MEMBER POWERS: I guess what I'm really worried about is, we've done, I don't know 17 tests something like that.

MR. NOWLEN: This set was 18, yes.

MEMBER POWERS: And you've got quite a few phases here. But a fairly limited set of experimental conditions, a fairly limited number, that I have a problem with the tests. It's very difficult for me to extrapolate them to the specific conditions of fire I'm likely to have in a nuclear power plant. And so I'm sitting here saying, gee, can I take that, use that 80 percent, should I correct it, should I fiddle with it, should I spread it out a little to account for all the problems I have in using the test data correctly?

What I'm asking for is, what are the caveats I put on this 80 percent before it becomes a number carved in stone?

MR. NOWLEN: Again, the caveats are that this is a mechanistic view of the way the cables themselves fail. It does not tie you to the circuits. It doesn't tell you whether you've got a spurious actuation yet or not. Now beyond that, you know, the issues of the test limitations of the data that we have, I place high confidence in this number as a indicator of the mechanistic mode of cable failure.

MEMBER WALLIS: I think it would very different if you had an external fire like yours or if you have a branch type fire where the fire was in the cables themselves.

MR. NOWLEN: I'm not so sure. I think it's -- I think you're still going to see this same behavior. We saw it -- you know, again, we did a review of that existing literature that was a number of tests that had explored this behavior in not quite as clear a manner but we saw very consistent numbers coming out of it on the order of 80 percent or more of these faults were always occurring conductor-to-conductor and some of those were, in fact, multi-tray tests. The one set that we had that was most complete was four tray tests where the fire was ignited in one tray and spread to 2, 3, 4 and those saw the same type of behavior, again 80 percent of --

MEMBER WALLIS: I guess failure to the tray is most likely for some reason the tray gets very hot not the -- it's not so hot -- I think it's from the tray rather than -- that would rather different to me than a fire from above that heats the cables first and not the tray.

MR. NOWLEN: Well, these were fires from

below and the tray and cables heat together really. I mean, they're an intimate system. The only way I could think of that is some how inducing inductive heating in the tray or something like that.

MEMBER WALLIS: A radiation fire to the tray rather than an inductive fire or some --

MR. NOWLEN: Yeah, that --

MEMBER WALLIS: That might make a difference, I don't know. It's speculative.

MR. NOWLEN: It might, yes. I suspect that you will still see in this mechanistic view of the cables failing, I think you're still going to see this number, take it to the bank and put it in your account. I think this is the right number.

MEMBER WALLIS: Was the tray perforated or was it solid?

MR. NOWLEN: This was a ladder. Yeah, it's a ladder. Yeah, it's like an aluminum ladder.

MEMBER WALLIS: An open tray?

MR. NOWLEN: Yes, that's the predominant configuration.

MEMBER WALLIS: That must make a difference.

MR. NOWLEN: It might, it might.

MEMBER SIEBER: It's like just being out in the air.

MR. NOWLEN: It's like -- well, except that you have the rungs supporting -- you know, the cables are resting on the rungs and that's a pressure point.

MEMBER SIEBER: That's the grounding.

MR. NOWLEN: That's where the ground path is, yeah.

MEMBER KRESS: Yeah, but that may a cooler spot, too.

MR. NOWLEN: It's possible, yes.

MEMBER KRESS: I think what's happening is you're heating up in between.

MR. NOWLEN: Okay, let's see.

MEMBER POWERS: Well, I mean, here's the -- we're talking about the research program here and you've gone and you've got a gee-whiz test and you've got some fuel for the modes of containing -- of conductive failures but I don't have a physical model for the cable here. So, I can't take an arbitrary fire and apply those results, whether it's blow torch over the top of the cable, whatever, some other fire and so I ask the question, why isn't the research program developing this mechanistic cable model, the whole shebang.

MR. NOWLEN: Can I defer an answer --

MEMBER POWERS: Is that the question that's on your mind, Graham?

MEMBER WALLIS: It's been on my mind for a long time, yes. This seems to very much the gee-whiz try it and see what happens type research.

MR. NOWLEN: Okay, let me defer that to my last slide.

MEMBER WALLIS: Generalizing it to some other situation and it becomes different.

MR. NOWLEN: Yes, I agree. Let me defer my answer to the last slide. Okay, let's see, the incidents factor as we saw, some of these that we thought to important proved to important. I think we've covered those. There was one new one that popped up. We had identified the circuit details and a general influence factor. But specifically in the NEI tests, the MOV circuits, these control power transformers turned out to a very important effect here. We hadn't picked up on that specifically. We had identified general configuration as a factor and I believe Fred will cover that, so I'm not going to get into detail there.

We did see a broad consistency between the IR and the MOV results that Fred's going to tell you about. The idea that the embedded conductors fail later. The conductors shorting to nearest neighbors, short complex behaviors, durations of the hot shorts and spurious actuations that were observed and the fact that all of the cables eventually shorted to ground, all those were consistent between the two sets.

MEMBER WALLIS: I'm curious about what happens if you turn on the sprinkler before the cables fail. Is it more likely to lead to failure, early failure?

MR. NOWLEN: That's a question we didn't answer. The sprinklers were turned on in a number of the tests but usually it was after the cables had all failed and fuses had blown. There was one case -- there was one -- no, okay, I'm going to let Fred answer that one then, because Fred knows the details of that.

MEMBER KRESS: On your second sub-bullet on that slide there, I would hard-pressed to see how conductor could short to something which wasn't as near as many.

MR. NOWLEN: We agree. Well, again, you know, these were things that we thought we knew and, you know, we've confirmed it. We've said that. These tests clearly give us definitive, yes, that's what happens.

CHAIRMAN ROSEN: This question about what would happen if the sprinkler turned on is that same question I asked this morning about damage to operable safety system equipment in the event of actuation of fire suppression equipment, either automatic or manual. We were talking about it in the context of a fire brigade but I was really thinking about this situation, too.

MR. NOWLEN: Yeah, yeah.

CHAIRMAN ROSEN: You said you didn't handle that in the modeling. You were talking about modeling.

MEMBER SIEBER: The other thing, as long as we're talking about things that bother us, one of the things that bothers me is not all cables in nuclear power plants are installed horizontal. Somehow they go up too, and down. So we don't have any tests of what happens when the cables are --

A VOICE: Some of these tests --

MR. NOWLEN: Yeah, some of them were vertical trays as well.

CHAIRMAN ROSEN: Oh, were they?

MR. NOWLEN: Yes.

CHAIRMAN ROSEN: And did you see any

difference in failure modes, anything different about that?

MR. NOWLEN: It wasn't a very strong influence factor. There were some differences. It wasn't very strong.

CHAIRMAN ROSEN: Because you showed us a plan view and it all looked like it was all at one level.

MR. NOWLEN: Yeah, I didn't show you the one with the vertical tray.

MEMBER SIEBER: I would think that the vertical tray would deteriorate faster because, you know, there's more space for combustion. On the other hand, gravity is not pulling cables into ground. They're tied in there with tie wraps.

MR. NOWLEN: That's right, that's the point is they are tied in with tie wraps, so it's not like they're sort of hanging out in air. That we didn't do. We didn't do the air drop configuration and --

MEMBER KRESS: But, you're not actually burning this insulation.

MR. NOWLEN: Not explicitly. In some sense there was some burning of the cables, but not --

MEMBER KRESS: It wasn't part of the test.

MR. NOWLEN: No, that wasn't part of the

test.

MEMBER KRESS: You're just heating it up and then --

MR. NOWLEN: Yeah, these were intended to exposures.

MEMBER WALLIS: Suppose I do a one-dimensional analysis? You have a round conductor and you have this stuff, and I instantaneously impose a temperature of x degrees on the circumference and it would seem not too difficult to develop some idea of what happens as a transient, chemically, thermally, diffusing and so on, one dimensional radial transport phenomenon. This must have been done by somebody?

MR. NOWLEN: Yes, it's --

MEMBER KRESS: I don't even think you need that. I think what you've got is radiant heating and conductive heating of the gases go through --

MEMBER WALLIS: Whatever you want to put on for your outside --

MEMBER KRESS: -- going through a --

MEMBER WALLIS: I'm trying to make the problem simple.

MEMBER KRESS: Well, this is --

MEMBER WALLIS: No, it's not because I've got a uniform temperature. I think it's an easier problem radiant than a convective flow.

MEMBER KRESS: Well, all I'm trying to do is find out when the given cable reaches a given temperature at a given spot. That's pretty simple.

MEMBER WALLIS: Well, I'm trying to figure out what's the given mechanism and it appears it has to some sort of diffusion of charred products through the char or something like that.

MEMBER KRESS: I think it's just the mapping of the cable.

MR. NOWLEN: Yeah, it's primarily a diffusion of heat into the cable.

MEMBER WALLIS: But that seems to me is much too quick. It seems to me --

MEMBER KRESS: I think when you get it up to the melting temperature or some other magic temperature, it fails. And I think you can correlate the temperature --

MEMBER WALLIS: That's too quick, that's too quick.

MR. NOWLEN: Well, keep in mind though --

MEMBER WALLIS: I think an order of magnitude, for heaven sake. Well, this is somewhat transient. What is the thermo relaxation time of this installation? It must very short.

MR. NOWLEN: Well, it's a very large mass of cables. It's not very --

MEMBER WALLIS: It's a very large mass?

MR. NOWLEN: It's a mass of cables, yes. It's big with lots of copper and lots of thermo mass.

MEMBER WALLIS: This is a lots of argument rather than a quantitative one? You're going to go back to freshman class here.

MR. NOWLEN: It's a semi-quantity. It was a --

MEMBER WALLIS: But I would encourage somebody to do some of these simple -- relatively simple calculations that we think it's thermo-mass, gee, whiz when we work out the numbers we get 10 seconds that are at 3,000 so we'd better change our minds or whatever.

MR. NOWLEN: I agree, and as I mentioned up front, we have barely scratched the surface of this data set. We've looked at it in this context, but there are many other contexts in which this data is interesting and important.

MEMBER WALLIS: I just can't see how you could resist doing at least one homework problem on this.

MR. NOWLEN: You haven't seen my work

schedule. Okay. Quickly, two more slides; we did see some unique things from the MOV tests, certainly. I think it's worthy of noting that in most of the tests here cables did fail, at least one device in the MOV circuits did actuate.

MEMBER WALLIS: Can I ask -- I'm sorry to keep on asking questions. Would you give me, please, the dimensions and properties of the stuff so that I could do a homework problem? Would that an unreasonable request?

MR. NOWLEN: No, sure.

MEMBER WALLIS: Maybe after a break or during a break.

A VOICE: I think it's in the report.

MEMBER WALLIS: Well, I don't think I have the report. I'm not sure I'm in the right pipeline here.

MR. NOWLEN: Yeah, we can get it to you. I don't have that information with me, but I certainly have it at home.

MEMBER WALLIS: Maybe someone has the report here I can look at. Okay, thanks.

MR. NOWLEN: The one you need is the test report, the published NUREG CR, not the draft.

Okay, the MOV tests, we did see in several tests there was more than one device actuation. In one test the -- there was one test where again, there was four MOVs typically in each test and there was one test where all four of the MOVs saw at least one spurious actuation hit. So, I think that was very interesting and it's important information for us. The device actuations due to intra-cable hot shorts were the most common but there were a number -- a small number of interactions due to inter-cable.

MEMBER POWERS: Then spurious actuation did occur.

MR. NOWLEN: It tells me that these are not incredibly low probability events.

MEMBER POWERS: Yeah, I mean, that's all it tells you, right?

MR. NOWLEN: Well, I think that's an important insight. I think there's been a lot of argument about what the likelihood of these is. I think we have a much better feel for what these likelihoods are today than we did two years ago.

CHAIRMAN ROSEN: These were originally thought to once in a lifetime, once in a million kind of events and in fact, they're not. These probable events in a serious fire. That's the conclusion I take away. You have a serious fire with a lot of electrical cables involved, you're going to have -- you'll probably have a hot short.

MR. NOWLEN: I tend to agree, yes.

MEMBER POWERS: I mean, I'm not sure how to interpret that exactly. It would probably operate from the frame of mind that say, I always thought actuations would occur.

CHAIRMAN ROSEN: Well, you know, I've always thought they wouldn't and, you know, now I think these tests say to me that they probably will. They're not all going to -- not every cable that's involved is going to show a hot short, but if you have a lot of cables involved and a persistent hot fire, you're probably going to have one.

MEMBER POWERS: What I struggle with a little bit is right now I have deterministic kind of analyses that say though shall hypothesize by shorts, possibility of spurious actuation and you do it for every conceivable configuration that you've got. Okay, so now I say, well, I'd really like to put this on a more probabilistic frame and do this in a less demanding fashion. And I'm not sure I can use this to these results, do that.

And so I'm asking is there -- am I wrong about that? Has my life changed? I mean, I want to do a sophisticated job. Can I use these results to change my life and I'm not sure I can but see my next question is, can I do a test in which I do change my life. And then my third question is, should we do a test to change my life. I eventually get back to you, David.

MEMBER WALLIS: The thing is can we devise a test which will change your life?

CHAIRMAN ROSEN: Have you ever changed your mind about anything is the question? Let me take control here for a minute and tell you what's going to happen. We've got 20 minutes more till we break and four more minutes of that time is up for you and the rest is reserved for Fred.

MR. NOWLEN: Well, we still have Fred as well.

CHAIRMAN ROSEN: That's right. He's got -- after you get done messing with the four minutes you've got, he gets the next 15.

MEMBER POWERS: Well, I thought he got the break?

CHAIRMAN ROSEN: What?

MEMBER POWERS: I thought he got the break.

CHAIRMAN ROSEN: No.

MR. NOWLEN: Okay, the last slide. There

are challenges that -- and areas of uncertainty, clearly that we have not yet resolved. The first one gets to the point that was raised earlier, the combinatorial models, this mechanistic connection between the behavior of these cables and the behavior of some circuit that I'm specifically worried about in my plant. There have been some proposals made in this area, in particular Dan Funk, one of the industry folks, has proposed a model. We haven't really had a chance to explore that fully to see how well it works. I think we're -- you know, we're working that direction. We're not quite there yet.

The DC versus AC we talked about, still some uncertainty there. We're not quite sure why. There's a little uncertainty on the conduits, not quite so bad. The influence factors, we didn't look at all the influence factors and some of them have been bandied about here, the things that we didn't look at. So we need to understand those better or at least understand which ones are going to make a difference to us. Quantification for a specific case still requires some expert judgment.

And this is just the last point, can you use this? Yes, absolutely. I argue this is the best stuff you've got. Now, can you just take the number and apply it in your analysis? No. It still takes some expert judgment to make the connection between the behaviors we observed in these tests and your circuit and your cable. That still has to happen and we're still partly expert judgment here.

MEMBER POWERS: This is the problem I have when you tell me use expert judgment to transfer the results from these tests to the real accident, without experimental data, how do I have expert judgment in this thing?

MR. NOWLEN: I understand. It's a challenging problem.

MEMBER WALLIS: By expert judgment, he means guesswork and --

MEMBER POWERS: Hope and prayer it looks to me like all you've got going for you right now. I mean, it's -- the only way I can make this transition is to have a mechanistic mental model of the fire both the accident fire and the test fire, and a mechanistic mental model of the way the cable behaves. Now the trouble with that is that it's my mental model and I don't give the opportunity for Graham to criticize my momentum equation in there because I don't write the damn thing down.

MEMBER WALLIS: I don't think the momentum equation is all that important in this --

MEMBER POWERS: Well, it's never very important.

MEMBER WALLIS: It isn't going to go very far very fast.

MEMBER POWERS: But I also don't let you criticize my chemical kinetic model because you don't ever get to see it here.

MEMBER WALLIS: I don't think you have one.

MEMBER POWERS: Oh, I always have a chemical kinetic model, you can go to the bank on that one.

CHAIRMAN ROSEN: You're using up his four minutes.

MR. NOWLEN: Yes.

MEMBER POWERS: I'm using my four minutes here. So the question we come back to is the one you deferred, is why aren't we producing these mechanistic models?

MEMBER SIEBER: The better question, a forerunner to that is, do you think you have enough data to validate --

CHAIRMAN ROSEN: Not from these tests.

MEMBER SIEBER: This gives good insight but it's not a validated model.

A VOICE: This is the way you develop a model.

MR. SIU: I think we are well beyond where we were, as Steve indicated, two years ago. I think we actually do have some valid test data which certainly doesn't cover all possible conditions. I'll certainly grant that. I guess one of the reasons that we haven't thought about the mechanistic model, maybe that's something we'll need to address as we update our research plan.

When we think about the application of that mechanistic model in the real world PRA, start thinking about the data demands of such a model, I get a little worried. It's my similar fears about computational fluid dynamics. Yes, I know I can do very nice jobs -- a very nice job using those models but I have to develop the model actually to employ that. I have to put the cables in there, I have to put in the supports, I have to do a lot of things that take a lot of time and effort and maybe I don't need to do that.

You asked that question, what's good enough? I'm not sure -- let me back up a little bit. Some of the factors Steve has mentioned before in, I think, a previous talk, we talked about where the cable is in the cable tray. Is it on top, is it on the bottom, because the effect of the weight on top of that cable could make a difference. How are the wires hooked up, which one is the power wire, which one is not? These are things that if you get into a very sophisticated model, which is quite possible, I think it's quite feasible to develop this, you're going to have to do a lot, so this is -- I'm not saying that we're not going to do this. I'm simply saying that this -- in the past, this is some of the thinking that's gone behind where we are now.

We've put a lot of our resources in this whole program, into this effort and has continued and continued, kind of like Topsy.

CHAIRMAN ROSEN: I'm going to let you finish and then I'm going to let Graham Wallis have a word.

MR. SIU: So I'm just -- and maybe it's a rationalization of why we're not -- we haven't done it to date and again, we're listening and we welcome your input on that.

MEMBER WALLIS: I'm usually very impassioned but now you're giving the standard student excuse that I don't want to do any analysis because I'd have to analyze everything and it would too difficult. I think you can go quite a long way with some relatively simple analysis to figure out what matters and what doesn't matter, what might different about your test and the nuclear plant test and so on. You've got to do that. I don't think it's that difficult.

You cannot say, it's difficult because the model is going to have to too complicated. You haven't even tried it seems to me the simple one.

MR. SIU: Well, I'm sorry, maybe I gave the wrong impression. I'm sure we can come up with a reasonable explanation of what's going on, what's the mechanism driving this. I'm going the next step and saying, how do I apply this in the PRA and that's where I'm -- I have certain expectations of what I think is going to important and therefore, what I'm going to have to model. And if I have to start modeling in this mechanistic, completely mechanistic view where exactly the cable is, sometimes it's on top, sometimes it's on the bottom, sometimes the fire is off to one side, sometimes it's directly underneath, I'm wondering if I'm at a point of diminishing returns.

MEMBER WALLIS: But it's simply time to melt, and you simply --

MR. SIU: Well, no, the time to melt again, that's the problem. I don't -- we know how to model it and we are modeling that. It's this competition between the specific locations of the melt point if you will that's telling me do I connect these two conductors first or these two and if these two conductors are connected first, I might just go directly to ground and I don't have a problem or my trips match actuation device. I'm sorry.

CHAIRMAN ROSEN: All right, thank you very much.

MR. NOWLEN: I will leave my last bullet unstated because that's another hot -- you know, there's another aspect of this that we're not dealing with very well yet and that's the transient behavior and this gets you to some of the regulatory issues of simultaneous, concurrent, sequential, how do I deal with it. And again, that's another challenge that we have. So with that --

CHAIRMAN ROSEN: NEI, it's your 15 minutes.

A VOICE: Surely you can more generous than that.

CHAIRMAN ROSEN: Generosity is not the issue. Wait for Christmas and you'll see generosity.

MR. EMERSON: Thank you. Given the

discussion that has taken place over the last hour and 15 minutes, I've concluded that there is absolutely no way I can do justice to these slides in 15 minutes. Take me time?

CHAIRMAN ROSEN: No, take your 11 minutes.

MR. EMERSON: So I will take my 11 minutes.

CHAIRMAN ROSEN: I'll give you the full 15, but go ahead.

MR. EMERSON: Okay. First I'd like to start by -- you're going to probably have to review the slides to get a lot of the data that I'm going to present but let me just try to summarize briefly what the differences are between what Steve presented and what we presented. Steve was looking for IR results, insulation resistance breakdown. We were looking more for circuit effects in circuits that reasonably approximate what you would see in an actual nuclear plant. Take fire phenomena and determine what would happen to reasonably, accurately portrayed circuits for control cables, for -- which is where you expect the bulk of consequences to with spurious actuations and that was really our goal.

So with that, I'm going to skip the first couple of slides. Now, what I have in my presentation is a quick summary of an EPRI test report that Steve indicated is still -- the report is 400 some odd pages long, covers a great deal of ground and as I say, I'm not going to try to do justice to it. And the last two slides in the presentation are a couple of the more important results of the EPRI expert panel that was convened to determine what the probabilities of spurious actuations are from the results of these and other tests.

Steve gave a pretty good summary of what the tests included. What we will include in the test report, we'll reporting on the test arrangement parameters, electrical results and temperature results and melding those together. The -- you'll see them for all of the 18 tests, you'll see key observations and conclusions and you'll see implications for the NEI guidance document that's being developed to guide the industry in the resolution of circuit failure issues.

Steve presented some profiles or presented one example profile from the IR measurements that he did. I'd like to show one typical example of what you will see in the EPRI report for one of the tests. Now, you can see what this represents, that's one bundle of seven conductor and single conductor cables, 350 kilowatt heat release rate and with the bundle located in the bottom of the tray and the laboratory power supply as opposed to a CPT.

MEMBER WALLIS: What do you mean by the 350 kilowatt heat release rate, that's in a fire of some sort somewhere?

MR. EMERSON: Yeah, that's the heat release rate associated with the fire for this particular test.

MEMBER KRESS: That's basically the rate of gas flow.

MR. EMERSON: Yeah, it's based on the rate of gas flow. That's correct.

MEMBER WALLIS: But you still don't know the heating weight of the cable itself.

MR. EMERSON: That's correct, this was based on the parameters of the fire itself, not of the cable.

MEMBER KRESS: Now, when you talk about a bundle, cables?

MR. EMERSON: Yeah, the bundle is the --

MEMBER KRESS: Are they just strapped together or is there something that --

MR. EMERSON: The bundle is the seven conductors surrounded by three single conductor cable configuration that Steve showed.

MEMBER KRESS: Yeah, my question is, what holds the bundle together?

MR. EMERSON: They are strapped together loosely so that they won't --

MEMBER KRESS: Okay.

MEMBER SIEBER: But the seven has a single jacket, right?

MR. EMERSON: Yes.

MEMBER SIEBER: And the three are on the outside.

MR. EMERSON: Right.

MEMBER KRESS: It has a jacket of what?

MEMBER SIEBER: Some kind of a thermo-plastic material.

MR. EMERSON: It's either thermo-set or thermo-plastic material.

MEMBER SIEBER: Usually the jacket is thermo-plastic even though the insulation may thermo-set.

MEMBER KRESS: Okay, so it's completely closed to the gas flow.

MEMBER SIEBER: That's right. And then the three extra cables are tie wrapped to the outside.

MR. EMERSON: Basically.

MEMBER SIEBER: That's what it looked like in the drawing.

MR. EMERSON: That's correct.

MEMBER KRESS: Okay.

MEMBER BONACA: Which means the outside cables are not --

MEMBER SIEBER: They're not inside the jacket.

MR. EMERSON: Well, they could but we tried to keep them as equally spaced as we could and there were four such bundles in each test in addition to the IR bundle that Steve talked about.

Now, this is a typical temperature profile from the test that shows not only the average and maximum temperatures and when I say that, I mean, these are the temperatures that were -- we had thermo- couples attached to bundles that were adjacent to the test bundle. We didn't want to attach them directly to the test bundle itself because when the jacket goes, then you get some interference between the measurement and the cable itself in terms of sorting. So we put them on the adjacent ones.

MEMBER WALLIS: What's the temperature of the flame?

MR. EMERSON: The temperature of the flame? I'm sorry, was that your question?

MEMBER WALLIS: Yes, the temperature of the flame.

MR. EMERSON: We did not measure the flame temperature directly. We measured the temperatures on the tray and adjacent to the cable bundles and we had two thermo-couples trees that measured temperatures in the hot gas layer and the plume of the fire.

MEMBER KRESS: What kind of gas are you using?

MR. EMERSON: I think it was propane but I'm not --

MEMBER WALLIS: This is just a heat-up of cable. You'd expect a simple RC type transient expediential. It looks a little bit like an expediential to me. No one has tried to model that? You --

MR. EMERSON: No one has tried to model it.

MEMBER WALLIS: Okay. Like an RC, right.

MR. EMERSON: What we've tried to portray with this temperature measurement in addition is there's a line for the -- let's see if I've got this right, for the onset of failure which was basically the point at which you started getting leakage currents and the time when you got full failure which is either a hot short or a short to ground, depending on the particular failure.

This one is a little harder to read and in your package you should have a full size slide. I'm not going to try to describe what all of the curves mean. This particular one indicates when you start off with a zero voltage and then it spikes up, that's where you had a hot short.

MEMBER KRESS: What's the voltage on the top?

MR. EMERSON: This is 120 volts and the nominal voltage that we ran in the conductors that we had powered.

MEMBER KRESS: Okay, so that's the potential difference.

MR. EMERSON: That's the potential difference is 120 AC. So in a case like this, it would start off with zero volts. There would an interaction with a 120 volt cable and it would spike up and you would get a hot short in that case. Whether or not you got a spurious actuation depends on the current and we found pretty much throughout the test that it required a current of about a quarter of an amp to actually get it. When you had a spurious actuation it as associated with a current of about a quarter of an amp.

MEMBER KRESS: That's for a particular MOV or something?

MR. EMERSON: This is for -- the type of MOV we tested, it wasn't actually an MOV, it was a motor started for one and this is a relatively small one.

MEMBER SIEBER: This is a relay in effect.

MR. EMERSON: Yeah, it was a relay, the kind you would find on the typical small valve, small MOV. But below 25 milli-amps you would get -- I'm sorry, before 250 milli-amps, you would get a hot short but not necessarily a spurious actuation.

MEMBER SIEBER: Right.

MR. EMERSON: In a case like this, this shows where you have a short to ground that's going along a 120 AC and then bingo, it falls off when you shorted it out.

MEMBER SIEBER: One point, when you get the short, it's a high resistance short, then there's this relay coil attached to it, it wouldn't go all the way up to 120 volts, would it?

MR. EMERSON: Not all cases did it, but typically you wouldn't get it. The lower threshold was probably about 80 or 90 volts.

MEMBER SIEBER: Okay, so that's the reason why the relay didn't pull in --

MR. EMERSON: Right.

MEMBER SIEBER: -- because you didn't get enough voltage to it.

MR. EMERSON: Right.

MEMBER SIEBER: It's not a current thing.

MR. EMERSON: Okay, I'd like to talk briefly about the summary of the types of failure modes. Now I'd like to emphasize that this slide and the next one are covering hot shorts and then after that we'll talk about spurious actuations and as Steve indicated the two phenomena are not identical with each other.

Okay, in this case what we were trying to do is to illustrate the -- by cable type what generally you got in terms of ground faults or faults to ground versus hot shorts as a percentage of total failures. And we did that, we broke that down for armored, thermo-set and thermo-plastic cable and totaled them. Now, recognize this covers a wide range of fire conditions so this is not -- this is just a very broad indication of the overall results.

What you can take home from this slide is that generally the percentage of ground faults is a percentage of total faults is roughly the same for thermo-set or thermo-plastic cable. The phenomena are different when you go to spurious actuations but for the basic faulting modes that's what we saw. For armored it's a little bit different. There was a higher percentage of ground faults and from what Steve said, you might expect that given the grounded -- the fact that the armor is grounded.

MEMBER SIEBER: A question on that before you move on.

MR. EMERSON: Sure.

MEMBER SIEBER: I take it that some of the hot shorts show up in these numbers covert themselves to ground faults?

MR. EMERSON: Yes, all of them do eventually.

CHAIRMAN ROSEN: But I think this --

MR. EMERSON: I'll talk about duration later.

CHAIRMAN ROSEN: This is the slide where it says that originally we would have argued or some of us or I would have argued that that 31.6 percent is an order of magnitude too high. Now, we see a third of the faults are going to hot shorts.

MEMBER SIEBER: And these are hot shorts that are solid enough to able to actuate the starter coil.

MR. EMERSON: No, these are hot shorts, not spurious actuations.

MEMBER SIEBER: Okay.

MR. EMERSON: This is where we saw evidence of shorting between the conductors and I should indicate that although -- we were measuring two different things. One was actually what happened to a typical circuit, but we were also taking fairly detailed voltage and current measurements to correlate the electrical behavior with what happened in the circuit, so we can see what was actually going on in the circuit at the time of the spurious actuation.

Okay, the next slide has a somewhat different view of this data and rather than looking at it by cable type, we were looking at it as to whether a seven conductor or a single conductor cable. As you see for the seven conductor cable, the percentage -- and again, this is brushing across both thermo-set and thermo-plastic, there's a lot of ways you could slice and dice the data but we chose this one. The percentage of down faults and hot shorts for seven conductor cables is about the same. In fact, it's exactly the same based on the data that we took.

For single conductor cable, you're more

likely to get ground faults. And that's really to expected also because there are more opportunities for hot shorts in a seven-conductor cable. And the next slide I'm going to talking about the spurious actuations rather than the hot shorts and what we saw there. And the first two lines show spurious actuations as a percentage of the total devices where you could have had spurious actuations and the tests that we ran. You can see that there's a much higher percentage for thermo-plastic cable and thermo-set cable. So you can see that although the percentage of hot shorts versus ground faults is the same -- is about the same for the two cable types. The percentage of spurious actuations is different.

And again, given the less robust nature of thermo-plastic cable, that was to expected. Armored is lower because, again, the inherently more rugged construction of the armored cable. The next two lines show spurious actuations as a percentage of the total cable failures and as you can see here, for armored cable, given the two tests that we ran there, this -- you could argue that this wasn't a very complete data set but we -- I'm presenting it for illustration that the percentage of spurious actuations to total cable failures is about 30 percent. For thermo-set it's about 40 percent and thermo-plastic it's about 50 percent.

The last two lines show the average time to failure and as you can see, the lowest average was about 26 minutes for thermo-plastic, 36 minutes for armored and 46 minutes for thermo-set cable, again brushing across a wide range of temperature conditions, heat release rates and so forth.

MEMBER SIEBER: Fred, do you have any data that you could tell us about that shows what percentage of hot shorts converts to a spurious actuation? It looks like it's about half.

MR. EMERSON: I think you can probably derive that from the figures that I've presented.

MEMBER SIEBER: Yeah, it looks like I would guess about half.

MR. EMERSON: Which would show you -- again, illustrates the point that not all hot shorts turn into spurious actuations. And the last line has to do with duration. The durations ranged from very short, just a few seconds, to as much as 10 minutes. The average was in the range of one to two minutes.

MEMBER POWERS: Let me ask you a question that there is, of course, no answer to.

CHAIRMAN ROSEN: If there was an answer

you'd know it and you wouldn't have to ask.

MEMBER POWERS: If I sat down and did this whole data set all over again, how would those numbers change?

MR. EMERSON: I'm sorry, if you did it all over again?

MEMBER POWERS: Yeah, did the whole data -- did the whole test sequence over again.

MR. EMERSON: Oh, okay, you're rerunning the tests.

MEMBER POWERS: As closely to identical as you did them in the original, how much would the numbers change? I mean, you've got 20.6 percent there.

MR. EMERSON: What you're asking is how repeatable are the tests.

MEMBER POWERS: Yes, that's right.

MR. EMERSON: Well, if you ran them in the same test chamber and you ran them with the same release rates as identical, same types of cables, same everything, I'm sure there would some variability.

R. KRESS: Did you run a couple of tests like that?

MR. EMERSON: We didn't run two tests exactly the same. Because a sequence of 18 tests, you're trying to get as much bang for the buck as possible and vary the parameters in an intelligent way to get useful information. So we did not repeat tests, no.

MEMBER KRESS: But that's useful information.

MR. EMERSON: Yes. It would useful information.

MEMBER SIEBER: It tells you something about the uncertainties.

MR. EMERSON: We didn't have --

MEMBER POWERS: There is at least one person at the table that believes that in a short sequence of expensive tests that it's absolutely essentially to run --

CHAIRMAN ROSEN: You mean there are two?

MEMBER POWERS: Two of us.

MR. EMERSON: As I recall, you gave us some input on the test plan before we actually ran the tests and we did take your advice as much as we could.

MEMBER POWERS: But you didn't run her up.

MR. EMERSON: We did not run her up. Okay, moving along, I want to go through the general observations, in fact, the rest of the presentation as quickly as I can. Steve mentioned this as an observation. We would certainly concur. Proximity is a strongly determining factor. One could argue on the second bullet that we didn't have enough data to support sweeping conclusions and I would agree with that but we think that given what we saw and while we didn't repeat any tests, we saw a lot of common phenomena in what happened when we tested the same types of cable under different conditions that we can achieve some statistical characterization and predict on a broad sampling of cables a certain fraction of failures as we did in the earlier data.

We have a better understanding of what were the main influence factors. Obviously, we could do more to beef that information up. What we can't do is to look at an individual circuit and predict how it's going to fail. We can't say this particular thermo-set cable in this particular room and under these particular conditions, we can't say you will have a short to ground here or you will have a hot short. We can't do that because, as Steve indicated, the short phenomena are pretty complex and very hard to predict on a microscopic level.

MEMBER SIEBER: But it's good enough to give you some sense of the probability.

MR. EMERSON: We think so, yeah, and the --

MEMBER SIEBER: And the distribution?

MR. EMERSON: And the expert panel felt that way, too.

MEMBER WALLIS: Now, you said the phenomena are hard to predict so you didn't do it.

MR. EMERSON: Well, on a microscopic level.

MEMBER WALLIS: Well, are they hard to predict on any level?

MR. EMERSON: We think if you look at a broad sampling -- if you look at say, I'm a plant guy and I have all thermo-set cables in my plant, and I have some knowledge of what fires I can expect in a certain area, yeah, I think I can say with some confidence that I can expect something to happen or something not to happen and from a spurious actuation standpoint. That doesn't mean I can't ignore --

MEMBER WALLIS: But if I knew that really was happening, it was simply heating up the cable till it reaches a temperature and then it fails, and this is a transient heat-up problem, all you need to know is get the integrated heat transferred to the cable from the fire, then we're learning that the uncertainty and prediction is in characterizing the fire.

MEMBER KRESS: That's right.

MEMBER WALLIS: And it's in relationship to the cable.

MR. EMERSON: Yeah, you need to --

MEMBER WALLIS: If we knew that, that would help us because we would stop worrying about some other uncertainties.

MEMBER KRESS: Maybe we could find that out.

MEMBER WALLIS: You might able to find that out by rather simple calculations.

MEMBER KRESS: Run a test --

MEMBER WALLIS: Right.

MEMBER KRESS: Yeah, I think you're right. I think the thermo-set probably tells --

MEMBER WALLIS: Just by heating it up.

MEMBER KRESS: -- the product time and temperature and the thermo-plastic fails when it reaches melting.

MEMBER WALLIS: Whatever.

MR. EMERSON: These are the influence factors that we thought were -- based on the test results that we thought were important. Cable type, obviously, we think thermo-set is more robust than thermo-plastic in terms of its resistance. Tray fill, the more tray fill you have the less exposure you have of individual cables in the middle of the fill. You have a greater thermo-mass and we saw some pronounced effects when we ran a similar test with one row instead of four rows. The conductor connection pattern had some influence. We varied the connection of the conductors to the circuits so that some conductors where you had a power cable against -- right against an unpower cable or you had other cases where the power cable was in the middle and some of the target cables were on the outside, there was some influence of the connection pattern and as Steve indicated, the power source characteristics seemed to play a major difference, too, in terms of whether you had current limiting devices on your circuit or you were just using a regular power supply.

MEMBER WALLIS: You always had the same fire and the tray was in the same place? I forget now. I would think the biggest influence would where the fire is relative to the tray.

MR. EMERSON: As Steve indicated, we varied the location of the -- when we were looking for plum effects, we had the flame right under the corner of the tray and --

MEMBER WALLIS: So wasn't that the biggest effect, how close the fire is to the cable?

MR. EMERSON: Well, plume effects are certainly more pronounced than hot gas.

MEMBER WALLIS: I think that's the first thing my wife would tell me. Isn't that the biggest effect? I mean, you're saying influence factors, but really the biggest effect in all of this is where's the fire relative to the cable? How big is the fire? Isn't that the biggest thing?

MR. EMERSON: I think what we're talking about is --

MEMBER WALLIS: I think if you knew that you'd throw out all the other uncertainties as being relatively unimportant compared with that uncertainty.

MR. EMERSON: Yes, the location of the fire is certainly an important factor. If you're looking at influence factors for hot shorts versus spurious actuations, the location of the fire is less important than the temperature it gets to.

Some secondary influence factors and I'm not going to try and get into these in any detail, the orientation exposure type, we did run two vertical tests. We did run plume versus hot gas layer. To address the water spray issue that we touched no during Steve's presentation, the -- what we tried to do is to spray just before the end of the test when there was still some unfailed circuits to see whether those additional failures would take place just based solely on the water spray. And of the 18 tests we ran, only once did that happen. So there was some effect but it wasn't a major one.

MEMBER POWERS: Let me ask you a question, on the brute force you say five percent of the time the water spray caused failure, just strictly from --

MR. EMERSON: Yes, uh-huh.

MEMBER POWERS: Okay, but maybe I should do that. Maybe I should just say the result of the test is that indeed sprays can cause actuations.

MR. EMERSON: They can, that is true.

MEMBER POWERS: Okay, I mean, which conclusion am I sounder to take?

MR. EMERSON: Well, the reason we -- I'm sorry. The reason we ran the test was to see if it was a pronounced effect, whether you could get circuit failures like this from any time you sprayed it and if so, that would tell us we need to think about how we fight fires in areas that have this potential problem.

MEMBER SIEBER: But that alternative is to not fight the fire. And it would seem to me that it would better trying to put the fire out than worrying about whether something is going to --

MR. EMERSON: I don't know if it's a question of whether you put the fire out or not. It's what additional precautions you might want to take to deactivate the circuits before you fight the fire.

MEMBER SIEBER: That's true, you would want to do that regardless of whether you sprayed or not.

MR. EMERSON: You would think so but it would give you an idea of how much time you had.

MEMBER SIEBER: That's true.

MEMBER POWERS: The trouble is it's just not clear to me that the answer I come out of this is don't worry about it, it's only a five percent effect. It seems to me I come to the second conclusion, yeah, worry about it, because it does occur.

MEMBER WALLIS: I would worry about how I sprayed it. I mean, if I sprayed it with a jet which had momentum, I might create forces which would push the conductors together.

MEMBER SIEBER: Cable tray fires are usually fought with fog.

MEMBER WALLIS: Yeah, well, that's quite different.

MEMBER SIEBER: Yeah, it sort of diffuses out there and gets everything soaking wet.

MEMBER KRESS: What causes it to create a short then?

MEMBER SIEBER: Pardon?

MEMBER KRESS: What causes the -- what is the cause of --

MEMBER SIEBER: Water sprayed up.

MEMBER KRESS: It's a conductor, is that the problem you're stating?

MEMBER POWERS: I think that's right.

MEMBER WALLIS: I would think it cause brittle failure by thermo-shock.

MEMBER KRESS: That's what I would think.

MR. EMERSON: Well, by the time we sprayed the cables, the insulation was pretty well gone anyway, so it wasn't -- we weren't losing insulation. Okay, in looking at some of the observations we can make about internal versus external hot shorts and what you're seeing here is conclusions without seeing a lot of the data that went into it. Mr. Chairman, feel free to bang the gavel whenever you feel like it.

CHAIRMAN ROSEN: Well, I feel completely free, but you're making what appear to be unsupported assertions which is our stock and trade. Go ahead.

MR. EMERSON: It's the result of turning a 50-slide presentation into one with far fewer slides.

You have to cut the slides somewhere. When you read our 417-page test result, I think you'll have much better support for the conclusions. The external hot shorts do occur but we've -- the data tell us that they're less likely than internal hot shorts and you might empirically guess that anyway from the proximity of the internal shorts and the existence of jacket material between the conductors as opposed to the extra layer that you would get between two cables shorting externally.

One thing that was interesting was the second bullet it indicates that we did get external hot shorts but they've now resulted in spurious actuations. Does that mean we're going to say you cannot possibly get -- no, we're not going to say that but it was an interesting result of the data. And as we saw from the data table, thermo-plastic cable has a higher propensity for spurious actuations from external shorts than thermo-set cable does.

Now, if I were -- this first bullet was one as a true blue industry person, that I would least likely have wanted to see as a result of this test but it says that if you get a hot short in a multi-conductor cable it's pretty likely that you're going to see multiple hot shorts. And so we're going to factor that into the methods we have for addressing -- for doing -- for analyzing cable failures. These are what we would call and what the expert panel would call dependent hot shorts within the same multi-conductor cable.

You can have multiple independent hot shorts but it happens with less frequency than for a single multi-conductor cable. The next slide shows for all 47 spurious actuations that we observed it's just a bar chart of the time it took to get them and you can see some very, very long time frames and you can see some very short time frames.

MEMBER WALLIS: There's something odd about the two minute --

MR. EMERSON: That was the thermo-plastic cable in a plume which --

MEMBER WALLIS: Right above the fire.

MR. EMERSON: Right above the fire. It shows that spread over all of the tests a large majority of them were over 20 minutes, about two-thirds of them were over 30 minutes and about one-third of them were over 40 minutes. So what that tells us is that in many cases you'll have time to interdict the fire before you get a spurious actuation.

MEMBER WALLIS: Do you have a room like the one that Sandia has?

MR. EMERSON: A room?

MEMBER WALLIS: Yes, a steel room where the fire --

A VOICE: It's the same room.

MR. EMERSON: It's the same room.

MEMBER WALLIS: It's the same room.

A VOICE: It's the same test.

MEMBER KRESS: The same test.

MEMBER SIEBER: The same test.

MEMBER WALLIS: If the room is an oven, how long does it take to heat up to temperature? Does it take something like 60 minutes or something?

MR. EMERSON: Well, you could see from the earlier slide what the temperature profile is at the cable.

MEMBER WALLIS: I did. I noticed that. I thought that was very interesting.

MR. EMERSON: It was not a really quick rise. Obviously the --

MEMBER WALLIS: I was discussing with my neighbor here whether or not it's characteristic of the cable or of the room.

MR. EMERSON: It was some of both, I think.

MEMBER WALLIS: Ah, some of both.

MEMBER KRESS: I bet you could depending on how fast you heat up the room.

MR. EMERSON: Actually, I don't think that's true, especially in the case of the vertical test. Radiation heat transfer was -- might have been the predominant mechanism that was saw but I'm not an expert in that area.

MEMBER WALLIS: Especially if it's coming from the walls of the room rather than directly from the flame.

MR. EMERSON: This slide, I've pretty much covered before. It just gives a little more information about the durations, the shortest, longest average and standard deviations for each of the three cables.

MEMBER WALLIS: How hot does the room get, the wall of the room get?

MR. EMERSON: How hot?

MEMBER WALLIS: Yeah.

MR. EMERSON: We did not have the instrumented, but I guarantee you it was too hot to touch. It was not insulated.

MEMBER SIEBER: Fred, now these times here don't really make any difference if the fault causes the contact to close for an instant.

MR. EMERSON: The implication of this slide is that for most MOVs once you get an instantaneous fault you're locked in.

MEMBER SIEBER: You are locked in.

MR. EMERSON: For some AOV's it could make a difference.

CHAIRMAN ROSEN: Get to your key conclusions.

MEMBER SIEBER: You're talking about AOV's that are operative.

MR. EMERSON: I don't claim enough expertise to answer your question.

MEMBER SIEBER: For them to close, it takes an instantaneous signal. For them to open you've got to hold it.

MR. EMERSON: Okay, moving on to the key conclusions, given cable damage, you can certainly get spurious actuation singly or multiply. You can get external cable hot shorts but we didn't see any of those for thermo-set cables result in various actuations and overall, as Steve said, the likelihood of spurious actuations is higher than we thought using fairly elderly NUREG 258.

We think there exists thresholds below

which you do not get cable failures and this was a conclusion that the expert panel reached also in coming up with probabilities. The time --

MEMBER WALLIS: And of course that must true.

MR. EMERSON: Yes.

MEMBER SIEBER: Or they'd failing now.

MR. EMERSON: The fact, the time for failure was fairly significant, in many cases meant that in many cases people will have an opportunity to interdict the fires before you have the effect of a spurious actuation. And we've talked about the effect of current limiting devices like CPTs and such.

There are implications both for the deterministic analysis and the risk informed methods and I'm not going to go into detail on those. It will impact the way we think about both of those and those impacts will addressed as we finish this document in the next few weeks. Now, just quickly two slides on the expert panel results, these results are taken directly from the EPRI report which is currently available.

There are a number of cases from therm-set tray, conduit, thermo-plastic tray and armor tray that the expert panel and I'm not even going to begin to describe the process.

MEMBER WALLIS: The probability of this happening in a fire?

MR. EMERSON: This is the probability of spurious actuations based primarily but not exclusively on the test results that I just presented or that will available in more detail.

MEMBER WALLIS: But there must have been the real situation. The only thing that matters is the probability, I think, hot enough, close enough to damage the cable.

MR. EMERSON: And therein is a key point because this presents a probability given cable damage but there's also a probability associated with getting to the point where you have cable damage and that is reflected in the NEI document as a total risk treatment of likelihood of --

MEMBER WALLIS: I don't understand that because if you have cable damage and it lasts long enough or the fire continues after that point, you're eventually going to get short, aren't you?

MR. EMERSON: Yes, but --

MEMBER WALLIS: What is the probability really saying then? Eventually, if you wait long enough you always get a short.

MR. EMERSON: But if you have a hot short that results in a spurious -- an initial hot short for most MOVs, it doesn't make any difference how long it lasts if you get the initial voltage and current. It's locked in, you have the spurious actuation and --

MEMBER WALLIS: So these are probabilities of spurious actuation.

MR. EMERSON: That's correct, that's correct.

MEMBER WALLIS: Ah, okay.

MR. EMERSON: Given cable damage.

MEMBER KRESS: It seems to me like you need a model for what causes spurious actuation. That model involves getting up to a particular voltage to actuate the -- the question is how do you get that voltage? It seems to me there's a missing element here.

MEMBER WALLIS: It must depend on the relay, the voltage. The relay needs to --

MR. EMERSON: It depends on the characteristics of the relay or whatever the electrical --

MEMBER WALLIS: How can they make any estimate at all if they haven't done an electrical analysis of the relay? It's just a blind guess.

MR. EMERSON: Well, this is taking --

MEMBER WALLIS: For this particular relay that was used in this particular test.

MR. EMERSON: That's correct.

MEMBER WALLIS: Okay.

MR. EMERSON: Not intended to generalize to all types of relays.

MEMBER WALLIS: Okay.

MEMBER SIEBER: That's really not a bad value, 80 volts or so.

MR. EMERSON: And last but not least --

MEMBER WALLIS: But someone would take it out of context and apply it to any relay in any test.

MR. EMERSON: The other primary product of the expert panel was fragility curves which plotted the probability of any cable damage versus the temperature at the cable. This curve is for thermo-set, thermo-plastic cable. This one is for armored, this one is for thermo-set. And there were zero values if you will, below which probability was essentially zero. But now, I urge you to read the EPRI report which provides --

MEMBER WALLIS: Why does everything kink at .5?

MR. EMERSON: Well, that's an artifact of the way these were plotted. There were actually three values given. Basically, it was .05, .5 and .95.

MEMBER WALLIS: Oh, two straight lines, yeah.

MR. EMERSON: And it was just two straight lines.

CHAIRMAN ROSEN: Well, with that, I'll ask if there are any other brief questions. If not, we'll take a 15-minute break. Try to back at 3:25 and we'll try to make up some time. We've already lost control of the meeting. We will resume at 3:25.

(A brief recess was taken.)

CHAIRMAN ROSEN: It is definition 3:25. Please, Mark and See-Meng, you have the floor.

MR. REINHART: Thank you. I'm Mark Reinhart, the Chief of the Licensing Section of the Probalistic Safety Assessment Branch in NRR. Our purpose today is to discuss the fire protection significance determination process, a product we've been working on for about two and a half to three years. We've -- at our desire and the desire of the industry, we've been working at refining the tool we have.

Around April of this year we took some efforts in the staff to focus on the product, on what needed to worked upon. Then in July we brought the industry and other stakeholders into the discussion and today See-Meng is going to give us a presentation that will show where we are with the fire protection SDP and where we hope to go.

MEMBER WALLIS: And who are the other stakeholders?

MR. REINHART: It was a public meeting. Whoever showed up at the public meeting we had. It was NEI and licensees.

MEMBER WALLIS: That was all?

MR. REINHART: That was all that showed up.

MR. WONG: Some of the public meetings -- the public attendees as well. Thank you, Mark. Good afternoon. I'm See-Meng Wong in the PRA branch and as Mark has stated, we have been -- our branch has been involved in developing the fire protection SDP that is currently that exists in the inspection manual Chapter 06098 and is described as Appendix F. The original developer of this SDP is J.S. Hyslop who has moved onto the office of research and has been presenting a lot of the research work this morning to you.

As I look at it, it is more difficult to developing a tool and for me to involved in trying to improve it, I think it should an easier task.

Anyway the fire protection SDP is one of the many SDP tools that used in the direct oversight process. It is designed to assess the significance of degradations in fire protection defense and death elements, mainly fire prevention, fire detection and suppression and protection of the SSE's important to safety against fire damage to accomplish land safe shutdown.

And this fire protection SDPs those are designed to support the risk informed focus of the tri-level fire protection inspections that are going on. Just very briefly, as a background, go onto to summarize this actually what is in the two-phased methodology. The first phase methodology is essentially a qualitative screening process that screens the fire protection findings that are related to operational or functional fire protection future conditions, that means it will ask questions, is the fire protection system, whether there is a fixed suppression system or is a fire barrier, is it degraded and if it is, then it screens into the Phase 2 process.

The Phase 2 methodologies also by design is a screening methodology and it is more of a quantitative approach to try to assess the significance of the collective impact of the findings on the fire protection defense in-depth elements. This Phase 2 methodology is a nine-step process, okay, and within this nine-step process it uses a simplified fire risk equation which attempts to provide an integrated assessment of the fire ignition frequency with the degraded fire protection defense in-depth elements.

Fire protection defense in-depth elements are fire barrier effectiveness, automatic suppression effectiveness, and manual suppression effectiveness and also the term that try to come for common cause contributions.

MEMBER SIEBER: Before you leave this slide, when you screen using Phase 1, if it's of no safety significance, it goes away, right? If it has some significance in Phase 1, you come out with a color (phonetic) and then you go to Phase 2 and my question is, how often does the color decrease in significance between the Phase 1 screen and Phase 2?

MR. WONG: Okay.

MEMBER SIEBER: Do you see what I mean? Do you understand my question?

MR. WONG: Okay, right. The short answer is very briefly, okay, the Phase 1 screening process is that we want to screen findings that is of significance, so it is by design, conservative in nature. So most of the findings that we have --

MEMBER SIEBER: I understand that.

MR. WONG: -- may not string to green and most of the time, our top -- this is actually one of the issues that we're trying to find guidance (phonetic) and most of the time the findings has gone right through to the Phase 2 methodology. Then the Phase 2 methodology, because of some of the problems that we have experienced, that is why we are trying to come up with better guidance on each of the issues that I will discuss a little later.

MR. REINHART: Maybe I could add a thought. The Phase 1 screening needed work, so one of the efforts that we think we've made progress on to date is to get a better Phase 1 screening. Like See-Meng said, almost all of them right now have just ended up as Phase 2.

MEMBER SIEBER: And that's because Phase 1 determined significance, risk significance.

MR. REINHART: What Phase 1 would do, it would say it's either green or greater than green. If it's green, one of licensee's corrective action program. If it was greater than green, it would go beyond.

CHAIRMAN ROSEN: So you said almost all Phase 1 findings would greater than green, did I understand what you're saying?

MR. REINHART: What I've said so far is that the Phase 1 screening questions that were there, we saw a need to improve to make them more effective. Consequently, almost all of the performance deficiencies in the fire protection area were Phase 2 or Phase 3 efforts.

MEMBER SIEBER: That means that they were greater than green in Phase 1.

MR. REINHART: In essence it means that --

MR. WONG: Yes.

MEMBER SIEBER: Okay, now, let me ask the second part again. When you get to Phase 2, how many of the greater than green from Phase 1 turned into green in Phase 2, percentage-wise, roughly?

MR. JOHNSON: While they're -- this is Mike Johnson. While they're thinking about the answer to that, let me talk about Phase 1 one more time.

MEMBER SIEBER: Okay.

MR. JOHNSON: In Phase 1 what you're trying to do is to set aside those issues that are clearly green but certainly no more than green. So if you go

-- you pass the threshold where we've talked about you've got a performance deficiency that is significant enough to documenting. You go to Phase 1. If something doesn't screen beyond Phase 1, it's a green. If it goes beyond Phase 1, that doesn't necessarily mean that it will more than a green, but because it could potentially go to Phase 2 and then you decide that it's a green. It's just that simple screen that we have in Phase 1 can't make the determination.

MEMBER SIEBER: Well, I think it's fair to conservative in your screen. On the other hand, you may making yourself extra work because now you've got to do an additional phase of evaluation because it's too conservative. So my question is, how conservative is it really?

MR. JOHNSON: I understand.

MR. REINHART: If you go to slide 4, what it shows is there is 73 findings --

MEMBER SIEBER: Yeah, I read that, that's what prompted my question.

MR. REINHART: -- and 19 or 52 of those 73 ended up as green. Now, I follow up on both what you and Michael said, the -- my belief is that once we get our improved Phase 1 screening effective and as of our last meeting, I think the staff had some thoughts, the industry had some thoughts, and the industry is going to combine those and propose to us a method. If that's successful, that should do exactly what you said and screen out more of these so we don't have to go to Phase 2 analysis.

MEMBER SIEBER: Thank you.

MR. WONG: Well, I think we jumped ahead a little bit.

MEMBER SIEBER: Yeah, I know. I asked the question because I was looking at your later slides.

MR. WONG: Okay, then I'll just go very quickly to state that --

MEMBER WALLIS: Well, I'm curious about the first slide of Phase 2. You have this simplified fire risk equation. And if I were going to improve the fidelity, I would think that one way to improve it would to improve the equation. Is that part of the scope?

MR. WONG: Yes, yes, I will get to it when I talk about Phase 2 issues. In fact, I think that's probably central to the improvement initiative. This next slide is based on the information that we had from the inspection program branch. To date, since April 2000 there has been 50 tried fire protection inspection completed and out of this there as been 73 fire protection inspection findings. And out of this 73, 39 issues are related to safe shutdown and alternate safe shutdowns. For example, those issues are the associated circuits that are effected and which we have the moratorium on inspection until we resolve this issue.

And 17 of these 73 are fire protection system issues and this related to problems with suppression systems and detection systems.

MEMBER SIEBER: You mean inoperable.

MR. WONG: Inoperable, degraded, depending on the observation from the inspectors. Then there are 13 fire barrier issues. These are related to again degradations observed in three out of five barriers, problems with, you know, fire domes (phonetic). And then there are four procedural adherence issues. These are problems related to not taking appropriate corrective actions to correct some of the problems.

MEMBER SIEBER: Is anybody still using thermal lag?

MR. WONG: Yes, there is one issue.

MEMBER SIEBER: As a three-hour barrier or --

MR. WONG: As a three-hour barrier. In

fact --

MEMBER SIEBER: When do you think that one will disappear? I mean, when will they take it out?

MR. WONG: That question, I think, is the fire protection branch would probably have a better answer for you.

MEMBER SIEBER: Okay, so I take it some of these 13 in the fire barrier issues are thermal lag issues or are they?

MR. WONG: Well, some of this is related to the use of the hammock (phonetic) fire wrap issues and that again, is a generic issue. It's awaiting resolution but if you look at the SDP characterization, one of the issues that we finalize as a white finding is actually related to a degraded three-hour thermal lag fire barrier issue at one of the sites.

MEMBER SIEBER: Okay.

MR. WONG: And the other finalized white findings relate to an inadequate smoke detectors in the cable spraying room that was not installed in accordance with NAPA codes.

MEMBER SIEBER: Okay, thank you.

MR. WONG: Right, but what is of challenge to us is that there are a pool of 19 findings that are of significance that needs to determined and there is, therefore, the impetus for us to try to improve the tools that we have currently in place as soon as we can and we have -- as I will elaborate a little bit further, we have an aggressive schedule to try to accomplish this by next year.

MEMBER SIEBER: Now, is this a backlog that's being worked off, these 19 or are they just sitting there --

MR. WONG: These 19 are --

MEMBER SIEBER: -- waiting for you to come out with your guide.

MR. WONG: Yes, most of those 19 are sitting there and waiting, for example, the resolution. A lot of these 19 findings are the associated circuits and the use of the hammock wrap fire barrier issues. That's the pool of them.

MEMBER SIEBER: And they're sitting there because we're still working on associated circuits, right?

MR. WONG: Yes.

MEMBER SIEBER: So this could take some time.

MR. WONG: Yeah.

MR. REINHART: It could. I believe it's

waiting on the resolution of some generic issues. They're in the region. They haven't come to us, like as a Phase 3. But they are -- there's some generic issues also involved.

MEMBER POWERS: As I understood the resolution of the associated circuits, the NEI came forward with their proposal, right.

MEMBER SIEBER: That's true. On the other hand, I take it we're still not doing inspections on associated circuits, right?

MR. WONG: Yeah, my understanding.

MR. REINHART: That's our understanding.

MEMBER SIEBER: Okay, thank you.

MR. WONG: Okay? My next slide is to summarize the major issues related to the fire protection SDP as we have today, okay. And one of the first issue is a determination of the performance deficiency that is related to the fire protection finding. This came about actually from an experience that we have in trying to resolve one of the issues related to the Halon system concentration that did not meet the NAPA code but the point here is that --

MEMBER SIEBER: Is Halon -- there was some question as to whether that would allowed or not, right?

MR. WONG: Yeah.

MEMBER SIEBER: I don't think they even make Halon any more, do they?

MR. WONG: No.

MEMBER SIEBER: Isn't that an environmental concern?

MR. REINHART: They don't make any more but there are plants that have it stockpiled.

MEMBER SIEBER: Okay.

MR. REINHART: And it becomes very expensive because of that stockpile.

MEMBER SIEBER: Well, if you can't reach the concentration when it discharges, that means you don't put out the fire.

MR. REINHART: Right.

MR. WONG: Yes. The point I'm trying to make here is that in the determination of performance deficiency the question was did the licensee meet the licensing basis.

MEMBER SIEBER: Okay.

MR. WONG: And so this is one of the areas which probably await much broader generic resolution. So currently there is, in the fire protection SPD that we have today there is no clear guidance that asked inspectors how to deal with it.

MEMBER SIEBER: How to deal with it.

MR. WONG: So that's an area that we have to look at. The second bullet in this slide is the issues related to Phase 1 screening process and we have briefly touched on that. One of the things is related definition of the SDP entry conditions. The guidance that we had, we did not provide the verbiage to direct say the inspectors to go through what we call whether the observation is -- or the finding is more than minor through the criteria that is described in the inspection manual Chapter 0612. And then from there where does it go.

So there's kind of a linkage or direction but it's not clear how -- when do they go to the Phase 1 and then from Phase 1 how they go to the Phase 2 as the finding is being processed. So that's an area in which we think we need to provide better guidance.

But the main --

MEMBER SIEBER: But that's not why these 19 are sitting there, right?

MR. WONG: No, that's not why the 19 is -- the 19 is sitting there for other issues.

The four main issues that we have identified for the Phase 2 screening methodologies is, one area is the use of the fire ignition frequencies, okay. You've heard discussion on you know, whether we use a room frequency versus a component ignition frequency, whether we use the pre-data base as, you know, reflective of you know, the events data base that we should looking at to derive the fire ignition frequencies because this is always a point of contention when we try to process it, are we looking at the right fire ignition frequencies.

And this is an area which one of these solutions is that we might try to use the EPRI data base as, you know, one of the standards to try to derive fire ignition frequencies and then provide a table of fire ignition frequencies that as a guide for the inspectors when they use this Phase 2 screening process.

MEMBER SIEBER: Are you going to use the Houghton (phonetic) study?

MR. WONG: I've looked at the Houghton study and in fact, from my experience when I tried to process one of the findings looking at his -- his data base is limited to a certain time window, I think 1986 to --

MEMBER SIEBER: It ends at 1999 but he's on 2000 and 2001 right now.

MR. WONG: Right.

MEMBER SIEBER: But --

MR. REINHART: Well, we talked about this in one of our meetings. I believe if I remember the number right, there's maybe seven different data bases you could look at.

MEMBER SIEBER: Yes, there are.

MR. REINHART: And we --

MEMBER SIEBER: But this one is yours.

MR. REINHART: Right. Our long term goal would to get Jim Houghton's data base up to date and formatted in a way that we could go into it and come out of it simply and have everyone agree that that's the appropriate data base for the appropriate situation. If we can do that, we're miles ahead and we're working on that.

MEMBER SIEBER: Okay.

MR. WONG: So this is one of the areas.

MEMBER SIEBER: Okay.

MR. WONG: The second area is related to the degradation ratings for the --

MEMBER POWERS: Why is there a resistance to using for instance, the EPRI data base?

MR. REINHART: I don't think there's a resistance to it. I think we -- from time to time it gets used. What happens is in a given situation, somebody likes the EPRI, somebody likes something else and so we're in a discussion. What we want to able to do is say what's the appropriate place to go for category A, B or C to get the right answer.

MEMBER POWERS: If I'm a member of the public and I want to look at the data base that you've used to assess one of these things, can I get to the EPRI data base?

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

MEMBER POWERS: If I can't get to the EPRI data base, then I ipso facto can't use it?

MR. REINHART: The big picture, we want to make sure the data base that we agree with or data bases that we agree with are in the public arena. If the information is not, at least we'll able to show the information that we had that we used to make the decision. That would public. But whether the EPRI data base per se, in its entirety is public right now, I don't know the answer to.

MR. JOHNSON: And, of course, I guess, it goes without saying, the major challenge that we face on all of these issues is to make sure that we have an acceptable agreed upon methodology, in this case, an acceptable agreed upon frequency and then we've always tried in the SDP to make sure that whatever we use then in terms of the tool is available so that people outside of the agency can see what we've done so that the process is predictable.

So your question is a good one. We just haven't -- we've got to seize upon what is the right source of data, what is the right data base for fire ignition frequency and then we need to make it available to people can see what it is we used.

MEMBER POWERS: I can think of nothing that would -- I mean the peculiarity of fire is that it's one that everybody thinks they know everything about because, I mean, it's a hazard, it's a nuclear hazard. It's not like a neutronic hazard and nobody can calculate except some guy at Brookhaven or something with a fancy computer group. And so fire is of interest to people.

I mean, they know that this is a hazard and when you go through a significance determination process in a fairly mechanistic thing kind of that somebody can understand fire, fire ignition frequency, times the degradation factor, that I just love because I can never figure out what it is, but you go through these steps, you know, if I remember the public, you know, the first thing I'm going to do is say, gee, how would I get there. And I'm going to sit down.

And if I can't get to the data base, I'm going to irritated. I'm going to irked. And then, you know, you'd say, well, this is an agreed upon process. Yeah, you and somebody else agreed to it, I didn't agree to it.

MR. REINHART: I understand.

MR. WONG: Okay, let me go to the next major issue that we have through our discussions. The second major issue that we have identified has to do with degradation ratings for the defense in-depth elements, okay. The defense in-depth elements are -- that is currently we are -- that is in the SDP guidance document is the fire barriers, okay, the automatic suppression and also the manual suppression. And we have degradation ratings of whether that fire barrier is highly degraded or moderately degraded or whether it is in the normal operating state.

And this is an area in which there has been subjectivity and this is an area in which we're trying to get the I call the fire protection world to come to grips to provide us, you know, a good set of criteria what is really highly degraded, you know, description, what is moderately degraded? Is it nearer to scale of a highly degraded or is it more to the nominally operating --

MEMBER POWERS: Just what the hell do you mean?

MR. WONG: Yes.

MEMBER POWERS: You know, since this thing has been founded, I've been railing about, I don't know what -- how to evaluate that number.

MR. WONG: Right, so this is one of the big problem areas and this is actually -- a lot of these issues is causing us to get, you know, two hours or three hours of magnitude away from what we think is the, you know, the reasonable significance. And so this is a problem area which is part of the improvement initiative we're having for fire protection folks, and engaging or so the NEI industry to at least come to some consensus agreements like Dana, what you said is what does it really mean. Is it moderately degraded, versus a highly degraded description and the basis that go with it.

MR. REINHART: In fact, what you're questioning there is the question we have to ourselves for each factor. We want each one to scrutable, and understandable, why do we have it, what does it mean, when do we use it and where do we enter this table, chart, et cetera and how do we know we're right?

MEMBER SIEBER: What would nice is if you took five independent analysts and they all got the same factors.

MR. REINHART: Right.

MR. WONG: Well, that's one of --

MEMBER SIEBER: Because it's not clear to me that that's happening, right?

MEMBER POWERS: It's probably not clear it will ever happen but if you could have some categories and antidotes and examples and say, okay, this is what we mean by moderate, this is what we mean by severe and this is what we mean by close enough to normal operation, I mean, enough of them so that people could look at them and say, okay, since I will never have exactly that situation in any other plant at any other time, but I kind of know what pot to put it in --

MEMBER SIEBER: Right,

MEMBER POWERS: -- that's about the best you're going to ever have on that very subjective factor.

MEMBER SIEBER: Right.

MEMBER POWERS: I mean, that one is just really subjective.

MR. WONG: Yes.

MEMBER POWERS: Well, there's another one and that's the degradation of the fire brigade.

MR. WONG: Yes, that's another area which we're --

MEMBER POWERS: The guy's five pounds overweight, does that mean he's moderately degraded or badly degraded or what?

MEMBER SIEBER: That's easy. I've gone through all of those phases.

MR. WONG: Okay, the third issue is the use of the fire severity factors and right now in the current guidance document, we don't use it but when we do a Phase 3 analysis, we use it and the fire severity factors that I have used in Phase 3 analysis is from the -- what is provided in the five document, the EPRI five document.

Again, here it is, you know, how -- how do we -- you know, and when do we use it, you know, to adjust the fire ignition frequencies or the population of the fire because this is tied to when we develop the five scenario we're looking at, you know, a big challenging fire or do we, you know, screen away the smaller fires and try to establish the significance of that. So this one you know, it's one of those things that we have to come to have some agreement.

MEMBER POWERS: You're doing this radically differently than the analyses for Phase 2 significance determination processes for the really classic operational event analysis. I mean, they do Phase 1 by walking through a worksheet based on some PRA analyses and then in Phase 2 they actually run the SPAR (phonetic) codes and things like that.

MR. WONG: Right.

MEMBER POWERS: Why don't you just beat up research and say give me a good fire analysis tool and I can do Phase 2 by a risk assessment methodology the way the guys in Ops do? Make my life easy for me.

MR. WONG: They are part of the team.

MEMBER POWERS: Tell them it will make their life easy for them.

MR. REINHART: Our Phase 2 actually, it's a notebook that we run through and the SPAR would get involved in the Phase 3. Whether it's us running a software, a licensee running a software, comparing results, there's --

MEMBER POWERS: You're just determined to make Phase 2 difficult and make Phase 2 automatic.

CHAIRMAN ROSEN: What you're saying is they ought to get away from the subjective scales and get to analysis technique that provides some relevant answer. And to me, you know, as much as I hate to admit it, I think I agree with you. You know, trying to interpret these subjective scales, you know, look at a fire barrier, is that moderately degraded, minor --- degraded in a minor way or severely degraded, you know. It shouldn't matter. The question really is, is what is an analysis say.

It may turn out that the fire that you postulate doesn't require a fire barrier within that area. And so I think we'll never get done, we'll here in 10 years arguing about fire barriers and as a matter of fact, now that I say that, I think it was one of the NRC staff people who said we had a decade of arguing ahead of us. If -- and so, you know, I kind of agree with Dana's comment, that maybe rather than starting this six months into that decade, rather than do that, we ought to step back and say, let's figure out a way to avoid a decade of arguing, which might fire modeling.

MR. REINHART: We're aware of the sentiment and I think there's a spectrum of sentiments that are out there from going to a fully automatic analysis to a semi-automatic analysis, to the notebook check sheet type of an approach. We appreciate that.

MR. WONG: Okay, the last sub-bullet is the development of the fire scenario and here the issue is, you know, trying to develop a credible fire scenario or a fire modeling that is needed, you know, to support the SDP process. Basically, you know, the guidance that we have to identify the ignition sources, the likely ignition sources, the fire modeling, you know, from fire initiation to fire growth, the example, some of the switch gear room scenarios is what are the heat release rates that we will using to model the fire -- you know, to get the time line of when the fire will go to an extended damage cables that is overhead.

And we have again, argument as to, you know, which is the right heat release rates that we will using? Is it 200 kilowatt or is it 300 kilowatt or 400 kilowatt and that's an area which, you know, we want to take advantage of what the work that the fire protection folks have done in trying to develop a spreadsheet, you know, fire dynamic spreadsheet, you know. We want to see how we can take advantage of that and use that. This again, is an area that we need improvement and especially, you know, develop, you know, kind of a time line that we need to look at in order to say whether there's a credible fire scenario or not.

These are just the major issues. That's

not to say that there are other issues as well in the Phase 2 that we have identified and we're going forth to try to find you know, agreement and resolution for fixes for some of these issues. The Phase 2 objectives and the goals, this one is sort of a general issue and one of the things we're striving for in the objective of the Phase 2 screening methodology is you may have heard the word simplicity, transparency, repeatability and reasonableness. Okay. This is a list that we're trying to use as a measure to try to improve the SDP.

But really one of the desired goals is to see if we can come up with a methodology that we have like one order of magnitude so and see if we can strive to that, but recognize that the fire PRA methodology that we're using, we have been using the traditional fire PRA method and technique and so that's a achievable goal but that's something that we have to look at because from our past experience, we have, you know, been getting two orders and three orders of magnitude from the Commission's desires is that in the SDP to consistent with the overall RFP process the goals is to try to see in the Phase 2 what order of magnitude, so that if we proceed to a Phase 3 analysis, then all we have to do is to look at, you know, what are the findings and assumptions that we need to make to bring it back to that order of magnitude that we're looking for.

The second bullet is related to quantification approach and this was asked earlier. We have a simplified formula that is in the current Appendix F. And as I stated, it is this simplified formula that one, we tried to get what we call the fire mitigation frequency, okay, trying to integrate the assessment of the fire ignition frequency that we've calculated and used and what are the effectiveness of the defense in-depth elements. Okay, all those four put together.

What we see is that the problem is that it does not link some of the dependencies between one factor from the other and like you mentioned earlier, you may have a degraded fire barrier but if your ignition source or your combustible loading is very small, you know, it's how significant is this highly degraded fire barrier in the context of the SDP? Or you know, and there's also the -- when we model the fire scenarios, the competing factors of, you know, manual suppression when you postulate if there's a big fire growing, you know, if there's good suppression does this degraded, you know, fire barrier, does it come into play? So those dependencies are not there right now and so one approach which we're going to try out is to the same as like what we did in the safety SDP, try to develop an event tree and come up with, you know, some sequences and try to capture this dependencies and make this a better tool.

That's all that we can think at this point in time. The other issues is how do we credit for compensatory measures that has not -- to date has not been vigorously addressed in fire PRA methodology?

MEMBER SIEBER: You mean like fire watches and those --

MR. WONG: Yeah, fire watches, closed circuit TV, roving watches and so on and so forth. I understand that Sandia or Steve Nowlen is doing it and they have done some study looking at, you know, the net impact of, you know, compensatory measures. So this is an area in which we probably would take, you know, some of the insights and try to improve the guidance I this area.

Critical human actions and the treatment of safe shutdown actions, this again, we are trying to come up with a better, you know, basis and you know, common, you know, rules of how we credit the human actions and HEPs for, you know, manual shutdown and remote shutdown actions. So there's work that has been done and we'll take advantage of those insights from research work.

Treatment of Appendix R exemptions, this area is right now is not in the guidance and we need to take a look at how do we evaluate the risk changes due to a deficiency in the approved exemption and where against the baseline the approved exemption.

MEMBER SIEBER: What was the basis for the Appendix R exemptions in the past before risk consideration were predominant?

MR. WONG: That, I think --

MEMBER SIEBER: You know, there were some exemptions because of Appendix R came after some plants were designed and built and so you might have ended up, you know, I know of one plant where all the ox feed pumps were in one room and you're supposed to have redundancy. Even though they put in a fourth pump in a different room, it wasn't safety grade. And so there was an exemption there and but there's been a fair number of Appendix R exemptions in the past.

MEMBER POWERS: Didn't the agency go through and look at these for the previous chairman and come back and say that there were none of the exemptions whose risk wasn't adequately addressed by compensatory measures that they imposed? I mean, very few of these exemptions were given willy nilly.

MEMBER SIEBER: That's true, that's true. We had to do something for every one of them.

MEMBER POWERS: I think it cost you more to get the exemption than what it would without but I mean, haven't we looked at that once before?

MR. WONG: I think --

MS. BLACK: Yeah, this is Suzanne Black. We looked at that. I've seen a study that showed certain plants we had to go back and do some more. We did a screening study at first and then looked at a couple of plants for these specific exemptions and determined that the total of them was not really significant.

MEMBER POWERS: That's right, and so maybe we're recognizing too much of the risk exemptions here.

MS. BLACK: I hate to say that but the criteria we used, the 5109 criteria for exemptions, you know, to show that the alternative was as safe or almost.

MR. REINHART: And I think the thought here is whatever was done, is it appropriate or maybe not appropriate to consider that in the SDP. We just want to make sure, is this something we should give credit for, should we --

MEMBER SIEBER: I would think so. The exemption is out there and it's been audited and it's legitimate.

MR. WONG: J.S. has a comment.

MR. HYSLOP: There was one thing, as I recall this and I'm not sure we're getting at it, it was for a room or an area with an exemption, should the a part of the baseline from which you calculate departures for the risk significance associated with your finding. That's how I recall it coming out, or do you look at the case of compliance as your baseline and I think that was the thrust behind the statement treatment of Appendix R exemptions for purposes of impact on the SDP. I don't know if that's what everyone was getting at or not.

MEMBER POWERS: I doubt it.

MR. HYSLOP: Okay, okay.

MEMBER SIEBER: Well, I do understand it but it seems to me including whatever exemptions have been granted, if they were granted and it's true, then they weren't really significant. And that, I would think, becomes the licensing basis and a baseline to start for SDP. That's my opinion, personally.

MEMBER POWERS: Well, the headache in all of this stuff is that you end up with every SDP now becomes absolutely plant specific.

MEMBER SIEBER: That's right, absolutely.

MEMBER POWERS: And there's no generic guidance here whatsoever.

MR. REINHART: And we have to go back to that issue of the licensing basis, what is the licensing basis.

MEMBER SIEBER: That's right.

MR. REINHART: How things were written in the '80's and how people are looking at the words today, a different set of folks looking at those words. There's questions coming up, old issues coming up.

MEMBER SIEBER: Well;, and then you've got the added complication that different plants are under different sets of rules.

MR. REINHART: That's right.

MEMBER SIEBER: Some are Appendix R, some are not, some are branch technical positions.

CHAIRMAN ROSEN: And there are different people at the plants, too. It's not just on the regulatory side.

MR. REINHART: That's right.

CHAIRMAN ROSEN: There's knowledge transfers.

MEMBER POWERS: And to cap it all off, we don't know what the licensing basis is anyway.

MEMBER SIEBER: Well, somebody ought to and it may take awhile to find out but just the fact that there's different sets of regulations for different plants, every SDP is going to plant specific. So we might as well just make matters worse and add a new wrinkle to it.

MEMBER POWERS: I'm glad I don't have your job.

MR. WONG: Well, I want to make a closing statement. The next one is very easy. This is a summary of the -- all the actions completed to date that we started to embark on this implement initiative. This is essentially we do need a request to research.

CHAIRMAN ROSEN: You don't have to read it to us.

MR. WONG: Okay.

CHAIRMAN ROSEN: Go ahead to the next one.

MR. WONG: Go ahead to the next one? Okay. The next one is essentially the future activities, okay, what we plan ahead for us. And one of the things that we plan in the imminent future is to have a public workshop some time in the early or in early November to go through each one of these Phase 2 SDP issues and engage the external stakeholders and internal NRC stakeholders, meaning, the people, the -- from the regional offices, the inspectors, the SRA's to work through each one of these issues and reach, you know, a general consensus agreement. That's my goal on each one of these issues because at the end of the day and the bottom line is that I don't want to have to go to a regulatory conference and then have to in a contentious argument with the licensee on some of these issues which we can resolve it, you know, generically beforehand.

MEMBER SIEBER: I think you have your work cut out for you.

MR. WONG: Yes.

CHAIRMAN ROSEN: You have a busy year coming.

MR. REINHART: And hopefully, and to get back to your question, your comment, a goal is to have an SDP that is generic.

MEMBER SIEBER: But flexible enough to accommodate all these differences.

MR. REINHART: Right, and that's -- a

challenge is going to getting our arms around that licensing basis, how to address it up front and then what to give credit and not give credit for as we go through it.

MEMBER SIEBER: Do you folks know what the licensing basis is for each plant or would you rely on the licensee who may not know either?

MR. REINHART: That's an issue that is out there and the goal is to have the staff and the licensee able to understand what the licensing basis is.

MEMBER SIEBER: See, without knowing for sure what it is, I'm not sure how you can inspect the plant.

MR. REINHART: I understand the dilemma.

CHAIRMAN ROSEN: All right, it's quarter after 4:00. Thank you very much and we will --

MEMBER WALLIS: Can I ask a naive question?

CHAIRMAN ROSEN: -- move onto the --

MEMBER WALLIS: Can I ask a naive question?

CHAIRMAN ROSEN: Oh, you're asking them a question?

MEMBER WALLIS: Yeah, I wondered if I could. I mean, I'm just puzzled about what all this has to do with what we heard the rest of the day. I cant' make the connection.

CHAIRMAN ROSEN: It's just another fire protection issue. I mean, it's in the area of --

MEMBER WALLIS: Yeah, but I thought we were going to hear something about how the research being done served the needs of NRR.

MEMBER POWERS: Well, I mean, there were several points where the speaker said that they were going to look at what came from research. I think the research that we've heard about is well beyond this. I mean, I think he's looking at stuff that was done in the past.

MEMBER WALLIS: In the past, that's right.

MR. REINHART: Maybe a clarifying point, the person that did a lot of the initial work for us, as See-Meng mentioned, was J.S. Hyslop.

MEMBER WALLIS: Right, who presented this morning.

MR. REINHART: But now he went to research.

MEMBER WALLIS: That's right.

MR. REINHART: So he's supporting us along with his contractors are supporting our refinement.

CHAIRMAN ROSEN: Mark, one of the questions that was asked earlier today was about vision and it was about what is your vision for this fire protection area and maybe more specifically about fire protection research. Can you tell us what -- you know, we asked a few vision questions. You're asking really what would you like your future to like?

MR. REINHART: Well, I have to address the SDP, that's the part that I own, and my vision would , as I said, that we have a way to understand, first of all, what's a finding and what's not a finding, what's a performance deficiency, what's not a performance deficiency, get our arms around the licensing basis, then take that and most of those issues as in the other SDPs, are screened out through those ineffective Phase 1 screening.

The next part would the Phase 2, it could scrutable, repeatable, that we can quickly move through, move that and I know we talked about can the inspector do that, do we need a fire protection excellence group, somehow have a group that can quickly give us the significance so we can put it in its proper place and move on.

MEMBER POWERS: I guess the issue that I hear most from the licensees in connection with fire protection boils down to asking what do you mean by quickly, what would your target from going from a -- you've had a Phase 1 determination that something is greater than green, so it's gone to Phase 2. What kind of turnaround time would you like in Phase 2.

MR. REINHART: I'm trying to --

MEMBER POWERS: I'm not going to hold you to it. I'm just trying to understand.

MR. REINHART: Ideally, if an individual had everything at hand, he ought to able to sit down that week and come up with an answer that another person could sit down with the next week and come up with the same answer and depending upon the complication, it's going to longer than a week or shorter than a week.

MEMBER POWERS: Yeah, I would caution you against having as an aspiration that somebody else would come up with the same answer. I think my aspiration would somebody else could understand why he came up with the answer he did.

MR. REINHART: And they would hopefully agree that it's within the decade of green or yellow or white.

MEMBER POWERS: I understand. That's what I was looking for. Next year I will not say why you got eight days and you said a week.

CHAIRMAN ROSEN: I think you've annunciated a pretty useful vision. What I think -- what I would like you to do is to write it all down in one or two paragraphs. That would helpful. What is the vision and then you've annunciated and here's how I'd like my future to look. I mean, you could create --

MR. REINHART: That's a good suggestion. Maybe we could do that going into our workshop so that everybody can see --

CHAIRMAN ROSEN: You know, it ought to exceed your grasp, your vision. Man's reach ought to exceed his grasp but write down the way you'd like to and you might find a lot of people agree with you and that will a good basis to work together.

MEMBER POWERS: I think based on our interactions with the licensees, if they just understood that that's what we were trying to invoke, it would a great comfort to them. They just see us going in the other direction and taking longer and longer and longer to do these things.

CHAIRMAN ROSEN: Thank you. Mr. Coe, welcome back.

MR. COE: Good afternoon, Mr. Chairman. I'm always glad to come back.

CHAIRMAN ROSEN: One of the two greatest lies, right?

MR. COE: Even though I'm the anchor man.

CHAIRMAN ROSEN: The check is in the mail.

MR. COE: Not always the best position to in is the anchor man. So I've prepared a very brief presentation.

CHAIRMAN ROSEN: Well, I compliment you on the positioning of the staples in your package, something that's been giving people trouble with all day. You can see what the tenor of the debate has been.

MR. COE: I was asked to prepare a brief presentation on the type of inspection findings that we've had in our program since its inception. The ROP program that is. What you heard at the last presentation was a categorization I think and some -- of the inspection findings that came out of the tri-annual inspection procedure. We also have a monthly and a quarterly inspection procedures that is conducted by the resident inspection staff on site and what I'm going to give you here today is a little bit more expansive set of numbers. These are the numbers that have come from the reactor oversight program since its inception.

There's 156 fire protection findings that we've classified as fire protection findings. They fall into these four categories, which are the same categories that you just saw a moment ago. There is a little bit of overlap and there's maybe some findings that could fall into one or the other and we've made some choices here. But in general, you can see out of 156 findings, we've had two white issues and although I wasn't here for all of the last presentation, I understood that both of these particular issues may have been touched upon.

In each of these categories, all I'm going to do now is show you a set of -- or some examples of some of the findings in each of these categories. Okay, the first category is the safe shutdown/alternate safe shutdown. And here we're talking about as an example, the first bullet, inadequate protection of safe shutdown components, this might typically a safe shutdown path for a given fire area has not been protected in accordance with the Appendix R requirements.

CHAIRMAN ROSEN: What does that mean, the thermal lag isn't adequate?

MR. COE: Either the thermal lag isn't adequate or the separation isn't there or there's -- or maybe there's deficiencies in being able to complete the function that's intended by that safe shutdown path, path meaning a series of actions taken to provide a particular reactor safety function.

Okay, emergency lighting deficiencies for performing manual actions for the alternative safe shutdown path, shutdown outside the control room where the procedure itself could not performed as written under the circumstances that the procedure assumed or finally inadequate procedure for implementing alternate safe shutdown for fire in the main control room, just the procedure itself inadequate in some other aspect other than it couldn't performed or perhaps it would, you know a little bit confusing or it would lead you astray in some manner.

Okay, so these are findings and again, out of 157, you'll find -- we found most of these to of green significance. Fire protection issues, this really has to do with detection and suppression issues, smoke detectors inadequate, maybe they were misplaced, they weren't in the proper position. Perhaps they were inoperable, they wouldn't work for various reasons, inadequate testing with sprinkler system, inadequate Halon system, failure to maintain full area detector coverage, smoke detector or flame or fire detector, fire brigade problems. Okay, these we classified under this broad category of fire protection issues.

The third category is barrier issues. There are your typical barrier degradation issues, holes in barrier walls, lagging or a thermal lag that was not -- found not to rated at its required rating, fire doors that had been left open, compensatory measures that have not been maintained and adequacy -- questions, continuing questions of adequacy of thermal barriers.

And finally, failure to follow procedures is outside of the other category that we looked at, at the first. That was the alternate safe shutdown category also had some procedural problems in there, but other than that, other failures to follow procedures might involving transient combustibles, fire damper surveillance tests or surveillance tests in general, failing to follow those tests in accordance with the written requirements, equipment control, and failing to follow a procedure which actually resulted in a fire.

Okay, and finally, we have a category of findings that we send directly to traditional enforcement. I think we may have touched on this when I spoke on Monday. Impeding the regulatory process is one of three specific cases that we send directly to traditional enforcement regardless if there was an impact that could measured in using and SDP process. This, of course, would invoke escalated enforcement and civil penalties and those sorts of sanctions.

In this particular case, impeding the regulatory process may involve failure to obtain NRC approval when it was required, failure to provide the NRC with complete and accurate information if we -- if the approval was being sought, failure to complete -- failure to complete monthly inspections of extinguishers. That doesn't sound like it's in the right category. I don't think that's correct. I'm sorry, I guess it is an error. I apologize.

And the final point here is or the final example is failure to perform a safety evaluation and submit it again. It's just the general nature of these findings is that we should have been part of a decision that the licensee made and we were not provided that opportunity.

That completes my presentation.

CHAIRMAN ROSEN: Fantastic, Doug.

MEMBER POWERS: Doug, if I wanted to locate and follow up on the details of these, is there a summary written some place?

MR. COE: Yes, the way that we conducted these examples is we looked in our inspection data base procedure or our findings data base and if you wanted to look at more detail, we can provide that to either basically a high level line item description or we can gather further detail from our plant issues matrix.

MEMBER POWERS: I guess, why don't we start w with the highest, the next --

MR. COE: The next level down.

MEMBER POWERS: If I wanted to follow it up more than that, I can get in touch with you.

MR. COE: Sure. In fact, do we have a copy of that here with us? We do. We'll provide that to you right away.

MEMBER POWERS: Thanks. Let me ask a question. How do your inspectors feel about inspecting for fire protection nowadays.

MR. COE: How do they feel about inspecting for fire protection nowadays.

MEMBER POWERS: You know, the last time we talked they felt like they were --

MR. COE: I'm going to ask Peter Koltay to address that question. Peter is on my staff and is actively engaged in participating in the SDP process that you just heard about and the improvement process there. He also attends fire protection meetings that are held out in the field, in the regions and in various industry forums. So, I'll let --

MEMBER POWERS: Did he go to the Seattle meeting?

MR. COE: Yes.

MR. KOLTAY: Pardon me?

MEMBER POWERS: I asked if you went to the Seattle meeting.

MR. KOLTAY: Yes, I did. I missed you. I didn't see you there.

MEMBER POWERS: I know, I couldn't go this time and I was crying in my beer ever since.

MR. KOLTAY: I don't know if I need further clarification on your question, but the inspections are done at several levels. One is designated team leaders, each region has, and there's a -- I mean, some team leaders are better trained in fire inspection than others. So we get fewer phone calls from the ones that are trained and have more experience and have quite a few phone calls -- no longer directed to us because we refer them to the technical group, Eric Weiss' (phonetic) group for technical questions.

As far as the SDP goes, though, I would say that there's a good percentage of inspectors out there who do not dislike the existing SDP.

MEMBER POWERS: Do not what?

MR. KOLTAY: Do not -- they got used to it and after a year or so, they -- some of them actually feel that it works for them. Don't forget, not every issue comes into headquarters and not every issue is as complicated as the ones we constantly discuss. There are hundreds of issues out there handled in the region by the inspectors and the SRAs and they don't come to us because it works for them and probably because they screen them to green and they're comfortable with the outcome. So you know, it's not a total failure at that level.

MEMBER POWERS: You're giving me the sense that I'm looking for is that -- I mean, I think what you're telling me is that you have a growing and they're growing up comfortable with this whole thing.

MR. KOLTAY: I believe so, until we get down to the real PRA risk informed technical detail on what they should pick for an ignition frequency or they get confused just how to grade it or barriers or what do to with the fire brigade not performing properly and they don't even know how to enter it into the inspection report right now. So you know, those questions come up regularly but at some level, most findings are handled at the regional level by the inspectors.

CHAIRMAN ROSEN: Why don't you let them enter fire brigade performance into an inspection report? I don't understand that or I never knew that.

MR. KOLTAY: It's -- I'm not sure how we got where we are with this. Right now, we give instructions to the inspectors to inspect the fire brigade or observe fire brigade drills at least once a year and spend so many hours doing this. But there's no real -- there's not an SDP to assess the brigade performance, and their observations or any comments they would like to make about the fire brigade right now, manual Chapter 0612 on documentation, basically tells you, well, if it's a minor violation or just an observation, you can't really enter it here. So it's sort of a Catch 22 for them. We didn't provide them the right vehicle at this point and I think the technical people are looking at that and we should coming up with some kind of solution to that.

CHAIRMAN ROSEN: That's alarming, I think. I think because we count so much on suppression, and very much of that is the fire brigade, it would seem to me a fairly --

MR. KOLTAY: It's not totally lost --

CHAIRMAN ROSEN: -- not trivial but certainly possible to define two things that you wish fire brigades didn't do or maybe better what they do do, you know, that they look at the pre-plan before they go and fight the fire, that way they understand that and communicate each other to it, that their bunker gear is in good shape and that they don it properly and timely. I mean, it's the obvious things.

MR. KOLTAY: There is one source for that and that's really the licensee's drill critique. They're supposed to and they do critique their own drills and that's recorded and it's available to us.

CHAIRMAN ROSEN: Right.

MR. KOLTAY: But it would nice if they had a more independent assessment, like the NRC assessment.

CHAIRMAN ROSEN: So why don't you have your resident inspectors watch their drills?

MR. KOLTAY: They do. They do.

CHAIRMAN ROSEN: And write down what they see.

MR. KOLTAY: And they do and right now it's sort of information that they provide to the tri-annual team but it's not found necessarily in an inspection report like you would expect it to , I would expect it to .

CHAIRMAN ROSEN: Right, I didn't know you weren't doing that and that, to me, is -- that's alarming.

MR. COE: There is a threshold above which an inspector will write a fire brigade finding and I've given you one example that we drew from the data base of findings that we use to prepare this presentation. The specific case that I held up was a fire brigade that receives a failing grade during drill or the failure to use a self-contained breathing apparatus during a drill when they should have.

I think that the problem that Peter is relating to you is in many ways the standards that should applied to fire brigade performance are very unclear and subjective. And so I think it's difficult in some cases for inspectors to generate a finding when the standards are so subjective, but there is a threshold, as I've shown here, that clearly we will document.

MEMBER WALLIS: Can I ask my question again? Maybe I'm just perplexed because I have the wrong concept of what the meeting is about. I thought that part of our real purpose today was to look at the research program and see how it met the needs of NRR and I just don't see the connect. I mean, we hear this list of findings, it tells me nothing about whether the research program is adequate or not. Maybe I've got completely the wrong idea of what's going on.

CHAIRMAN ROSEN: Well, I think you did. I think our meeting was to look at the research plan but there were other objectives as well.

MEMBER WALLIS: So these are separate items all together.

CHAIRMAN ROSEN: Yes.

MEMBER WALLIS: They don't fit some overall objective.

CHAIRMAN ROSEN: Right. The meeting became a hodge-podge after.

MEMBER WALLIS: Okay.

CHAIRMAN ROSEN: Yes, there were some other issues besides the research plan.

MEMBER WALLIS: Okay, I was under some misunderstanding then.

MEMBER POWERS: One of the reasons these last two topics came up explicitly is some of the feedback we got during our various plant visits and to the regions and we got an earful on these things.

CHAIRMAN ROSEN: Doug, let me get back to your --

MEMBER POWERS: On the SDP, the fire SDP got hit more than any other single thing that I heard and it addressed all the issues that the speaker brought up. I mean, he got them all, so I suspect he's gotten an earful.

CHAIRMAN ROSEN: On this slide where you listed all the findings, you have URI there's 29 unresolved issues.

MR. COE: Yes.

CHAIRMAN ROSEN: Those are things that are tied up in these barriers, like 10 of them are in barriers.

MR. COE: Yes, yes, and typically they're either going to an unresolved item because we haven't decided if a deficiency exists and some of that, of course, goes to the question of the clarity of the design basis or the licensing basis and otherwise an unresolved item may that an issue has entered an SDP process and the report was simply not delayed for the completion of that process and so the report was issued as an unresolved item.

CHAIRMAN ROSEN: Well, it's 4:35 and we are finished except for what should we do with what we've heard. Thank you, Doug.

MR. COE: Thank you.

CHAIRMAN ROSEN: I have been taking notes of some questions that the committee has asked and what the committee seemed to interested in with respect to these speakers and I can go through that but I would prefer maybe before I did that or in lieu of doing that, perhaps give me some guidance to what we say, what I say on your behalf to the full committee on, I think it's Friday or maybe Friday and Saturday.

CHAIRMAN ROSEN: Yeah, that's why I asked the -- oh, I thought it was Mark Reinhart. Oh, well, okay. Let's -- we've got about, I don't know a really short time on the agenda, I think only a half an hour to summarize the subcommittee's deliberations today for Friday and what I was going to propose was that I just tell the full committee what we heard in terms of you know, just going through the agenda and then spend some time on everything you questioned and talked about but trying to hit some what I think are the high points of what the committee was interested in by extrapolation from the questions and comments. Dana, did you have any other ideas on that?

Okay, let me go through it. On initial

briefing, on fire risk research plan, the committee was interested in what the mission for fire protection research was and we didn't hear that and what future was desired. The committee was interested in what the likelihood of multiple fires was, what the cleanup from smoke effects of fires and the fire risks in non-reactor facilities, including facilities being decommissioned.

MEMBER SIEBER: That's a serious issue.

CHAIRMAN ROSEN: Stock side fuel fabrication.

A VOICE: Well, that's the only thing -- we looked at the risks. We spent some time looking at criticality but criticality effects people at the site itself. It's not going to go much beyond that. And we worry some about safeguarding the material but that's somewhat outside of the risk domain. When you get into the risk domain, the only place that we came up with anything that was really significant as far as the public was concerned was it's fire and it's fire over and over and over again. Every time you turn around in that facility, you got fire. And in the processing facility, you've got fire with kerosine. In the cindering facility you've got fire with the furnaces and in the fuel assembly area, you've got fire with clad.

A VOICE: Yeah, but you're grinding an oxide. You got a little aerosol problem there, you know, hook the filters and take care of it. But fire is -- fire is the biggy in this facility.

CHAIRMAN ROSEN: Okay, I've added that to the list. In the area of fire risk requantification activities that we heard about, the committee asked questions in the area of the scope and schedule and process and participants, who is involved. We note that fire risk requantification during shutdown is important and that it's excluded from the current studies. We noted that the techniques that are being developed in the requantification studies would used ultimately by plants that adopt NFP 805 so the whole issue of whether 805 will ever used by anybody, it's critically determined, I think, by how one ends up on risk requantification, whether that technique is amenable to use.

MEMBER SIEBER: I need somebody to refresh my memory. Was it ever decided whether licensees would allowed to partially adopt 805?

CHAIRMAN ROSEN: Yes, and it was decided and the answer is, yes, they can.

MEMBER SIEBER: Boy that turns things into another little bit of a mess as far as being able to inspect and establish what the licensing base is, I think.

CHAIRMAN ROSEN: Maybe.

MEMBER SIEBER: You know, they'll cherry pick whatever the --

CHAIRMAN ROSEN: Well, the issue is whether the staff should let them cherry pick and I think that the decision is based on that it was the desire not to place another barrier --

MEMBER SIEBER: Well, the argument to allow them to partially adopt is the fact that they would probably never adopt if they to do it totally all at once.

CHAIRMAN ROSEN: Right.

MEMBER SIEBER: On the other hand, I can picture the cherry picking.

CHAIRMAN ROSEN: Is there any --

MEMBER SIEBER: That's okay if it's okay with the staff.

MS. BLACK: We had a lot of discussion about that and what actually it means to cherry pick because in 805 you don't have to reanalyze all of your rooms and so I think our position is that when you decide to adopt it, you should do all the up front work that you need to do which is not that much to get into the process and then area by area you can decide to analyze an area once you run into a problem, but you don't have to analyze the whole plant. So that's what we would call cherry picking.

MEMBER SIEBER: So it's built into the process.

MS. BLACK: So it's built into the process. So you would an 805 plant but with your old licensing basis, you probably wouldn't pick it up unless you have one problem area that you wanted to analyze but you would 805 in the plant with your old deterministic licensing basis in most of the fire areas.

MEMBER SIEBER: Okay, thank you.

CHAIRMAN ROSEN: One other protocol question, I think that at this stage of the meeting we typically go off the record, just to -- am I correct about that?

So I'll adjourn the meeting for the purposes of the record.

(Whereupon, at 4:41 p.m. the meeting in the above entitled matter concluded.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on Reactor Safeguards Fire Protection Subcommittee

Docket Number: N/A

Location: Rockville, Maryland

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

/s/ Matthew Needham

Matthew Needham
Official Reporter
Neal R. Gross & Co., Inc.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
FIRE PROTECTION SUBCOMMITTEE MEETING
SEPTEMBER 11, 2002, ROCKVILLE, MARYLAND

Contact: Tim Kobetz (301-874-8716, tjk1@nrc.gov)

-PROPOSED SCHEDULE-

	Topics	Presenters	Time
I.	Opening Remarks	S. Rosen, ACRS	8:30-8:35 a.m.
II.	RES Staff Introduction	Mark Cunningham	8:35-8:45 a.m.
III.	Fire Risk Research Plan, FY 2001-2002	Nathan Siu/J.S. Hyslop	8:45-9:45 a.m.
	BREAK		**9:45-10:00 a.m.**
IV.	a. Fire Risk Re-quantification and Fire PRA Guide Upgrade Report	J.S. Hyslop/Steve Nowlen (SNL)	10:00-11:00 a.m.
	b. Risk Methods Insights Gained from Fire Incidents (NUREG-6738)		
V.	Fire Detection and Suppression Analysis: An Assessment and Update of PRA Methods and Data	Steve Nowlen (SNL)	11:00-12:00 noon
	LUNCH		**12:00-1:00 p.m.**
VI.	Circuit Analysis - Failure Mode and Likelihood Analysis	Steve Nowlen (SNL)	1:00-2:30 p.m.
	BREAK		**2:30-2:45 p.m.**
VII.	Improvements in the Significance Determination Process for Fire Protection	Mark Reinhart/See-Meng Wong, NRR	2:45-3:45 p.m.
VIII.	Plant Fire Protection Inspections	Doug Coe, NRR	3:45-4:45 p.m.

NOTE:

- Presentation time should not exceed 50 percent of the total time allocated for specific item. The remaining 50 percent of the time is reserved for discussion.
- 25 copies of the presentation materials to be provided to the Subcommittee

SUBCOMMITTEE CHAIRMAN OPENING STATEMENT
FIRE PROTECTION SUBCOMMITTEE MEETING
SEPTEMBER 11, 2002

Good morning. This is the meeting of the ACRS Subcommittee on Fire Protection. I am Steven Rosen, Chairman of the Subcommittee.

The ACRS Members in attendance are George Apostolakis, Mario Bonaca, Graham Leitch, Dana Powers, and Jack Sieber.

The purpose of this subcommittee meeting is to discuss the staff's Fire Protection Research Plan, status of the fire protection research activities, fire protection inspection process and findings, and other related matters including industry activities.

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

Tim Kobetz is the Cognizant ACRS staff engineer and the Designated Federal Official for this meeting. The rules for participation in today's meeting were noticed in the Federal Register on August 21st , 2002. A transcript of this meeting is being kept and will be made available as stated in the Federal Register Notice.

It is requested that speakers first identify themselves, use one of the microphones, and speak with sufficient clarity and volume so that they can be readily heard.

We have received no requests for time to make oral statements or written comments from members of the public regarding today's meeting. (if comments/statements received they should be presented/read now and then make the following statement: The staff will address these concerns as part of today's presentation.)

We will now proceed with the meeting. I call upon Mr. Mark Cunningham, Chief, Probabilistic Risk Analysis Branch, to provide some opening remarks.

FIRE PROTECTION FINDINGS

APRIL 2000 - PRESENT

	SSD / ASSD	FIRE PROTECTION	BARRIER	PROCEDURES
WHITE	0	1	1	0
GREEN	44	38	25	17
URI	13	6	10	0
TOTAL	57	45	37	17

White issues:

Smoke detectors inadequate in Cable Spreading Room (Palisades)

Failure to maintain fire area separation barrier between B Train switchgear room and A Train CSR as 3-hour rated (Harris)

SAFE SHUTDOWN / ALTERNATE SAFE SHUTDOWN

- Inadequate protection of safe shutdown components.
- Emergency lighting deficiencies for performing alternative shutdown actions.
- Shutdown outside control room procedure could not be performed as written.
- Inadequate procedure for implementing alternate S/D for fire in Main Control Room.

FIRE PROTECTION ISSUES

- Smoke detectors inadequate.
- Inadequate testing of sprinkler system.
- AFW pump room Halon system inadequate.
- Failure to maintain full area detector coverage.
- Fire brigade receives failing grade during drill; failure to use self-contained breathing apparatus during drill.

BARRIER ISSUES

- 3-hour fire barrier degraded.
- Unsecured fire door.
- Failure to establish compensatory measures for inoperable fire door.
- Adequacy of HEMYC cable wrap 1-hour fire barrier. (URI - 8 plants)

FAILURE TO FOLLOW PROCEDURES

- Failure to control transient combustibles.
- Failure to follow procedure associated with fire damper surveillance test.
- Failure to follow equipment control procedure.
- Failure to follow procedure resulting in a fire.

TRADITIONAL ENFORCEMENT

- 4 Issues (impeding the regulatory process)
  - Failure to obtain approval prior to changing fire protection program.
  - Failure to provide complete and accurate information.
  - Failure to complete monthly inspections of extinguishers.
  - Failure to perform safety evaluations and submit to NRC.

Circuit Analysis – Insights from Industry/NRC Joint Testing

Presented to:

Advisory Committee On Reactor Safeguards

Fire Protection Subcommittee Meeting

September 11, 2002

Presented by:

Steve Nowlen

Sandia National Laboratories

Sandia National Laboratories

Background

- Fire-induced circuit faults remain a focus point for NRC and industry (EPRI/NEI)
- RES efforts related to fire PRA circuit analysis methods and data were presented to this subcommittee in 10/00
  - This is a follow-up presentation on new information developed since that presentation
- One of the shortcomings identified on 10/00 was that test data on cable failure modes was sharply limited
- New cable failure / circuit fault mode experiments conducted during 2000-2001 by industry
  - EPRI & NEI with utility support

Sandia National Laboratories

Background (cont)

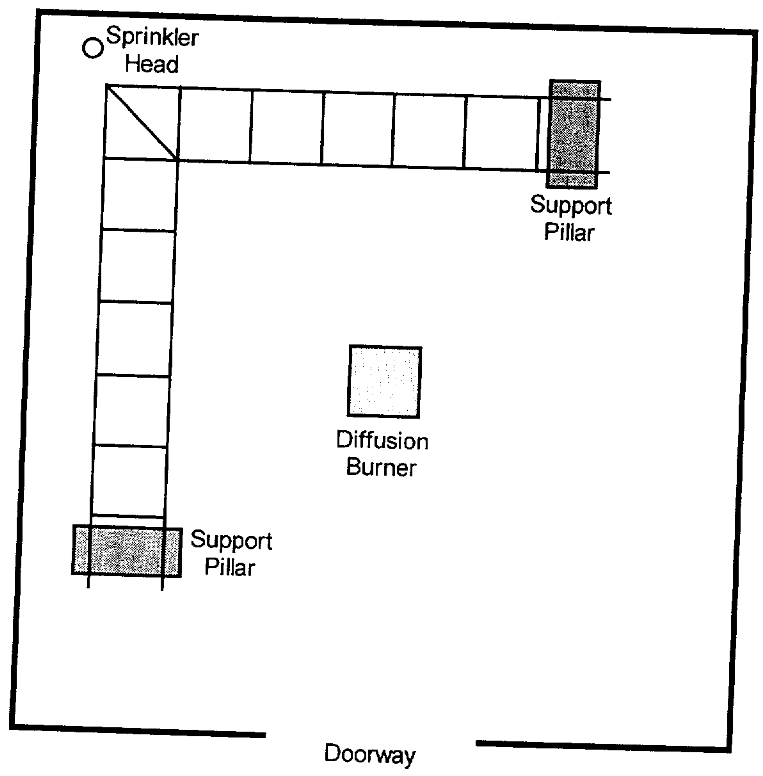
- NRC was invited to, and did, participate in tests
  - Test planning
  - Test execution
  - Data analysis and interpretation
- NRC and industry agreed to share all test data
- Each party to analyze and interpret all test data independently
- This presentation discusses our initial analysis of the test results:
  - Primary source: Draft NUREG/CR on circuit analysis
    - Undergoing internal NRC review
  - Supporting: NUREG/CR-6776 NRC/SNL test report
    - Now in NRC print shop

General Test Approach

- A series of 18 fire tests conducted
- Gas burner diffusion flame – 70-450 kW
- Test conducted in a plate steel box/room
  - 10'x10'x8'
  - natural ventilation
- One cable tray in each test, some tests also used one conduit
- Tests focus on multi-conductor control cables – often bundled with single conductor light power cables
- Thermoset and thermoplastic cables
- Armored and non-armored cables

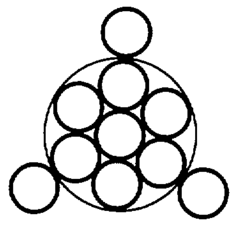
Sandia National Laboratories

Room Layout

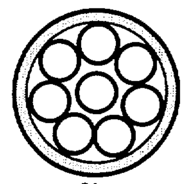


Sandia National Laboratories

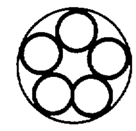
Cable Bundles Tested



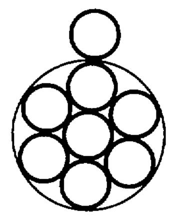
10/c
Bundle



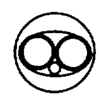
8/c
Armored
Cable



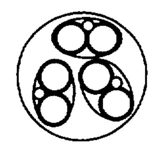
5/c
Cable



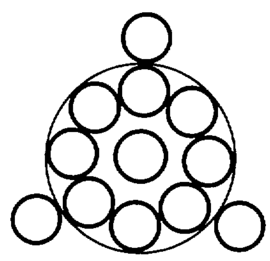
8/c
Bundle



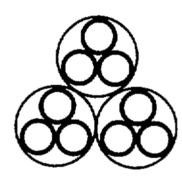
2/c
Cable



6/c
Cable



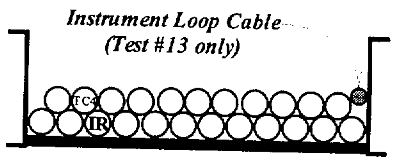
12/c
Bundle



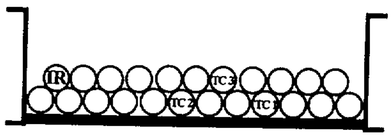
9/c
Bundle

Sandia
National
Laboratories

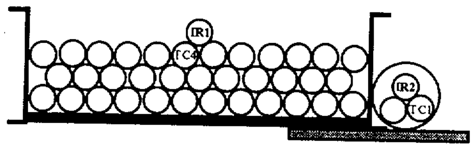
Cable Raceway Arrangements



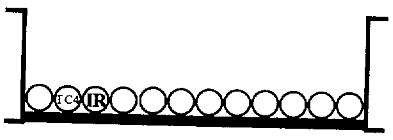
Tests #1, 2, 3, 4, 5, 7 & 13



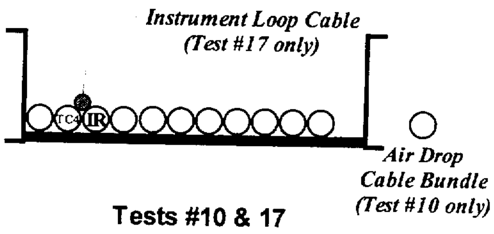
Test #6



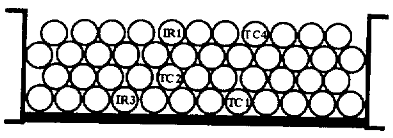
Test #8



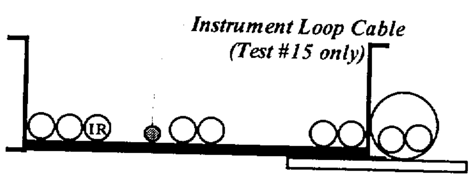
Test #9



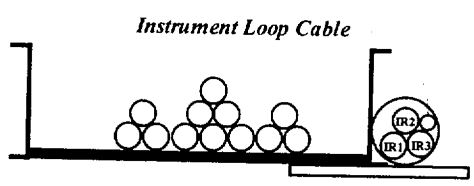
Tests #10 & 17



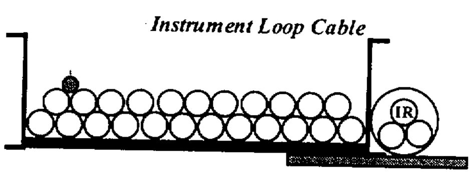
Test #11



Tests #12 & 15



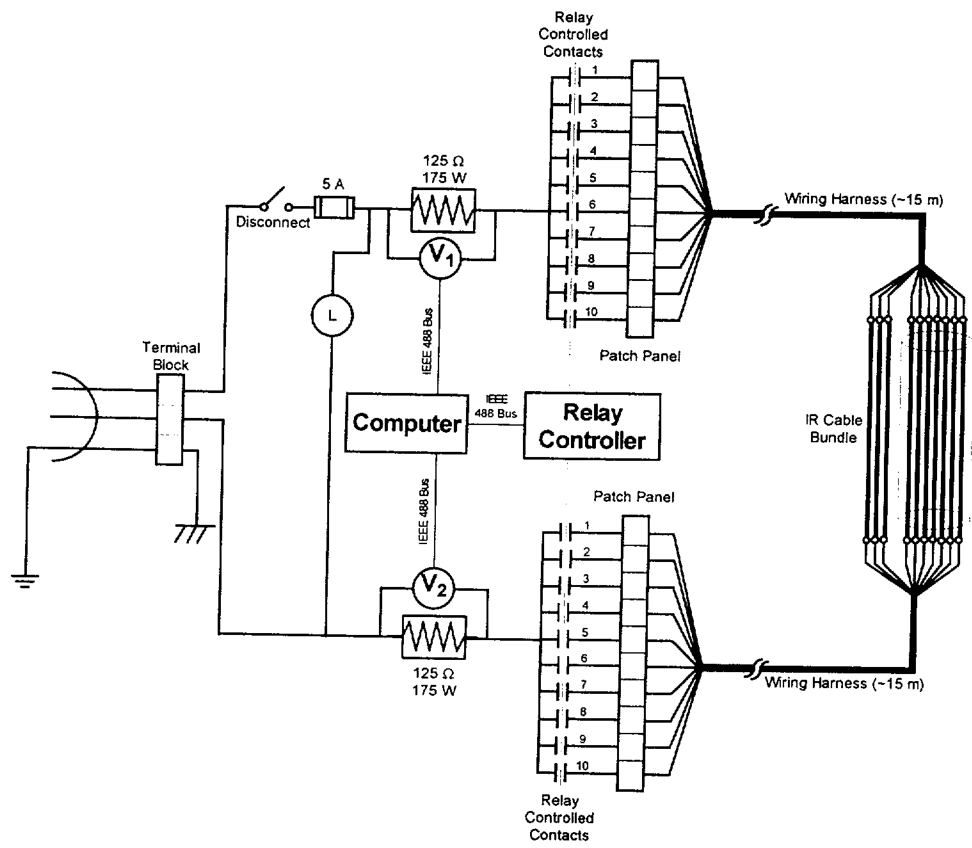
Tests #14 & 18



Test #16

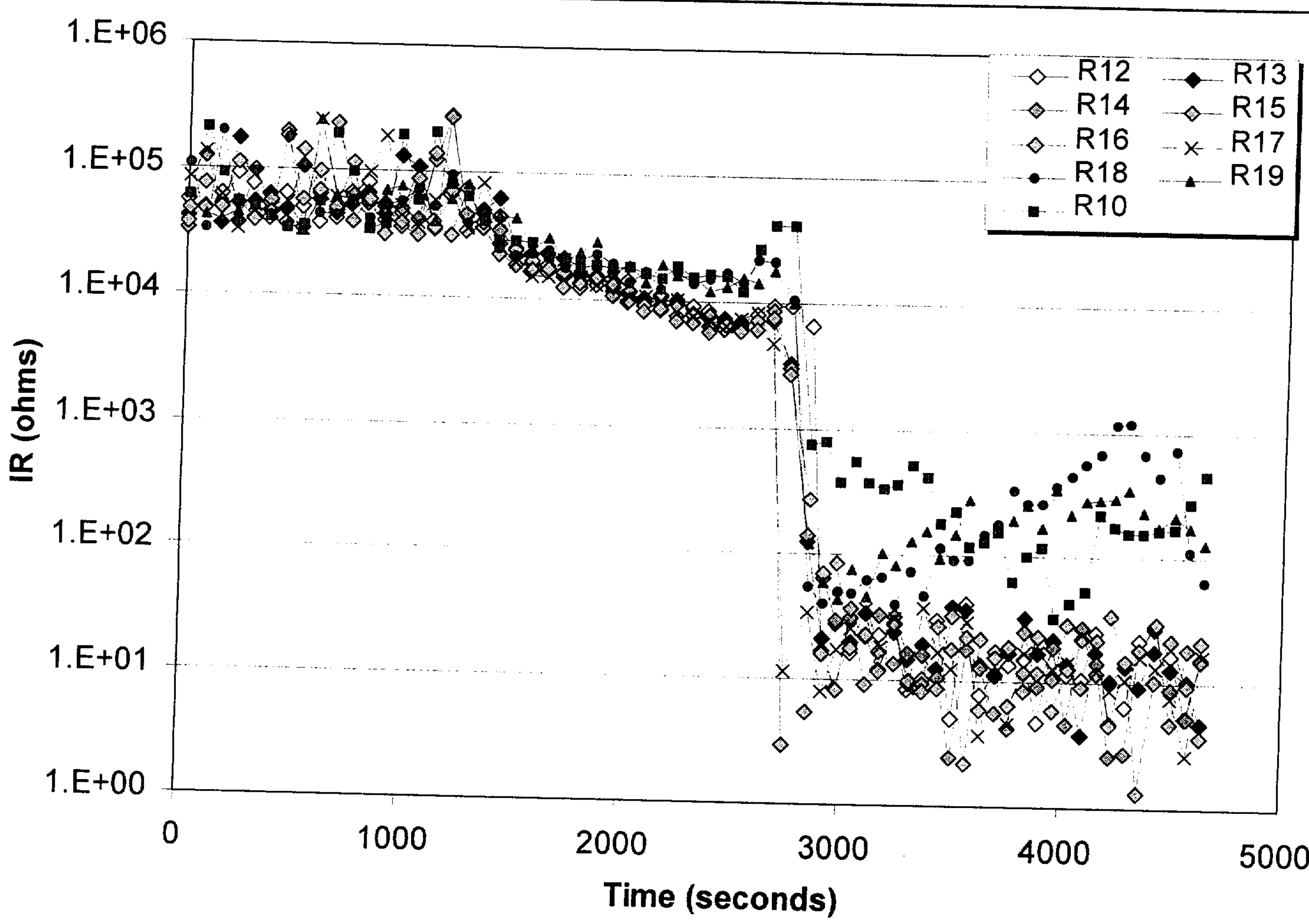
Sandia National Laboratories

NRC effort measured insulation resistance of the exposed cables



Sandia National Laboratories

Representative IR test results (Test 3)



Sandia National Laboratories

IR Test Observations

- For multi-conductor cables:
  - In trays 80% of initial failures were intra-cable conductor-to-conductor shorts
  - Conductor shorting groups/combinations were complex and transient
    - Number of conductors in a shorted groups varied from 2 to all available conductors
    - Outer ring of conductors shorted first, core conductor last
    - Shorts generally involved nearest-neighbor groups
    - Often saw two separate conductor shorting groups

IR Test Observations (cont)

- If the cables failed during a test, all conductors eventually shorted to ground
  - Transition times ranged from seconds to several minutes
- Various factors were seen to influence cable failure mode behavior:
  - Routing in conduits appears to increase likelihood of a short to ground as first failure mode
    - Conduit data very limited - inconclusive
  - Armored cables also appear to increase likelihood of a short to ground as first failure mode
    - Shorting to the grounded armor

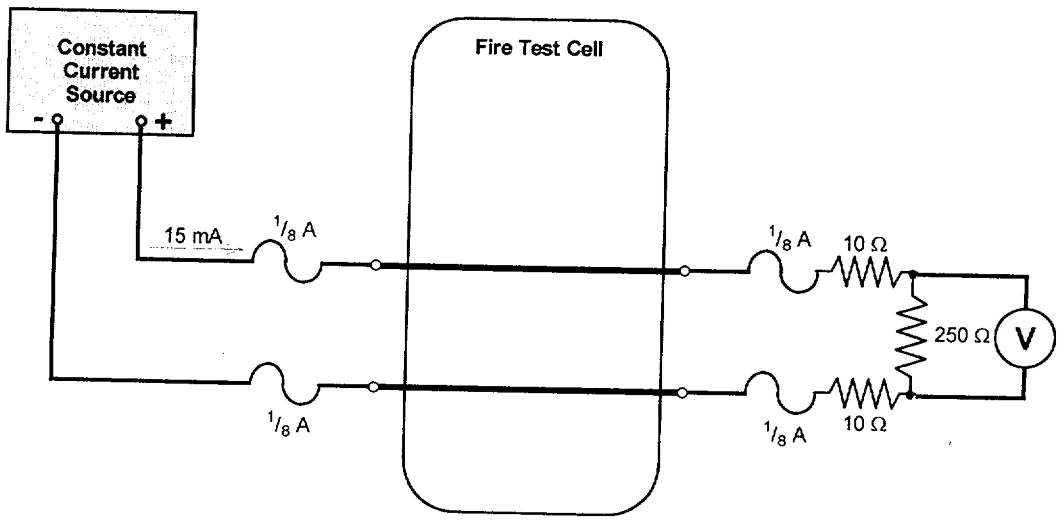
Sandia National Laboratories

IR Test Results and Observations (cont)

- Inter-cable conductor-to-conductor shorts were less likely than intra-cable, but were observed
  - Thermoplastic cables appear more likely to experience inter-cable shorting than do thermoset cables
  - Cables in conduits also experienced inter-cable hot shorting behaviors
- DC versus AC power may impact shorting behavior, but data is inconclusive
- No loss of continuity conductor failures observed
  - Behavior associated with more intense fires and/or high potential cables

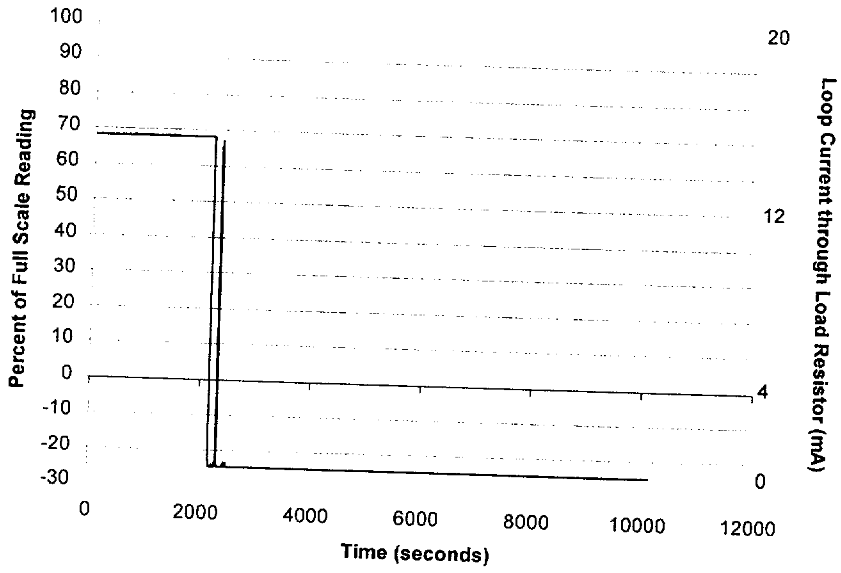
Sandia National Laboratories

Surrogate 4-20mA Instrument Loop Also Tested Under NRC Efforts

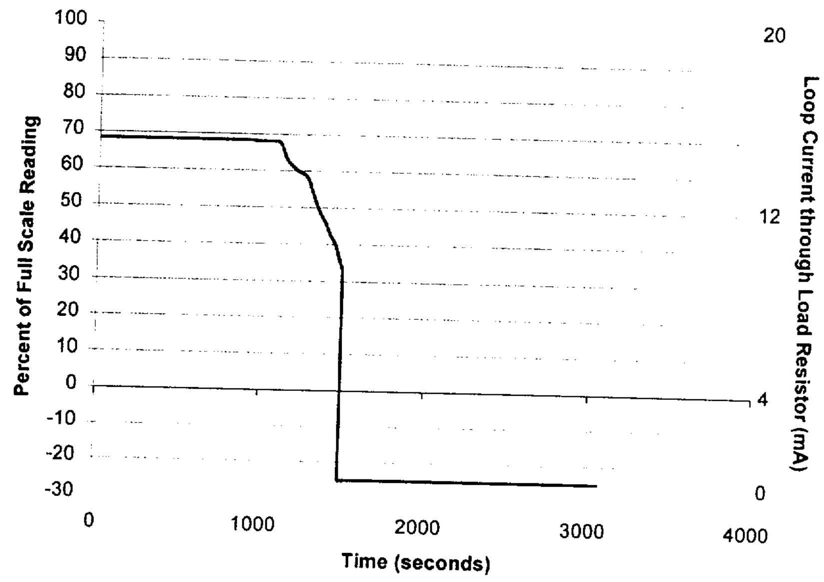


Sandia National Laboratories

Instrument Loop Results



Thermoplastic Cable



Thermoset Cable

Sandia National Laboratories

Instrument Loop Observations

- Pronounced behavioral differences observed between thermoplastic and thermoset cables
  - Thermoplastic cables: no signal degradation prior to the complete loss of signal
  - Thermoset cables: substantial signal degradation for a relatively prolonged time period prior to the total loss of signal.

Sandia National Laboratories

Complementary Industry Circuit Testing

- Focus on surrogate MOV control circuit
- Data analyzed in Appendix D of our draft NUREG/CR report on circuit analysis
  - NRC was given full access to all industry test data as a part of data sharing agreement
  - Based largely on my own input to EPRI expert panel
  - Report currently under review
  - Our findings reflect our current interpretation of the test data
- EPRI Expert Panel report is published
- Industry test report is being prepared, but not yet public
  - Presentations have been made at NEI Fire Protection Information Forum 2001, 2002

Sandia National Laboratories

Overall Conclusions

- Many of our previous findings were confirmed:
  - Multiconductor cables will initially fail conductor-to-conductor with a high probability (on the order of 80% or more)
  - The shorting pattern will be complex and transient
- A number of influence factors were verified as important to the cable failure – circuit fault behavior:
  - Raceway type - i.e. conduit vs. tray
  - Cable tray loading and cable position within raceway
  - Armored versus unarmored cables
  - Circuit to cable wiring scheme
- At least one new influence factor was identified:
  - CPTs in control circuit

Sandia National Laboratories

Overall Conclusions (cont)

- IR and MOV results are broadly self-consistent:
  - Embedded conductors are likely to fail later than outer ring of conductors
  - Conductors will likely short to nearest neighbors first
  - Shorting combinations complex and transient
  - Duration of a hot short / device actuation ranged from momentary up to ten minutes
  - All conductors of failed cables eventually shorted to ground given a persistent fire

Overall Conclusions (cont)

- The MOV circuit testing lent a number of unique insights:
  - In most tests with cable failures, at least one device actuation observed
  - In several tests, more than one device actuation was observed
  - In one test all four cable bundles saw at least one device actuation
  - Device actuations due to intra-cable hot shorts were most common
  - A smaller number of device actuations due to inter-cable hot shorts were also observed

Sandia National Laboratories

Overall Conclusions (cont)

- Areas of uncertainty and challenge remain:
  - Combinatorial models for cable failure behavior proposed but not yet validated
  - DC vs. AC may be a factor but not fully explored
  - Behavior of conduits appears different from trays, but data is limited and somewhat contradictory
  - Some potential influence factors not explored in these tests
  - Quantification for a specific case still requires application of expert judgment
  - Dealing with the transient nature of the faults – e.g., simultaneous vs. concurrent vs. sequential, fault duration

Sandia National Laboratories

Detection and Suppression Analysis

Presented to:

Advisory Committee On Reactor Safeguards

Fire Protection Subcommittee Meeting

September 11, 2002

Presented by:

Steve Nowlen

Sandia National Laboratories

Sandia National Laboratories

Presentation Outline

- Task Objectives
- Approach – task structure
- Results – by task
- General Insights

Sandia National Laboratories

Task Objectives

- Provide an improved modeling framework and data for estimating the reliability (including effectiveness, to the extent possible) of automatic and manual suppression activities

- Develop estimates of these conditional probabilities for currently operating nuclear plants

- Identify and quantify key uncertainties in these estimates

Sandia National Laboratories

Approach – task structure

- Modeling Framework
- Information Gathering and Data Analysis
- Document Results

Sandia National Laboratories

Modeling Framework

- Review of current practice reveals predominance of two detection/suppression methods
- Method 1: Direct use of historical data
  - Advantage: inherently captures long duration events
  - Disadvantage: difficult to tailor to specific application
- Method 2: Estimation of fire brigade response time
  - Advantage: nominally case specific analysis
  - Disadvantage: results vary little and may minimize contribution of long duration fires
- Conclusion: A more mechanistic approach might capture advantages of both methods

Sandia National Laboratories

Example of Historical Data Approach

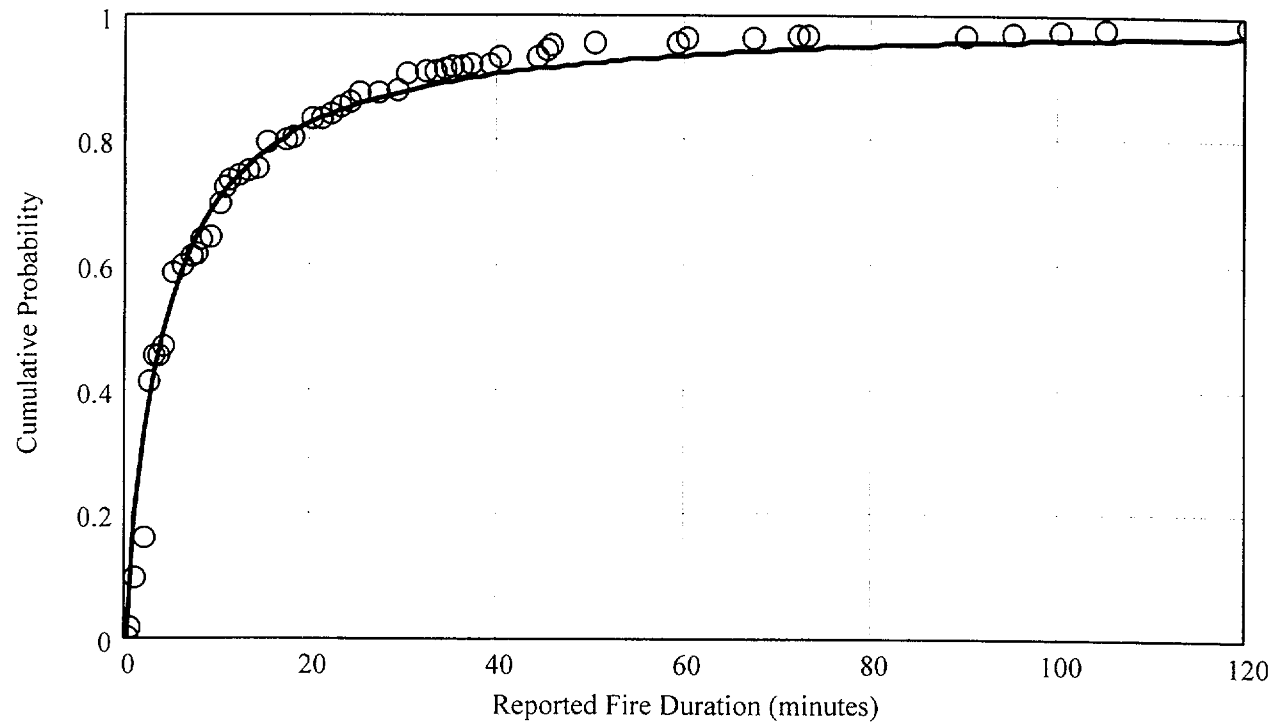
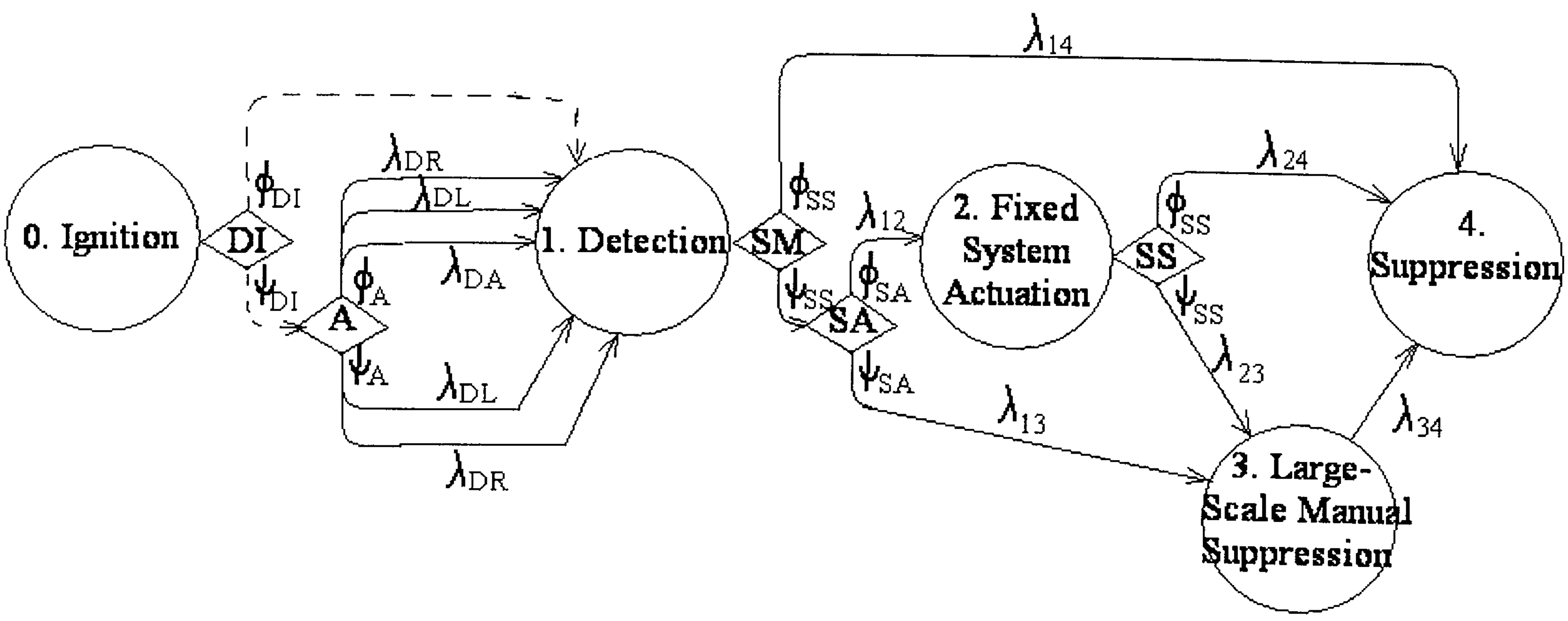


Figure 1: Example cummulative probability distribution curve for indoor NPP fires in the US (based on 651 events with reported fire duration times out of a database of over 1300 events).

Sandia National Laboratories

Modeling Framework (cont)

- Siu & Appostolakis published a mechanistic model in 1983:



Sandia National Laboratories

Modeling Framework (cont)

- Conclusions on model applicability:
  - Siu/Apostolakis model includes key features of interest
  - Identified desirable modifications:
    - Add path for self extinguished fires
    - Combine local and remote manual detection paths
    - Revise/redefine manual suppression paths:
      - Original model:
        - Manual suppression by on-site personnel
        - Large-scale manual suppression with off-site support
      - Revised model:
        - Prompt manual suppression (e.g., fire watch)
        - Delayed manual suppression (i.e., fire brigade)
    - Add suppression path for remove power or isolate fuel source when applicable (e.g., electrical fires, gas leaks)

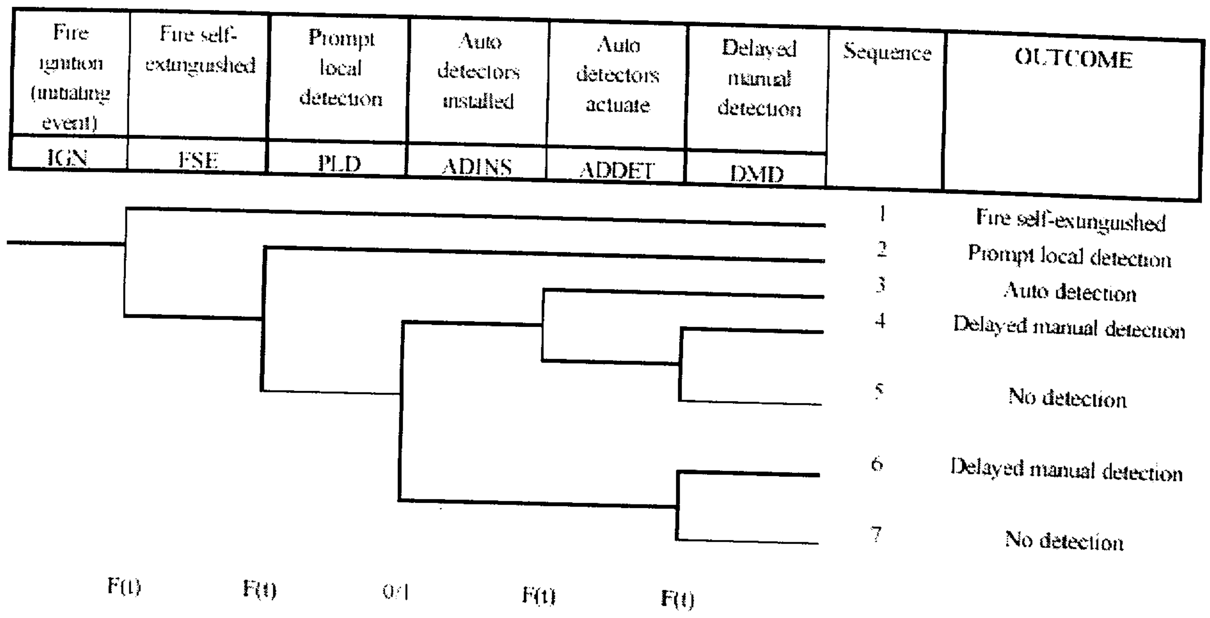
Sandia National Laboratories

Modeling Framework (cont)

- Format as network model potential barrier to acceptance (unfamiliar format)
- Translation to an event tree format is possible
  - No feedback paths
  - May increase acceptability/use

Sandia National Laboratories

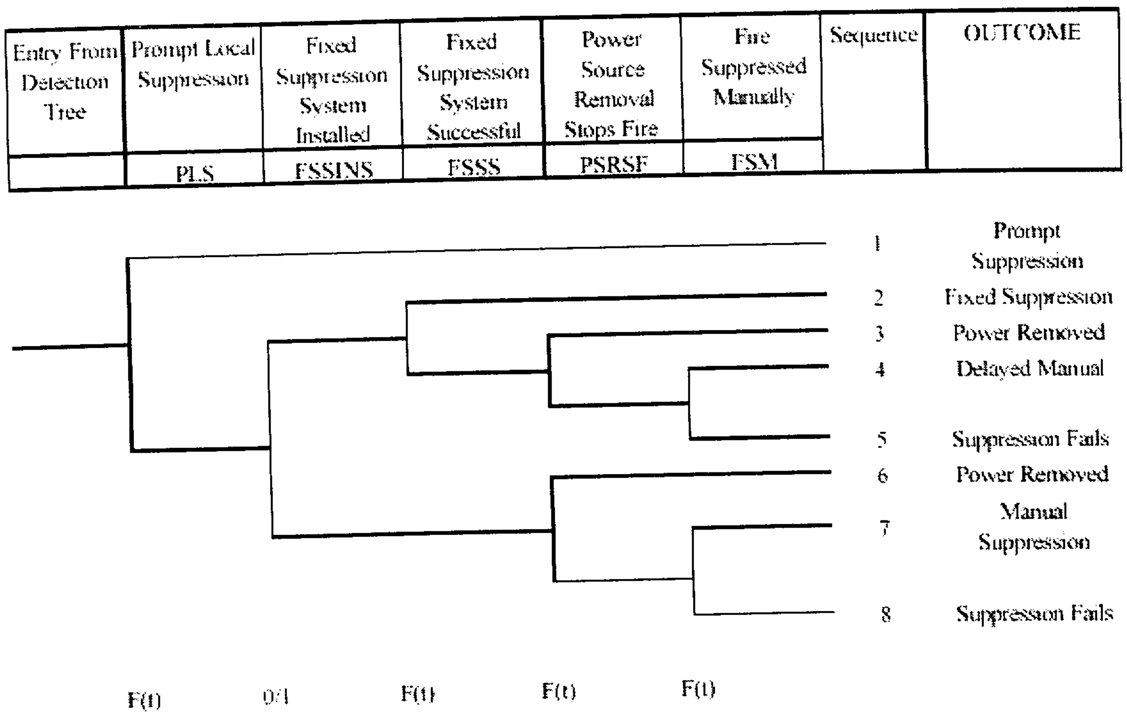
Fire Detection Event Tree



Fully General
Fire Detection Event Tree

Sandia National Laboratories

Fire Suppression Event Tree



Fully General
Fire Suppression Event Tree

Sandia National Laboratories

Information Gathering and Data Analysis

- Based on USNRC/Houghton data base
  - Covers years 1986-1999
  - Over 350 events
- Data Parsed and analyzed – e.g.:
  - Method of detection
  - Manual vs. auto/fixed vs. self suppression
    - Manual suppression method (extinguishers, hose stream, removing power, isolating fuel source)
  - Indoor vs. outdoor fires
  - Fires for key locations (e.g., T.B., R.B., containment, etc.)
  - Fires involving key sources
- Fire duration for various event sets estimated using Bayesian analysis

Sandia National Laboratories

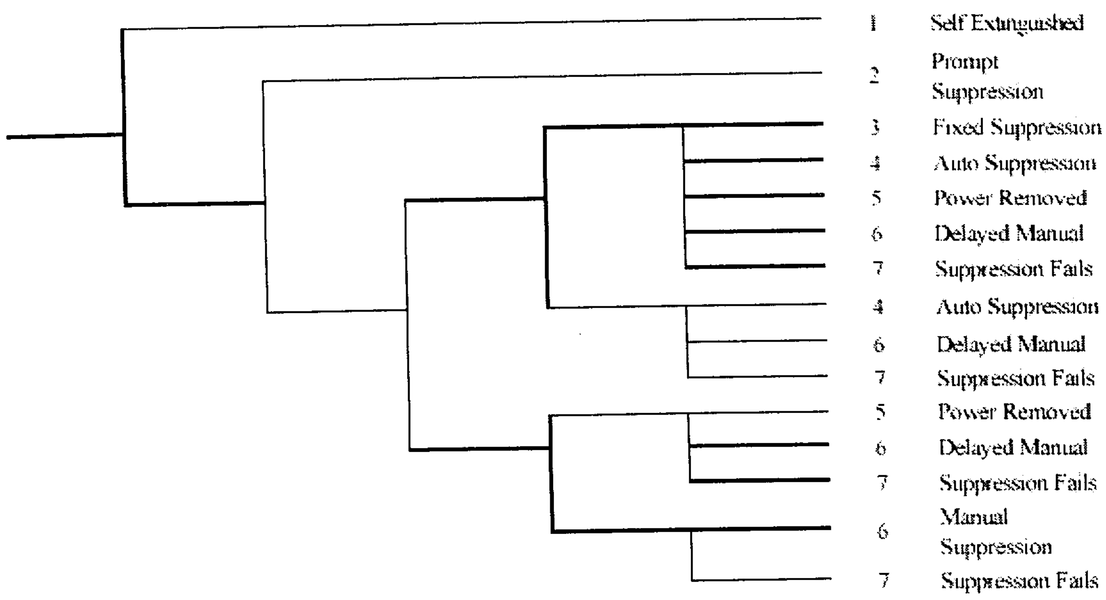
Data Limitations Identified:

- Fire detection times not available / not reported
  - Need independent means for detection time analysis or must treat implicitly (e.g., modeling assumptions)
- Limited data on fixed suppression system actuation timing, reliability, effectiveness
- Data base does not provide insights on suppression success/failure paths
  - May be possible by searching underlying event information – this activity not pursued
- Data does not support 'fine tuning' suppression analysis based on path to detection
  - Exception – prompt detection/suppression paths

Sandia National Laboratories

Simplified Det./Supp. Event Tree

Ignition	Fire Self-Extinguished	Prompt Local Detection and Suppression	Fixed Suppression System Installed	Electrical Fire (or other fuel source that can be isolated)	Fire is Suppressed	Sequence	OUTCOME
IGN	FSE	PLDS	FSSINS	ELEC	FS		



Simplified Fire Detection and Suppression Event Tree

Sandia National Laboratories

General Insights

- Limitations of event data remain an obstacle to more detailed analysis of detection and suppression

- Detection methods:
  - Nearly 25% of fires (in this data base) report prompt detection (e.g., fire watches, reports of an explosion, flash of light, etc.)
  - Only 6% of fires (in this data base) reportedly detected by fixed detection systems
  - Majority assumed to be delayed manual detection, but not all events report detection method

Sandia National Laboratories

General Insights (cont)

- Suppression method – all onsite fires:
  - Manual suppression – 63%
  - Self-extinguished – 18%
  - Power removed / fuel isolated – 16%
  - Fixed system (deluge – manual or auto) – 3%
  - Focus on manual suppression in fire PRAs appropriate

Sandia National Laboratories

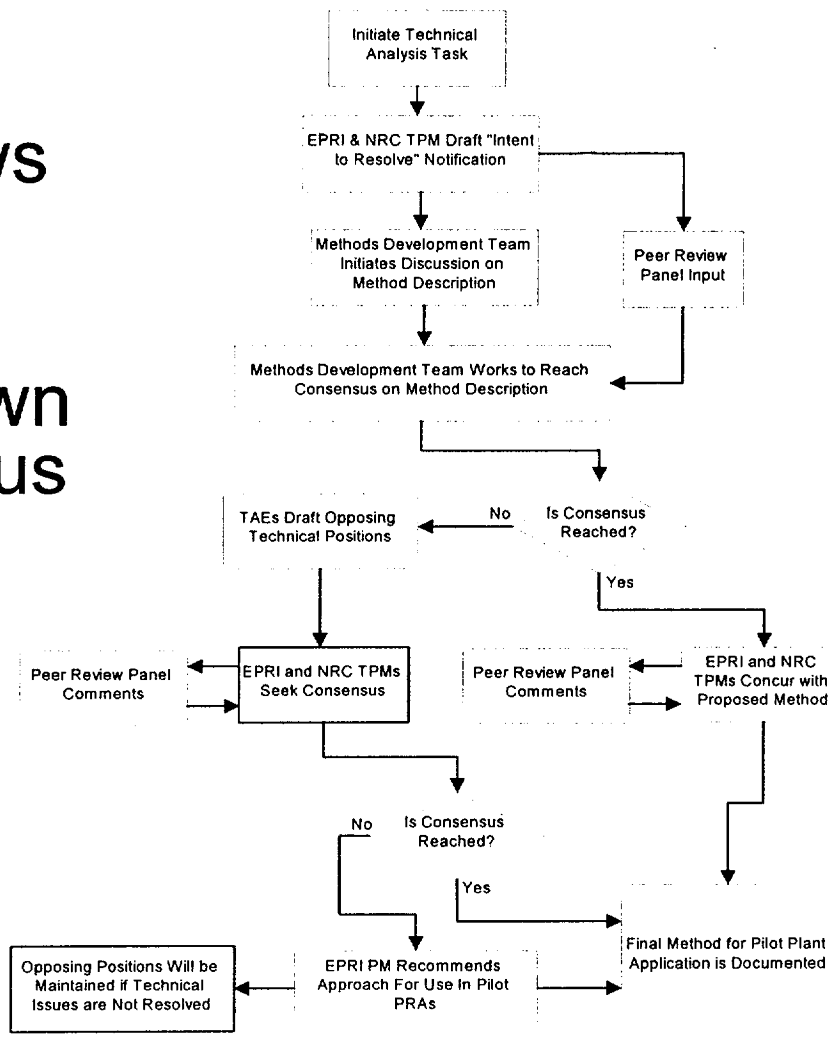
General Insights (cont)

- Involvement of fixed detection and suppression systems relatively rare in event reports
  - Reasons for lack of involvement not clear
  - How we treat fixed systems in fire PRA remains a challenge
    - Reliability
    - Timing
    - Effectiveness

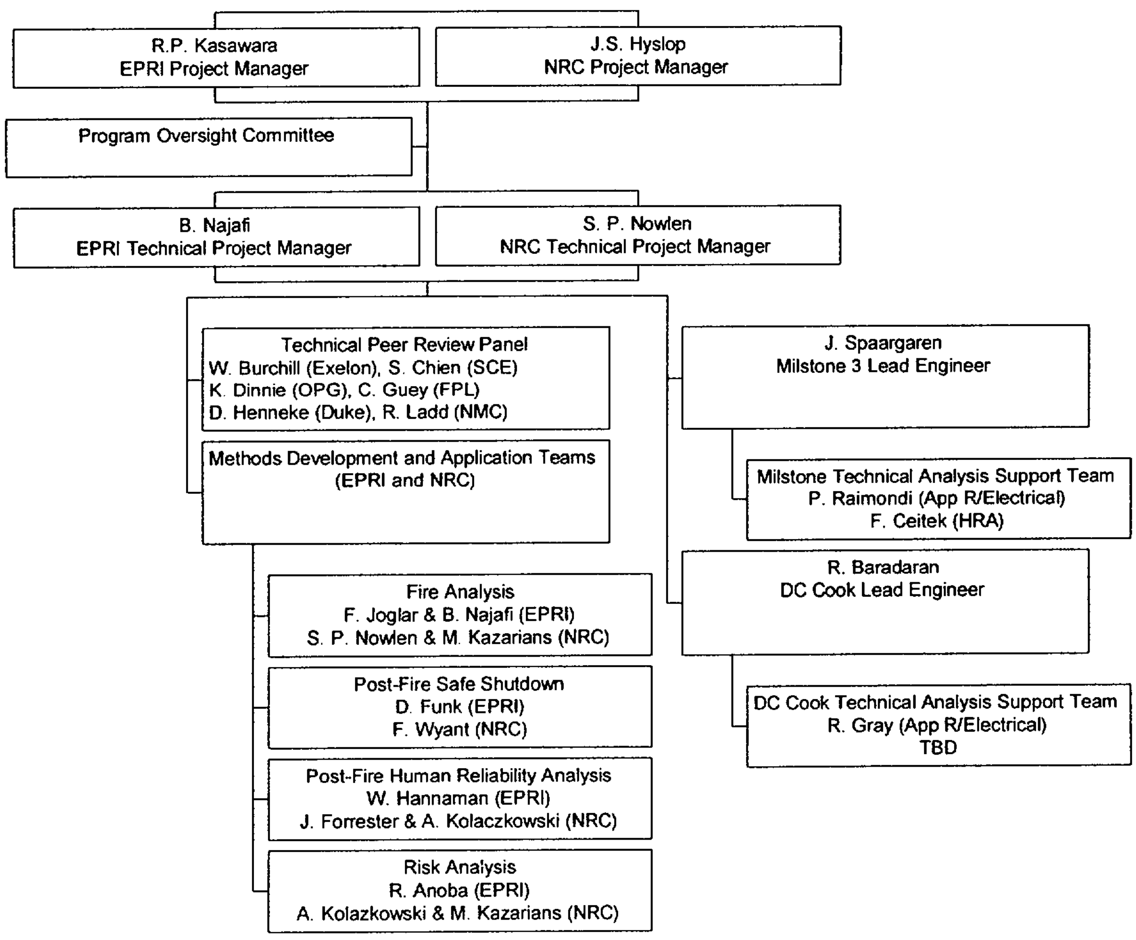
Sandia National Laboratories

TECHNICAL ISSUE RESOLUTION

- Clear process to allow consideration of all views
- Strive for consensus at many points in process
- Each party maintains own point of view if consensus not reached



Project Team



JOINT NRC/EPRI FIRE RISK REQUANTIFICATION STUDIES

J.S. Hyslop, RES/PRAB
Steve Nowlen, SNL

Presented to ACRS Subcommittee on Fire Protection,
Sept. 11, 2002

BACKGROUND

- MOU between NRC-RES and EPRI
- Fire risk addendum
- One of several elements on fire risk addendum

OBJECTIVES

- Develop state-of-art fire risk estimates
- Determine qualitative and quantitative impact of improved methods, tools, and data on predicted fire risk
- Develop guidance for conducting FRA
- Develop guidance on strengths and weaknesses
- Technology transfer

SCOPE

- Full power, including estimates of LERF
- Excludes
  - Low power and shutdown modes of operation
  - Spent fuel pool accidents
  - Sabotage
  - Level 3 estimates of consequence

PARTICIPANTS

- NRC
- EPRI
- Pilot plants
  - Millstone Unit 3
  - D. C. Cook
- Six non-pilot participating plants

TECHNICAL ISSUE RESOLUTION

- Provides clear process to allow consideration of all party's views in development of methods
- Strive for consensus at many points in process
- Each party maintains own point of view if consensus not reached

PRODUCTS

- NRC-RES will produce NUREGs on insights, and methods
- EPRI will produce updated Fire PRA Implementation Guide (FPRAIG)
- Pilot plants will develop updated FRAs

DEMONSTRATION STUDIES

- Analyses performed jointly by NRC and EPRI using case examples from pilot plant FRA.
- Purpose
  - Demonstrate that methods can be implemented successfully in FRA
  - Technology transfer to pilot plant
- Demonstration studies comprise NRC's full involvement in pilot plant FRA
- NRR retains its independence in review of applications based upon pilot plant FRA

SCHEDULE

- Kickoff at Millstone in May 2002
- Kickoff at D.C. Cook in Oct 2002
- Complete Millstone in Sept 2003
- Complete Cook in Nov 2003
- EPRI update FPRAIG in Dec 2003
- NRC produce NUREGs in spring 2004
- Workshop (TBD)

REQUANTIFICATION STUDIES TECHNICAL STATUS

- Current technical activities focused on two areas:
  - Defining a consistent set of analysis steps
  - Writing procedures for early analysis steps
- Analysis process being broken into manageable pieces for purposes of procedure writing
  - Example of early task elements leading to qualitative screening:
    - Plant Partitioning
    - Selection of critical equipment – the fire PRA equipment list
    - Selection of critical cables and circuits – the circuit analysis list
    - Fire PRA database development

LEVEL OF ADVANCEMENT VARIES BY TASK

- Consolidation of existing methods, e.g.:
  - Plant partitioning
  - Screening
  - Documentation guidance
- Incremental improvements, e.g.:
  - Fire PRA database
  - Fire ignition frequency
  - Uncertainty and sensitivity analysis

LEVEL OF ADVANCEMENT VARIES BY TASK (cont)

- Significant advancement:
  - Plant Fire-Induced Risk Model
  - Circuit Analysis Tasks
    - Identification of Critical Cables/Circuits
    - Detailed Circuit Analysis
    - Circuit Fault Mode Quantification
  - Detection and Suppression
  - HRA
  - Fire modeling

Risk Methods Insights from Fire Incidents – A Brief Status Update

Presented to:

Advisory Committee On Reactor Safeguards

Fire Protection Subcommittee Meeting

September 11, 2002

Presented by:

Steve Nowlen

Sandia National Laboratories

Sandia National Laboratories

Background

- Task presented to ACRS Fire Protection Subcommittee October 2000
  - Objectives
  - Approach
  - Results and insights

- 10/00 presentation was based on a draft for public comment of the task report

Sandia National Laboratories

Current Status

- Insights and conclusions of study remained essentially unchanged given review comments
  - Editorial changes only
- Report has been published – NUREG/CR-6738
- Positive feedback received from both domestic and international readers

Sandia National Laboratories

FIRE RISK RESEARCH PROGRAM: STATUS UPDATE

J.S. Hyslop & Nathan Siu

Probabilistic Risk Analysis Branch
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission

ACRS Subcommittee on Fire Protection
September 2002

OUTLINE

- Status
- Program objectives
- Recently initiated tasks
- Planned/potential activities
- Accomplishments (existing tasks)
- General elements of plan
- Events since plan development
- Concluding remarks

STATUS

- Program plan being updated
  - Last version for 2001-02
- Considering 4 year plan for new version (2003-06)
  - Detailed plan for 2003-04
  - Less detail for 2005-06

PROGRAM OBJECTIVES*

- Improve qualitative and quantitative understanding of the risk contribution due to fires in nuclear power plants.
- Support ongoing or anticipated fire protection activities, including the development of risk-informed, performance based approaches to fire protection
- Develop improved fire risk assessment methods and tools (in support of above objectives)

*From FY 2001-2002 plan

RECENTLY INITIATED TASKS

- Fire risk requantification studies (technical activities)
  - Joint NRC-RES/EPRI studies
  - Represent integration of many tasks
  - Many objectives, including new methods
  - Expected to support ANS fire risk standard
- ANS fire risk standard development
  - RES is providing two members of the writing committee
  - Kickoff meeting recently held
- Fire protection SDP revision
  - RES is supporting NRR direction to revise
  - Comprehensive review
- Providing assistance to NRR to develop risk-related guidance to support inspection of fire protection circuit analysis issues

PLANNED/POTENTIAL ACTIVITIES

- Fire model benchmarking and validation (and testing)
- Fire protection for gaseous diffusion plants
- Fire risk assessment for precursor analysis
- Fire protection rulemaking support
- Fire risk assessment guidance assessment

ACCOMPLISHMENTS (EXISTING TASKS)

- Tools for circuit failure mode and likelihood analysis

- Tools for fire detection and suppression analysis

- Fire modeling toolbox
  - Collection of references re: HRRs, cable fragilities, ignitability

- Frequency of challenging fires
  - Model for handling early stages of fire development (expert judgement)

- Experience from major fires
  - FRA framework captures chain of events observed in real fires
  - Some exceptions, i.e. multiple fires

ACCOMPLISHMENTS (EXISTING TASKS) (cont.)

- Fire model benchmarking and validation
  - Various fire models provide consistent results for cable tray fires

- Integrated model and parameter uncertainty
  - Bayesian technique for addressing modeling uncertainty

- Significance of smoke effects (review of literature)
  - Threshold smoke level for damage for digital circuitry is very high concentration (films provide adequate protection)
  - Some evidence that high voltage is vulnerable

- Fire protection SDP support
  - Model for quantifying the effectiveness of manual actions at remote shutdown operations

- NFPA 805 development support

GENERAL ELEMENTS OF PLAN

- Overall objectives
- Background (e.g. initial prioritization, RIRIP)
- Program outputs and regulatory uses
- Relationship with other programs/activities
- Specific technical objectives
- Tasks and Milestones
- Communications plan

EVENTS SINCE PLAN DEVELOPMENT

- Issuance of risk-informed, performance based fire protection rulemaking plan
- Issuance of NFPA 805
- Plan to revise the fire protection SDP
- Industry development of risk-informed approach to resolve the circuit analysis issue (NEI 00-01)
- Potential needs established for non-reactor applications
- Cooperative activities initiated
  - NRC-RES/EPRI MOU
  - Fire modeling
  - COOPRA, WGRISK (in process)
- NRC Public Workshop on RES Fire Risk Research Program (Aug 2001)
  - Discussed technical progress of tasks
  - Attended by industry, user offices of NRC (including Regions)
  - Feedback very positive

CONCLUDING REMARKS

- Research results are addressing ongoing regulatory technical issues
- Staff is participating in cooperative efforts with industry and international organizations
- Needs for research are evolving
- Research program is evolving to meet needs