alternate FAQ Resolution

- After several months of minimal progress, NRR management determined the need to close the outstanding PRA-related FAQs
- A description of the process that was to be used to close these FAQs is described in a 6/1/2009 letter to NEI
- A number of open PRA-related FAQs (with proposed resolutions) were also closed
- Aligns with regular FAQ process described in RIS 2007-019

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Alternate Resolution Process Steps

- Step 1: NRR and RES develop interim position
- Step 2: RES engages EPRI under MOU to obtain comments [non-public]
- Step 3: NRR and RES resolve comments
- Step 4: NRR releases position for public comment
- Step 5: NRR and RES resolve public comments
- Step 6: NRR issues final position

Example Timeline: FAQ 08-0046

TOPIC: Incipient fire detection

- 4/08: Problem statement introduced into FAQ process – no proposed resolution
- Balance of 2008: Several monthly FAQ public meetings are held; minimal progress realized
- 5/1/09: NRC draft interim position sent to MOU

Example Timeline Continued

- 5/19/09: Comments received
- 6/1/09: Alternate resolution process published
- 6/26/09: NRC interim position released for public comment
- 7/31/09: Comments received
- 12/1/09: NRC closure memo issued

PRA FAQ Resolution Breakdown

Total PRA FAQs	16
Standard resolution path	7
Alternate resolution path	9
With initial proposed resolution	4
Without initial proposed resolution	5

Key Lessons

- When used as intended, the FAQ process is very successful.
- An initial proposed resolution is vital to the successful collaborative resolution of any FAQ

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PRA FAQ Details (Backup)

FAQ	Topic	Resolution Proposed?	Alternate Resolution?
06-0016	Ignition source counting guidance for electrical cabinets	Yes	No
06-0017	Ignition source counting guidance for high energy arcing faults	Yes	No
06-0018	Ignition source counting guidance for main control board	Yes	No

PRA FAQ Details Continued (Backup)

FAQ	Topic	Resolution Proposed?	Alternate Resolution?
07-0031	Miscellaneous fire ignition frequency binning issues	Yes	No
07-0035	Bus duct counting guidance for high energy arcing faults	Yes	No
08-0042	Fire propagation from electrical cabinets	Yes	Yes
08-0043	Cabinet fire location	Yes	Yes

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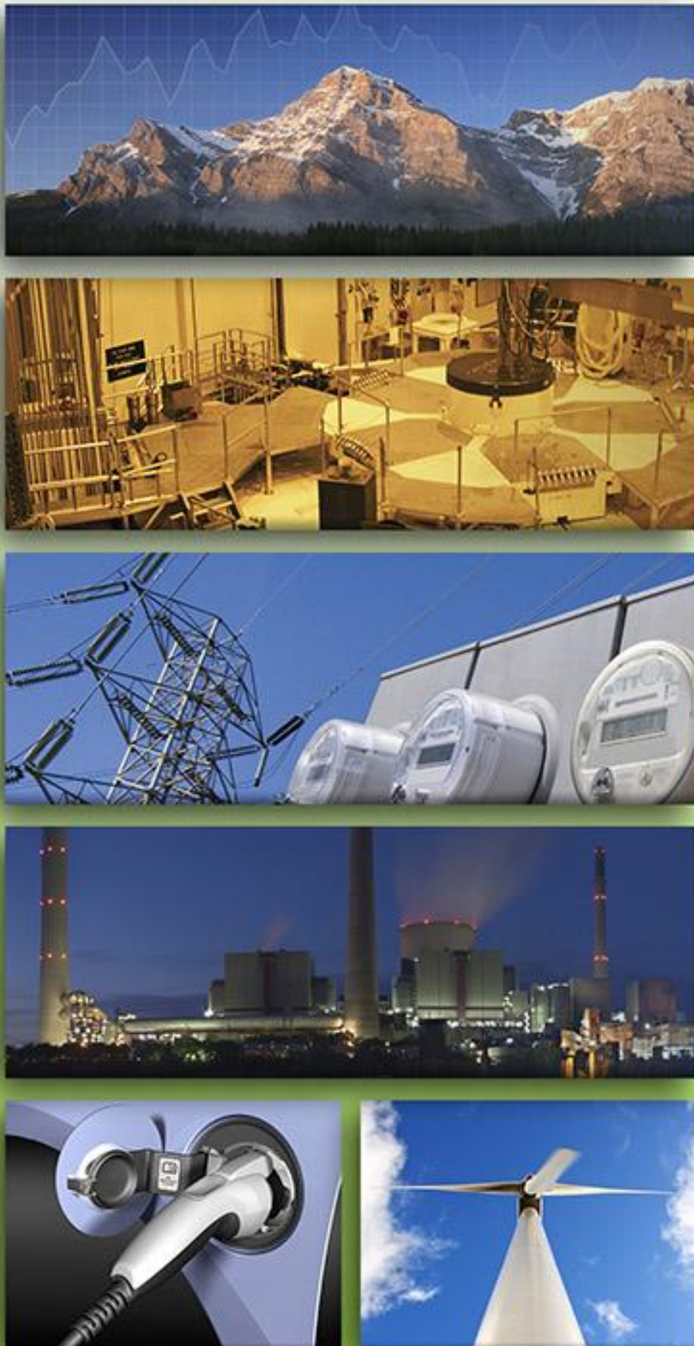
PRA FAQ Details Continued (Backup)

FAQ	Topic	Resolution Proposed?	Alternate Resolution?
08-0044	Large spill oil fire size	No	Yes
08-0045	Fire Growth in Electrical Cabinets	No	Withdrawn
08-0046	Incipient Fire Detection Systems	No	Yes
08-0047	Spurious Operation Probabilities	Yes	No

PRA FAQ Details Continued (Backup)

FAQ	Topic	Resolution Proposed?	Alternate Resolution?
08-0048	Fire Ignition Frequency Update	No	Yes
08-0049	Cable Tray Fire Propagation	No	Yes
08-0050	Manual Fire Non Suppression Probability	No	Yes
08-0051	Hot short duration	Yes	Yes
08-0052	Transient Fires	Yes	Yes



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Fire PRA FAQ Process

Ken Canavan
EPRI

ACRS PRASC
December 14, 2010

FAQ Process – NUREG/CR-6850 Supplement 1

1. NRR staff, in consultation with RES staff, will develop an Interim Position for each FAQ.

2. NRR will transmit the draft Interim Position to RES within two weeks.

3. RES will engage EPRI under the MOU to obtain comments on the FAQ Interim Position within two weeks from receipt of the NRR draft. The MOU Team (RES and EPRI) may agree, disagree, or concur on additional confirmatory research.

4. RES will return the FAQ Interim Position to NRR with recommendations, as appropriate, within five weeks after the start of the process.

FAQ Process – NUREG/CR-6850 Supplement 1

5. NRR will appropriately incorporate recommendations generated through review under the RES/EPRI MOU and provide a proposed resolution of the FAQ for industry and other public stakeholder consideration within seven weeks after the start of the process.

6. Industry and other public stakeholder comments will be received and appropriately considered in finalizing the FAQ resolution and issuing the final FAQ closure documentation within sixteen weeks of the start of the process.

Status of Topic Resolution

FAQ #	Topic	Status	Fire Action Matrix ID
06-0016	Counting cabinets	Closed	
06-0017	Counting cabinet HEAF sources	Closed	
06-0018	Counting Main Control Board	Closed	
07-0031	Misc. frequency binning issues	Closed	
07-0034	Determination of HRR from non-vented cabinets	Withdrawn	2.2
07-0035	HEAF for bus ducts	Partial	2.7
08-0042	Propagation from electrical cabinets	Open	2.2, 2.9
08-0043	Location of fire in electrical cabinet	Partial	2.9

Status of Topic Resolution (continued)

FAQ #	Topic	Status	Fire Action Matrix ID
08-0044	Pump Oil Fires	Partial	1.4
08-0045	Incipient growth phase in electrical panel fires	Open	1.3
08-0046	Incipient fire detection systems	Partial	1.5
08-0047	Spurious operation probability	Open	3.1, 3.2
08-0048	Fire ignition frequency trend	Open	1.1, 1.2
08-0049	Cable tray propagation	Open	
08-0050	Manual non-suppression probability	Partial	1.6
08-0051	Hot short duration	Partial	3.2
08-0052	Transient fire growth rate	Partial	3.2

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BACKGROUND

High Energy Arc Faults for Bus Ducts

FAQ:	HEAF for bus ducts (07-0035)
Status:	Partially Resolved
Issue:	Addressed counting and fault placement for: Segmented, Iso-phase, Non-segmented and Cable
Problem:	Guidance for zone of influence is conservative
Resolution:	Action matrix item 2.7 Review of data from bus duct events and formulation of revised treatment

Propagation from Electrical Cabinets

FAQ:	Propagation from electrical cabinets (08-0042)
Status:	Open
Issue:	Allowed screening of unvented cabinets that are robustly secured Clarified that fire-sealed does not mean fire-rated
Problem:	Likelihood of propagation outside the cabinet was not pursued to get the screening question resolved Heat release rates different cabinet configurations left unresolved Experimental data used to generate the HRR values mixes experiment types and does not take into account actual configurations
Resolution:	Action matrix items 2.2 and 2.9 Address HRR and propagation as a function of cabinet characteristics and configuration

Location of Fire in an Electrical Cabinet

FAQ:	Location of fire in an electrical cabinet (08-0043)
Status:	Partially Resolved
Issue:	Addressed placement of the cabinet fire for fire modeling purposes
Problem:	Does not address configurations where no propagation occurs – More likely case for many configurations In original FAQ, but dropped during final stages of resolution
Resolution:	Action matrix item 2.9 Review of database and development of revised treatment based on cabinet-specific factors

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Pump Oil Fires

FAQ:	Pump oil fires (08-0044)
Status:	Partially Resolved
Issue:	Main Feedwater Pump oil fire treatment addressed
Problem:	Original question dealt with all pump oil fires Resolution left all but MFP unresolved
Resolution:	Action matrix item 1.4 Extend the MFW pump fire size argument to other pump types Investigate ways to model both leaks (small, med, large) and spills (small, med, large)

Incipient Detection Systems

FAQ:	Incipient detection systems (08-0046)
Status:	Partially Resolved
Issue:	Credit for aspirating smoke detectors installed in a specific configuration
Problem:	Difficult to apply for configurations outside the one explicitly described in the interim resolution
Resolution	Action matrix item 1.5 Refine FAQ 08-0046 to address different configurations on a more generic basis

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Spurious Operation Probability

FAQ:	Spurious operation probability (08-0047)
Status:	Open
Issue:	Provided an interim interpretation for use of the existing data
Problem:	Behavior of hot shorts remains unresolved Joint NRC/Industry panel is reviewing the AC and DC test data to provide long term resolution
Resolution:	Action matrix item 3.1 and 3.2 DC circuit testing completed. Need to post-process data into DC circuit hot short probability and duration curves Extend the lessons learned into AC circuit hot short recommendations

Fire Ignition Frequencies

FAQ:	Fire ignition frequencies (08-0048)
Status:	Open
Issue:	Acknowledged that there appears to be a change in the data trajectory post 1990
Problem:	Does not allow plants to use the newer data pool if the change in data (from new to total pool) would be significant, eliminating any benefit from using the newer pool
Resolution:	Action matrix items 1.1 and 1.2 Revise the FEDB and include data through 2009 Develop revised fire ignition frequencies

Cable Tray Propagation

FAQ:	Cable tray propagation (08-0049)
Status:	Open
Issue:	Provides guidance for two configurations
Problem:	Leaves all other configurations (e.g., in a cable spreading room where cable trays may run the entire upper half of the room in close proximity and in all directions) unresolved
Resolution:	Not explicitly included in action matrix Items expected following publication of CHRISTIFIRE report

Manual Non-Suppression Probability

FAQ:	Manual non-suppression probability (08-0050)
Status:	Partial Resolution
Issue:	Addressed suppression by personnel that detected the fire
Problem:	Non-suppression curves used in the response are conservative
Resolution:	Action matrix item 1.6 Develop recommended approach for non-suppression curves

Hot Short Duration

FAQ:	Hot short duration (08-0051)
Status:	Partially Resolved
Issue:	Provided duration for some AC control circuits
Problem:	DC circuits not addressed Joint NRC/Industry panel is reviewing the AC and DC test data to provide long term resolution
Resolution:	Action matrix item 3.2 DC circuit testing completed Need to post-process data into DC circuit hot short probability and duration curves

Transient Fires

FAQ:	Transient fires (08-0052)
Status:	Partially Resolved
Issue:	Addressed non-suppression curve to be used in MCR Provided fire growth times for certain types of transient fire sources
Problem:	Left open other types of transient combustibles Did not address the disconnect between the types of combustibles modeled and the transient fires in the operating experience
Resolution:	Action matrix item 2.3 Analysis may be needed to develop a more accurate HRR estimate for transient fires Address generic 320 kW HRR used for 98 percentile Ensure accurate reflection of the plant control procedures

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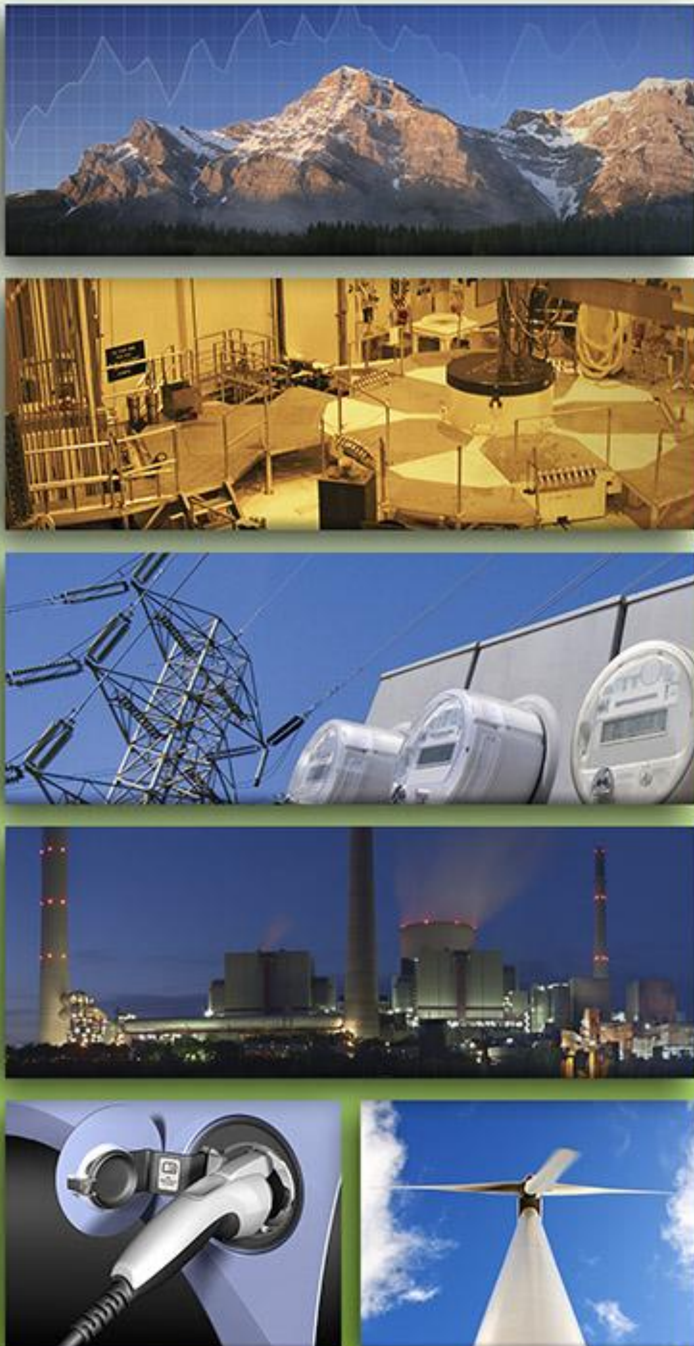

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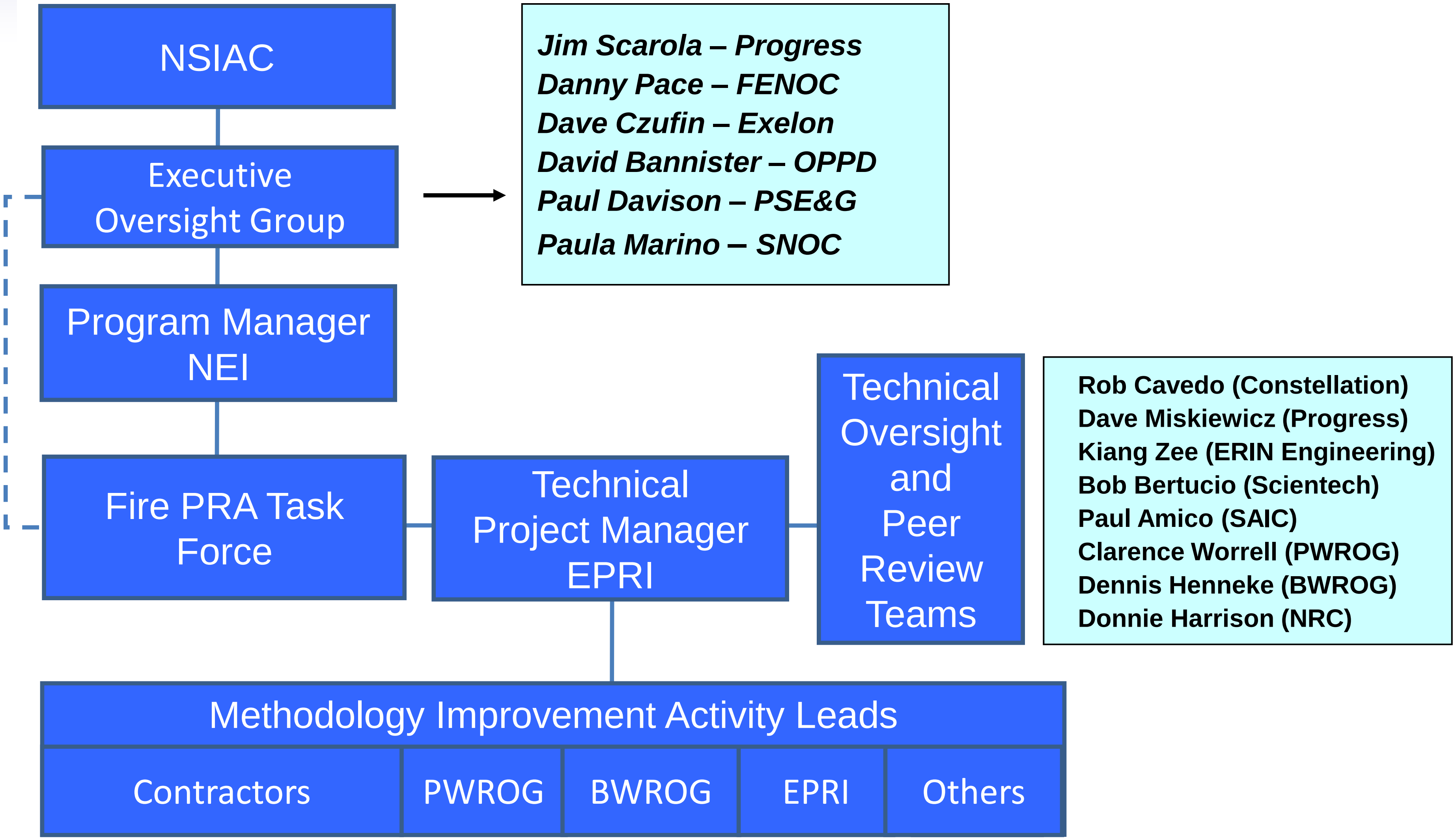
Fire PRA Research Coordination

Rick Wachowiak, EPRI
Ken Canavan, EPRI

ACRS PRASC
December 14, 2010

Fire PRA Industry Organization



Characteristics of Fire PRA Research

- Foster development of more realistic and consistent methods
- Modeled after internal events processes
- Relies on expert peer reviews
- NRC participation is desirable
  - Cognizant of process used for each item
  - Understand the limitations of the models
  - Stable regulatory environment

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Categories of Fire PRA Research

- Three categories
  - Development of methods and models
  - Testing to support the methods and models
  - Tools to implement methods and models
- Methods and models drive the testing and tools
- Coordination with industry groups (e.g., owners groups and NRC) is different between the categories

Tools Research

- Industry identifies needs for tools to implement methods and models
- Addresses efficiency
- Typically independent of the NRC

Experimental Research

- Industry or NRC identifies testing that is needed to support methods and models
- Address large uncertainties
- Tends to have long timeframe
- Highest level of coordination needed

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Experimental Research – Conceptual Coordination Model

- Defined a scope of experimental research based on nature of model, application of results, etc.
- Identifies the phenomena to be investigated
- Specify the parameters for the experiments
- Reviews the results
  - Determine adequacy
  - Determine applicability
- Results published / presented after wider review

Process given to an "expert panel" type approach

Methods and Models Research

- Industry or NRC identifies methods of models needed
  - Address realism
  - Address efficiency
- These can be generic, application specific, or plant specific
- Need for coordination depends on the topic

Methods and Models Research – Coordination Model

- Anyone can propose a method or model to EPRI
  – Must champion the method
  – Define the need for the method
  – Provide specific application examples
  – Drafts the report (EPRI coordination)
  – Expectation that the method will be public
- EPRI makes "abstracts" available
  – Gauge applicability / priority
  – Panel qualifications

Methods and Models Research – Coordination Model (cont.)

- Expert panel review
  - Defined qualification of members
  - Six to ten members ideal
  - NRC participates subject to qualification requirements
- Deliberations published as part of the method report
- Iteration may be required
- Intent is to determine the boundaries within which the method / model is applicable
- EPRI publishes final method / model
  - Joint publication under MOU is an option

Research Framework Summary

- This framework provides a structured, scrutable way to introduce the latest information
- Informed by the needs of the users
- Efficient way to distribute information to the industry
- Consistent with internal events PRAs
- Fire PRA action plan activities being worked under this framework today

Fire PRA Action Plan – Category 1: Fire Initiation, Detection, Suppression

1.1 Fire events database

1.2 Fire ignition frequency

1.3 Incipient fire growth in electrical cabinets

1.4 Oil fire severity

1.5 Credit for incipient detection

1.6 Fire suppression probabilities

Fire PRA Action Plan – Category 2: Fire Damage Assessment

2.1 Fire growth and comparison with data

2.2 Electrical cabinet peak heat release rate (HRR)

2.3 Transient ignition source HRR

2.4 Hot work HRR

2.5 Other HRRs

2.6 Switchgear HEAF zone of influence (ZOI)

2.7 Bus duct HEAF ZOI

2.8 Damage to sensitive electronic equipment

2.9 Electrical cabinet propagation

2.10 Fire modeling guidance

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Fire PRA Action Plan – Category 3: Plant Impact, Fire PRA Scenarios & Quantification

3.1 AC circuits hot short probability and duration

3.2 DC circuits hot short probability and duration

3.3 Human reliability Analysis (HRA) methods and performance shaping factors for fire PRAs

3.4 Control room modeling and treatment in the fire PRA

3.5 Address unrealistic model simplifications

PRA Action Plan –
Category 4: Other Fire PRA Items

4.1 Update of the fire PRA section of the standard, given lessons learned from the initial peer reviews

4.2 Additional peer review guidance.

4.3 Results comparison

4.4 Fire PRA and NFPA 805 training

4.5 Support for peer review of new methods

Summary

- This framework provides a structured, scrutable way to introduce the latest information
- Informed by the needs of the users
- Efficient way to distribute information to the industry
- Fire PRA action matrix activities being worked under this framework today
- Consistent with internal events PRAs

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NRC Perspective on Fire PRA Research

Christiana Lui, Director, RES/DRA
Mark Salley, Chief, RES/DRA/FRB

December 14, 2010

ACRS Reliability and PRA Subcommittee Meeting

Framework

- Focus on NRC regulatory needs
  - Technical basis for regulatory products (Regulations, Regulatory Guides, etc.)
  - Develop tools, models, methods, and data for safety evaluations
- Work closely with the licensing offices in shaping the research program
  - Agency-mandated programs
  - Short-term needs
  - Long-term outlook

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Mechanisms

- In-house analyses
- Contractual support
- Domestic and international collaborative efforts
  - Identifying common development needs
  - Building on strengths offered by the participants
- Transparency, traceability, and openness

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Current Activities – High Priority

- Fire PRA Training (EPRI)
- Update NUREG/CR-6850 (EPRI)
- Long-Term 10 CFR 50.48(C) Support
- Fire Model Application Guide (EPRI, NIST)
- DC Circuit Testing (EPRI)
- Requantify Spurious Actuation (EPRI)
- Fire Events Database (EPRI)
- Fire Protection Metrics Updating (EPRI/NEI)

Current Activities – High Priority (cont.)

- HRR & Flame Spread Testing
- Kerite Cable Performance (EPRI)
- Effects of Cable Fire Retardant Coatings & Cable Tray Covers
- Incipient Detection System Performance (EPRI)

Current Activities – Medium Priority

- HRA for Post-Fire Human Actions (EPRI)
- Electrical Cabinet HRR
- Compensatory Measures Evaluation
- Fire Protection Meeting Support

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Current Activities – Low Priority

- Observe Industry Fire Testing
- Low-Power Shutdown Fire PRA (EPRI)
- Smoke Damage to Instrument & Control Circuits
- Gaseous Fire Extinguishing Agents
- Documentation of Circuit and Manual Operator Action Closure
- Documenting Regulatory History of Radiant Energy Shields & Fire Resistant Cables

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Fire PRA Results and Operating Experience

Sunil D. Weerakkody, Ph. D.

Deputy Director-Fire Protection

NRR\DRA

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Without knowing the degree of use of plant specific insights (e.g., detailed fire modeling tools used by plants X and Y) staff cannot meaningfully address the difference between industry statements w.r.t. inconsistency between op. experience and fire PRAs.

Example from Beaver Valley (Compartment 1-NS-1)

- *Initial fire PRA screening model CDF = 7.7E-03/Yr*
- *Latest detailed fire modeling CDF = 8.6E-06/Yr*

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NRC staff will address the ACRS question using data that is readily available to the staff.

Results of staff analysis of OE

- Browns Ferry is included in the estimations ~ order of 1 E-5/yr

- Browns Ferry fire is excluded in the estimation ~ order of1E-7/Yr

Risk reductions associated with post Browns Ferry actions (App. R) vary among operating plants.

- Pilot plants ~ 1E-5/yr
  - Harris analysis
  - Oconee analysis

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Impact of Fire PRA Uncertainties on Other PRA Applications

Sunil D. Weerakkody, Ph. D.

Deputy Director-Fire Protection

NRR\DRA

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OTHER APPLICATIONs

- *10 CFR 50.65*
- *RI-ISI*
- *NOEDs*
- *Risk-Informed Licensing Actions*
- *Tech Spec 5B Initiative*
- *Tech Spec 4B Initiative*
- *Reactor Oversight Process*
- *10 CFR 50.69*
- *10 CFR 50.46(a)*
- *Prioritization of licensees' resources for safety improvements*
- *…………………*