Official Transcript of Proceedings

ACRST-3249

NUCLEAR REGULATORY COMMISSION

ORIGINAL

Title: Advisory Committee on Reactor Safeguards
Fire Protection Subcommittee

Docket Number: (not applicable)

PROCESS USING ADAMS
TEMPLATE: ACRS/ACNW-005

Location: Rockville, Maryland

Date: Tuesday, September 9, 2003

Work Order No.: NRC-1067

Pages 1-383

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

TR04

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

SUBCOMMITTEE ON FIRE PROTECTION

+ + + + +

TUESDAY,

SEPTEMBER 9, 2003

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m.., Stephen L. Rosen, Chairman, presiding.

COMMITTEE MEMBERS:

STEPHEN L. ROSEN, Chairman

GRAHAM B. WALLIS, Member

THOMAS S. KRESS, Member

DANA A. POWERS, Member

JOHN D. SIEBER, Member

ACRS STAFF PRESENT:

MARVIN D. SYKES

NRC STAFF PRESENT:

JOE BIRMINGHAM

SUZANNE BLACK

DAVID DIEC

RAY GALLUCCI

JOHN HANNON

J.S. HYSLOP

NAEEM IQBAL

PAUL LAIN

ERASMIA LOIS

PHIL QUALLS

MARK HENRY SALLEY, P.E.

SUNIL WEERAKKODY

ALSO PRESENT:

H. DOUG BRANDES, Duke Power

FRED EMERSON, Nuclear Energy Institute

DENNIS HENNEKE, Duke Power

I-N-D-E-X

OPENING REMARKS, Chairman Rosen 4

STAFF INTRODUCTION AND OVERVIEW
Mr. Hannon 6
Mr. Weerakkody 6

10 CFR 50.48 RISK-INFORMED FIRE PROTECTION RULE
Background and Overview
Mr. Lain 10
Proposed Rule Language
Mr. Birmingham 44
Implementation and Pilot
Mr. Hyslop 70

NEI DISCUSSION
Mr. Emerson 77
Mr. Brandes 79
Mr. Weerakkody 110
Mr. Salley 114
Mr. Hyslop 178
Mr. Emerson 181

FIRE DYNAMICS SPREADSHEETS 253
Status of NUREG 1805 266
Inspector Training 273
Demonstration of Tool 275

MANUAL ACTIONS
Background 303
Rulemaking 305
Inspection 314
RES Support 319
Schedule 321
NEI Discussion 332

GENERAL DISCUSSION 355

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

8:33 a.m.

CHAIRMAN ROSEN: The meeting will now come to order.

This is a meeting of the Advisory Committee on Reactor Safeguards Subcommittee on Fire Protection. I am Steve Rosen, Chairman of the subcommittee.

ACRS members in attendance are Jack Sieber, Tom Kress, Dana Powers, Graham Wallis.

The purpose of this meeting is to discuss a number of the fire protection issues which include 10 CFR 50.48 rulemaking which would permit licensee to voluntarily adopt National Fire Protection Association Standard 805, performance based standard for fire protection for light water reactor electric-generating plants as an alternative to existing fire protection requirements.

Number two, the staff's approach for resolution of issues related to post-fire safe shutdown circuit analysis.

Number three, development of fire dynamics tools for inspectors, and;

Number four, the staff's proposed rulemaking for post-fire manual actions.

We will be hearing from representatives from the Office of Nuclear Reactor Regulation, the Nuclear Energy Institute and Duke Energy will be making presentations during this meeting.

The subcommittee will gather information, analyze relevant issues and facts and formulate proposed positions and actions as appropriate for deliberation by the full committee. Marvin Sykes is the cognizant ACRS staff engineer for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the *Federal Register* on August 19, 2003.

A transcript of the meeting is being kept and will be made available as stated in the *Federal Register* notice.

It is requested that speakers first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

We have received no other written comments or requests for time to make oral statements from members of the public regarding today's meeting.

We will now proceed with the meeting. I call upon Mr. John Hannon of the Office of Nuclear Reactor Regulation to begin.

MR. HANNON: Good morning. I'm John Hannon, plant systems branch chief. And with me this morning is Suzie Black, the division director for DSSA.

We have been working very diligently behind the scenes to prepare for this session. We appreciate the opportunity to meet with the ACRS Subcommittee on Fire Protection.

Let me now turn over to Sunil Weerakkody, he's the section chief in charge of the fire protection section

MR. WEERAKKODY: My name is Sunil Weerakkody. I'm the section chief of fire protection. I assumed this position June of this year.

What I'd like to do first is as part of the old, we'll introduce the key elements of the presentations that Office of Nuclear Reactor Regulation and the Research Office would present. And also identify the case staff members who make those presentations.

The first presentation would be 10 CFR

50.48(c) which is rulemaking. It is also called NFPA 805 rulemaking, and it's in its final stages.

The key people who would make the presentations are from the rulemaking branch, Joe Birmingham and then from my staff I have Paul Lain sitting somewhere. Paul Lain and J.S. Hyslop will speak to how the Office of Research is supporting that effort. And what they will do is since I am told that we have not meet with you for about a year, so we will give you an update of what we have accomplished over the last year and the status, and then there's a number of another elements that we would be discussed pertaining to the rule.

The second topic will be risk-informing associated circuits. That presentation would be made by myself and Mark Salley who is in my staff. And we have a number of accomplishments that we have made as a branch. We have gone as far as we can go in this area.

Just a quick background on this topic. About 3 years ago we stopped the inspections on circuits because of a number of issues. And over the last 3 years we have done a lot of work in this area including a number of experiments, including creating a new inspection guidance that helped

inspectors identify that are risk significant. Again, I'll leave the details to the presenter. That will be our second presentation.

The third presentation would be made Naeem Iqbal on the development fire dynamic tools. And I think here you have shared the NUREG 1805 which is a draft document. I think you have shared with the ACRS members. And what we have done there is a number of things were purely qualitative many years ago. We have developed some screening quantitative type tools for the use of the inspectors. And Naeem would go into how and when these tools would be used in our regulatory process, and then go into some details of what the tools do.

And our final presentation would be on manual action rulemaking. That will be presented by David Diec of the Rulemaking branch and he would be supported by Ray Gallucci and Phil Qualls from the Fire Protection and also by J.S. Hyslop from Research.

And I also understand there is one other key element that you would be hearing from our parent branch, that's on the fire protection significant determination process.

One of the things before the oral

presentations start, I want to sort of give you a very quick overview of the common thread, so to speak, that I have recognized as the common thread that runs all these issues. I was able to take an outside look at the fire protection issues just because I'm new to the area. And what I am finding is there's a legacy issues. What I mean there is that because of the regulations, the reg guides, the information notices there are some confusions out there in terms of the licensing basis, what is real licensing basis, what is outside licensing basis. And in all of these efforts that you would be hearing today one common thread you would find is that we are looking for creative ways to achieve safety without undue burden to stakeholders. The reason I state it this way is one of the easiest solutions if both us and the industry had unlimited resources is to say, you know, spend a lot of resources clarifying what the licensing basis is and get the licensees to address all compliance issues. We are not going down that path. The path that we are going down is a path where we use the performance basing and risk-informing as the nexus or as the main approach.

That is my last slide. I just want to

make sure that I take a few moments to thank you for giving us the opportunity to come to you. And we are going to sit down here and listen to your questions, take your feedback and determine how or whether we need to change the direction we are heading in the fire protection area.

Finally, if after our presentation if you feel that the fire protection we aren't going in the right direction, we would appreciate your endorsement of that. Because, as I said, the legacy issues to solve the number of issues that we confront, the whole agency has to work together and your endorsement of the overall direction can help us achieve that end.

Thank you very much.

CHAIRMAN ROSEN: Well, thank you very much, Sunil, for that useful introduction. We certainly will do our best to provide you with the support you have requested.

MR. LAIN: Hello. My name is Paul Lain. I'm a fire protection engineer with the plant systems branch.

This briefing on NFPA 805 rulemaking is going to be done by three people. We have on sort of the technical support Joe Birmingham's in the

rulemaking branch and he's the project manager for the rulemaking. And then J.S. Hyslop will tell us how Research is assisting in the 805 rulemaking.

We've briefed the ACRS annually for the last 4 years. I think the last one was June. Maybe the whole committee. It was June of last year with Eric Weiss. We've had a lot of people changing. But I just wanted to quickly review some of these items. This is sort of the briefing here.

I'll go over the first four sections, background advantages and structures and Joe will be going over the rule structure and the status of the rulemaking and then J.S. will come back in with the related Research side.

Background. I think all of you are very probably familiar with a lot of these items.

Appendix R came in in 1980 and then the agency got very involved with the PRA in the late '90s. We came in our different SECYs, one to work with industry to develop the fire protection standard, the rulemaking plan in 2000. And NFPA 805 was published in 2001 and we went out with the proposed in 2002.

Just to quickly go over some of the advantages of 805. One is to reduce regulatory

burden, you know. One way it does that, there's going to be with the circuit analysis which you're going to hear about later, I think there's going to be a lot of issues. And this is going to be one way that licensees can use this approach to sort of reduce the exemption process and be able to ferret out the risk significant issues versus the non-risk issues and deal with them themselves versus coming into headquarters with a lot of exemptions.

It also endorses the National Technology Advancement and Transfer Act of 1995 and encouraged agencies to endorse consensus standards. I think that was probably one of the lead pieces why we went this way.

We've also involved industry in the development of the standard, plus also we've helped to develop the guidance for the implementation guidance.

It will be voluntary, so then licensees that take a look at this and feel that they don't necessarily gain a lot economically won't be forced into going this way. But if they feel they can, I think we've got some indication, we've got at least 15 plants I think looking at going this way. So the number is increasing as to the rulemaking.

MR. SIEBER: So you aren't going to allow picking and choosing?

MR. LAIN: No. It's going to be the whole facility will have to sort of switch and become an 805 plant.

MR. SIEBER: You either buy it or you don't? Right.

CHAIRMAN ROSEN: Would you characterize those 15 plants without naming them? Are they the older plants, the new plants, the bigger plants, the smaller plants? Is there anyway to characterize them?

MR. LAIN: Doug Brandes might be able to tell, but I know his facilities are looking into it. I think a lot of them are the pre-'79 plants. But, Doug, would you like to comment?

MR. BRANDES: Yes. Can you hear me now?

I'm the one that came up with the number 15, so I thought I'd volunteer to explain a little bit.

There are a number of utilities who are currently working to update their fire protection program, primarily the safe shutdown program. And our thinking was that these guys are right now under pressure from their respective regions to press

forward. But if they have the opportunity to delay their update until the new rule was available to them, they would probably benefit from adopting it. So this is a combination of older and newer plants.

CHAIRMAN ROSEN: So it's plants that have found the need to update their fire protection licensing basis, that would be a way to characterize it?

MR. BRANDES: Yes, primarily their safe shutdown program.

CHAIRMAN ROSEN: Safe shutdown program. Okay. Thank you.

MR. BRANDES: Thank you.

MR. LAIN: Something 805 does, it does set specific performance goals and criteria which we don't have in Appendix R. And you can focus in on your risk significant issues and then prioritize your issues and spend your resources in the most significant way and all the while maintaining safety margin and defense-in-depth. I think those are going to be some key hurdles within the implementation that you basically have to go over as you maintain sufficient safety margin and defense-in-depth.

DR. WALLIS: Do you have a measure of

what the safety margin is or something to be --

MR. LAIN: Right now it's qualitative. We are working with the implementation guide to sort of confirm it.

DR. WALLIS: So how do you know that you've maintained a safety margin?

MR. LAIN: That's a good question, I don't have an answer for you.

DR. WALLIS: The same thing goes for defense-in-depth? I mean, these are good words.

MR. LAIN: Yes.

DR. WALLIS: But without some kind of a hard measure or something quantitative or definite or tangible.

MR. LAIN: Yes. Yes.

Doug, you have a comment?

MR. BRANDES: Yes. Again, Doug Brandes.

And I'm involved with this. I chaired the NEI task force working with this rulemaking so I'd like to at least offer some insights.

One of the fundamental premises in transitioning to a risk-informed licensing basis based on 805 is that the plant is safe today, safe tomorrow. So that the way we're structuring it is that existing licensing basis can be dropped in as a

point of departure with the caveat that we're recommending that licensees look back at any engineering analysis to be sure that all the historical engineering analysis for fire protection meet the quality of our expectation for current day engineering analysis. And with that concept in safe today/safe today makes sense.

We also have a provision for any change to the licensing basis. We run through a change evaluation process essentially based on the reg guide 1.174 to be sure that you maintain safety margins.

DR. WALLIS: So this is so you can look at your PRA?

MR. BRANDES: I'm sorry?

DR. WALLIS: You use the PRA then as --

MR. BRANDES: If available, either the PRA or the whatever IPEEE analysis is available.

MR. LAIN: I think Fred may be getting into this a little bit later. His presentation will follow us and he'll probably be talking about the implementation guide in depth. Is that correct, Doug?

MR. BRANDES: That's my presentation.

MR. LAIN: Okay. Okay.

Yes, sir?

DR. POWERS: You've addressed maybe the issues in margin, but the issue of defense-in-depth, unlike many aspects of reactor safety, defense-in-depth is a fairly tangible specific thing within the area of fire protection.

MR. LAIN: Yes.

DR. POWERS: I mean it has a definition?

MR. LAIN: Yes.

DR. POWERS: And we know what the layers of defense are. I mean, it's pretty transparent whether you have that or not have that. I mean, at the end of the day after you've done everything you either have that or you don't. It's not a judgment call.

MR. BIRMINGHAM: Paul? Joe Birmingham, Office of NRR.

And briefly what NFPA 805 does it carefully defines what defense-in-depth is and then it talks about if you make a change to a plant, then you review the defense-in-depth. And if you've changed anyone of the three typical things that we have that if you've reduced one, then you'd better look at the other two carefully to see if you either: (a) increased those to preserve an adequate

amount of defense-in-depth or that you haven't reduced that one level of defense-in-depth to a point where it's not tenable.

DR. POWERS: Well I mean it seems to me if you've reduced any one of the layers to the point it's not tenable, then you don't have defense-in-depth?

MR. BIRMINGHAM: Absolutely.

DR. POWERS: It seems to me that the more crucial thing is that you may have rendered them not independent of each other. That would be the more difficult thing, I think. Because imbedded in the concept of defense-in-depth is one layer doesn't impact the other.

MR. BIRMINGHAM: Right. 805, we basically describe it as integrated and then the assessment is an integrated assessment of defense-in-depth. And your point is a good description of the way 805 approaches it.

DR. WALLIS: Yes. You need some kind of a mathematical formula that says you have to have all three up to a certain level. As you approach that limiting level in any one of them, some kind of a measure goes off scale. I don't know what the measure is. I could probably construct a formula

that would have that characteristic.

MR. BIRMINGHAM: Yes. And as you pointed out, you cannot reduce any one of the levels below where it's no longer useful.

DR. WALLIS: Less than minimum level. And do you know what that is? Is it specified?

MR. BIRMINGHAM: Each level -- I mean, it really is a specific -- you have to approach each application on a specific basis. For example, in fire protection defense-in-depth you start off with --

DR. POWERS: Detect fires. Prevent fires.

MR. BIRMINGHAM: -- prevent fires and detection and mitigation, suppress, mitigation and so on. If, for whatever reason, you reduce one you need to ensure that the others have complete adequacy.

DR. POWERS: Let's explore the first, as well as this description of this just a little bit.

You have to prevent fires. Okay. I mean, it's pretty hard to know. If you're successful, it's hard to know that you're successful. If you're not successful, it's very obvious you're not successful. So I'm not sure how

you rendered that into a mathematical formula.

MR. BIRMINGHAM: It makes it a difficult thing to do. And if you go into a fire area and you decide for whatever reason this fire area is difficult to prevent fires, it has more oil pumps and so on that are in there, therefore more combustibles, you have to look at your mitigation systems. Are those going to be adequate should we have a fire?

If you go into a fire area and you're able to say this area has none and we're going to prevent the introduction--

DR. POWERS: Now I understand what you were talking about reducing things. You're saying it's not so much you're reducing things, that things are reduced just be it's function.

MR. BIRMINGHAM: Correct.

DR. POWERS: And so now you have to bolster something else because it's impossible to change the function of this facility.

MR. BIRMINGHAM: Yes.

DR. POWERS: This particular region.

CHAIRMAN ROSEN: Let me recognize a member of the public.

MR. HENNEKE: I'm Dennis Henneke with

Duke Power, and I'm a PRA guy. And I was on NFPA 805 committee in circuit analysis and I'm working with implementation guide with NEI.

Defense-in-depth and safety margins is one of the key areas that we recognize in the implementation guide that really needs to be better defined out of 805. 805 does define it and because fire protection has something you wrap your hands around about ignition frequencies and, you know, likelihood of a fire, suppression capability and safe shutdown that people feel comfortable that defense-in-depth can be measured and maintained. But in actuality when you start looking at it it's as complex as any other defense-in-depth argument. And so we're trying to look at specifics in the implementation guide.

And you talk about formula for it, the PRA is a formula for defense-in-depth. It is a defense-in-depth model because it takes all the attributes of defense-in-depth and measures it. So one would think that you could measure low risk and you've maintained a measure of defense-in-depth. However, the PRA's uncertain and so you have to look at defense-in-depth in a qualitative standpoint and you have to put some guidelines out there.

One of the aspects, for example, that we've had with the staff, say, in the circuit analysis you can't have circuit analysis issues where the conditional core damage probability is 1.0. And we'll argue back and say well, first, you have a spurious operation probability but if you look at defense-in-depth, you can fail an attribute of defense-in-depth like safe shutdown, which is a core damage of 1, as long as the other attributes are strong.

So if you had a likely fire with a conditional core damage of 1, then that would be insufficient defense-in-depth. If you had an unlikely fire and you had suppress but you still had a core damage of 1, that would maybe be okay as long as your risk is shown to be low.

So there's still things about defense-in-depth we have to define, and we've made an attempt in our draft and implementation guide to do that. But it is one area I've talked to Paul about that really the NRC needs to look at and make sure that we've taken a shot to define it better, take a look at it and make sure that that's kind of what we were thinking and make sure that's strong. Because that's definitely an area going forward if we're

going to safe today/safe tomorrow, that's where we're going to validate that that's true.

DR. WALLIS: Can I ask if we're going to see this implementation guide then?

MR. LAIN: What was the question?

DR. WALLIS: Are we going to see this implementation guide? Are we going to have a presentation on it or does --

MR. LAIN: Yes, you'll be having a presentation on it. And I think it was also, did we not provide you a copy of that?

DR. WALLIS: But it's a draft, isn't it?

MR. LAIN: Okay.

DR. WALLIS: But that may be where the real issue gets faced?

MR. LAIN: Yes.

DR. WALLIS: Okay. Thank you.

MR. SYKES: Let me correct that. You may have provided a copy of it, but the Committee members have not gotten a copy of it. I'm not sure. I need to go back and check my files, but I don't recall getting a copy of it.

MR. LAIN: It was a fairly thick document.

MR. SYKES: Okay.

CHAIRMAN ROSEN: I would have to speak up for the PRA branch of the ACRS which would point out the PRA doesn't introduce uncertainty. The uncertainty is there. The PRA simply takes a shot at attempting to quantify it.

DR. WALLIS: And then DID or defense-in-depth is a way of taking care of the uncertainty. So look at the worse thing and say how do we defend against that, even if we are wrong about bits of the PRA, we still got some defense. So they are intertwined.

MR. BIRMINGHAM: Joe Birmingham, NRR again.

The process for NFPA 805, the analysis that it goes through, is an engineering analysis that uses quantifying the risk. But then when you get done, it then purposely takes a look at defense, did we preserve defense-in-depth adequately, did we preserve safety margin. And it follows that formula.

DR. POWERS: Without wanting to delay the procedures, I will not contest my fellow member's use of PRA as the quantifier of defense-in-depth.

DR. KRESS: Although you would like to.

DR. POWERS: I'll reserve that for

either later in the proceedings or tonight.

It's not that I disagree with the utility of PRA as a way of assessing. I just don't believe that defense-in-depth is solely a manifestation of PRA and uncertainties identified in the PRA. I believe it addresses more.

DR. KRESS: I think that would be one aspect of it.

DR. POWERS: It is one aspect of it.

DR. KRESS: Yes, but there is an additional aspect that I agree --

DR. POWERS: An additional aspect of it that says there are things --

DR. KRESS: You just don't know the quantitative side.

DR. POWERS: -- that we don't know how to do.

DR. KRESS: That's right.

MR. LAIN: Okay. A quick overview of the 805 structure. It has a core fire protection program, fundamental program within it. It also has sort of a parallel structure. It has a deterministic side and a performance based side where you can transition into the deterministic side and then use the change control process to change your facility.

I think it was designed that way to make transition not as hard.

It requires to establish your fundamental fire protection program to go back and do a reevaluation to transition and to modify, I guess we're modify your existing fire protection program to conform to 805. But it also it allows including existing exemptions in Generic Letter 86-10 of type evaluations to be able to sort of grandfather your existing program into 805.

It also provides guidance on performing your nuclear safety analysis, fire modeling and fire PRAs.

To quickly go over the core fundamental program, I'm not going to hit each one of these points, but this contains a lot of what sort of Appendix R also has, but it's your design elements, your design requirements. If you have a sprinkler system, it says it needs to follow NFPA 13, your fire brigade needs to follow NFPA 600; it has those types of items. It has some deterministic requirements like you need to 5 fire brigade members.

DR. POWERS: That's one that has been a curiosity to me because of the interface with OSHA

rules on entry where if you have two lines of attack on a fire, you haven't got enough people to comply with OSHA with 5 member team.

MR. LAIN: Yes.

DR. POWERS: Have you run into a problem with that?

MR. LAIN: Not that I've heard. I sort of get the feeling that they would like to even less than that 5 person team, I think. I think there's a history on it. I'm not that familiar with the history, but I think they fought for at a minimum of having a 5 member team. And I see where you're going here that it's --

DR. POWERS: Yes. If you have 2 people entering into a hazardous area, OSHA wants 2 people outside.

MR. LAIN: Yes.

DR. POWERS: That pretty well consumes your team.

MR. LAIN: Yes.

DR. POWERS: And so 2 lines of attack on a fire, which is a pretty common strategy, you haven't got enough folks. I mean, how does that interface with OSHA work?

MR. LAIN: I don't have the background

on that particular topic. I don't know if anybody else here does.

DR. POWERS: I mean, it seems like we've got to.

MR. LAIN: Yes.

DR. POWERS: I mean, 805 says minimum of 5 members on a team. Okay.

MR. LAIN: It doesn't say you can't have ten.

DR. POWERS: But it says a minimum of 5. But it seems like a minimum of 5 runs counter the common strategies for attacking of fires. Now, 805 doesn't say you have to have two lines of attack, but if you look at the fire protection plan at plants, it's not uncommon for them to have --

MR. LAIN: To have more.

DR. POWERS: -- a strategy of two lines of attack on a fire.

DR. KRESS: Where does the local fire department other than the plant personnel fit into that?

DR. POWERS: You know, I'm not sure how it does, Tom. Because I mean the local fire department is going to have a two line of attack approach on every fire.

DR. KRESS: That's what I mean. That's why I mentioned it.

DR. POWERS: I mean every fire they're going to have this two line of attack. But --

MR. LAIN: Their response time is a little bit longer And it's sort of they're called in afterwards, after the initial fire brigade.

DR. POWERS: Okay.

DR. KRESS: So it's the response time that would prevent that?

MR. LAIN: Yes.

DR. POWERS: I mean this a question that's come up to me every since the first draft of 805 came out, but I don't see how it -- I mean, it just seems like it has to at least say something to somebody about this OSHA requirement.

MR. QUALLS: Paul, may I ask a question?

MR. LAIN: Yes. Sure. I remember it being discussed before I joined the branch. This is Phil Qualls from the plant systems branch.

MR. QUALLS: Hi. My name is Phil Qualls. I've inspected a ton of fire drills. I was an inspector in Region V for a lot of years before they closed it.

What you typically see during the fire

drills is actually the fire brigade leader making the decision to attack it from one side based on the size and the location of the fire which leaves actually 4 members to make that approach. There are two approaches to every fire area, typically, in the pre-fire plan such because the fire is perhaps in a location where you have to approach it from one of two directions. But typically there is one fire brigade making the approach in one direction based on the location and the type of fire which allows you 2 people to make the first entry and 2 people free and a fire brigade leader to satisfy the OSHA needs.

DR. POWERS: And what you're saying is the practicality of the matter is that in the event of a fire the attack is really from one direction?

MR. QUALLS: Typically, yes, because they have two approaches because that's the pre-fire plan. So there's going to be two approaches. But it depends generally on the location and the type of fire as to which approach is used.

DR. POWERS: Well then it seems to me that what you've got to say in your plant plan is the fire brigade leader will select a line of attack from the two options that he has and attack it only

in one direction and not claim that you're going to take a two direction attack.

MR. QUALLS: Well, that's what you usually see in the drills, is attack from one direction based on the size and location of fire.

DR. POWERS: But that's not what you see in the plan. I can't say universally true, but it's not uncommon.

MR. QUALLS: I usually see the option.

DR. POWERS: You always had the option to attack in only one direction.

MR. QUALLS: But that's what I see during the drills. And that's certainly --

DR. POWERS: What you're telling me is, is that it's common to attack it on one direction, and I accept that.

MR. QUALLS: Well, see, most fires that would require--

DR. POWERS: Here it looks like to me that you're stuck. If you can only attack it in one direction, then you got to make a decision.

CHAIRMAN ROSEN: Well, in the beginning. Later on, I mean after your reinforced by the off-site fire --

MR. QUALLS: In the incipient --

DR. POWERS: Yes, once you're reinforced, then you got enough.

MR. QUALLS: If it's too large that they can't put it out from one direction, my experience has always been that the fire brigade leaders are ready to recommend off-site assistance. I haven't seen any hesitancy about that.

DR. POWERS: Well, we have lots and lots of examples of whether there's been hesitancy in the combating of fires.

MR. QUALLS: I've seen some of that, too, but not in getting off-site assistance.

CHAIRMAN ROSEN: All right Paul.

MR. LAIN: Okay. Next slide.

Some items in NFPA 805 some differences from Appendix R. One is cold shutdown. You guys might be familiar with this. Basically the fuel needs to be brought to a safe sable condition, meaning hot standby.

The lighting requirement, there's not a specific 8 hour emergency lighting requirement. What is in 805 is within the nuclear safety analysis and Appendix B is some guidance that sufficient lighting needs to be available to perform the intended actions. So that's going to be one of those

inspection items where they go in and they make sure that they have sufficient lighting to do all their manual actions or other items that they do.

The term alternate and dedicated --

DR. POWERS: Does that give you a problem on the lack of specificity? We've had in the last 5 years I bet you have seen a dozen complaints about the lack of emergency lighting at plants for fire protection. And here the inspector is looking against a fairly objective criterion. Now he's going to look with something that's more amorphous, it becomes more contentious here. Is that going to cause you a problem?

MR. LAIN: Well, I think the history is that they've allowed in a lot of exemptions that they've allowed to use portable lighting and the light. I'm not exactly sure why it didn't necessarily get in 805 or not.

MR. SIEBER: Candles.

MR. LAIN: No. Hopefully, no candles.

Any help from the gallery back here?

MR. BIRMINGHAM: One of the observations in 805 is that you're basically advocating a performance based approach. And the deterministic approach says we need 8 hours to go to cold

shutdown. In 805 you only need to go to hot shutdown to be in a safe stable condition typically. And you can achieve that much, much more rapidly than getting to cold shutdown. So the amount of time you need is far less.

So to say, for example, an 8 hour would be excessive--

DR. POWERS: But if I look at the history of things that have come to me, whether there was lighting or not?

MR. BIRMINGHAM: Whether there was lighting or not. And we have complaints under our existing Appendix R --

DR. POWERS: Yes.

MR. BIRMINGHAM: -- the deterministic requirement.

DR. POWERS: Yes. These are all Appendix R or its branch technical position alternative and things like that. And technically it was you didn't have enough lighting to work the alternate shutdown panel. I mean, is there lighting or not? It's not whether you had 8 hours of lighting. And clearly it's a judgment, but they're reducing this now to a judgment call. And the guy says yes, I can put it out with the pen light. I can

run the shutdown panel with the penlight on my key chain versus the inspector that says now you need 50 lumens per square foot or something like that.

MR. LAIN: I think we're going to find a lot of those items within the performance base.

DR. POWERS: I bet you do. And especially in 805.

MR. LAIN: Inspecting them is going to be --

MR. BIRMINGHAM: I'm going to take just one small objection to the judgment call. The judgment call is supposed to be based on engineering analyses, which sometimes get real close to a judgment call.

DR. POWERS: Yes, it's real close.

MR. BIRMINGHAM: But I agree. It does force them at least to look at it and make that call.

DR. POWERS: I think my overall point is when looking at 805 I think we need to look at where our history of difficulties has been and say are we going to make this worse or are we going to clear up some of these things in a way that both the licensee and the regulator can look at it and say, yes, we understand what's required here. And we're reducing

the requirement to make judgment.

But we got a lot of these things. I mean --

CHAIRMAN ROSEN: But the best example is not the dedicated shutdown panel. Because these are operators operating within a procedure at a facility that they've been trained on and all they really need is a powerful flashlight. I don't think a light on your key chain is what's anticipated, but with a powerful flashlight or a lantern it seems to me fairly obvious. This is not a hard judgment for me as an engineer to make and a trained operator with a powerful flashlight operating on a small, effectively small panel can usually do the job.

Now, there are lot harder engineering than that is my point.

MR. BIRMINGHAM: Thank you.

MR. WEERAKKODY: This is Sunil Weerakkody again.

Dr. Powers, I think your observation, I would say we could even somewhat generalize in that what you're saying is since we are going to a performance based risk-informed rule let's look at the performance history and let that guide us. So if we have any really caveat I would add is there

may be a lot of performance issues out there, but we got to take the substantive performance issues that can have an impact on the key goals and the performance criteria. You know, that's my take of that.

DR. POWERS: I mean, that's my generality. The lighting sort of thing is just an example of where -- you know, and there's a dozen of them that have come in over the last 5 years. And you're going from a fairly specific requirement to one that's a lot more nebulous here.

You know, I can understand why you might well want to do that, because as Mr. Rosen points out, the requirement to have fixed emergency lighting versus a strong flashlight is one that I think is suspectable to analysis. And it would probably come out the way he says it is, that you have a strong flashlight, it's perfectly good enough. But my point is that this history, that we ought to use when we're looking at this 805.

MR. WEERAKKODY: Yes, I will agree. And this is very consistent with, let's say, maintenance rule. You can't performance based without a precision of the past performance, or that's what it's coming down to.

MR. HENNEKE: Paul?

MR. LAIN: Yes.

MR. HENNEKE: Yes. Dennis Henneke, Duke Power.

My understanding is 805 still requires emergency lighting similar to Appendix R. And so if you have an action, a manual action or working on, say, a shutdown facility, emergency lighting is still required. It's just not the 8 hours.

It says, for example, if you have a fire within 10 minutes you perform an action and you can perform that with certainty within 15, then performance requirements would say you have emergency lighting that's 15 minutes long. There's no provision in there to take exceptions for flashlights at this point. So that still has to be something somewhere now as far as a deviation or something of that sort.

CHAIRMAN ROSEN: You're saying that's what 805 now requires?

MR. HENNEKE: Yes, it still requires emergency lights, it's just a matter of time.

MR. LAIN: Yes, it's under a guidance under the nuclear safety guidance that basically you have to have sufficient lighting to be able to do

your analyzed shutdown.

MR. HENNEKE: That's right. So there's really no difference, it's just no timing of 8 hours.

MR. LAIN: Well, it's a realization that you don't have to have fixed 8 hour emergency if you're going to have a shutdown.

MR. HENNEKE: And in fact, we've looked at cases where you may be running emergency shutdown for 24 hours, you have to have 24 hour lighting. I mean, there may be cases where it actually may be more strenuous. But the timing is based on the actual timing of the expected action. And I think that's the only difference, there's nothing in there that says you can't have it.

CHAIRMAN ROSEN: Okay. Will you move on.

MR. LAIN: The terms alternate, dedicated I think are not necessarily spelled out. I think people are going to have to document their analyzed shutdown method. And it could be the same sort of concepts that, you know, you have an alternator, you have a redundant safe shutdown train. You know, it talks about protecting your one shutdown train.

One thing 805 does allow is sort of feed and bleed for pressurized water reactors. And I think we take an exception to that in the rulemaking and don't necessarily allow that as your sole safe shutdown method.

Recovery action. Recovery actions, I guess, are defined are actions outside the control room or outside your other control panel. And the deterministic approach says you basically can't use recovery actions and if you do use recovery actions, then they have to be analyzed and that puts you into the performance based approach is what 805 talks about.

And then an addition requirement or criteria is 805 has added a radiation release criteria for areas like waste processing.

So our implementation strategy, one of them is working with NEI on the implementation guide. We're also talking about having a regulatory guide, a performance based fire protection regulatory guide. It's a deterministic regulatory guide, which is 1.189 and we've decided, I guess, to put together a reg guide that will have the NEI implementation guide, also the NEI circuit analysis.

We are in the middle of reviewing rev D

of the implementation guide. Joe will probably talk about that a little bit more. We've participated on their two pilots. They had a change control process pilot in Farley and a transition pilot in McGuire. I think both of those went very well. I think everybody on the teams learned a lot and I think the implementation guide is going to benefit from this.

You'll probably hear a little bit more about the circuit analysis here in the next presentation.

License amendment SRP, we are developing a SRP to take a look at the first couple of submittals. We expect them to be extensive to kind of put together a template on how to do or how a transition should do. And then we're developing a standard review plan to review those initial SRPs. We expect the follow ons to be more administrative and have the ROP process review those changes to the 805 plans.

We are also looking into enforcement --

CHAIRMAN ROSEN: The ROP process? You mean the normal inspection process?

MR. LAIN: Yes, the normal inspection process.

And we're looking into having

enforcement discretion during the transition process. We don't necessarily want to penalize somebody for doing a lot of self analysis and finding any problems and documenting problems. So we're looking into not necessarily writing violations for any new found items or old design issues that come up during the transition process.

And then I guess in the future also we'll be developing inspection procedures for the inspectors as to how to review these 805 plans. We'll probably get a lot of that out of the audit, the SRP type work to figure out what needs to be reviewed and then how to review it. I think that's going to be probably a lot of work in 2004 for us.

MR. WEERAKKODY: Again, this is Sunil Weerakkody.

One comment I'd like to add is for some of these items that we are considering we may have even a need to go to the Commission level to get approval.

MR. LAIN: This is on the enforcement discretion?

MR. WEERAKKODY: Yes. Because anytime we have to use a process other than the one we currently have to give usually for the licensees to

find and fix issues, sometimes that need arise. And so we're looking on those, too.

MR. LAIN: Yes.

CHAIRMAN ROSEN: Now, how is that done? What regulatory process is it through which you request the Commission to grant you authority to use enforcement discretion?

MR. WEERAKKODY: If you take the case of manual lighting, there I think we sort of stayed ahead of the game in the sense that when you send the proposed through for Commission work, we attach the enforcement description also for their work.

In the case of manual action what we are considering doing is working with the other offices in the agency and their branches to come up with the change we need and use a SECY for a notation board to send it up to the Commissioners.

MR. LAIN: For 805 and circuit analysis.

CHAIRMAN ROSEN: You would use a SECY and wait for the Commission to come back with an SRM or --

MR. WEERAKKODY: Yes. Yes.

MR. LAIN: Okay. I would like to turn it over to Joe Birmingham, the project manager for the rulemaking.

MR. BIRMINGHAM: Good morning. I'm Joe Birmingham. I'm going to talk to you a little bit about the rule structure.

NRR looked at and made an assessment that we needed to modify the rule for 10 CFR 50.48 in order to adopt 805. Specifically what we did is we are going to incorporate NFPA 805 2001 edition into 10 CFR 50. So 805 will actually become part of the rule.

Within the rule structure we've identified six exceptions to the standard. It will probably -- actually, I think we're going to end up with seven because we're going to add an exception that allows license amendments for those things in Chapter 3.

Some of the examples of other exceptions are 805 will allow a manual process in lieu of seismic standpipes and hoses for some plants that can't meet that requirement. We, as an agency, are going to insist if that's in your licensing basis, you need to comply with your licensing basis.

The rule structure requires a license amendment to adopt 805 including identifying any license revisions or any tech specs that need to be changed at the time that the license amendment is to

be granted.

The rule structure also requires licensees to complete a plant wide evaluation. This is the integrated evaluation. It's a fire area-by fire area evaluation that's built into 805 before changing any of the fire protection program element.

Under the rule structure licensees will document this evaluation and retain the records on site. It's not purposeful. We're trying to make this as easy as possible to adopt this new program. Rather than send volumes of stuff to the staff, we're going to allow licensees to maintain it on site, the site wide evaluation, and then we will as part of the reactor-oversight process come in and selectively look at parts of that.

Those alternatives to means of complying with 805, alternatives to 805 and changes in Chapter 3 elements, as I mentioned before, we're going to require a license amendment. We look at Chapter 3 as a core of fire protection program elements that gives us kind of a transition to a risk-informed performance based approach. It won't be so radically a change that we won't have time to adjust, yet at the same time we wanted to allow licensees to be able to make changes to these over

time. And we think for now this is the right structure to go through.

We made a determination that NRC proapproval of methods will not be required. This is a consideration that certain methods such as fire modeling, fire PSA currently are not developed or to the point where NRC could review and approve them, yet at the same time we don't want to restrict licensees from taking benefit of these models when they become available as part of their risk arguments. The change I'm making, one I want to input as much information as I can into this change from fire modeling then I would like to quantify the risk in using a fire PRA would help from that.

DR. POWERS: Let me ask a question of this third one. I'm operating from memory, but doesn't 805 say you can use methods approved by the regulatory authority having jurisdiction or whatever language they use?

MR. BIRMINGHAM: Yes.

DR. POWERS: And you're bathing out on this?

MR. BIRMINGHAM: Let me clarify very carefully. What 805 requires is that licensees use methods that are acceptable to the authority having

jurisdiction. And acceptable means it's something that we as an agency looked at and can accept. We may not have completed the review and approval process, for example, but licensees need to make an assessment that is going to be acceptable to us.

DR. POWERS: Here's the difficulty I'm running into with this collection of things here. A guy goes through and he uses something that has some currency in 5 methodologies and things like that. And he has all the documents on the site and he sends you notes, and says I've done all this. And you say great, I'll get around to checking you. Okay. There are what? Sixty-eight sites or something like that; you check them at the rate of about 4 a year. So it could be 15 years before this guy gets checked, right? And he's hacked it up completely.

MR. BIRMINGHAM: I'm not the inspection expert, but I will point out that we do triennial inspections. And one of the things we're trying to do is work with the regions, work with the IPM, work with the inspection branch on focusing the triennial inspection to take an overview look of how they've implemented the change, too.

You know, if we've got 15 of 16 plants

transferring to 805 over the next 3 or 4 years, you know, the rate that they will get looked at is much more frequent than you are conjecturing there.

DR. POWERS: When I visit the regions there are a few things consistent in their comments to me. One, they hate the significance determination process and the second one is they don't have enough expertise to help the in fire protection.

MR. BIRMINGHAM: I think I've heard that point expressed a few times about the IPA. I think it's a thing where they're growing to learn to appreciate certain aspects of it.

Obviously when you change from I have a clear violation licensee, you must correct it because it's a violation versus licensee at you're not in compliance and it goes into your corrective action program. And then under the corrective action program it may turn out that I can do something else that brings itself back into compliance.

DR. POWERS: I understand that. But my point is here, the one I'm trying to pursue, is do you really understand how quickly these things -- I mean you said the plants are transitioning into 805 at a measured pace.

MR. BIRMINGHAM: Yes. We guess about 4 a year.

DR. POWERS: Four a year. And you can run about 4 inspections a year?

MR. LAIN: Within each region.

MR. BIRMINGHAM: We don't have specific plans to inspect each plant specifically as it transfers.

MS. BLACK: Excuse me. This is Suzanne Black, division director. Excuse me.

Our current plan is the first triennial after transition would be kind of a baseline inspection like we did after maintenance to look at how they implemented it. And we would have a specific inspection procedure for that. And then they would routinely go back to the triennial inspections that we do, the next round.

DR. POWERS: But the question is who inspects all this stuff? Is it going to be the regions that inspect it? Because they're complaining to me that they can't do it.

MS. BLACK: Well, the regions, we had planned on having the regions do it with an inspection procedure and training that would help them. And, of course, if they needed assistance, we

could look into providing either contractor, headquarters --

DR. POWERS: It is a fairly subtle thing, especially in the methods.

MS. BLACK: Right. And I agree. I mean, the maintenance rule we had the same problem because you're sending inspectors out there to look at something they've never looked at before. And it takes some training and some good inspection procedures.

CHAIRMAN ROSEN: I think this is similar but more complex than the maintenance rule.

MS. BLACK: Yes, definitely.

CHAIRMAN ROSEN: Because if they're doing fire modeling --

MS. BLACK: Right.

CHAIRMAN ROSEN: -- then they're using computer code and all kinds of assumptions and the details of that modeling are significant.

MS. BLACK: But you'll hear some more about that later this afternoon about what kind of guidance we're putting out on that.

CHAIRMAN ROSEN: Okay. Good.

MR. HANNON: This is John Hannon.

If we were in a perfect world, we would

have approved fire models, approved fire PSA. But we're not there yet. And to the extent that any of these items are available to be approved by the time we issue the reg guide, we would intend to endorse those in the reg guide. But that's not likely just due to the time.

DR. POWERS: But you see what the difficulty you've got is on the one hand -- you're right. There are a lot of ways of do these things now. Nobody has ever come up and said, ah, this way is perfect. This is the good way. Consequently, people are doing things in an imaginative way, trying to do a good job, but people make mistakes. It seems to me you should be looking much closer at that than if you had one that everybody said yes this is the way to do it, they went to school, they learned how to do it and it would be oversight, at best, for making a mistake. Now they can make a mistake just because it's easy to make mistakes in fire analyses.

MS. BLACK: One of the things that Research is doing is they're looking at different fire models. And we're going to put out a guidance document that says you can use a fire model in this way, but this is where it's inappropriate to use it.

And with that kind of guidance, we think it would be easier for the inspectors to look at it and say well this doesn't look like it's within the requirements of its use or the area where it's appropriate to use it.

MR. BIRMINGHAM: I think your observation is that, you know, it's a challenge for the regions, that they're going to need some training, that they need to be brought up to date on the changes that 805 introduces. That it is easier when you're doing a new process such as introducing fire modeling that these things are a little more subtle than they have a deterministic requirement and go out to see if the licensee meets it. And we need to work with the regions.

I think you may or you may not hear, but I believe the industry has already pointed out that we need to work with the regions. They've asked us to work with the regions to get a comprehensive approach to this. And I believe the implementing guidance is one of the areas we're going to do that in.

The thing that's a little in our favor, there won't be all that many plants immediately. We'll have a chance to --

DR. POWERS: Well, I mean, you got a lot of things going in your favor. I mean, if nothing else the NEI's fire protection forum is just an excellent vehicle for the transmission of knowledge and understanding and where difficulties come up. I mean, that's one of the best forums, I think, for people making the transition to go to and whatnot. So, I mean, there are a lot of advantages, but this does seem to be a rough spot.

MR. BIRMINGHAM: Okay. Thank you.

My last bullet was on approval methods. The NRC is not going to do prior approval, although when these methods are submitted, we plan to review them for approval.

Decommissioning plants may also comply with the NFPA 805. There's a section of 805 that's set up for that. And this is just a follow on once a plant has changed over to 805, they can continue complying with it as they go into decommissioning.

DR. POWERS: When the fuel is removed from the plant, then they can switch to something else? I think that's what it is. I mean, I think you have a rule that says that.

MR. BIRMINGHAM: The way 805 is structured, basically the emphasis which is from,

say, shutdown to radioactive release control. And the emphasis -- I mean, that's an appropriate -- once you've actually entered decommissioning you take the fuel out, so that's the appropriate.

I wasn't quite sure, you said they could switch to something else. And I didn't know if --

MR. LAIN: They can go from 50.48(c) to 50.48(f) I think in the requirements. Then there's also items within 805, I guess, that is the emphasis.

DR. POWERS: Well, I think there's a different NFP standard they go to once the fuel is gone.

MR. BIRMINGHAM: Oh, I understand what your question. No. There's a different portion within the standard for it, it's Chapter 5. Yes.

DR. POWERS: Okay.

CHAIRMAN ROSEN: What about future plants?

MR. BIRMINGHAM: Good question. The NFPA people have already thought about future plants and there's NFPA 804 that has been developed for future plants. I don't have a lot of knowledge about it myself, but that was something they had already looked at.

MR. LAIN: We are pushing them to try to make a performance based standard for advanced reactors right now. 804 right now is pretty deterministic and we are the committee, and we sent a letter in requesting them to work on a performance based.

CHAIRMAN ROSEN: Is there something about future plans that would make them different to where a risk-informed performance based method would not be --

MR. LAIN: Well, we're going to try to look at other plants besides the light water reactor plants.

CHAIRMAN ROSEN: I understand there may not be light water reactor, but the only part of it that seems apparent to me is there is will be very little performance basing for future plants when there have been none built.

DR. POWERS: If MIT has its way, there aren't any future plants so we don't have to worry about it.

CHAIRMAN ROSEN: Well, I don't have any comment whether MIT will have its way or not.

But just thinking about future plants and fires, fires are going to be relatively more

important in future plants than they were in past, in my view, simply because LOCAs are going to be relatively less important. So core damage will likely be more likely to occur from fire in future plants than they were in the current plants, relatively speaking.

MS. BLACK: This is Suzanne Black.

In my opinion, and there are opinions I've heard of others, is that if you had known what you know about fire protection before you built the plants, you could have routed cables and separates things much so that it should be a much less risky situation due to fire if you properly design the plant. But to try to retrofit these plants after the Browns Ferry Fire and even as far as future plants that were built after that, they were already pretty well designed. And so I think that's one thing that's being taken into account in advance of building it that should help the situation.

CHAIRMAN ROSEN: Well, I think we have to competing effects in the future plants. Future plants will have a lower core damage frequency from internal events, first.

MS. BLACK: Right.

CHAIRMAN ROSEN: And as you suggest

they'll also have a lower core damage frequency for fire. The only thing we're discussing here is which one will be, of these two lower peaks will be higher?

MS. BLACK: Right.

CHAIRMAN ROSEN: And in my view the fire one will still stay higher, even though as you suggest, those plants will be specifically designed with separation and all of advanced kind of ideas that were built in, for instance, to the later plants of this generation.

I was simply wondering why a risk-informed standard would a priori not apply to or be more difficult to apply to future plants than current plants? Thus, it's not apparent to me why.

MR. HENNEKE: Yes. This is Dennis Henneke, Duke Power.

804 was actually written before 805 as kind of the first shot. And they had some new aspects, but didn't have a lot of PRA input and risk-informed input. And then they wrote 805 and were intending to go back and rewrite 804. But 805 took a tremendous amount of effort by a lot of people, including the staff and the industry and, you know, a committee of 30 people working for a

couple of years with contract help and everything.

So, going back and rewriting 804, they can use 805 but there's still a tremendous amount of work to do that and there really hasn't been any push at this point to rewrite 804 until 805 bugs are all worked out.

CHAIRMAN ROSEN: Right. But what I hear you saying, Dennis, is that it's clearly the intent of the committee to do so and to provide that alternative to designers of future plants.

MR. HENNEKE: Yes. Sure.

DR. WALLIS: Well, there must be some limits, however, to the scope of something like 804. I mean, you're not considering a situation where the entire core catches fire?

CHAIRMAN ROSEN: It's made of combustible materials.

DR. WALLIS: Yes. But that's beyond the scope.

DR. POWERS: So are the light water reactors.

DR. WALLIS: That's beyond the scope of NFPA. That's a major accident and that's not covered by the thing we're talking about today, surely.

How do you decide? What's the limit of a fire? I mean, how big a fire are you considering in these sorts of standards?

MR. SIEBER: It consumes all the combustible material.

DR. WALLIS: Well, the whole core.

MR. SIEBER: Yes.

DR. WALLIS: That's not within the scope of this standard.

MR. BIRMINGHAM: I think we probably addressed the original question. And the question of what we do for future reactors, which is beyond 805, certainly is a good subject that we could expand on.

CHAIRMAN ROSEN: Well, the staff isn't prepared to discuss future plants. But the ACRS is.

MR. BIRMINGHAM: Thank you. I understand that.

CHAIRMAN ROSEN: We're always prepared.

Please continue on the current plans.

MR. BIRMINGHAM: Okay. The last thing I want to mention in the rule structure is that it does allow NRC to review new risk-informed, performance based methods as they are introduced in the future. The structure has a -- we've introduced 10 CFR 50.48(c), at paragraph (c) as an alternative

basically to paragraph (b), which is sort of Appendix R. We are considering whether or not there ought to be a paragraph (d) that introduces things such as -- it would be placeholder for things like manual actions. A placeholder for future risk-informed methods to be placed under rather than going back and modifying 10 CFR 50.48(c), but we haven't really made up our minds on that. But this is 10 CFR 50.48(c) alternative to (b).

Any questions on the structure? Okay.

Next I want to go into a little bit of what is our current schedule. The proposed rule was issued in November 2002. We had a 75 day comment period, which ended January 2003. We've developed comment resolution and worked that out pretty much with OGC at this point.

The *Federal Register* notice package is in concurrence with OGC.

As has already been noted, we have received Revision D of the implementing guidance that was provided to the NRC in April 2003. The staff has reviewed it and had comments on it, benefits probably from the pilots. And one of the things that I think that we were concerned about is what appeared to us as an attempt to introduce a

lot of risk or risk-informing of the Chapter 3 elements in those. That's probably some of our major comments.

Staff has prepared comments on Revision D and we will be transmitting those to NEI for their review shortly.

Office concurrence's plan for October of 2003. We would like to present the final rule to the ACRS, CRGR in December of 2003. We say December, but actually we'd like to try for November. When I prepared this I slated December for the outlier. And I really would like to try to get it into November.

DR. WALLIS: When we see this, can we see the implementation guidance as well?

MR. BIRMINGHAM: Well, certainly we can give you that revision.

DR. WALLIS: And that will be the final version of implementation guidance?

MR. BIRMINGHAM: No.

DR. WALLIS: Would it still be a flexible document that's going to change after the rule comes out?

MR. BIRMINGHAM: Revision D was given to the staff. It's a full version, but it was a version

for comment. And the staff feels we have substantial comments on it. And NEI does plan to provide us an additional revision of it that will follow later than the rule follows.

DR. WALLIS: Don't the two go together? I mean, you can't very well have a rule which can't be implemented.

MR. BIRMINGHAM: I don't expect licensees to implement the rule without the implementing guidance. It's just that in this case the rule is probably going to be finished up a few months in advance of the implementing guidance.

DR. WALLIS: You see what I'm getting at? I mean, they're just sort of a package. The two go together. But there's some hitch in how it's implemented. Maybe the rule itself has to be fixed. If you have a rule which you cannot implement for some reason, then you go back and have to change the rule, presumably, even though it sounds like a good idea on paper. So I'm suggesting that we see them both together. Perhaps you can work that out.

MR. BIRMINGHAM: Well, as I said, our plan is to provide you with the version of the implementing guidance and you'll have a chance to --

DR. WALLIS: I'm not anticipating any

difficulty.

CHAIRMAN ROSEN: Well, I am.

DR. WALLIS: You are, are you?

CHAIRMAN ROSEN: In a sense that I think -- in the schedule.

DR. WALLIS: Oh, in the schedule.

CHAIRMAN ROSEN: I think we'll likely need another subcommittee meeting to look at the implementing guidance and that means that the November would be very challenging. Possible December, but November I don't -- it's already September.

MR. HANNON: Joe, this is John Hannon.

Just one point on your schedule there. You don't identify that there will be an accompanying reg guide with it which would provide the endorsement of the implementation guidance. I agree with the comments being made by the ACRS that they have to be -- it has to be a packaged deal. The rule needs to have the implementation guidance with it in the form of a reg guide endorsement.

DR. WALLIS: Well, what's the progress in this reg guide?

MR. LAIN: I think we're working on the implementation guide right now. And once we have an

acceptable implementation guidance, we see the reg guide being very short as just endorsing the implementation guide. So --

DR. WALLIS: So it will take a week?

MR. BIRMINGHAM: I think -- yes. Our original version of the rule was it's an enabling rule. And as such, we wanted to write the rule carefully to allow licensees to take advantage of the future methods, etcetera, and also develop the implementation guidance at the same time. The implementation guidance takes the rule and just quantifies and gives licensees a process by which to do the actual implementation.

I think we would like to move forward with the rule and get the rule issues as an enabling rule, get it looked at, get any comments that we can and then move forward with the implementation guide shortly thereafter.

We have a version of it which the staff with the comments and exceptions and things that we see in it that we would like to change. We think the implementation guidance will work, it's just that, as I said, that we are uncomfortable with some aspects of it as far as what we think our attempts to risk-inform Chapter 3 elements which to us are

the core program.

So, I'd like to kind of keep that clear that that's -- our original intent was to separate the rule from the implementation guide somewhat.

CHAIRMAN ROSEN: But as Dr. Wallis points out, it's hard for us to do that to agree to the rule without understanding that there are methods that we believe are possible to implement and come up with reasonable answers available. So if you want endorsement from the subcommittee and the full ACRS, possibly thereafter, we kind of need a package. And I think that's what John was saying.

DR. WALLIS: Yes.

CHAIRMAN ROSEN: But I understand the implementing guidance is available. And the ACRS staff will be providing that to members shortly. And we can get started, at least with our review.

MR. BIRMINGHAM: Back to schedule. We were hoping to present the final rule to the Commission in the spring of 2004. And then follow it by publishing the rule one month after, assuming them approving it is issued. That's pretty much standard. We would incorporate any comments from the Commission.

The Commission seemed to be pretty --

they gave quite a bit of approval to the proposed rule. The caveat that they gave us was that they wanted us to explore ways to reduce the number of license amendment requests to adopt methods. And we've accomplished that. We feel that it wasn't necessary to require prior approval or a license amendment for a licensee to use in their methods, particularly once that method if it's ever -- when that method has NRC approval, it didn't seem to be necessary to have a license amendment to adopt it.

That concludes my part of the presentation.

CHAIRMAN ROSEN: Before you get away, let me ask you one question. There is an ACRS letter which people on the ACRS read, I don't know whether the staff reads them. But we read them. And one of the things that our letter said about this was that we were issued a cautionary note that the real value of the work accrues when licensees voluntarily adopt the standard and begin to revise their fire protection programs. Where do you think you are on getting real interest from the licensees? Is this really going to move or the ACRS was worried that we would create such barriers to entry in the implementation guidance or in the rule itself that

people would just throw up their hands and say I'll with it as it is now.

MR. BIRMINGHAM: What we've worked with, and it's been a back and forth thing with industry, we've requested from industry their point of view as far as what the things about NFPA 805 the way you see it that would be obstacles in your way to adopting it. And basically they provided us with what they thought were the obstacles.

Sometimes we refer to, you know, what are the incentives we can give, come up to make it easier to adopt 805 and make it more useful. And the primary things were the expenditures in reviews of license amendments requests was one of the primary things, but there were a few other things. They wanted to be able to use methods as they became available without having to wait, because let's face it. NRC review and approval can take an additional 2½ to 3 years to review a method. And that method may have been developed by NRC and industry, and basically it's already been looked at as something that is acceptable to both sides.

The key to what your question is was brought up earlier. And I'm going to ask industry, probably Doug Brandes, if he would just go back over

what he said earlier about there are many licensees out there who feel that 805 does hold out some really good benefits for them.

They're reviewing their fire protection program. They see things in there that will benefit them. This is a great time for them to adopt it. And with that, if Doug would be willing to talk a little bit about that?

MR. BRANDES: Yes. A couple of things I would like to say.

Doug Brandes with Duke Power Company.

A couple things is, the first point I'll offer is that the NEI Fire Protection Information Forum is scheduled for next week, and on the agenda is a panel discussion on the risk-informed rule. And I'm moderating that panel, so I was tasked with finding the speakers.

One session I've structured is an industry individual to talk as a proponent for adopting the rule. And then as a counterpoint, an industry professional speaking against adopting the rule.

And there's a lot less reluctance by industry professionals to consider adopting the rule today than there was just 2 years ago. And my

personal view is I've characterized this as evolution, and I predict that eventually the majority of the industry will adopt it. It's a matter of, perhaps, timing and perhaps understanding and there may be some that it just doesn't make sense for them to go forward.

I will say right now the biggest hesitation is that we don't know what the final rule will look at. We don't know fully the staff's objection or concerns with the implementing guidance. And, you know, until we really know what it looks like and what's acceptable, nobody's going to volunteer to go forward. But my opinion is that if it comes out the end of the pipe essentially as the rule has been published and the implementing guidance submitted and the NEI 00-01 circuit analysis guidance have been submitted, that that if I were in the process, and a lot of utility in the process of rebaselining our program, it would make a lot of sense to use the risk-informed approach. And I'm going to talk about that a little bit during my presentation later this morning.

CHAIRMAN ROSEN: Well, good. That's all very hopeful stuff. Thank you very much.

With that, we'll go on to the next.

MR. BIRMINGHAM: Thank you again.

MR. HYSLOP: My name is J.S. Hyslop, and I'm from the Office of Nuclear Regulatory Research. The Office of Research is providing support to NOR in this area of the risk-informed fire protection rulemaking. I've provided a couple of slides, the first of which is the one on the projector. The second slide I'll hold until the circuit analysis discussion occurs, since that's what the topic of the second slide is in my package.

Research has agreed to develop review guidance to support evaluations that would be part of a licensee's submittal. That evaluations constitute reviews of fire models, inputs to fire models and fire risk analysis methods, tools and data.

In particular under fire models, we've agreed to do a verification of and validation of several fire model codes. The first two codes, the Five Revision 1, that's an EPRI code. The second is the fire dynamics tools, which is the NRR Plant Systems tools. Those both rely heavily on empirical equations to predict temperature.

We've also agreed to V&V other codes. Those two codes are NIST codes, that's CFAST and

FDA, the fire dynamics simulator.

As you move from left to right on that top line you go to more rigorous fire models. You begin solving more of the conservation equations and with FDS you can get quite local effects because it is the computational fluid dynamics code which allows you to overlay a grid on the area of interest.

We intend to use an ASTM Standard to perform that V&V. The Standard is 1355-97. That is standard developed specifically for V&V of fire models. As a result, it indicates that the V&V is to be done on a scenario bases.

These scenarios which we will be analyzing are going to be provided by NOR from their experience in the inspection arena and the other challenges they find need to be addressed, they're going to be providing us those scenarios for us to include into our V&V process.

Now regarding inputs to fire models, you know of course a fire model evaluation has to approve the input. One of the inputs in particular that's been challenging in the past is heat release rates. It's been quite controversial. And many analyses there was a lack of treatment of the low

probability/high consequence fires that resulted from heat release. And we'll be remedying that in our review guidance.

The last type of review guidance will be fire risk analysis methods, tools and data. And they have indicated some of the areas; frequency, severity, circuit analysis, detection and suppression.

The basis for these V&V and fire models are the international benchmark exercising that we're doing on cable tray fires. There's some analyses of pool fires and some comparisons that are going on. And we're doing some testing. There's some testing that has occurred at the National Institute of Standards and Technology, and we have other testing planned or potentially planned.

And then there's some testing at France on the DIVA facility, which is a fairly large scale multi-compartment facility that we intend to do some testing to give us confidence in the V&V process.

The basis for the fire risk analysis methods, tools and data are the joint NRC EPRI fire risk re-quantification studies which we've talked to the ACRS about last year.

And so what I've done in the slides,

I've focused review guidance. But in actuality these processes are developing guidance on how to perform an analysis, namely the fire risk re-quantification studies are identifying guidance and procedures on what to do. And the V&V, of course, identifies the acceptable of fire models.

So in a sense we're in the background sort of developing how to do an analysis. We feel like we're in a better position to then review guidance having that knowledge in hand. So, you know, we're providing substantial support to NOR in this rulemaking effort.

DR. WALLIS: But you're not going to present any of the details today?

MR. HYSLOP: No, we were asked to do that. We were just asked to identify how we were supporting NOR.

MR. LAIN: Is there a meeting next week?

MR. HYSLOP: It's penciled in.

That concludes my presentation.

CHAIRMAN ROSEN: Thank you J.S.

DR. POWERS: Maybe just a word.

MR. HYSLOP: Sure.

DR. POWERS: On what's entailed in V&V especially for a CFD code.

MR. HYSLOP: Well, the ASTM standard is a process standard. It involves performing an analyses and comparing the results of that analyses with data.

Moni Dey is doing this. I'm not. So I'm up here representing Moni Dey.

Certainly, that's one of the things that's common to all these V&V processes, the scenarios that we identify and that we choose to V&V against.

At this point we haven't developed any specifics on exactly how we're going to be V&Ving these codes. Certainly the FDS can characterize local phenomena much better than the other codes, so there will be an emphasis on that. But I don't have a complete answer to your question at this point.

DR. POWERS: I mean, as you go from left to right it becomes more and more possible to compare against data.

MR. HYSLOP: Yes.

DR. POWERS: And more and more able to do so. Technically challenging to do so.

MR. HYSLOP: More of a burden to get the data.

DR. POWERS: I mean a 5 comparison to

data, I'm not exactly sure what that would mean since 5 is a bunch of empirical bounding kinds of analyses, empirical equations. So I suppose if you got data that exceeded the prediction of 5, you'd be distressed. But --

MR. HYSLOP: Yes.

DR. POWERS: -- the fact that 5 over predicted wouldn't surprise you at all?

MR. HYSLOP: Yes. And 5 provides you, you know, a very coarse description of the area and you're looking at temperatures from the plume and certainly it's more limited than what you can do with a more complicated FDS code.

MR. IQBAL: Excuse me. Five is -- FDS is a detail --

DR. POWERS: Yes, I know. I just don't know how you compare 5 against data.

MR. IQBAL: What they are doing there, they are taking the data from a NIST test and they're comparing with a CFAST and FDS and the French test. And then they will provide us a document. We have the document. Okay. These models are good with the data and these aren't.

DR. POWERS: What you're saying I think is you can see a 5 is qualitatively correct as a

string --

MR. HYSLOP: I think you're right. You'd be concerned if it underpredicts. In fact, you'd be concerned if any of the codes underpredicts, for that matter.

DR. POWERS: Well, as you get up into the CFD realm, you more expect a line through the data, there's going to be scatter around it.

MR. HYSLOP: Of course, yes.

CHAIRMAN ROSEN: One thing about this puzzles me, though, J.S.

MR. HYSLOP: Yes.

CHAIRMAN ROSEN: And that is isn't there any existing V&V for these codes? Why do we have to start over?

MR. IQBAL: Not for the nuclear power plant.

CHAIRMAN ROSEN: But I mean a fire in a chemical plant with the same source as a nuclear plant, the fire doesn't know it's in a nuclear plant.

MR. IQBAL: Most of those models like the CFAST and FDS, they are tested for residential facility and --

CHAIRMAN ROSEN: Oh, residential

facilities rather than industrial facilities.

MR. IQBAL: Right.

CHAIRMAN ROSEN: And the loadings are different?

MR. IQBAL: Different. We have cables and oil.

CHAIRMAN ROSEN: So the V&V is for residential facilities for these codes you're saying?

MR. IQBAL: Office buildings.

CHAIRMAN ROSEN: Office buildings and residences.

MR. HYSLOP: Thank you.

CHAIRMAN ROSEN: The industry always gives you problems. And the NRC always gives the industry problems, and one of those problems is that they've taken 20 minutes out of your allocated hour.

MR. BRANDES: Well, for that we thank you.

MR. EMERSON: This is Fred Emerson with NEI.

I'd like to also thank the ACRS for the opportunity to present this as one of several topics we'll be discussing with you today.

CHAIRMAN ROSEN: We're glad to have you

here.

MR. EMERSON: Thank you.

I'd just like to just give a minute or so of introductory comments, and Doug Brandes will conduct the presentation on the risk-informed fire protection.

We've been active, as you've heard from some of the industry folks, with both the development of 805 on the NFPA committee along with NRC and with preparation of the implementing guidance and extensive interactions with the staff on the rule language as it has become available for public comment. We have investigated a lot of effort in making the implementing guidance attuned with the rule, which was a concern expressed earlier. There's always some difficulty in trying to get two elements of a parallel activity to coordinate with each other properly, but we've been working very hard with the staff to do that.

We've also expended effort, as Doug will discuss, in testing the implementing guidance. And Doug's utility was gracious enough to volunteer to do this. This is no small effort. And NEI would like to express our appreciation to Duke Power and to the Farley plant for their efforts in supporting the

development of this through actual testing and increased exposure to regulatory scrutiny that always involves.

So with that, I'd like to turn it over to Doug.

MR. BRANDES: Okay. Thank you, Fred.

I'm Doug Brandes from Duke Power Company. I'm a fire protection engineer and I chair the NEI fire protection rulemaking task force. And as such, I will be speaking about our perspective on the risk-informed fire protection rule.

DR. WALLIS: Are you involved with the implementation guide, too?

MR. BRANDES: Yes, sir. Our task force actually coordinate development and actually we are responsible for the implementing guide.

Fred? Okay.

The topics I want to talk about then, I think NRC has covered my first one pretty well, the current status of the risk-informed rulemaking. Then I want to talk about the McGuire pilot project, and I'll also talk very briefly about the Farley project, although I don't have a slide concerning Farley. And then I wanted to talk about my perspective on the draft rulemaking as it's

currently available to us.

Okay. The current status is that the draft rule language is indeed available for comment. It's on the NRC website.

The implementing guide, as has been mentioned, has been submitted for NRC review and comment, and we eagerly anticipate receiving those comments. And NEI 00-01 has been resubmitted to NRC addressing the comments we've previously received.

Since the ACRS has not seen the implementing guide, I wanted to talk briefly just about the structure of the implementing guidance. And I'll be glad to answer any questions I can, although I didn't prepare an in depth discussion of the implementing guide.

This slide shows the organization of the implementing guidance. Chapter 1, of course, is background, introduction an we characterize it as boiler plate history of fire protection in nuclear power plants and how we got to this point.

Chapter 2 goes to the qualification of the professionals and the responsibilities of those who are involved. I heard questions earlier concerning the qualification and proper use of the tools. And that very much concerns us, and it's our

opinion that that goes directly to the qualifications of the individuals using the tools and responsible for the overall program. So what we've tried to do is define in a fairly narrow fashion the qualifications that we expect from a fire protection engineer responsible for the overall program for the safe shutdown engineers, both the mechanical nuclear and the electrical circuit analysis engineers and the PRA risk analyst who would be involved in this project.

CHAIRMAN ROSEN: Doug, are fire protection engineers covered by the engineering support personnel training requirements in the INPO and National Academy training programs?

MR. BRANDES: Let me answer it this way: All plant engineering personnel are required to be certified or qualified or trained to the INPO standards. But it's not a fire protection qualification in and of itself.

CHAIRMAN ROSEN: Because I know mechanical engineers, electrical engineers are all covered by that program, design engineers.

MR. BRANDES: Right.

CHAIRMAN ROSEN: And plant support engineers. And I was just wondering whether there

fire protection engineers are also in that program?

MR. BRANDES: They're in that program, but they're not certified as a fire protection specialist.

CHAIRMAN ROSEN: I understand that. But they are covered by that program.

MR. BRANDES: Yes.

CHAIRMAN ROSEN: Which means they have to have training materials developed for them and attend the course work? So there's some structure of their training?

MR. BRANDES: That's correct, yes.

Okay. Chapter 3 of the implementing guidance talks about applicability when it's appropriate to use the guidance document and occasions where it's not appropriate to use the guidance.

We get into the meat of it in Chapter 4 which talks about the regulatory framework and how one would go about transitioning from a current state licensing basis to a new risk-informed licensing basis. As we've mentioned, the concept of adopting the risk-informed regulations licensing basis is you're either in or out. It will not be a partial adoption. So we've in Chapter 4 described

the process for making the adoption, and I'll talk about this a little bit more when I talk about the McGuire pilot project.

And we've also talked about if you adopt the entire licensing basis and then want to focus in and discriminate between different fire areas, how to use the deterministic versus the risk-informed process.

Chapter 5 talks in large measure about how to use the tools, proper use of the risk-informed tools either in existing licensing basis or in use for transitioning to the new risk-informed licensing basis.

Chapter 6, again, talks about the transition process. And the concept is that you should be able to transition your current licensing basis into the 805 risk-informed licensing basis and then start the application to use the risk-informed tools, if that's your preference. So in our experience in developing Chapter 6 it was our opinion that Chapter 3 of NFPA 805, which is the classical fire protection issues and fire protection program, is really not clear in its intent about meeting Chapter 3 in toto. So we tried to elaborate in Chapter 6 about transitoning existing licensing

basis into Chapter 3 of 805 where you didn't have a direct compliance. And if you're not in compliance and not fully covered, then what steps are available to you to resolve issues that are not addressed NFPA 805 Chapter 3.

MR. SIEBER: Is there any time limit for undergoing this transition or could you make it last ten years or 20 years or 30 years?

MR. BRANDES: Yes. We anticipate a time limit. I'd like to talk about that a slide or two further down when we talk about the pilot project and perhaps even further when we talk about the overall resource allocation.

Chapter 7, again in some measure, reiterates the use of the tools within existing licensing basis. Our opinion is that for those who don't decide to transition early on and for those who decide that it's not appropriate ever to transition to risk-informed licensing basis, they still need to make use of the state-of-art tools that are available through the NFPA 805 and NEI 00-01. And so our intent is try to give guidance on how to properly use the tools for either developing exemption requests, deviation requests or using it for making nonregulated plant programmatic

decisions.

Chapter 8 is the chapter that talks about maintaining the design basis, the licensing basis, configuration control. It talks about monitoring system availability, system performance. For those systems where we take credit for performing within the context of our PRA we have assigned some degree of availability and performance in our PRA format. So we have to monitor these systems to be sure they're meeting our performance expectations.

Also in Chapter 8 is where we included the change evaluation process which is, indeed, the PRA formulas. And, again, we adopted essentially the reg guide 1.174 process for evaluating the acceptability of changes.

I want to talk now about the McGuire pilot process. The documents we used as the basis of performing the pilot were the NFPA 805 2001 version, the language of the draft rule, the draft D of the implementing guidance as was submitted to the staff for review and comment and the NEI 00-01 as it was submitted to staff for final review.

As we were structuring and developing the McGuire pilot, it looked like there were six

discrete elements of overall transition. And first of all is the licensing transition, how to properly transition from current state to a future state licensing basis. And I'll talk more about that.

Then there is the classical fire protection program as delineated in Chapter 3 of 805 and the challenge was to demonstrate that your current licensing basis is comprehensive and complies with those elements of Chapter 3.

The next task was to look at the safe shutdown analysis and to be sure that it met the requirements of 805 and that you've captured the licensing basis.

The next issue was a new issue to the fire protection licensing basis, which is outage. I characterize it as outage management or a nonpower mode operation.

The next discrete element was radiological protection, and that's a function primarily of fire fighting.

And then there's the overall configuration management to manage monitoring of system performance and availability, and setting up the changed management evaluation process.

The first team, and to conduct this

pilot, we had a contract team that was essentially the contract team that has assisted us in developing the implementing guidance. And on that team there is an attorney who assisted us in the licensing transition in cooperation with a Duke Power compliance engineer. As part of this pilot we realized that our initial concept of the transition process needed to be improved. And what we conceived then was a three stage process rather than a one stage process as is currently described in the implementing guidance.

The first stage of this process was to advise the NRC of intent to transition the program. And this is the letter, the initial submittal that would include the information such as the intent, the schedule and the milestones along the way. As we have been discussing with the NRC staff about some of the incentives for transitioning, one of the incentives we've discussed and was mentioned earlier is the enforcement discretion during this transition period while the engineering analyses are ongoing. And we concede that this draft letter of intent would then invoke the incentive for enforcement discretion while we go forward with the evaluation.

Just to go back and I guess answer the

question that we had earlier about what is the time frame. It's my opinion, and we're trying to structure our guidance as such, that the time frame depends on the degree of difficulty and some of the impediments that a licensee envisions going forward with the new licensing basis. So the draft letter intent would stipulate projected time frame and the milestone schedule.

The next letter would be a request for license amendment. And we envision that to be submitted sometime downstream, probably as the engineering analyses are wrapping up, at which point the licensee would have a good understanding of what if any modifications needed to be made, what would be involved in the transitioning the plant programs to the new licensing basis. And only then if major issues arose during this engineering study would the milestone schedule and the ultimate schedule change in any way.

So the license amendment then would be specifically a request for a change in the license condition with a schedule. And it would also identify any regulatory documents that needed to be changed, any licensing conditions such as technical specifications, selected licensee commitments or any

previous commitments such as safety evaluation reports. So our intent was that that license amendment would be submitted with a request of response date from the staff.

And then we would follow up, the third document that the licensing team developed and it was really a good idea that we had not conceived prior to the pilot, is actually a transition document. We initially conceived this because the staff had agreed to review the first few applications that were submitted and do a comprehensive review so that going forward licensees could have confidence that they were doing the right thing in being comprehensive. So this transition plan is going to be a document that essentially compares the elements of Chapter 1, 2, 3 and 4 of NFPA 805 to how the plant was evaluated for transition and compliance to each of those items.

It's a fairly high level document, but it's cross connected to the existing plant program so that if somebody takes this transition document and reads how the plant complies with a certain section of NFPA 805, they can then go to the plant specific design basis document or other programmatic document to look at the details of the compliance.

CHAIRMAN ROSEN: And that section would also say, I presume, what changes to the plant's programs or hardware, presumably if needed, would be made in order to make the transition?

MR. BRANDES: Yes.

CHAIRMAN ROSEN: So you could pick up pieces of it and go do an inspection?

MR. BRANDES: Well, not only can you pick up pieces, but ultimately it would be summarized in the license amendment of here are the additional things that we need to change.

CHAIRMAN ROSEN: Okay.

MR. BRANDES: Okay. The next section or next team is the classical fire protection program. And what we found in going through the license renewal several years ago is that we didn't have our fire protection current licensing basis captured well enough that any outsider could come in and completely review it. And it was a good lesson to us, so we at that point literally, first of all, we started going back through all licensing documenting correspondence pertaining to fire protection.

McGuire is in a situation where the construction permit request was issued in 1970. So McGuire had been on the books a good while. And so

we initially responded to Appendix A to the branch technical position 9.5-1. Because of the delay in actually construction and reaching the in toto status we were reviewed to this Appendix A it seems to meet subsequent staff expectations.

Now, the Duke plants, including McGuire, had conceived and proposed to have a standby shutdown system in 1978 which was prior to the conception of Appendix R. So when McGuire was being reviewed by the staff, the staff didn't have anything to compare McGuire to other than the Appendix R requirements that were either in draft stage or on the books. So they would go through the evaluation of the standby/shutdown system and say this appears to meet this section of Appendix R or this meets Appendix R.

And so what we did is we developed a spreadsheet that started with here is the Appendix A, here's our response to Appendix A, here's some NRC correspondence, here's the SER, here's any engineering analysis that we have developed to address this specific issue. And we rolled that all into here is our current licensing basis. So we had a good point of departure. And my opinion is anybody that doesn't have that as a point of

departure would need to develop that or should need to develop it as part of their transition.

But having that spreadsheet available then, we were able to extract very easily our current licensing basis and map it or compare it to each element of Section 3.

DR. POWERS: It seems to me that this dispersed nature of the current licensing basis at plants is something that was revealed in previous versions of the triennial inspections that were done. I mean, we see it. It's pretty common across the plants. Is that going to get corrected?

MR. BRANDES: Well, you know, let me first of all speak for Duke. Clearly it was corrected. You know, the situation was that I needed a license basis and I could go to a document and hand it to an inspector and the site fire protection engineer could do the same, but that wasn't properly structured for an ongoing, you know --

DR. POWERS: Nobody else can do it. I mean, if you get hit with a truck, we're in big trouble.

MR. BRANDES: Right. And so we realized that and we have corrected that for the Duke plants.

For those going forward with Chapter 3,

then the answer is clearly yes. You know, the way that we have structured meeting, showing you meet each section of Chapter 3 will compel a licensee to be sure they've got all that captured.

DR. POWERS: We've been doing triennial inspection for some time now. And I mean it seems like that ought to be one of the first things that gets inspected. There ought to be a place that I can go sit down and say here is the licensing basis for the fire protection for this plant. You got to have that. That thing's just got to be set down.

MR. BRANDES: Well, you know, having been through the process, I can preach now. And I can only preach about Duke. But I know we clearly needed that before we had it, and it was a good exercise.

DR. POWERS: Because I think all plants are kind of in the same situation. If you go to the fire protection specialist, he's got it all in his file cabinet, the back of his head and things like that. But nobody else does. And the difficulty we're running into is that when we look at fire as a risk contributor, it's bigger than what we thought it would be. And it impacts what you do in the rest of the plant.

MR. BRANDES: The next team -- by the way, in closing I'll mention that for this classical fire protection team we had contractor who was on the contract team helping us develop the implementing guide and then the site fire protection engineer worked on updating the classical fire protection licensing basis. And that effort is essentially done. If we decide to transition, there's no additional work to do.

The safe shutdown team was comprised of our site Appendix R engineer whose a mechanical engineer and his support engineer, the electrical circuit analysis engineer and our PRA analyst whose also a shutdown expert, that's Dennis Henneke and a contract person who had, again, worked on drafting the implementing guidance for the safe shutdown program.

The safe shutdown program is for the new regulation is structured such that you can drop in your current licensing basis without doing the full risk-informed analyses prior to transition. So as part of that structure again to properly document the existing licensing basis we went through a fire area by fire area description of how we meet the safe shutdown requirements. And we had done that in

a current design basis document. We had done it at a very high level. And in this new mapping of the licensing basis we took it to a very low level, including emergency lighting, operating procedure, manual actions and anything that was specifically germane to our ability to show that we could achieve and maintain safe shutdown.

Since we had not done that, that was done in sample form and there is still more work to do if we decide to go forward and complete that effort. But the Duke plants, specifically at McGuire, we're more interested in looking at transitioning our safe shutdown approach, our program to the risk-informed program that's available in 805. And there's several compelling reasons.

Part of it is that our original licensing basis, which was conceived prior to Appendix R, just had some deterministic elements that didn't have any technical basis and we see continuing challenges every time we see a regional inspector. And, you know, it makes sense to look back and look at these nontechnical decisions and see if there's any safety significance in the way that we have implemented them. So that was one of

the compelling reasons to look at the risk-informed analysis. And also the Duke plants and specifically McGuire have a couple of safety features that we think make them perhaps more safe than the norm.

One is that we use the armored interlocked cable, which is relatively unsusceptible to the spurious activation events, and we'll talk more about that. And also McGuire has the dedicated third train shutdown systems such that there are only a couple of areas where this third train actually interacts or is located in the same area with both other normal plant trains.

So we feel like we need only need to look backwards and to understand the potential safety significance of our current licensing basis, but we also need to look forward and see, you know, if we can take advantage of some of the inherent safety features at McGuire.

So to do that, several years ago we reconfigured or we started to update our safe shutdown analysis. And I continue to make this point when I talk to industry peers that Appendix R analysis, the traditional, looked at one train of equipment versus another and was essentially an electrical interaction analysis once you defined

separation between the big redundant components. And so it's heavily burdened with the electrical interaction analysis.

The way we have structured the new safe shutdown design basis document is that we have looked at the multiple success paths for nuclear safety function, such as decay heat removal. And that's an example of a slide that I put together to typically use at these NEI forums to try to convey to our peers that there is, as an example, a lot of ways to get water into the steam generators. And that Appendix R analysis for simplification typically took one path versus another and looked at the separation of electrical interaction. And that the way that we have structured it now with multiple success paths is we have looked at the fire areas and assured ourselves that the pumps and the motive forces are separated so that one fire won't damage them all.

And then to start with looking at okay, how many combinations of spurious activations would it then take to cause loss of that safety function altogether. And what we're looking at is if the number of combinations of spurious activations based on the risk numbers that are emerging now through

the EPRI and NEI research, if the combinations are that required are below the safety significance threshold, then we would at this point set that aside and think about okay, at this point we have screened this nuclear safety function such as decay heat removal.

CHAIRMAN ROSEN: Is that safety significance threshold something related to reg guide 1.174?

MR. BRANDES: Yes. Yes.

MR. HENNEKE: This is Dennis Henneke.

It's a little bit more complex because we have circuits and circuit failures that go area to area, so they might go in multiple areas. But generally it's the 10 to the minus 6 number for core damage and 10 to the minus 7 for LERF.

MR. BRANDES: Okay. And I think that's a segue to what I wanted to discuss next, is the use of the NEI 00-01 risk-informed circuit analysis method.

At McGuire we conducted a pilot examination or pilot use of the NEI 00-01. Ironically it was just 2 years ago right now. And what we did is we compared our logic diagrams that we developed for the new design basis document flow

paths, we compared it to our fire PRA. And it was pretty graphic that the pinchpoints and potential problem areas popped up pretty quickly by comparing these two documents. And it was encouraging that they both showed essentially the same pinchpoints.

So we went through analysis looking at ten specific fire scenarios and combinations of potential failures that could be effected by those scenarios. And then rolled that into the NEI 00-01 pilot report.

Now, during this 805 pilot, the bigger picture, we decided we would build on that 805 or the NEI 00-01 pilot and that to feel comfortable that we had identified enough combinations or the right combinations so that the low probability combinations don't compound at any particular location and potentially reach a level of safety significance, we feel like that we need to go look at probably another ten or so combinations in the plant. Again, just to be sure that we're way below the level of safety significance combinations we've not specifically looked at.

DR. POWERS: Doug, as you look at this and certain analysis document, below this formula, the 16 --

MR. BRANDES: I'm sorry?

DR. POWERS: A bunch of probabilities that get most comprised together.

MR. BRANDES: You mean probabilities such as the fire ignition, fire growth? Yes, sir.

DR. POWERS: And all those things are still treated as independent factors?

MR. BRANDES: Help me. Dennis?

MR. HENNEKE: Yes.

MR. BRANDES: Thank you. Thank you, Fred.

DR. POWERS: You're going to tell me somebody explain to me how they can be independent?

MR. EMERSON: When we have several hours to present that in that kind of detail, yes, we will.

MR. HENNEKE: Yes. This is Dennis Henneke.

They are treated independent except where we know they're not. For example, fire size and manual suppression, it's all the data. It depends on how you do the data. And so the EPRI NRC re-quantification that's going on right now will be developing some new data which will be much more useful and they'll address the dependence and

independence much better than the EPRI data we had previously.

DR. POWERS: So what you're telling me is that the thing was in the works here, it's not a final done deal?

MR. HENNEKE: Yes. And we know some dependence is there now and we treat that correctly. But I'm not sure we know everything, so hopefully the EPRI NRC with re-quantification will address that.

DR. POWERS: Well, I mean the truth of the matter is that you'll never know everything. You create independence by an argument that that's the best you can do. Because I guarantee you, everything's dependent on everything else at some level. But there's a point where you can view them independently careful. It's just the original incarnation of that wasn't obvious, though it was independent.

MR. HYSLOP: This J.S. Hyslop of Office of Research.

And, yes, the studies that Dennis referred to are looking at the fire frequencies in a manner such that that dependence isn't going to be a problem. So the double kind which is often a

concern of many people between frequency and suppression, we're looking at that very carefully.

DR. POWERS: Yes. As it was, the putting out a trash can fire and putting out a lube oil fire were kind of the same thing in the way the format was set up.

CHAIRMAN ROSEN: I will point out to the presenters that we're now entering the forbidden period. So do what you can to speed it up.

MR. BRANDES: Yes, sir.

Okay. The next task was to look at the new issue of low power and shutdown operations. And about 10 years from McGuire we did an analysis based on NUREG-1449. And we actually did an Appendix R type analysis for these systems that we would need for low power and shutdown operation.

In the meantime, we've become much more sophisticated in our outage management and our task going forward would be to synthesize our old study with our current outage management program.

The next segment was for the issue of radiological protection for fire fighters to protect them against Part 20 releases while doing fire fighting activities.

We looked at the McGuire program and

McGuire actually has an RP technician on shift assigned to accompany the fire brigade, not as a fire brigade member but as an advisor to the fire brigade leader. And this individual acts, has authority to stop fire fighting and evacuate the area if he identifies a radiological hazard.

DR. POWERS: Does he have criteria for doing that?

MR. BRANDES: He has criteria which is part of his RP training.

DR. POWERS: It's a judgment call or does he just have an actual --

MR. BRANDES: No, it's a judgment call.

DR. POWERS: You're going to get X number of rem and if there are, stop?

MR. BRANDES: Yes.

CHAIRMAN ROSEN: Judgment call or actually my understanding or recollection is that during emergencies there are specific standards for saving life and saving equipment, which are obviously different, for persons to actually, those requirements. That one can go up higher than normal operational things.

MR. BRANDES: Yes. In effect.

CHAIRMAN ROSEN: So those criteria are

in effect for in the emergency plan.

MR. BRANDES: Yes. And indeed, I think Part 20 has very specific limits. But the RP technician that accompanies the fire brigade has authority to stop fire fighting activities and evacuate the area at their discretion.

CHAIRMAN ROSEN: Oh, yes. He can override the team leader, the fire brigade leader?

MR. BRANDES: Yes, sir.

And then the next element was the configuration control and monitoring and so on. And we found that having a new licensing basis would fit well within our existing plant programs and it would be a matter of transitioning to the things we would take credit for as a future state licensing basis.

The resource requirement, that was something that we were interested in and felt like it was very important to be able to properly describe to industry what the resource investment would be to make this transition. And as no surprise, the amount of work is directly dependent on the quality of the initial document.

At McGuire we had done a lot of leg work already. And McGuire would be on the very low end of the resource investment to complete the transition.

We think it's about a 1000/1200 hours for McGuire.

My personal estimate was on the order of 2000 to 6000 work hours. And as part of this pilot program we're developing a report that should be available within a month or so. And we'll refine that estimate a good bit and we'll also define the work hour estimate for each discrete element of this transition so a licensee should have confidence in the investment requirement before they decide to proceed.

Another important issue is what skill sets do you need to go forward with the transition.

DR. POWERS: Doug, excuse me. When you developed the -- these are our estimates, one of the things we developed very, very dramatically in the license renewal process is that once somebody had gone through it for your kind of plant, your time was dramatically -- maybe the total time wasn't reduced, but the magnitude of the effort was heroically reduced. Okay. We're kind of the first guy, and now the next guy ought to be less or that kind of an estimate, or you just getting -- or what kind estimate are you giving?

MR. BRANDES: Yes. What we're estimating on giving is based on each discrete

activity and the time that we think would be allocated to actually conduct that activity.

I guess the direct answer to your question if you had the same contract team that was doing the same task at each station, could they speed it up? The answer is surely they could, but I don't have a feel for that.

DR. POWERS: Okay. So you're really giving here's kind it would take if you were to do McGuire again?

MR. BRANDES: Right.

DR. POWERS: If now you have kind of a process of doing it. The first time you didn't have that.

MR. EMERSON: This kind of an estimate is going to be very important for utility managers in making a decision as to whether to go forward.

DR. POWERS: Now, but it strikes me that what I'm willing to bet that he gives a high estimate for the nth plant of a given type. Okay.

MR. BRANDES: Yes, that would stand to reason, but I don't have a feel for what it would be.

DR. POWERS: Yes, I understand.

MR. BRANDES: The skills sets are you

certainly need a compliance person. The pilot project was able to provide draft documents for the letter of intent, the license amendment request and the transitioning plan such that any licensee should be able to pick it up and insert name and his plant specific information and move forward fairly rapidly.

You need a classical fire protection engineer, and that would typically be the site fire protection engineer who would be responsible.

You would need the safe shutdown analyst, both the mechanical nuclear, electrical and the PRA risk analyst.

The fire brigade person is, of course, important to be sure you've properly protected the fire fighters from the radioactive release. And then you need the design engineering, configuration management type of folks to be sure that that's properly implemented.

My conclusion in looking at all this is that it might actually work. You know, we had six discrete teams and six discrete tasks, but at the end of the week it seemed to all flow together and out the end of this report to become something that it would appear to be a very comprehensive program

that would make sense and people at the plant could implement.

And in closing very briefly I'll just say that I have one comment on the rulemaking as it stands, or as I understand it. And perhaps the good news is I don't properly understand the wording or the intent of the rulemaking language that's currently out. But it talks about the use of alternate analysis, methods and techniques and it suggests that a license amendment is required. And I guess I'd envisioned that as use of new computer models or new analytical techniques such as NEI 00-01 and enhanced. And it doesn't seem to me that a license amendment is the right way to go about approving or having the NRC accepting use of new tools. And, hopefully, I just don't understand that properly.

DR. WALLIS: Especially since the whole basis is performance based.

MR. BRANDES: And that concludes my presentation.

CHAIRMAN ROSEN: Thank you very much. Are there any other questions or comments from the committee members? The public? Staff?

MR. BIRMINGHAM: Perhaps a brief comment

that the version of the language that was available on the website, we're negotiating a piece of that with OGC and it had to do with this alternative method. And we're making progress in that area.

MR. BRANDES: Okay. Thank you.

CHAIRMAN ROSEN: All right. Well, with that we'll steal five minutes --

DR. POWERS: Mr. Chairman, can I just ask a question for you to think about? We have the staff from 805 coming in and saying that thou can go to hot shutdown rather than cold shutdown in response to a fire event. If I was going to go to a plant with a complete all bells-and-whistles PRA such as, oh I don't know, South Texas perhaps and ask what is the risk significance of going to hot shutdown rather than cold shutdown, would I get an answer or a blank stare? I don't expect an answer now, but I sure would like one after the break.

CHAIRMAN ROSEN: I'll give you a blank stare right now.

With that, we will recess until 5 minutes after the hour of 11:00.

(Whereupon, at 11:51 a.m. a recess until 11:08 a.m.)

MR. ROSEN: Okay. We're back in

session, and we'll turn the discussion over to Sunil.

** MR. WEERAKKODY: The next presentation is on circuits. I'm going to have a quick overview of the subject, and Mark Salley -- you know, he's fire protection -- will go into the details of this issue.

Let's go to the next one.

Just to give a quick background, this is one area, I think, where we have made, you know, significant accomplishments since we met you last year. The background goes to when about three years ago we issued a memo holding inspections on circuits and also simultaneously making a change to our enforcement manual on the circuits, and subsequently, you know, there was some experiments performed, you know, by NEI to determine the hot short failure probability.

And then there was a series of activities including a meeting on February 19th with all stakeholders to come to a consensus or decision on what the significant and non-significant hot shorts are, and we are getting ready to retract the memo halting (phonetic) inspections, and when we do this, again, I'm not going to go to a lot of

technical details. Mark will do that.

When we do that, the new inspection is going to focus on very significant issues rather than any hot short in any circuit, and we believe although that this is the approach that we want to take because this will enable us to, you know, get the most effective use of inspection resources and also would prevent undue licensing resources.

I do want to elaborate a little bit on this last bullet here in terms of right now, you know, some of the activities that we are working on or considering.

We have overall objectives in this. When we restart inspections, you know, I can summarize our overall objectives in three bullets.

We want to make sure that we do this in a manner so that the licensees and we are motivated to find and fix significant circuit issues.

We want to make sure that whatever obstacles we have to overcome we will do that to minimize the agency or the licensee's spending resources on issues that don't add value to the public safety.

And a subsidiary of that is we want to find a way; we are thinking very hard, and we are

looking at all kinds of options to find a way within our processes and including changes to our processes to eliminate unnecessary engagement with licensees that go on forever, again, without any added value to us or the licensees.

Under that umbrella, you k now, if I become more specific as to what we are doing, within the Fire Protection and the Plant Systems Branch, Mark will demonstrate or Mark will give you a briefing on the number of things we have accomplished, and frankly, I feel that we have gone as far as we can go as a branch.

So what we have done is we have engaged the other officers, the other divisions, the other branches that come in and who have a role to play in terms of, you know, making this happen within our overall objectives, and we have a lot of meetings to discuss details on that. We are working those details.

And also, sometimes in these discussions we find, in fact, we have found maybe in some situations, again, given that we are required to stay within our processes, we may have to go to the Commission. We have the same vehicle I described to you under 805 to get certain processes changed.

Then finally, let me go over these items real quickly, and Mark will go into details. One item that is not here just last week we held a workshop with about 30 inspectors from the regions, and in trying to inform them of what's coming and then sharing them information on a number of fire protection matters, including the models that we use.

Then the first bullet here, we are planning, you know, and again I emphasize the word "plan"; we planning to have a public workshop at NRC headquarters in the November time frame to share with our stakeholders as to what our new findings are and the approach and the directions we plan to take.

We have issued a regulatory issued summary that shares our findings in terms of very significant hot shorts and how they would be used in a new inspection guidance.

We are planning to publish the draft for comment that summarizes a knowledge base of the post trial safety analysis, and then we are working very closely with our Inspection Branch to revise the inspection procedure. In fact, informally we have made long strides in that area.

And finally we are working with our partners in DSSA to have a workable SDP ready to enable this process.

That is all I have.

MR. ROSEN: Thank you.

* MR. SALLEY: I'm Mark Salley, fire protection engineer in SPLB, and I'll go through my slides here.

I'd like to give you a quick background. We'll run through a quick background and show you where we're at and what we've accomplished.

By way of background, 10 CFR, Part 50, Appendix R, NUREG-0800 standard review plan, they've got the guidance in there, the requirement to "provide a reasonable assurance that fire induced circuit failures that could adversely affect the ability to achieve and maintain post fire safe shutdown will not occur.

That's where we're at with the associated circuits and what we're looking at.

Beginning back in about '99 time frame, we issued an Information Notice 99-17. Ninety-nine, seventeen identified a number of problems that different licensees were having with associated circuits. The issue was thought to be somewhat

generic because it was coming from a number of different licensees.

In November of 2000, the NRC suspends the associated circuit inspection.

Next slide.

NEI had taken on an initiative to look into this and see what they could find, as a part of that initiative, they did a series of I believe it was 16 fire tests out at Omega Point in San Antonio. From that data we gave --

MR. ROSEN: Mark, could you hold on just a minute? I'm sorry. On your prior slide, you talk about recent problems with associated circuits at a number of licensees. Could you just give us a flavor of what kinds of things were being seen at that time?

MR. SALLEY: Yeah. Information Notice 99-17 goes into detail, and it's basically a lot of LERs where the licensees had found things and submitted LERs. It covers the gauntlet pretty much. Okay? I mean cable routing errors, separation errors, fire induced hot shorts, spurious operations.

MR. ROSEN: These were problems where the licensees were postulating hot shorts?

MR. SALLEY: Yes.

MR. ROSEN: And then saying because of this configuration we've got an issue here?

MR. SALLEY: For the most part it was self-identified, and it came through LERs, and what they were doing was going back and looking at their Appendix R analysis and finding these types of design problems and reporting them.

And they were pretty widespread. The information notice talks about it being a generic concern. It would be handled generically, and I believe that's why NEI stepped up and did the initiative.

DR. WALLIS: So the LER, it's an event report. This event was finding something which they could analyze. It wasn't something actually happening physically.

MR. SALLEY: No, no. It was through their review, their design or, you know, a lot of times in a plant you'll do a mod, and sometimes they won't catch that that mod impacted their Appendix R analysis till later on and they've picked it up, self-assessments, that type of thing.

MR. ROSEN: There's enough interest that we'll have a copy of the 99-17 given to each member.

MR. SALLEY: Sure. Yeah, it's a good background.

Now, we're talking about the NEI fire testing, and the NEI fire testing was very good. There's been a lot of cable fire testing over time. The NEI test program was real good. In fact, it specifically was looking for the spurious actuations, and they designed their tests around that, pulling the relays to actually get the spurious from the cable fires.

So it had a definite goal, is what it was looking for.

The results of that testing when all of the data came back, NEI worked with EPRI, and in May 2002, they published "Spurious Actuations of Electrical Cables to Cable Fires: Results of Expert Elicitation," and that document kind of brings it all together, and it wants to put the risk aspect on it as to the probabilities and such. So that's a pretty good reference also, and like I said, it was based directly out of the NEI testing.

Last year we met with you in June of 2002. The key to that meeting was to look at your recommendations for NEI '01, if you remember, and you gave us a number of ideas in that meeting.

Following up this year, in February 19th of 2003, we held a facilitated public workshop. Mr. Chip Cameron led it for us, and it was a very good workshop. We brought together all of the stakeholders. NEI was there, a number of licensees; the NRC staff was there, and we had, and we had a good, open discussion on, you know, can we get a consensus on the most risk significant scenarios.

We want to try to take things that we learn from the testing and how do we really focus in on what matters.

Just as a side note here, when we're looking at a circuit analysis for a power plant, thinking back to my time at TVA and Watts Bar comes to mind as the last one; when you look back at that effort for circuit analysis, I tried putting a number on it, and it's about five man-years for an electrical engineer to actually run the cables, figure out.

So what I'm saying is it's a pretty involved process to go through the completely circuit analysis for Appendix R.

DR. POWERS: A couple of years ago we were discussing the time involved in doing this circuit analysis, and the running of the cables, you

had looked at -- I can never produce the language exactly -- you've got to look at all the possible faults one at a time, and that's something that's really easily done by a computer and really terrible for a human being to actually do it.

MR. SALLEY: Right.

DR. POWERS: And I was just wondering if they had made any progress on just getting a computer to -- once I know where all of the cables are and things like that, I can go through and just have the computer tell me about what the effect are that unfolds.

MR. SALLEY: Like I said, I've been away from that. I can't give you an answer on that.

MR. GALLUCCI: I can. I'm Gallucci. I'm a new hire, but I just came from Ginna. So I was there as late as August.

And up at Ginna, we have aa complete cable track database where every cable that's in the Appendix R program is computerized. It gives the fire zone, the cable circuit tracing, et cetera, and when we did our fire PSA, when we had to look at what cables were in a certain fire zone, we just went into the access database, and it would pull up all of the cables that were in that zone, and you

know, where they go and things like that. I mean, there's practically nothing you can do except just sit down and do that.

MR. SALLEY: Right.

DR. POWERS: But once you have all of that information, the discussion centered on the idea that one can computerize the subsequent analysis.

MR. SALLEY: Oh, yeah.

DR. POWERS: has any progress been made in that direction?

MR. SALLEY: I've been out of the utilities for a few years, but I know back at TVA we were doing that back then where we had data bases, and the database was important for a number of reasons: Appendix R, knowing where the cables were.

The civil engineers also used it a lot for their seismic loading and their trays. So the computerized database had a lot of advantages. And like I said, when you did a plant mod, it was important to know that when you were doing a modification.

DR. POWERS: Well, I was thinking it was actually just going through and doing the volts and the subsequent analysis. One could -- because you

could then link to the PSA to see what components are supplied by each of those cables.

So I imagine some of the other plants that have full fire PSAs are very advanced. They wouldn't be able to do it without a computerized database as well..

DR. POWERS: Yeah, the database is one thing, but doing the analysis is what I'm after.

MR. GALLUCCI: The analysis of the fire?

DR. POWERS: The Appendix R requirement is that you look at faults one at a time among all of these cables.

MR. GALLUCCI: Oh, you're looking at like cable-to-cable, cable-cable interactions?

DR. POWERS: Sure.

MR. GALLUCCI: I mean, if you want to postulate, you have the cables that are in a specific location. So if you wanted to do that, the computerized database would allow you to do that.

DR. POWERS: Yeah, but you end of doing it by hand.

MR. GALLUCCI: I can't answer. I think it could be done by computer.

DR. POWERS: Yeah. I think it -- I mean, the suspicion was that you could actually do

it by computer once you knew where the cables were and what they were connected to, but it seems like that's one of those things that research ought to have a tool and say, "Okay. For this plan here's what we know and here's how to do it."

MR. ROSEN: I think you're bordering on what's in the NEI guidance, what should be in the NEI guidance on how to do associated circuit analysis and maybe would include these tools you're talking about.

DR. POWERS: Well, yeah, I mean, I presume that the NEI guidance would be part of the expert database that you would give the computer program that does the analysis.

MR. WEERAKKODY: And, Dr. Powers, I just want to make one point. In terms of it is true that there are a number out there that have the cable information or computerized, but I think you already know this.

DR. POWERS: Yeah, but, I mean, what you're doing is you have to review these things, and you're tying up expensive manpower doing a grunch job. Why aren't you beating on research. Tell them, "Give me a tool. Save my guys. I want to use them for the things that only people can do."

DR. WALLIS: Also we can't look at all of the possibilities, whereas a computer can --

DR. POWERS: Yeah, zip through them all.

DR. WALLIS: Right.

DR. POWERS: Instantly, and it does it fairly reproducibly and fairly reliably. How come you're not beating on research? I mean, what in the hell good are they for you if they don't help you save your manpower?

MR. WEERAKKODY: This is true, J.S.

(Laughter.)

MR. WEERAKKODY: I hope you're taking notes there. But while I was at ADNIS (phonetic), one of the things we found out when we had this workshop with the inspectors is that it is also true that there are a number of utilities out there who met appendix, our old rule (phonetic), simply by knowing where their cables associated with the safe shutdown parts are, but not knowing what the layout of most of the other cables are.

DR. POWERS: The guy comes in with a plant change and says, "I'm going to reroute this cable." I mean, think of what this would be. You could just run your computer code and say, "Oh, no. You're not going to reroute that cable because it

goes through this fire zone and you get a circuit problem here."

I think you need to get research to do some decent work for you instead of just sucking up the money, you know.

(Laughter.)

MR. HYSLOP: I'll respond to that later in the presentation.

MR. ROSEN: We'll give research its due.

DR. POWERS: We'll give you equal time.

MR. ROSEN: But I do have another question on the slide that's currently on the screen, and that's the third bullet, the consensus on the most risk significant scenarios --

MR. SALLEY: Yes.

MR. ROSEN: -- that was arrived at at this facilitated public workshop. It seems to me that that would be a hard thing to do because isn't it true that these most risk significant scenarios depend very -- are very plant specific?

How does one do that, in general?

MR. SALLEY: You will get different opinions on that from different people depending upon who you talk to, and this was a lesson, a valuable lesson, Sunil and I learned last week when

we brought all of the regions in and talked to them.

The inspectors have a pretty good notion of seeing a number of plants, and they can see equipment that's going to give them problems or things they want to look at, and they start to get an idea f developing that.

Yes, the cables are typically routed uniquely to the plant, but when they go back to the P&IDs and look a component that would give them a problem, you know, diverting flow or something along those lines, they get a pretty good idea what they're actually looking for, and they can even get through a Westinghouse versus a BMW unit a to what components they've seen in the past.

So they get smarter the more they inspect, which is real good.

MR. ROSEN: Unless they get to a plant that has, for example, three safety trains.

MR. SALLEY: Right.

MR. ROSEN: And they've never seen anything like that before.

MR. SALLEY: The facilitated workshop though, I think, was a pretty good experience, and we had a lot of good discussion and a lot of good ideas on how to do this, and it forms the basis for

the risk, and that's what we'll discuss here in a second.

The next bullet. The RIS is currently available. It's on the public server. We announced it in the Federal Register, and it's available for comment. I have gotten a few comments back, mostly from in-house NRC. The inspectors gave me a lot of good comments last week and a few of the other staff members. So I'm still waiting for a lot of public comment on it.

MR. ROSEN: Now, what are you going to do with these most risk significant cable configurations and attribute?

MR. SALLEY: I'm glad you asked that. If you'll turn the slide there, when we look at the risk from associated circuit failure, there's a number of factors that we need to consider to gear the risk analysis toward the cables. These are some of the things we've learned.

When we set the basic equation up, and Steve Nolan helped us with this from Sandia, is that we could define the risk as simply a three terms: the fire frequency, that's a number we know the plants have different frequencies of fire based on the historical database, and that's well established

and the SDP and the IPEEEs.

The second bullet or the second item is kind of unique to the cables, and it's the likelihood of the cable, the fire effects and cable attributes that contribute to the failure.

This one is very important because we're not just looking --

DR. POWERS: I'm struggling to understand what a "creditable fire threat" is. "Credible ones" I know about, but "creditable" is saying that this is a good fire to have? It keeps you warm at night?

MR. SALLEY: That's a typo. That's a typo. Sorry about that. You caught that good. Yeah, we were going to check and make sure you caught that.

But the likelihood of the fire effects and the cable attributes that contribute to the failure, that's an important bullet. I'm going to talk a lot about that bullet because what we're doing here is we're not just saying a cable is a cable is a cable. Looking back at some other research, looking at what NEI did in the fire testing is that we learned that cable attributes are very import to the failure, and we learned a lot

about that, and that's going to form a big part of this.

DR. WALLIS: Your equation, it seems to me isn't complete. It should have another term in it, which is a magnitude of the consequences. It cannot just be probabilities. It has got to have some magnitude of consequence or something.

MR. SALLEY: Right. The third term is that likelihood of the undesired consequence, and --

DR. WALLIS: If it's only one consequence like core damage, maybe that's okay, but it has got to be some measure of the size of the consequences in risk.

DR. POWERS: See, Graham, I mean it's not just that. It's the likelihood that the fire -- hopefully its affects and not effect -- cable attributes and the likelihood and desire consequences can't possibly be independent of each other.

DR. WALLIS: You've got it in the last bullet behind your shoulders there. It says severity of consequence, but that has got to be somewhere in the risk.

MR. SALLEY: That is the consequence. When you look at the consequence of an associated

circuit, when you have the cable failure, the hot short, if you will, that causes something to happen, that something can be different.

PARTICIPANTS: Yes.

MR. SALLEY: Okay? It can be a small test line flow diversion or it can be a much larger one. So that's the consequence that we use here, and we'll talk about that at the end here because we do address that.

Okay. So that was kind of the basis of how we started the February workshop, and like I said, the first time fire frequency, that's well defined. We didn't spend any time on that.

The second and third ones are the ones we really focused on, primarily the second.

DR. POWERS: It does not describe the fire frequency is something that you can ignore totally. Maybe you could do it for this study, but in general it seems to me that one of the features of fire risk analysis is that we plot frequency versus fire size, and we find quickly you don't have much data for larger fire, large damaging fire. So you tend to extrapolate that linearally, maybe linear in one space and whatnot, because you just don't have much data there.

And the question always is: should you make that linear extrapolation or, in fact, do you have some sort of a curve so that you end up by linear extrapolating over predicting the frequency of large fires?

MR. SALLEY: For our purposes, we knew fire frequency was being worked on elsewhere and we focused on the circuits. That's what I meant to say.

DR. POWERS: You're just going to do the rest of it.

MR. SALLEY: J.S. can address fire frequency per your question, but like I said, we knew research and other people working on that. We weren't going to work on that inside associated circuits. We wanted to focus on --

DR. POWERS: I understand. I mean that makes sense because I think that fire frequency is one of the great assumptions that's made in the fire risk analysis.

MR. WEERAKKODY: J.S., that's one of the task forces that you are in, right? The fire frequency EST?

MR. HYSLOP: The requantification studies are looking at frequency and are looking at

fire severity. As I put on my slide, you know, one of the things we're looking at is heat release rates, and there we're looking at a range and we're trying to characterize it more accurately such that those higher consequence fires will be included in an analysis. And so in that sense we're trying to capture, I believe, what you're talking about.

DR. POWERS: It's a real problem. I mean, I don't know how you do it, but I'm encouraged that you're looking at new ways of looking at it because it has always has been just very glaring, and it's that extrapolation that tends to dominate all of the consequence analyses because you've got a probability of a big fire and nothing works. That's what gives you big consequences.

MR. HYSLOP: And that's why we're particularly interested in it, because of the consequences that can come from those larger fires, and the reason why we feel like we need to consider it in that research project. And naturally the insights from the research project carry over into the other activities as well, the requantification studies.

DR. POWERS: See, I was wrong. He is spending your money well.

(Laughter.)

MR. SALLEY: I'm sorry. Do you have a comment?

MR. ROSEN: Well, that's the first time you have been wrong.

(Laughter.)

MR. BRANDES: Very briefly if I may, the industry understands this issue, and we are implementing a fire reporting program that is voluntary, but our intent was to set the fire reporting threshold very low, much lower than the existing regulatory threshold, and so that we could, indeed, capture fires and promptly understand the frequency of significant fires.

And this information is being captured and then being provided to EPRI to dissect and, I guess, properly evaluate the significance and the frequencies.

DR. POWERS: But then, Doug, the problem still is that, quite frankly, you don't have many larger fires at nuclear power plants.

MR. ROSEN: That's a very good thing, Dana, actually.

DR. POWERS: And consequently these guys end up when they do their risk analysis, end up

doing an extrapolation, which up until now has been done linearally. I mean, there's nothing else you can do right now unless somebody looks at it in a very imaginative way.

MR. ROSEN: Let's go on.

MR. SALLEY: Next slide.

Let's talk about fire testing because this is the crux of this argument. The cable fire testing, there's been a lot in the past. Sandia and Factory Mutual were two laboratories that have done 20 years or so of this, and they've done it for a number of reasons.

After Browns Ferry, of course, they looked at things like flame spread and combustibility cables. They did do a little looking at the spurious operation and how the cables are going to interact. Sandia has done a number of that.

I've got to acknowledge NEI did a very good job of setting their experiment up because they specifically went in for the things of spurious operation and designed their testing around that, which was an excellent effort by the industry.

From that effort and the previous work, we could see some things come together about the

cables, and this is important because in the risk aspect this is going to set the stage for how the cables respond.

Let's take a break from the slide for a second, and I'm going to pass a sample around, and this is an actual cable out of NEI testing that I recovered from the dumpster. That's the Pittsburgh.

MR. SIEBER: That's where we eat.

(Laughter.)

MR. SALLEY: I'd like you to take a look at this cable.

DR. WALLIS: Well, when you recovered it from the dumpster, how did you really know what its origin was?

MR. SALLEY: Well, I watched it go out there, and then I --

DR. WALLIS: Well, I see, I see.

DR. POWERS: Is that the same place the fuses were found?

MR. SALLEY: Actually, we took it off the sample when it was disassembled from the test. Fred took a lot of samples, and I took some back from this type demonstration here, and there are very important things I'd like to point out to you and have you take a look at, the failure mechanisms

and modes of cables that we understand.

You'll notice there were three seven-conductor cables here and a number of single conductors around it, and like I said, NEI designed this experiment to look for these failures. We can have a number of different failures.

We can have, for example, what we call intra-cable failures. Intra-cable failures are when you have like seven conductors inside a single cable, and the conductors within the cable fall together. Okay?

Then we define what's called an intercable failure where we have two separate cables coming together and shorting that way. Okay? So the test was designed very well to find that.

Also, when we look at cables, we can break it into two garden variety types of cables. We can have thermoset materials or we can have thermoplastic, and the failure mechanisms of the cables are very specific.

If you'll notice here, this single cable that kind of looks like it was a hot dog on a grill a little bit too long, this is a thermoset cable, and when the thermoset cable fails, it tends to expand. It cracks, and it basically blisters up.

So in the jacket or the insulation, this is the classical failure mode we're seeing with thermoset materials.

Thermoplastic materials, on the other hand, tend to melt and drip. It's interesting to note here that these two cables, I believe, came out in TVA, and these were what TVA called PJJ, which is a PEPVC cable, and it's actually what was in Browns Ferry. This is some leftover stuff on the reel.

But you'll notice that it forms the dripping, and also that the failure mechanisms, the thermoset cable doesn't want to interact with the other cables, be they thermoset or thermoplastic, where the thermoplastic because it's going through a melting phase, it wants to interact cable to cable, an intercable failure.

You can also look in here and you'll notice where some of the conductors actually shorted. So let me pass that around and go through the slides.

Mr. Sieber?

MR. SIEBER: Thanks.

MR. SALLEY: Watch it. It's a little bit --

MR. SIEBER: I should have worn a dark

suit.

DR. WALLIS: Well, when it melts then, whether or not a short must depend a lot on the mechanical state because whether or not these pieces of metal which make up the conductors want to push sideways so that they hit another one is going to depend upon some stresses, is it not?

MR. SALLEY: Yes, it is in the cables.

DR. WALLIS: So if there's a bend in the cable or something that makes a big difference.

MR. SALLEY: Sure. Bend radius becomes important that you're on the bend radius.

There's one other factor that I kind of glossed over here that's important when we look at cables, and that is at what temperature these things occur. Now, that sample you're looking at there, obviously they were all exposed to the same fire. Okay? So they all got the same thermal insult from the fire.

What we've seen from some of the early research is that the thermoplastic cables tend to fail approximately 425 Fahrenheit. That's when things want to start going south, if you will, with the thermoplastic cables.

MR. ROSEN: Soft and then melt at? At

what temperature do they melt?

MR. SALLEY: They start melting and igniting at around 425 Fahrenheit.

MR. ROSEN: Okay.

DR. WALLIS: Now, you said they go south.

MR. SALLEY: Go south.

DR. WALLIS: Not soft.

MR. ROSEN: Oh, south.

DR. WALLIS: You know what south is.

MR. ROSEN: Yes, I'm from the South.

DR. POWERS: It's where Tom lives, a terrible place.

MR. SALLEY: The thermoset material has a much higher threshold, and that tends to be around -- the garden variety thermoset material is around 700 degrees Fahrenheit. So you can see that when you start factoring these into the risk, you know, it matters on your fire intensity.

For example, if I had a hot gas layer that was in the 600 degrees Fahrenheit range, if I had thermoplastic cables there, I could start saying, you know, I'm going to have failures. I'm going to have ignition to cable, where if I had thermoset I wouldn't be as excited because I haven't

reached the activation temperature of the thermoset material.

And it's good that we're looking at it in that way. In the past you've always heard IEEE 383 qualified or nonqualified. You can again take a broad slice and say that most of your thermoset materials are the 383 qualified materials. Most of your nonqualified 383 materials are your thermoplastics.

Again, those are broad slices and we're looking at the cables for what they are, which is a very important part of this.

Okay. Next slide.

Getting back to your question on the risk significance, from discussions with the inspectors and the fellows who do the NSSS work, what we feel is the most risk significant for a number of reasons are the spurious actuations that occur in the first hour of the event. Those are the ones that the inspectors need to focus in on as far as risk significance.

So as you're looking at the consequences, we're looking at those actions that really hurt you in the first hour of the fire event.

Next slide.

Base on all this data and the work that industry has done, the work that the NRC has done, we had Brookhaven assist us with a letter report. Bringing that all together in February, we came together, and we said, "Okay. Now, how are we going to look at this?"

And these are some of the results that came from the February 19th facilitated workshop. The first thing is -- and Dr. Powers talked about this a little earlier -- is how many credible failures do you take. If you look at a cable tray and you can see it's a large mass of cables, it may have thermoset; it may have thermoplastic. It could have Hypalon. It could have EPR. It could have any number of materials in there. How do we start looking at that to do a circuit analysis?

What was agreed upon at the workshop or at the facilitated workshop was that it would take two cable failures per scenario. They would be intra-cable failures for thermoset and thermoplastic. That would be acceptable. Any number of conductors and combinations possible within the cable is acceptable, and that intercable failures were possible for the thermoplastic cables because of their failure mechanism. So --

MR. ROSEN: And impossible for thermosetting?

MR. SALLEY: No, they would not be impossible. What we did in the February workshop was we took the items and we sat three bins up. Okay? Bin one were the items that everyone said, "Yeah, that's probably going to happen for a fire involving the cables. These are the bin one type items."

Bin two was, gee, that could happen, but then, again, we didn't see it in the limited number of testing. That needs further research.

So that currently has been sent over to J.S. with the user needs saying, "We've identified these items. Could you please look at this? Should they be in bin one?" or bin three was where we had conditions that we didn't think were possible.

For example, the one we came out with in bin three was you heard Doug talk about his armored cable. Okay? Armored cable, the cable failure, an intercable failure, that's probably never going to happen because we have to have the conductors short through the steel jacket, which is grounded, and it should have tripped out by there. So those were the bin three type items.

MR. ROSEN: Yeah, your next slide answers my question.

MR. SALLEY: Okay. Last evening I made a little hand sketch here. I'll pass this around to you to give you an idea how this comes together.

Pass these around, please.

DR. POWERS: Sure.

MR. SALLEY: And, again, this is out of the February facilitated workshop. This is what's documented in the risk. This is kind of the one where I think the picture is better than 1,000 words kind of deal.

When we look at a cable, I drew a seven conductor cable up here. You can see that we get 21 possible combinations that we can have come out of that pairing if we needed a pair to give us the spurious operation.

Now, we can spend a lot of inspection time going through the analysis and trying to look at what the color code was for the cable as to how the device was actually wired. And we could spend a lot of time doing that or we can look at the test samples and say, "Hey, just consider that in that cable whichever ones brought you into the spurious, you'll accept that that was the pair that came

together."

For example, if it was three and four, they were the two next to each other, and they came together and gives you the spurious.

DR. WALLIS: So this is seven factorial over two factorial times five factorial?

MR. SALLEY: You start getting into that fine math, yes.

So that's how we decided we would handle it, is whatever combinations could come in the cable, take it as the conservative approach, as those were the ones that came together and caused the spurious actuation.

Now, how many cables are you going to look at was the next question. Are we going to look at one cable, two cable, five cables, ten cables? Where is the realistic -- where do you get your -- you know, where is the -- to get the most out of your inspection, how far do you need to take this?

The consensus appeared to be if you had two cables and they both had the smart failures that gave you the spurious actuations you wanted, that you would catch probably the large majority of the high risk applications, and everyone felt pretty comfortable with that, and that's where we're going

to start, with two cable failures.

Again, in the bin two items we said, "Okay. Could it be three, four, or more?" Again, we pushed that off to research, and we said, "Hey, research, you know, give us a little help here," and J.S. has that.

DR. WALLIS: I have a problem here.

MR. SALLEY: Yes.

DR. WALLIS: I can see how you put all of the combinations two at a time. Number four short to number seven.

MR. SALLEY: Right. You would have to short through number one.

DR. WALLIS: Right.

MR. SALLEY: That would be true, but with the thermoplastics, for example, depending upon how that cable was constructed, how it was wound, they can come together, and the conductors can move around. So that's why we didn't want to make it into a research project of figuring that combination out. We said let's take that as a given and we'll move on.

The other thing is how do you know what combinations the electricians actually hooked up without opening and seeing what his color code was?

DR. WALLIS: That's your state of knowledge.

MR. SALLEY: Right, and we could spend a lot of time tracing things to the n^{th} detail, but we don't get a lot of inspection done. So we had to make some adjustments here.

To give you a quick example of how this would come into play, I've drawn a little sketch here. It's very simplistic, and it really wants to just emphasize how we'll look at a cable failure attribute. I've got a tank, and that tank has water that is used for fire safe shutdown function.

Coming off the other side of the tank I'm worried about a spurious operation. Cables pass through the same fire area. That could drain my tank time. So I want to make sure that I don't have a spurious that deletes my water supply.

Now, if I had one seven conductor cable and that seven conductor cable was daisy chained between the MOV and A, the pump start and B, and the MOV and C, and that one cable could fail and cause both valves to open and the pump to start and it would drain my tank, that would be in scope. Okay?

The second one, if I had two cables, one seven conductor going to the valves A and C and one

going to the pump start B, again, applying these roles for inspection, I would assume that the failures came in the right order. Our valves would open and my pump would start, and I would drain the tank time.

Now, where we start getting out on the probability curve, where we drew the line was for Item C. If I had three separate cables, one to A, one to B, one to C, and all three cables had to fail and get the correct pair to come together to make the two valves go open and the pump start, we'd say, "Wait. We're starting to get out a little too far into the probability here. That's over in bin two for research."

Does that make sense?

MR. ROSEN: It makes qualitative sense.

MR. SALLEY: Okay.

MR. ROSEN: But quantitative sense I can't get from this because I don't know how. I haven't done the math. I don't know how likely or unlikely, let's say, the third case is.

MR. SALLEY: Right, and you have to look at the expert elicitation from the EPRI report because a couple of things come up that the probability -- and I'm speaking off the top of my

head -- but for thermoplastic cable to fail and give you a spurious was like .6. So 60 percent of the time it was going to give you a spurious.

MR. ROSEN: So I have to multiply .6 three times.

MR. SALLEY: Right. Now, would it give you the correct pairing you heed? Again, it turns into a PRA exercise, which is better handled by people like Dennis. I'm still trying to help with the inspection attributes.

MR. HANNON: Yeah, for these a typical MOV, it's going to be .3, and for the pump, if it doesn't have some sort of current limiting device like a CPT, it would probably be .6. But typical MOVs is what we're concentrating on.

For MOVs, you know, you get .3 times .3 times .3, and at some point given fire frequencies that we typically see of a large, damaging fire with multiple cables down to ten to the minus four to the ten to the minus five range, at .3 cubed you're already below your level of concern.

MR. ROSEN: Point, six cubed?

MR. HANNON: Yeah, but most circuits we're concerned with are MOVs, and they'll have a .3 to start with.

Armored cable .075 to .0075, depending on the circuit.

MR. SALLEY: Right. It is important to keep in mind that we're trying to restart the inspections in a risk informed manner, and we've got questions over to research that we don't have answers yet. So this is subject to change based on what research brings back to us.

MR. ROSEN: So now you're going to use this protocol qualitatively at least, correct, to restart inspection?

MR. SALLEY: Yes.

MR. ROSEN: Show me. Tell me how that works.

MR. SALLEY: Tell you how that works. Okay. Let me see if I've got that in a slide here.

MR. WEERAKKODY: Are you asking for how this information is factored into the procedure?

MR. ROSEN: Yes. How does one now use this general idea in an inspection, or is that too detailed for this? And I can accept that.

MR. SALLEY: I can give you a quick overview, is when the inspector -- backing up -- let's back up to this one that said risk. It was fire frequency.

MR. WEERAKKODY: Mark, Pete, did you? We work with Pete from the Inspection Branch in terms of taking this input and working the inspection procedure. I don't know. Mark, if you're comfortable answering, go ahead.

MR. SALLEY: Yeah, I can, and Pete will correct me if I'm wrong.

The one that had risk equals fire frequency.

The challenge, and this is what we worked on a lot last week and this is why we had the regional folks here with us, to help us so that we get this right, is that when we do this in a risk informed manner, fire frequency, once again, that's established. Classically they're looking at the IPEEEs and seeing where does the fire frequencies and where was the risk sensitive parts of that unique plant.

So that's typically coming out of the IPEEEs.

This likelihood of fire effects and cable attributes, that's what we just talked about. Okay? If they have thermoplastic cables, hey, that can go cable to cable. I know that.

If I have thermoset, I'm looking at the

inter or -- excuse me -- the intra-failures. So those are the kind of insights that we're putting into the inspection guidance, and the third thing is that undesired consequence, once again, from the P&IDs. They're looking at what happens in the first hour that is really risk significant that's going to cause a flow diversion, cause a drain down. What's going to really give me my problems?

DR. WALLIS: So when you do this inter thing, you have, say, a tray with ten cables in it.

MR. SALLEY: Right.

DR. WALLIS: So any cable can short to any other cable in that tray; is that right?

MR. SALLEY: No.

DR. WALLIS: no?

MR. SALLEY: If they're thermoplastic.

DR. WALLIS: If they're thermoplastic?

MR. SALLEY: Yes.

DR. WALLIS: Any cable can short to any other cable even if they're on the extreme ends?

MR. SALLEY: That's where the level of detail starts to get a bit much. If they're in the same raceway, yes.

DR. WALLIS: You don't know where they are. You simply say they could.

MR. SALLEY: Those would be things we would start looking at in Phase 3's SDP.

MR. ROSEN: You just have to go look at the cable tray installation in any plant to realize that you could go to one spot on the tray and it could be here and here and then ten yards down the tray you'll find the right --

DR. WALLIS: So you don't know where they are. So they could easily short to any other one.

MR. SALLEY: Right. Random fill.

DR. POWERS: Let me ask you about the one hour. Clearly, if I think about the Browns Ferry fire, one hour is not a good time frame to think of.

MR. SALLEY: Right.

DR. POWERS: But Browns Ferry was a long time ago. Things are different.

If I think of, say, a more recent fire, like the San Onofre fire, again one hour is not the right time to think about it. So why one hour?

MR. SALLEY: I will defer to Phil Qualls. Phil.

(Laughter.)

MR. SALLEY: From the NSSS side of

things.

MR. QUALLS: Hi. I'm Phil Qualls. I'm in the Fire Protection Engineering Section.

One hour is kind of an arbitrary time, but there's two or three things that happen at one hour. The initial major events that we've found in analyses during the inspection process over the years, things like Westinghouse pump, RCP seal failures, events like that are typically very time constrained with the capability of the systems to make up. That's usually within one hour.

At time equal one hour also at most facilities, we also keep in mind that the plant gets augmented; the plant staff gets augmented significantly through the emergency plan. A severe fire that causes damage to safety related equipments, typically an alert or higher events, you man the TSC, the OSC, the EOF. The plant gets a lot of additional support, a lot of additional engineering support, a lot of other operators. Plant management is involved directly. NRC may be involved.

At time one hour, there's a lot of additional resources available to the operators also, but --

MR. ROSEN: The one thing I would think some of those things might be counterproductive, the ones you mentioned. But the ones that are productive are the off-site fire response. It seems to me within an hour is reasonable.

MR. QUALLS: It is at most utilities. There's a few outliers I'm aware of that it takes over an hour for off-site response. That's true, too, Off-site response is typically 15 minutes or less away.

DR. WALLIS: This is assuming you know you have a fire.

MR. QUALLS: Well, yeah. I was on the AIT for water. I know what you're talking about.

DR. WALLIS: Well, I'm just thinking if TMI took two hours before the new shift came on, certain things were realized. This wouldn't happen with a fire?

MR. ROSEN: Fires tend to be hard to ignore.

DR. WALLIS: Well, I think what happened to TMI might have been hard to ignore, but somehow it got ignored

MR. ROSEN: Well, I think in the main you're going to find a fire or it will find you

DR. POWERS: I mean all of this is true, but what you don't assume is that the mere existence of these people puts the fire out. And so the question is: why do we stop the analysis at one hour?

And it seems to me I could make all of that argument and say surely then two hours.

MR. SALLEY: Let me clarify. We don't stop at one hour. What we're saying is if you have all of the possible associated circuit interactions that are going to occur, okay, in the first hour of trying to safely shut the reactor down, which ones am I most concerned about?

That's what we're saying here from a risk standpoint.

DR. POWERS: That's a little different

MR. SALLEY: It's a little different. I'm sorry. Let me clarify.

But in that first hour of we scram the reactor and we're going into shutdown; we have a significant fire; in that first hour what are the possible associated circuit interactions that would give me the most trouble?

That's what we're asking the inspectors to look at. We just had an inspector transfer to

headquarters, George. I don't know if you could from all of your inspections provide any insights on that. You've looked at a number of these.

PARTICIPANT: I'll pass.

MR. SALLEY: Thank you.

DR. WALLIS: So you seem to be assuming a fire is a rapid thing.

MR. SALLEY: Of course.

DR. WALLIS: The kinetics are such that a fire is rapid, but a fire is an oxidation reaction. It can glow. It can go very slowly.

Davis-Besse was an oxidation reaction. They call it a fire. It took a few years before --

MR. SALLEY: You can't pin that on Fire Protection.

DR. WALLIS: No, but you see what I'm saying?

(Laughter.)

DR. WALLIS: You see what I mean. You've got the idea that fire should be a rapid thing, but you can have slow fires.

MR. SALLEY: Yes, yes.

DR. WALLIS: Which may not be detected for a while.

MR. SALLEY: Yes.

DR. WALLIS: And yet there may be shorts.

MR. SALLEY: Yes, and there's also the location factor. When you look at a compartment and you have the cables run around as to where is the location that the fire takes place, but let me just clarify that the thing that the inspectors were looking at is in that first hour. We scrammed the reactor. We know we have a fire. We're going to fire safe shutdown. What are the key associated circuits that give me the biggest problems?

That's where we've directed them.

DR. POWERS: Then it's important to take your one hour because you're saying surely in one hour I'll have all of this additional support to handle the plant. What's given the operators before is all of this additional support. I understand now.

MR. SALLEY: Right. The ones that pose the most risk.

MR. ROSEN: One second, one hour, let's get off that and tell me what the inspectors do with this conceptual chart. How do they decide using this rationale, this logic what things to inspect or what things to be concerned about?

I don't get it.

MR. SALLEY: That's what we worked on last week, and that was the very argument or very discussion that we had with the inspectors, is how can we best guide you through this to inspect this in a risk informed manner.

Sunil used the term that we want to put the risk on the front end of the process rather than just grabbing a random associated circuit in the plant and saying, "Okay. This is an associated circuit. Was it protected? If it failed, what could it do?"

We wanted to try to be up front and put the risk informed part up front and look at, okay --

MR. ROSEN: Screen out a whole bunch of stuff.

MR. SALLEY: Right, and we get to that screening process. Now, I had a very good lesson with the inspectors last week that screening is not a good word. Well, when I started going through a number of screens, they wanted to stay in process with steps, okay, as to how they're used to inspecting.

And the key here and the challenge that we have with the inspection procedure with Peter is

how do we focus them on, you know, what is the most risk significant ones, and that's the process that we're doing right now with the inspection procedure.

MR. ROSEN: Oh, so you're not going to answer the question. You're going to tell me that's a good question and we're working on it?

MR. SALLEY: Okay. I can answer it a little better than that. We had a number of steps in there. Let's call them experience, and it was things to look at. If you have this, then you should go here. If you have thermoplastic cables and it's two cables that give you the action, that's definitely one you want to consider.

Another one that we haven't talked about yet is the credible fire threat. You know, do we have a credible fire threat that's going to make all of this, make the cables do what they do?

So a number of guidance steps, if you will, to help focus the inspectors is what we're trying to come up with. That's what the procedure is going to say.

MR. ROSEN: Now, are they going to conduct a de novo review of the whole plant based on this logic that you've provided us, plus these steps that you want?

Are they going to start at square one and go right through to square 540 or however many?

MR. SALLEY: No, they have the freedom to inspect how they want to inspect. You know, they have enough latitude to do what they think is best.

MR. ROSEN: So they're going to do some sampling.

MR. SALLEY: Yes, it's always sampling, but as to where they sample, they can have a number of options as to how they want to sample. For example, what was classically done in the first round of triennials was to look at the IPEEEs and say where is the most risk significant areas of this plant, and that was one area they liked to pick up on.

They have that same option with this or they can look at the components, and when they back off of P&ID and say, "These are the components I'm concerned in. Which fire areas do they pass through?"

MR. ROSEN: So let's take a hypothetical inspector at a hypothetical PWR. He knows the auxiliary feedwater system is one of the most risk significant systems. He knows which compartments hold key auxiliary feedwater system components,

pumps, valves, and so he says, "Okay. Here's this compartment. I select this compartment. I'm going to do this analysis."

He finds out what cables are in that compartment and in what trays, and he then applies this kind of logic to that kind of cable. Also he finds out what is thermoset or thermoplastic, and he picks out, "Ah, here's one that doesn't pass my set of tests."

Isn't it certain that if he's going to do that, that he's going to find areas where the test, the multiple kind of thinking that this implies will not pass because that was not a criteria for the design of the facility in the first place?

MR. SALLEY: That's a long question. Let me break it into pieces that I can answer.

Was it a criteria for the plant in the first place? That's the kind of licensing basis, design basis, and, yes, with some plants he could find that. The licensing basis on some of the plants are different.

MR. ROSEN: And the multiple spurious associated circuit failures is beyond the design basis or is it within the design basis?

MR. SALLEY: It's within it, but how it was interpreted has been done differently at different plants, depending upon when they were licensed. That's part of the problem of how this all got started.

MR. ROSEN: How 8-99-17.

MR. SALLEY: Yes.

MR. EMERSON: And if I can interject here, the difference in interpretation of the regulatory guidance was how this issue got started five years ago. Most licensees would say multiple spurious actuations was not within their design licensing basis, and their argument over whether it was or it wasn't led to the desire for a risk informed solution

MR. ROSEN: So in some places at least this hypothetical inspector will, in fact, find problems.

MR. SALLEY: Yes.

MR. ROSEN: Then what?

MR. SALLEY: Then he has to enter the process. If it's in the licensing basis, how he deals with it, we have the SDP as to the risk significance.

Sunil, if there's anymore on process.

MR. WEERAKKODY: If we had started the inspection process today, then they are finding -- I don't think there's a whole lot more to add to what you say -- they will enter the reactor process and look at if they are significant and then whatever, you know, color that the finding gets colored that way, and if it's green, you know, depending on the color there will be -- I think your interaction matrix --

MR. ROSEN: Let me roll you back again.

MR. WEERAKKODY: yeah.

MR. ROSEN: I understand the action matrix and the ROP. Coming back to the beginning now for plants that have gone through this analysis, we're talking about cable attributes, that portion of your thing there.

But the plants have barriers to fire progression.

MR. SALLEY: That's right.

MR. ROSEN:

MR. ROSEN: Does that get counted, taken into account?

MR. SALLEY: Sure. I mean, this all gets down to Appendix R. I mean, the 3G2, if the licensee had that cable and that cable gave them the

interaction and they protected it with an electrical raceway fire barrier system, then obviously it's in compliance and the inspector moves on.

It is, I guess, the compliance issue to the licensing basis is where it all begins.

MR. ROSEN: Okay. AT some point you're going to write an inspection for this?

MR. SALLEY: It's drafted.

MR. WEERAKKODY: It's drafted already.

MR. ROSEN: Well, Peter can give us some insights.

MR. WEERAKKODY: Come on over.

MR. KOLTAY: My name is Peter Koltay. I'm with the Inspection Program Branch.

First of all, the inspection procedure that exists out there is a viable procedure. The only thing we stopped three years ago, we asked them not to identify or pursue issues that deal with associated circuits.

So we stop inspecting in that one area. So the inspection procedure that's going to be updated is the same inspection procedure we had before. The information on procedures coming out of the technical group, okay?

And we're still trying to figure out

where we break down the inspection guidance to the inspector and then the screening process that the inspector is going to use to determine if they have a finding.

Like Dr. Rosen just said before, an inspector is going to go into a room and start looking at associated circuits and evaluating them. I'm not sure that's going to really happen.

First, the inspector needs to have a reason to suspect or identify performance deficiency. Going back one more step, the inspector has to understand the design basis, and based on the design and licensing basis, he's doing his inspection. He identifies a performance deficiency. It may or may not be in the associated circuit or any circuit area at all. It could be separately criteria. It could be any other defense in depth element in that specific fire area that starts them off on the process of determining how significant the performance deficiency is.

And that may lead him to looking at the associate circuit analyses. That's how I foresee at this time getting into that, unless you have some other thoughts.

MR. ROSEN: What you were saying, I

think, is that there is not going to be a broad scale, de novo review. There's only going to be a case-by-case review if something else that the inspector sees or if that point event occurs prompts him.

MR. KOLTAY: Exactly. In other words, I don't foresee inspectors going out and saying, "The purpose of my inspection today is to evaluate the way associated circuits were handled in this particular room, although they may -- well, let me take that back.

They may go back and ask, "Give us your associated circuit analyses for this room," and they review that. And if they feel that there's something wrong with that, they'll go down the path of additional evaluation and determine what may be wrong with it and determine where the performance deficiency is.

Okay. That's one way of getting into looking at associated circuits.

MS. BROWN: Hi. I'm Eva Brown. I'm the lead PM for Fire Protection and also was a team leader on several inspections, one at some of the Duke plants.

We've had some of these issues, and we

would look at associated circuits once we get permission to do so. It would be a risk informed choice of certain circuits, block valves, poured valves, other types of valves like that that we know are associated circuits and maybe important to the maintaining the ability to safely shut down.

And also in the course of an inspection if we did find something else in another area that may be associated circuit related, then we would get into what Pete was discussing, but we will be looking at associated circuits for a certain group that are risk --

MR. ROSEN: Well, my question went to the question of what is the catalyst for this inspection, and Peter answered it by saying something else is going on, not just a purely I'm going out today into a pristine environment, to a safety significant space, and starting an associated circuit evaluation. That wouldn't be the way it would start.

MS. BROWN: It's going to be both.

MR. ROSEN: It would be both you think?

MS. BROWN: It's the way I plan my inspection, yes, sir.

MR. ROSEN: Oh, okay. All right.

MS. BROWN: It would be both.

MR. KOLTAY: It's part of the alternate shutdown inspection.

MS. BROWN: Yeah, that's part of what the electrical inspector does, is they take a look at --

MR. ROSEN: Okay. So that clarifies it.

MR. SALLEY: It's an element of the overall procedure, I think is the summary.

Back to my slides, I talked about what we called bin two in February, the moderate risk items. This is -- J.S. maybe able to answer this a little bit better than me -- but these are the items that are currently with our research folks over in Research.

This is the questions that we're not sure of. We don't have a good feel from the tests that were done, and that's the intercable shorting between the thermoset cables.

Speaking from memory, I believe there was like one case maybe where that occurred in all of the testing that was done in Texas.

How many cables do we have to have to get the bad action scenario? Is it three, four, five, six, seven? Where do you draw the line in a

realistic space?

That question is currently over with Research. We've got two, and that's where we're going to start this from.

Dennis had mentioned CPTs. Control power transformers were put in halfway through the NEI testing, and they made a difference because now you can make the spurious activation happen. Depending upon your current leakage through the insulation, it can significantly reduce them.

Just as to what effect and, you know, what balance it is, we don't have an answer. Research is looking at that.

The other question then, too, is how long does this hot short last for. Speaking from memory, I believe that 20 minutes was the longest one that we had seen in about that area, and after 20 minutes if you take the hot short away and the valve returns to its normal position, how do you factor that into the overall analysis?

So these are the questions that are sitting today.

MR. ROSEN: Well, the valve did not return to its position, too. I mean, the circuit may be designed in such a way that it seals in.

MR. SALLEY: That's true.

MR. ROSEN: In the valued position.

MR. SALLEY: Right. So it depends on the circuit design.

MR. ROSEN: We understand that, yes.

MR. SALLEY: But that duration time is something we need to look at, and these are the items that are currently with research today.

J.S., do you have anything you would like to add?

MR. HYSLOP: I'll talk about it in my presentation. Basically like Mark said -- this is J.S. Hyslop -- research has a user's need to identify if any other circuit issues should be added to the inspection, and for that user's need, we're going to be looking at the current available information to make this decision.

And so whatever decisions we can make with the current information we'll make, and then we'll go from there.

DR. POWERS: Are you going to comment on the current information?

Much has been made about the EPRI fire tests which have been presented to this subcommittee, and I think in fact even to the full

committee, and in the course of those presentations, the speakers would put, as all experimentalists tend to do, put lots of caveats that said, "Ignore these experiments," and lots of criticisms have arisen.

I mean, the fact of the matter is it's one set of tests and one particular configuration. It's a subset of all of the conditions that you're really interested in.

Are you going to identify what a really useful database would look like, how big it is, what kinds of conditions it would look at?

MR. HYSLOP: Well, whatever conclusions we draw will be predicated upon the data that we've decided to base those conclusions on. So in that sense, you know, we'll be supporting our conclusions.

DR. POWERS: But, I mean, here's what I know, is that fire has become an issue of international significance, and everybody out there is facing the same problem. To create a database is an expensive thing, and it's difficult for one person to do it.

If a guy could come in and say, "Look. I've looked at this data that we have. I've looked at our needs, and here's the data we ought to have,

and the highest priority data to facility things, the second and the third."

He might be able to put together an international consortium type experimental program that would actually get it, whereas right now everybody looks at the cost and says, "Huh-un, I just don't know whether I can do it," and the guys that are doing it, you know, in those cases like in France where they have experimental programs, they're not coming in armed with some comprehensive examination of what the needs are, the fighting, whatever flaming duck is the current big brouhaha.

And so something like that might get you into a position where, you know, some critical examination of what the database needs are as opposed to the data that you have might get you into a position where you could get some of these data.

MR. HYSLOP: I think the results of this public meeting and the next one may help steer us in that direction because, you know, this last public meeting where important circuit analysis and ones we weren't quite sure of were developed, and to my knowledge, that was the first coming together of a group.

So, you know, I see these public

meetings as potentially spawning activities, and you're right. There are international programs. The Germans are doing some testing it is my understanding, too, and you know, research. We collaborate with these groups.

And so I would expect us to start thinking along the lines related to this information that has come out of these meetings.

DR. POWERS: Well, I'm just suggesting make it an ancillary. I mean, as you go through these things --

MR. HYSLOP: Be organized about it.

DR. POWERS: -- find holes in the database and find challenges. If you just keep a set of notes and say, "This would be very useful and this would be useful," and put out a document that says, "Here's the data that would be really useful for this," then you've got a position to go to these people and say, "Hey, if I've got these needs, everybody else does," because these plants are not all that different in Western Europe and Japan.

You might be able to put something together here that no individual country can really afford to do. Become a hero.

MR. HYSLOP: Yeah.

MR. ROSEN: Okay.

MR. HYSLOP: That's a good suggestion. I'll take that back.

MR. ROSEN: Mark, you've got three more slides, and I'll give you three more minutes.

MR. SALLEY: Okay.

DR. POWERS: He's giving a good presentation. Lighten up.

MR. SALLEY: I'm on Slide 9. Okay. These are the bin three items, and this is what the consensus of the group said were the lowest of the risks in the associated circuit arena, and let me just walk through the list that easiest.

Open circuits. We defined open circuits as were the copper conductor typically vaporized, and you physically lost the continuity. You know, we didn't see that in any of the tests. You didn't see that in Browns Ferry. So that seemed to be a low risk where the conductor physically leaves.

DR. POWERS: I have seen fire tests of bore rate packed cables in which the copper didn't vaporize. It dissolved in the borate, and the borate was put in as a fire suppressant and melted and lost the copper not by vaporization, but by dissolution.

MR. ROSEN: Well, you could take that for study.

DR. POWERS: But it's another thing to look at because I don't know whether MGO packed cables will do this, but the borate ones -- I mean, the work was done in the Netherlands, and the idea was the borate would act like a really good fire suppressant, and it was a really good way to wipe conductors out and create a liquid now that itself was highly electrically conducting, and it just shorted out everything.

MR. SALLEY: That's interesting.

DR. POWERS: If you need a reference for it, it was the Material Research Society meeting in San Francisco about four years ago.

MR. SALLEY: And they do that for fire protection, was why they put the borate there in the first place.

DR. POWERS: What did you say?

MR. SALLEY: He had the borate there for fire protection?

DR. POWERS: Yeah, that's right. That's right.

MR. SALLEY: Okay. The second item we're going to look at is the intercable shorting

between conduits and armor cable. Again, we want to be complete. That's why we want to look at it, but I think we can all fathom that if you have an air drop that passes along a conduit, that air drop is not going to pass through the conduit and get the conductors inside.

But we want to be complete and look at it.

Multiple high impedance faults of a common power supply, that's one that seems to be somewhat weak. The probabilities of that happening based upon what we're seeing didn't seem to be that good. We want to look a little more at that and make sure that that doesn't occur.

DR. POWERS: It has occurred to me.

MR. SALLEY: The three phase failures occurring with proper polarity, what we're looking at here is the power cable, and typically you'll find your three phase cables are set up in a piece of triplex. They have a piece of triplex on a power side along with another piece of triplex such get to it from Phase A to A, B to B, and C to C.

Again, in reality space this tends to be out there quite a bit.

And reversible DC motors, the power

cables, from what the electricals have explained to me that you need five failures to come in in the correct polarity in order to make that DC motor work.

Again, getting the five failures, getting it in the correct polarity for that reversing motor to work seems to be getting more far out on the probability curve.

Again, this is the second tier of things that the folks in research will be looking at it for us.

Next slide.

These will be quick. Our remaining activities. Just to finalize what Sunil said in the opening is we plan to --

MR. ROSEN: This is number ten, right?

MR. SALLEY: N, this is number ten.

MR. WEERAKKODY: We skipped one.

DR. WALLIS: We have it. So you can talk about it.

MR. SALLEY: Okay.

MR. ROSEN: You're talking about ten. He's got 11 up there.

MR. SALLEY: I'm on ten.

We're going to issue the risk as final

after we've gotten comments, and I have gotten a number of comments, and it will do some changes.

We are going to be issuing a draft NUREG. I've got a number for it. It's 1778, and it's going to be out for public comment, and this will form the knowledge base of all the circuit analysis we've had since 1980, and try to put everything into one coherent package.

A public workshop. Before we actually start the inspections, we'll have a public workshop with our stakeholders. We're looking at about the November time frame, November of this year.

And Peter, as he said, he's revised the insepction procedures. That will be continual. If the bin two items come back with something that's risk significant, Peter will make an adjustment in the inspection procedure accordingly. So that will be ongoing with the Office of Research.

In conclusion, our goal here was to try to make the associated circuits, the inspections be in a more risk informed manner and look at the risk significant cases. That's what we're going for, and we're trying to do that, of course, so that we can make the most effective use of the inspection resources.

That's all we have.

MR. ROSEN: All right. Are there any questions from members of the -- pardon?

I'm sorry. J.S., how much have you got?

** MR. HYSLOP: J.S. Hyslop, one slide.

MR. ROSEN: We're 20 minutes into our slide.

MR. HYSLOP: Yeah, I have one slide --

MR. ROSEN: All right. Go ahead.

MR. HYSLOP: -- just to sum up research support for the circuit analysis resolution.

First of all, Research participated in the industry Omega Point circuit analysis test. We did that by adding cables and a test rig to provide more extensive information on cable failure modes. This complemented the industry test.

We supported the expert elicitation panel, which was the panel to interpret spurious actuation data on the test.

We've authored a chapter on risk in the draft N.R. NUREG 1778, which was described earlier, and there we've identified risk insights as far as circuit analysis goes.

We participated in the February public meeting to identify important circuit issues for

plant inspections, their research law with NRR and industry.

We've been asked by NRR to participate in the upcoming public meeting on associated circuits later in the fall.

And then the last thing that we've done is agreed to address the user's need, which I described in response to Dr. Power's earlier question on research support for circuit analysis.

I guess lastly I'll give a little promotion. Research is in the process of publishing a NUREG which is a multi-year effort on circuit analysis. Sandia is the author of that NUREG.

And it's that NUREG which is really enabling us to or the work done in that enabling us to help NRR so effectively. We initiated this program prior to those Omega Point tests. So I just wanted to let ACRS know about that.

MR. ROSEN: Well, that's all very helpful. We have to write an input to the ACRS report on research agency wide. So this is the kind of stuff we need.

MR. HYSLOP: Yeah. Any questions?

(No response.)

MR. HYSLOP: If not --

DR. WALLIS: So you are doing all of the things that Mark said you were doing?

MR. HYSLOP: I can't remember what Mark said, but I'll just summarize. Yes, we've got a user's need.

DR. WALLIS: It's Sandia that's doing that work --

MR. HYSLOP: Sandia is looking to identify whether any of the circuit analysis issues were excluded, whether they should b included in bin one or using the available information to make that determination. So we're doing that.

MR. ROSEN: All right. Well, with that, we'll thank you all for this morning's presentations. We'll stay in recess until 1:15, and I'll try and squeeze a little more time out of the presenters this afternoon and get that on schedule.

Thank you. We are in recess.

(Whereupon, at 12:25 p.m., the meeting was recessed for lunch, to reconvene at 1:18 p.m., the same day.)

CHAIRMAN ROSEN: We're back. Mr. Fred Emerson of NEI. Nice to see you, Fred.

MR. EMERSON: Thank you. You'll see more of me later, too.

CHAIRMAN ROSEN: We're reflecting, meditating.

MR. EMERSON: Most people are sitting in the back.

MEMBER WALLIS: Are you going to resolve something for us?

MR. EMERSON: Well, I've been working at it for the last seven years. I hope to.

MEMBER SIEBER: When are you eligible for retirement?

MR. EMERSON: About another seven years.

CHAIRMAN ROSEN: They haven't told you that this needs to --

CHAIRMAN ROSEN: All right. I think we are ready, Fred.

F. NEI DISCUSSION

MR. EMERSON: Thank you for the opportunity to present some of the industry perspectives on fire-induced circuit failures. You heard this morning from the staff about their plans for proceeding with the inspection of associated circuits again. I am going to provide a little bit different viewpoint.

Mark Salley made a number of references to the NEI testing. Topics I am going to cover, I

am going to spend one slide telling you what we told you last June from the standpoint that I am not going to cover the same ground again. Then I am going to talk about the current status of resolving fire-induced circuit failure issues.

These were the topics we addressed at the last meeting. We talked about the EPRI-NEI circuit failure testing. I want to be sure I give due credit to EPRI because they were an important part of this testing activity. At the time we talked last, we only had observations. We didn't have hard data and conclusions. We do now.

We talked about the expert panel development of probabilities of cable damage and due to fire and the probability of spurious actuations. So I will not be going into that at all.

MEMBER WALLIS: As I remember, you had lots of observations, but it wasn't much in the way of theory or correlations or something that you could use to predict what would happen.

MR. EMERSON: Well, I'll be touching on the point of how predictable these are, how well you can characterize them a little bit later in this talk. We talked about the pilot evaluations. And Doug touched on it again this morning.

And we talked about some of the issues that remain to be resolved with NEI 00-01, which is the industry document intended to resolve some of the open issues related to circuit failures. But that was in draft, and it has now been issued as Rev. 0.

So the topics I will address today, I will be presenting a sampling and only a sampling of the conclusions, the results and conclusions of the EPRI NEI testing. And I would refer you to this EPRI report that is on the screen for a detailed summary.

That report is about 400 pages of text and many, many, many tables and figures showing detailed results for each of the 18 tests that we did. A complete review of that would depend on the review of this document.

MEMBER WALLIS: Again, are these just curves or something or is there some attempt to understand what happened and model it?

MR. EMERSON: We have not made any attempt to model it. We are reporting on observations and conclusions that we had drawn from those observations in making an attempt to use that information to move forward with the resolution of

this longstanding regulatory issue. I would leave any modeling to a research effort, which we're not really funded to do.

The second topic I will cover briefly is a summary of where we are with the NEI 00-01 document, the Revision 0 that has been submitted to the staff for review, its intended use. And I'll address specifically the deterministic methods, the probablistic or the risk methods that are in there, and our conclusions on multiple high impedance faults, which was touched on this morning in Mark's presentation.

The last, very last, of the 35 slides that I have will be recommendations for issue closure, more regulatory than a technical position. Because there are 35 slides and I have an hour, I am going to be going through them fairly quickly.

This is what the EPRI test report includes. There is a detailed description of all the tests. Each test is reviewed and analyzed on a test-by-test basis. And the information about those tests that you see listed is provided in the test report.

MEMBER WALLIS: How is it analyzed if you didn't do any modeling?

MR. EMERSON: In other words, by "analysis," I meant we went through the results of the tests and tried to draw some conclusions on it based on the information that we got, the temperature curves, the electrical profiles that we generated, the actual spurious actuation results that we got. We tried to correlate all of that information to try to get a picture of just to see what conclusions we could draw.

MEMBER WALLIS: So this will be the sort of word analysis that a lawyer might view as rather than a scientific type of analysis?

MR. EMERSON: I would like to think there was some science involved in it. We didn't have a lawyer review it.

MEMBER WALLIS: But it is a word analysis?

MR. EMERSON: It is an analysis of the data, rather than an attempt to model.

MEMBER WALLIS: It's descriptive and --

MR. EMERSON: It's descriptive of the actual results, rather than an attempt to be predictive. Dennis?

MR. HENNEKE: Yes. Dennis Henneke, Duke Power.

When you refer to modeling, there was a considerable amount of modeling done for predictive purposes, the features that can affect the circuit analysis and spurious actuation failures; for example, time, which Fred will talk about in a little while.

They did some time curves on there to see how long the spurious actuation can occur and found the median time for spurious actuation was about two minutes. And then all circuits cleared within 13. So then you can set that to a probability. And you have a model of time versus spurious actuation.

They also looked at temperature and the probability of cable damage versus temperature. We looked at the effect of CPTs and what factor that would have on the risk.

There are factors in order to generate if you have a configuration at your plant. You look at the various factors, and you can determine the spurious actuation probability, but it's not extended to a circuit that they haven't run tests on to create a model to predict what its probability is.

MEMBER WALLIS: No. What I just mean is

that you must have strongly resisted the temptation to do technical analysis when you see a temperature which is going on so exponentially for some sort of equilibrium.

It must be very tempting to say, "I understand why it is doing that because I know something about heat transfer, heat capacity, and so on." You resisted the temptation to use what you learned in school. That's all.

MR. HENNEKE: Well, it was just after failure we were looking at the various probabilities of when it failed, what it would fail to look like, rather than why, I guess.

MR. EMERSON: Okay. This was the configuration. This is a typical configuration. And I'll show you a sampling of the curves that were generated for the test pertaining to this configuration.

Typically we had two layers of cable in a ladder-backed tray. It was in an L-shaped configuration, as I've indicated in previous presentations here. We had four instrumented cable bundles of the type that Mark showed this morning, where we had a single multi-conductor cable surrounded by three single conductor cables. Those

are the orange circles in the tray.

MEMBER WALLIS: Can I ask you, when they actually lay cables, they don't fit as neatly as this, do they?

MR. EMERSON: Well, in an actual plant, some plants have them, some tied off. And they're kept pretty much in order. Some plants it's very random.

We tried to create some reproducibility in the test so that we could make changes.

MEMBER WALLIS: So you laid them in very carefully and straight and parallel?

MR. EMERSON: Well, they were touching each other. It doesn't show that here, but we tried to create a configuration that was as close to an approximation of how they are actually done in a plant as we could.

The instrumented bundles are shown by the DA numbers, DA 1, 2, 3, and 4. We tried to vary the locations to measure the -- we tried to measure the effects of locating the cable on the bottom or the top of the rows. Sometimes we varied the number of rows of cable to see what the effects were of varying tray fill. And I will get to that a little later.

The test results, we created temperature and electrical profiles for each one. And I'll show you a sampling of those profiles for this actual case in a slide or two.

We created a graphical depiction of cable performance. And these were helpful in identifying patterns and trends. We made observations and tried to draw conclusions from collections of the data.

And we spent a lot of time reviewing. There was a huge amount of data that we gathered from these tests. And we did the best we could at trying to draw conclusions that were useful in a regulatory environment.

As was indicated this morning, there are probably some areas where questions still remain that are subject to further research. The example profiles you'll see on the next couple of slides involve a seven-conductor and single-conductor thermoset cable bundle.

As I mentioned, the heat release rate for this particular bundle was 350 kilowatts, which was toward the upper range of the heat release rates we tested. It was located in the bottom of the tray and used a laboratory power supply.

This presents a temperature profile. This is typical of the types of temperature curves that we have in the -- this represents -- I'll see if I can speak into the microphone while turning it around 00 average and maximum temperatures in the vicinity of the cable bundle.

You'll see a reference to the onset of failure and full failure. In the subsequent figure, I'll explain just exactly what those terms mean. The onset was at 35 minutes, and the full failure was at 42.

MEMBER WALLIS: Onset is the beginning of a short --

MR. EMERSON: Yes. And I'll --

MEMBER WALLIS: -- the beginning of melting or --

MR. EMERSON: It will be very clear on the next slide what that means.

MEMBER WALLIS: So the maximum temperature is on the outside of something?

MR. EMERSON: The maximum temperature is in the dark blue line.

MEMBER WALLIS: That's the outside of the cable?

MR. EMERSON: Yes. The temperatures

were measured not in the cable. We didn't insert thermocouples into the cable itself, but we measured them on adjacent cables.

MEMBER WALLIS: So the maximum, so skin temperatures, as they were? And the average skin temperature is on the outside of the cable?

MR. EMERSON: On the outside of the cable.

MEMBER WALLIS: Probably where the breakdown would probably start would be on the outside?

MR. EMERSON: You would think so, yes, following classic heat transfer.

MEMBER WALLIS: And the failure was the one that was at the maximum temperature? Which one failed?

MR. EMERSON: I'll get to that.

MEMBER WALLIS: I was wondering what I should interpret from the fact that you got a maximum and an average here.

MR. EMERSON: We were, again, trying to correlate the failures that we got, whether they were hot shorts or spurious actuations or shorts to ground with the temperatures at which they occurred to try to get some feel for how long it takes and

what are the temperature conditions required to produce the cable failures of interest.

MEMBER WALLIS: You are going to show us more? This is the only temperature profile we are going to see?

MR. EMERSON: Yes. This is the temperature profile. If you keep that in mind while we are looking at the next slide, it shows on the left is the voltage performance of this particular cable bundle and on the right is the current. I am going to try to illustrate this. I guess I can't pull that out.

The onset of failure is at the far left here, where the voltage between the two cables starts to increase.

MEMBER WALLIS: What's the one which has already started? That yellow one has already done something before 4:30.

MR. EMERSON: Each of the colors represents a different conductor in the bundle.

MEMBER WALLIS: They should be either zero or 120.

MR. EMERSON: Right. That's correct.

MEMBER WALLIS: Some of them have already departed before you got to 35 minutes

presumably. Am I looking at the wrong thing? They should be all either zero or 120. At least two of them are at some intermediate place at 35 minutes, right?

MR. EMERSON: Well, the start of the picture is at 35 minutes, rather than at zero.

MEMBER WALLIS: Something has failed before that.

MR. EMERSON: Since this is 35 minutes -- back at zero, they will either be zero or 120.

MEMBER WALLIS: That one which is brown or red or some different color there, red, that has already failed a long time before presumably.

MR. EMERSON: Well, it hasn't achieved full failure yet. We started to get some current leakage between --

MEMBER WALLIS: Any current leakage is symptomatic of failure because insulation should prevent essentially any current leakage.

MR. EMERSON: Symptomatic of failure, but it has not yet resulted in a hot short or a spurious actuation.

MEMBER WALLIS: But it might have started at 20 minutes.

MR. EMERSON: The insulation resistance

breakdown? Yes, it might have, but it hasn't yet resulted in a --

MEMBER WALLIS: That might be enough to cause a spurious signal to something.

MR. EMERSON: Well, the spurious signal is that particular curve where it spikes up to 120 volts, starts from zero and spikes up to 120. The information you saw in the previous slide for the onset of failure was here beginning at 35 minutes, where you started to get a slow increase in the voltage to that conductor.

When the failure actually occurred at 42 minutes, it spiked up. And you got the spurious actuation here.

MEMBER WALLIS: Okay. What are the other two curves, then?

MR. EMERSON: The other two curves represent other conductors, where the voltage did not get up to --

MEMBER WALLIS: It never got up to 120?

MR. EMERSON: It never got up to 120. It did not. There was no spurious actuation.

MEMBER WALLIS: Obviously something has happened to the insulation.

MR. EMERSON: Yes. Oh, yes, it

certainly has, but --

MEMBER POWERS: If we had done this experiment ten times, would we have seen the same conductor spike up to 120 and the other 3 conductors give just this small lump or would one or the other one of them have spiked up to 120?

MR. EMERSON: That's difficult to say. I wouldn't care to predict that we would get exactly reproducible results in ten separate experiments.

CHAIRMAN ROSEN: Could it have been worse?

MR. EMERSON: It could have been worse. It could have been better. It's very difficult to reproduce the exact temperature profiles, the exact layout in the tray, the exact --

CHAIRMAN ROSEN: So you're not going to hang your hat on the fact that you've got 42 minutes until we get a spurious actuation?

MR. EMERSON: Not for a single actuation, not for a single result. But if you look at the aggregate of the results, which we will do in a little bit, we believe that you can. That information is useful.

In fact, that is one of the conclusions that we drew, is that in the aggregate, the data can

be useful for generating conclusions that can be applied in the regulatory arena, but you cannot predict for any single conductor or any single cable exactly what will happen. You just can't do it.

MEMBER POWERS: Would you remind me, Fred? Did you conduct any of the tests such that they were as identical as humanly possible, one was identically as possible to another one?

MR. EMERSON: No. With the limited number of tests, we were trying to cover as many parameters as we could. If I remember a meeting that we had in front of the subcommittee maybe three years ago, while we were setting this up, you all recommended that we have an analysis done to make sure that the data we were capturing -- it was reasonable to make the parameter variations we were.

We were to get as much information as we could. And we had the University of Maryland analyze our test setup to make sure that we were doing that.

MEMBER POWERS: I can't imagine somebody on this subcommittee didn't whine that you have to do a replicate test and --

CHAIRMAN ROSEN: There was someone. It was you, actually, Dana. You were arguing for more

repeatability, and Nei was arguing for a broader set of tests given the finite resources.

MR. EMERSON: There was no way we were going to do enough tests. We just didn't have the resources or the time to do that. We were trying to get the maximum amount of information from a minimum number of tests.

And that's what we asked the University of Maryland to help us decide, whether we were going about that the right way. And their answer was yes.

MEMBER WALLIS: Something that is peculiar, it says "spurious actuation of DA number 3-2." This is cable number DA number 3? The "-2" color doesn't correspond to that color of the one that reached 120 volts. Number 2 has a different color, both number 2's. It looks like number 3 at the bottom or something. Which is it?

MR. EMERSON: Well, there were seven conductors in bundle DA 3.

MEMBER WALLIS: And then they start again at CUR number 1, 2, 3 as well. It's the seven.

CHAIRMAN ROSEN: One conductor.

MEMBER WALLIS: There is one conductor, and then there are seven. But the color doesn't

correspond to the number.

MR. EMERSON: I'm sorry. I'm not quite following you.

MEMBER WALLIS: The color. That one that spiked to 120, the light greenie-blue color there, doesn't correspond to number 2 on your table. That's all.

CHAIRMAN ROSEN: It's number 4 on your table. It looks like 4.

MR. EMERSON: That one was for wire number 4 in the bundle.

MEMBER WALLIS: Anyway.

CHAIRMAN ROSEN: I see your point. The label on the chart says "spurious actuation of DA 3-2." Do you see that, Fred?

MR. EMERSON: Yes.

CHAIRMAN ROSEN: The color that looks like it's spuriously actuated starts down at 35 minutes, flips around a little between 36 and 37, showing some indication of distress, then comes over and at 43 minutes or so is the one that creates a spurious actuation, conductor number 4, not conductor number 2.

MEMBER WALLIS: One would think so.

CHAIRMAN ROSEN: Right, by the colors.

Now, that is easy to screw up when you are doing a chart like this.

MEMBER WALLIS: But number 2, isn't number 2 the one which was wandering around and partially wrong before? What's the one which was --

CHAIRMAN ROSEN: Number 3.

MEMBER WALLIS: -- you couldn't quite see the color scheme there?

CHAIRMAN ROSEN: Number 3 is all drifting upward. Number 4 wiggles around a little bit.

MEMBER WALLIS: What's the one which is -- what's this one here?

CHAIRMAN ROSEN: Yes. That's probably number 7. But it cuts across here, goes right across there. So it never reaches the full 120 volts. The point is that one conductor in this cable becomes distressed and eventually provides 120 volts --

MR. EMERSON: Right.

CHAIRMAN ROSEN: -- current of voltage across the actuator.

MR. EMERSON: Right. The other thing from this slide that you can look at is a short to ground, which is the performance typified by that

curve when you start off at 120 volts. And at some point, it shorts to ground and drops almost instantaneously to zero voltage.

So those were the two types of phenomena that we saw, the spurious actuations and the shorts to ground, in this. We saw no open circuits as initial failure modes.

CHAIRMAN ROSEN: Now, if you are riding a pump and it's running and that is a good thing, your losing power and shorting to ground means the pump stops.

MR. EMERSON: Right.

CHAIRMAN ROSEN: That's a bad thing. But if it's a valve and it's already open by 53 minutes into the accident or whatever, it's probably fine that it has long since taken its accident position. And at 53 minutes, it shorts and stops. And motor operating valves typically fail as is. In this case, it wouldn't matter.

So you have to take into account the design --

MR. EMERSON: Of course.

CHAIRMAN ROSEN: -- in terms of whether these are significant failures. In every case, you have to look at when did it happen, what was the

position? If it's a valve, is that the safe position or the non-safe position? If it's a pump, has the pump already discharged enough fluid to not matter if it fails at 53 minutes and so on?

MR. EMERSON: And those are things that are considered in the safe shutdown analysis as what the failure mode is for each of the components you're questioning.

CHAIRMAN ROSEN: And timing.

MR. EMERSON: Right.

CHAIRMAN ROSEN: Just by way of information, the right-hand curve shows that doing the same spurious actuation, the current was about .25 amps. And we observed that in general, if the current -- in some cases, you can see from the current chart, the current ranges up to, say, .1 amp or higher. In those cases, we did not get a spurious actuation. It was the .25 amps were pretty characteristic across many tests of the current level when you did get one.

MEMBER WALLIS: The maximum amperage there is bigger for the green one, which got to 120. There's one above it which didn't get to 120 but had more amps. So I don't quite know what to conclude.

MR. EMERSON: Well, the conclusion that

we drew from this chart is that if you are looking at the data and you are trying to determine just by looking at the data whether a spurious actuation has occurred or not, that if it hasn't gotten 2.25 amps, you didn't have a spurious actuation.

CHAIRMAN ROSEN: For this test configuration?

MR. EMERSON: For this particular test configuration, for this particular equipment setup.

MEMBER WALLIS: It looks to me as if 2.25 amps could be caused by a voltage less than 120.

MR. EMERSON: Well, the two were together. It wasn't caused by the voltage being less than 120. We found that the voltage levels when you didn't have a spurious actuation were on the order of 90, 80 volts or less. So it's a combination of the two of them occurring simultaneously or not occurring.

MEMBER WALLIS: So the real criterion was the amps, rather than the volts?

MR. EMERSON: Again, we were using this as a way to determine just by looking at the data and trying to correlate what the temperature, what the current, and what the voltage profiles were at

the time that we saw an actual actuation. The actuations, as Mark had indicated, we set up actual devices. And it was pretty obvious from looking at the devices and the noise that was involved when an actuation had occurred.

MEMBER WALLIS: So a motor wouldn't start. It would probably go "brrrrrrrrrrrrrrrrrr." And then it wouldn't start until it went up to a high enough voltage?

MR. EMERSON: In some cases, we saw that, where it just didn't quite get there. We saw some relay chatter, but it didn't actually lock in.

MEMBER WALLIS: So the point is all of this is very dependent on what is downstream. So the --

MR. EMERSON: Certainly.

MEMBER WALLIS: -- behavior of the device that is connected at the end of the wire.

MR. EMERSON: Yes, the type of device you have connected, the type of current limiting devices you have, all of that. Again, this was provided only to indicate as a typical example the type of electrical data that was generated.

And, again, we tried to do that. We didn't want to measure just electrical conditions or

just spurious actuation, existence or nonexistence. We tried to correlate the two to get some feel for what was actually going on electrically when you did have a visible spurious actuation.

MEMBER WALLIS: Now, to get back to my colleague's question about repeatability, it seems to me the actual trays, the wires are more higgledy-piggledy, they're not put exactly parallel, exactly straight, and that you would get a great variability in the amount of shorts you would get and which ones would short depending on all sorts of uncontrolled variables here.

MR. EMERSON: That would be true if there were a lot of cable-to-cable interactions, but if you are looking at actuations within a single multi-conductor cable, the location of the cable in the tray is less important. You don't really care whether it's higgledy-piggledy or whether they're laid out in straight rows.

MEMBER WALLIS: The thermal transient might depend on these things.

MR. EMERSON: Yes. Whether you got the cable damaged would certainly be impacted by the location.

Okay. Moving along, I am going to

provide, try to provide, a fairly quick summary of the overall results. Again, this is a very broad characterization with very little analysis involved. Just this is a reporting of what we actually saw.

MEMBER WALLIS: This is why we're asking so many questions. We are trying to figure out what it is you actually took as a measurement and how repeatable it was and what it might be due to and what uncertainties there were so we can understand sort of the meaning of these numbers you are going to show us.

MR. EMERSON: Right, right. What we measured were temperature, voltage, and current. What we observed were spurious actuations or failures of circuits via shorts to ground. And we tried to correlate the observations with the electrical and temperature measurements.

MEMBER WALLIS: So this failure is which of these things. Is it a voltage or a current or spurious actuation?

MR. EMERSON: The phenomenon that you see electrically is a hot short. And the spurious actuation is a result of the hot short. Not all hot shorts result in spurious actuations.

MEMBER WALLIS: These numbers here where

it says "failure"?

MR. EMERSON: The failure was intended to the three classic types of electrical failures that are discussed in appendix R: open circuits, ground faults, and hot shorts. So those are the three types of failures we were attempting to --

MEMBER WALLIS: So a hot short is when you get any volts or when you get 120 volts or when you get any current or .25 amps or when is a hot short a hot short and when isn't it a hot short?

MR. EMERSON: A hot short is when you get two conductors transferring voltage from one to the other. It may not be --

MEMBER WALLIS: Any deviation from zero is a hot short?

MR. EMERSON: A hot short is when you get two conductors touching and transferring voltage.

MEMBER WALLIS: So any voltage recording on your instrument other than zero or 120 presumably is a hot short?

MR. EMERSON: It was probably a threshold involved. I can't say that any voltage, any minuscule voltage, would be considered a hot short.

By way of general observations, we noted that the percentage of ground faults versus hot shorts for thermoplastic and thermoset cable was approximately equal. Then the percentage was higher for armored cable. I don't have a similar table for spurious actuations, but what we observed is that there was a higher percentage of ground faults for thermoset cable than for spurious actuations. Again --

MEMBER WALLIS: I am puzzled here. I mean, when you showed us the data, you looked as if you had 2 cables at 120 volts and 5 or 6 or something, 5 at zero. So how do you get a ground fault on the voltage that is already zero?

MR. EMERSON: Well, the ground fault is when a voltage of 120 goes to zero.

MEMBER WALLIS: But if only 2 of the cables are that, then are you taking 64 percent of the ones which are hot? You must be doing that. The ones which already have zero voltage but still are grounded don't count?

MR. EMERSON: The ones which were already at zero voltage obviously --

MEMBER WALLIS: They may have failed to ground but you didn't know it.

MR. EMERSON: That's correct. You would not know that.

MEMBER WALLIS: So I am trying to see if this is percent of the ones which were at 120 that --

MR. EMERSON: That's correct, the percentage of ones that were at 120.

In general, we had gone into the test with a theory, which did not hold up, that there was some residual impedance between two burned conductors. There would be some sort of a char layer on the outside which would provide some impedance. That did not, in fact, turn out to be true.

So that was one valuable result. Generally when a cable fails, it goes very quickly from 120 volts to zero, rather than there being a gradual drop-off.

MEMBER WALLIS: How about the ones that got 40 volts?

MR. EMERSON: In what respect?

MEMBER WALLIS: Well, when you said there is no residual impedance, but if there are either zero or 120 because there is no impedance, how come some are 40?

MR. EMERSON: Yes. For those, yes. I'm speaking in terms of the cables that actually were subject to spurious actuations.

Along the lines of our earlier discussion, looking at the results of a whole, looking at 4 cables times a number of circuits times 18 tests, we came to the conclusion that you could generally predict trends and you could draw conclusions based on some of the more important factors, which I'll cover in a minute.

You gave us an understanding of the primary influence factors. But in terms of probabilities, the probabilities, though the expert panel came to some conclusions, the uncertainties are still fairly high. And that's one of the outputs of the expert panel.

MEMBER POWERS: How do you envision developing the probabilities and the associated uncertainty on them? Do you, say, well, look at the several hundred cables that were tested overall in all of these experts and use that as my devisor as the number of full tests solved or do you do something more detailed than that?

MR. EMERSON: I'm not sure I understand your question.

MEMBER POWERS: I want to know the probability that a thermal set insulated multi-conductor cable developed, say, a hot short, for example.

MR. EMERSON: Okay.

MEMBER POWERS: How do I develop that probability out of your data set here?

MR. EMERSON: That's what the expert panel did for us.

MEMBER POWERS: Right.

MR. EMERSON: Those results are reported in that. Are you asking how --

MEMBER POWERS: Yes.

MR. EMERSON: -- we developed the probability?

MEMBER POWERS: Do you take the number of thermoset semiconductor cables that you tested and do you count the number of volts that are observed by that count, by the number of cables tested, and you say that is probability?

MR. EMERSON: I would say that would be a crude way to do it. You would want to try to group them by the parameters you were trying to measure. I didn't say that very well. You would want to make sure you understood the inputs into

that and try to differentiate the varying parameters, rather than just taking a very broad approach.

MEMBER POWERS: You could do it in a more microscopic way and say, "Well, is the conductor varied?" or you could use a function of the heat flux that is imposed on it, things like that.

MR. EMERSON: You could vary it. You could look at it by heat flux, by the amount of fill that was in the tray, by the type of insulation it had. That was probably the biggest --

MEMBER POWERS: Suppose I get the -- I want to get the actual number in mind here. Suppose I say, "Okay. Having done this analysis, I get a ten percent probability that I will get a hot short in this class of conductors."

MR. EMERSON: Okay.

MEMBER POWERS: Now, how do I go about saying it is 10 percent plus or minus 20 percent or whatever it is? How do I get that plus or minus probability?

MR. EMERSON: How did you get the uncertainty band that was associated with that? Frankly, I don't know the answer to that question

because there were a number of different experts, each of whom may have had a somewhat different approach to doing that.

Dennis was one of the reviewers of it. Dennis, would you care to comment on that?

MR. HENNEKE: Yes. There were a number of people on the expert panel. Mark Salley was also on that from the staff. Basically, Bob Budnitz ran the expert panel.

Everybody went out independently and gave probabilities for what they felt comfortable with giving with regard to influence factors, temperature, time, the use of CPTs, current power transformers, that type of thing. And that was brought back in. They were asked to give it. And if they couldn't give their best guess, you had uncertainty.

They were all given the same data. So they had to analyze the data in different ways. And then Bob Budnitz put it together. And based on the variability of the expert panel and their variability of uncertainty gave uncertainty bounds to the best of his ability.

MEMBER POWERS: Without knowing the variability of a given experiment, how did they come

up with that number?

MR. EMERSON: How did each of the --

MEMBER POWERS: How did they come up with that number without knowing -- how do you measure trends when you don't know the variability from experiments to experiment?

MR. EMERSON: Well, they had access to the test setups that were used for each experiment. So they could see which items were varied from experiment to experiment. They had access to all of the results and all of the --

MEMBER POWERS: What I am asking is, I can see in experiment configuration A, I've got a ten percent failure. In experiment configuration B, I get a 20 percent probability of failure. And I can attribute the difference between those numbers entirely to the fact that it's varied when, in fact, it may simply be had you repeated experiment A 50 times, you would have seen 20 percent on average. It just happened that that particular test, you had ten percent.

And there may be no trend there at all without knowing the experimental variability, just the variability in the experiment itself.

MR. EMERSON: That is true.

MR. HENNEKE: I think the uncertainty, though, is from a general standpoint of looking at a cable. You really don't know where it is on a cable tray, how across are the cables, that type of thing, that you could see. From the experiments, you could see cables getting above their damage temperature. And you might get one spurious actuation. And then you repeat a test in a different way.

But cables get above their damage temperature, and you have three. So you will get a .5 for the worst and a .15 for the best. That gives you an upper bound and a lower bound.

If you look at the variation for similar types of experiments, you can see a general trend of upper bound and lower bound based on the worst and best that you have seen.

The tray fell. And how the cable laid out was all fairly similar. So all you were varying was some of the electrical characteristics and then how quickly they got the temperature.

MEMBER WALLIS: But there are also other things that matter. The whether or not a conductor is going to lean over and touch another conductor, given that there is some kind of softening of the interaction, is going to depend upon maybe residual

stresses in the wire itself. It's been bent before, and it wants to bend back to what it was before when it was in the loop. So it's got some residual stress. And when you soften it up a bit, it leans over. It's the other one.

If they're resting on top of each other, this weight and so on, there are individual mechanical forces on these wires, which you know nothing about, which depend upon history and how the cable will be laid in the tray. All of these are going to influence the result.

MR. HENNEKE: More influence on the inter-cable than the intra-cable. For example, we didn't expect spurious actuation of armored cable. And we saw one. It turned out that they had an L-shaped bracket that the cable is run and the inter-cable, the very first cable, was bent beyond its radius. And so we saw a spurious actuation, which was quite a surprise.

We reran the test with the correct cable tray. And we didn't see any, as what we expected. The expert panel took that under advisement and actually showed a lower voltage for spurious actuation for armored cable --

MEMBER WALLIS: In the plant, it may

well be that these cables at some time have been bent beyond their radius.

MR. HENNEKE: Based on the insulation specification, they wouldn't be. If you did that, you would have to remove it and replace it. And we do inspections. So you shouldn't have anything bent beyond its allowable bend radius.

MR. EMERSON: The types of questions that you're asking certainly support what we have on this slide, that it would be very difficult to predict with any certainty what is going to happen to any given cable in any given tray.

But, again, the results across the whole spectrum of tests for comparable heat release rates, for comparable tray loads, for comparable positions within the tray do indicate enough consistency that it's useful information.

MEMBER POWERS: I think what you are saying is that you have a plausible story. It may not be statistically rigorous, but it's a plausible story.

MR. EMERSON: You could certainly improve on the statistical rigor, though. There's no question about that. Basically what we were trying to do is improve on the state of knowledge,

which was essentially zero for a phenomena like this.

So is this a finishing point? No. Is it a good starting point? Yes, we think so.

MEMBER POWERS: What you're saying conclusively is that it's an excellent motivator for the material that has been discussed throughout the day.

MR. EMERSON: Yes, I would say so.

Okay. There were two tests with no failures at all. Those were the HGLs, hot gas layer. Those were the types of fire phenomena that we saw for those tests. They both involved thermoset cable.

Now, the cable fragility curve was developed by the expert panel. And that's this particular set of curves.

MEMBER WALLIS: They must have had a tremendous bias about the number .5. It kinked everything .5.

MR. EMERSON: Yes. I should indicate here that there were three separate probabilities estimated by the expert panel.

MEMBER WALLIS: This is before they saw any data or after?

MR. EMERSON: No. This was after they saw the data. Now, the 5 percent, 95 percent, and 50 percent probability is a failure. At what temperature --

MEMBER WALLIS: That is what they were asked?

MR. EMERSON: That's all they were asked.

MEMBER WALLIS: Okay.

MR. EMERSON: That's all they were asked. And we just drew lines through the points.

CHAIRMAN ROSEN: All those dots imply some sort of extraordinary laboratory precision.

MR. EMERSON: No. There was certainly not that extraordinary laboratory precision. Basically it was me taking the three data points and trying to create curves out of three data points for each of those types of cables.

CHAIRMAN ROSEN: I would have used each of the three points in a straight line. It's elegant fiction.

MEMBER POWERS: Then you have to make something that is visible as a viewgraph.

CHAIRMAN ROSEN: All right. We understand that. Okay. So now it becomes

artistically --

MR. EMERSON: Moving right along, what we observed is the important influence factors were the cable --

MEMBER WALLIS: The problem is, though, when you present something like this, someone is going to believe it. And they are going to take, say, .75 on that curve, which is probably completely wrong, the thermoset. It is unlikely that there is going to be that ramp between .5 and 1.

MEMBER POWERS: If there's one thing you can be confident about, it's knowing it can't be wrong by more than 50 percent or so.

MEMBER WALLIS: You guessed 50 percent.

MEMBER POWERS: Right.

MR. EMERSON: Again, not statistically rigorous, but it's better information than we had before.

The judgments we arrived at on influence factors: cable type. You've heard that already, thermoset versus thermoplastic versus armored.

MEMBER WALLIS: It says "probability of any cable damage." I'm sorry. Do you really mean probability of a short?

MR. EMERSON: The definition of cable

damage was a subject of intense debate amongst the members of the expert panel. Is it any cable damage? Is it the type of cable damage that will result in a spurious actuation or a short to ground?

MEMBER WALLIS: Well, at least it's a short. It's not just that you melted some of the insulation.

MR. EMERSON: Right.

MEMBER WALLIS: So the probability of any kind of a short is what --

MR. EMERSON: Getting to the point where you could get a short or a cable failure of the type that we were trying to measure during the test.

MEMBER WALLIS: So you could take this thing up to 1,200 degrees without a short?

MR. EMERSON: The actual temperatures we measured were up. I think the highest temperature was somewhat over 1,000.

MEMBER WALLIS: What happens to copper?

MEMBER POWERS: I think their temperatures are put into Fahrenheit, I believe, aren't they?

MR. EMERSON: That's correct.

MEMBER POWERS: And copper is about 1,000 degrees Centigrade.

MEMBER WALLIS: All right.

CHAIRMAN ROSEN: For melting.

MR. EMERSON: Yes. We weren't melting any copper.

MR. HENNEKE: Yes. I had a thing. This is Dennis Henneke again.

There is actually a misnomer on this curve. There were actual cables; for example, the eight major and armored cable. There was one cable that went way beyond the temperature curve here that never failed. And there were thermoset cables that also never failed. Some were in the 700-800 degree temperature range. Those were thrown out of the data.

So this was actually when the failure occurred, what did it fail at? What temperature did it --

MEMBER WALLIS: You threw out the data? You only had a few data points, didn't you?

MR. HENNEKE: Well, with the armored cable, we had eight cables. And with the thermoset, we had some 50-something?

MR. EMERSON: Something like that.

MEMBER WALLIS: But you arbitrarily threw out some of the data?

MR. HENNEKE: Well, I was a reviewer on the expert panel. I commented on that, but they were looking at the actual failure temperature. When it failed, this was the temperature it failed at. That's what the curves are based on.

So if you were actually looking at how do you treat when it only got to 700 and your curve is going out to 1,100, it would have failed 720 or 730. They did not know how to. So they threw it out.

Of the ones that failed, that's what's plotted there.

MEMBER WALLIS: But if it didn't fail, it is also useful information. Anyway, we'll move on.

MR. EMERSON: Okay. Now, Mr. Chairman, I have a fair amount more to cover. So I am going to try to get beyond the test results if I can because that seems to be generating the --

CHAIRMAN ROSEN: More questions.

MR. EMERSON: There's a couple of other points that I would like to make. So I'll go through the remainder of the test-related slides very quickly. And then I'd like to spend a little bit of time on where NEI 00-01 is because that has

something to do with the NRC's plans for restarting inspections and for the licensees, how they're going to be approaching circuit failures in the future.

CHAIRMAN ROSEN: Please go ahead.

MR. EMERSON: Okay. Thermoset cable, more resistant to failure than thermoplastic cable. Tray fill showed the more tray fill you have, the more resistance there is to failure because of the thermal --

MEMBER SIEBER: Insulation.

MR. EMERSON: Right. There's more mass there to take up the heat that the fire is generating. If you have volt current-limiting devices, you are less likely to have a spurious actuation if you have a hot short.

It doesn't affect the incidence of hot shorts. It does affect the incidence of spurious actuations if you -- these limiting devices are typically installed and control circuits of the type that you see in nuclear plants. So this wasn't just a way to reduce the number of failures.

There were some second-order influence factors of the type that you see on the slide.

MEMBER SIEBER: Say a few more words about water spray.

MR. EMERSON: We attempted to see whether the existence of water would create additional failures for badly damaged cable. So we sprayed at the end of each test in any case where there was a cable that was damaged but had not yet resulted in a failure to see if a failure would result.

In one out of the 18 cases, that occurred. So we thought that was a lower-order influence factor. The water by itself did not substantially increase the likelihood of failure, which has some ramifications for fire-fighting operations.

MEMBER WALLIS: The orientation was horizontal or vertical?

MR. EMERSON: Horizontal or vertical.

MEMBER WALLIS: I would think a bend would be more than susceptible.

MR. EMERSON: We had a bend in all of the horizontal tests. And we had no bend in the vertical tests.

CHAIRMAN ROSEN: And in every case, you used water. That tended to lower the temperature and put the fire out.

MR. EMERSON: Well, it was certainly

useful for lowering the temperature, but what we were trying to measure is electrical effects to see whether a badly damaged cable would result in additional electrical failures. And in only one case, it did.

You do get external hot shorts from cable to cable, but the likelihood is lower than internal. And, as Mark showed from the information that came out of the workshop this morning, you really don't expect it is very likely for thermoset cables.

One additional conclusion that came out to be useful was that if you have a failure in a multi-conductor cable, you can't just say, "You're only going to have one interaction. You could have any number of interactions."

MEMBER WALLIS: What was the purpose of this work?

MR. EMERSON: First, to see how likely spurious actuations were; and, secondly, under what conditions they would occur; thirdly, how likely they were in comparison with shorts to ground.

MEMBER WALLIS: The reason I ask, it sort of sounds exploratory. If you were actually going to put it into some kind of a failure model

for some -- I don't know -- PRA or something, put it into some model for risk, you have to be asking certain questions that you needed as input to your risk model.

I don't think you got to that stage yet at all. You are just looking at the kinds of things that might happen and saying, "Is there a problem here? Is there not? How big is it?"

MR. EMERSON: Well, we did try to characterize the risk levels associated with different but related types of failures. That was one of the purposes.

MEMBER WALLIS: Some specifications for what you wanted to get out of the tests in terms of a quantitative risk model.

MR. EMERSON: We were trying to get a better handle for how likely spurious actuations and ground faults were.

MEMBER WALLIS: So you could have predicted how many tests you needed to get statistically significant answers?

MR. EMERSON: Given the number of variables we had, the number of tests needed was always going to be greater than the number we could do. But, again, we were trying to --

MEMBER POWERS: That's always true.

MR. EMERSON: Again, given the number of variables that there are to measure in tests like this --

MEMBER POWERS: It was my impression that the going-in hypothesis was that spurious actuations would be quite rare.

MEMBER WALLIS: Yes, that's right.

MR. EMERSON: There was a school of thought that felt that way.

MEMBER POWERS: And that as a result, to disprove that, you needed X number of tests, which is certainly smaller even than the number you did.

MR. EMERSON: I want to be sure we understand. We weren't trying to prove or disprove any particular theory. We were trying to see what happened in typical fires and typical circuits.

MEMBER POWERS: I am just trying to cast it in the terms that the question was posed. So as soon as you saw one spurious actuation, you knew they were not quite rare.

MEMBER WALLIS: I think this is what I remember from the previous presentation was the main message, was that there was this theory that nothing much is going to happen and, gee, whiz, when you did

a few tests, a lot of things happened.

There were lots of hot shorts significantly. So you had to obviously change your mind or somebody had to change his mind.

MR. EMERSON: Well, having been involved in this from the very beginning, I can categorically tell you that while it might have been nice to see no hot shorts, we didn't approach it with the idea that we were trying to prove that theory. Again, we wanted to see what happens. And we were going to live with the results.

MEMBER SIEBER: It seems to me that during the Browns Ferry fire, which was a real fire, there were a spurious actuation.

MEMBER POWERS: Quite a few.

MEMBER SIEBER: And so that established --

CHAIRMAN ROSEN: As there were at San Onofre.

MEMBER SIEBER: -- that it is possible.

MEMBER POWERS: I didn't know that.

MEMBER SIEBER: And then beyond that, then in a deterministic sense, you can say you need separation criteria like appendix R has. And if you want to say that's too stringent, then you ought to

go to some kind of a risk argument, which the data supports both deterministic and risk arguments provided you can have confidence in it. So it seems to me that is why you are doing this and the conclusions one can draw from it.

MR. EMERSON: This slide indicates that if you have, again, a failure in a multi-conductor cable, you can't just categorically say you are only going to get one interaction. You may get any number of them.

MEMBER SIEBER: Right.

MR. EMERSON: If you have different multi-conductor cables in the same fire exposed to the same conditions, you can get more than one hot short, but the likelihood that it will be between those two particular cables is much lower. The likelihood that that will be the result of cable-to-cable interactions is lower.

In terms of the times to actuation, this slide indicates generally the trends that we saw in times two spurious actuations. As you can see, most of them are over 30 minutes. Some are well over 30 minutes.

MEMBER WALLIS: This x-axis is not a scale of number of actuations. These are all

individual actuations, I take it?

MR. EMERSON: These are all the actuations we saw plotted against the time to actuation.

CHAIRMAN ROSEN: One took only two minutes is what I see.

MR. EMERSON: Right. There were a few. Those were the thermoplastic cables that took place much sooner.

MEMBER WALLIS: Was it all the same fire?

MR. EMERSON: Oh, no. This is over a range of fire conditions from 70 kilowatts to more than 400 kilowatts.

MEMBER WALLIS: So the short one is a very hot fire or a very bad cable?

MR. EMERSON: It's thermoplastic cable, which tend to fail at a much lower temperature, as Mark indicated this morning.

MEMBER WALLIS: Presumably it's a very hot fire very quickly, too, isn't it?

MR. EMERSON: Well, as you could see from the temperature profiles I put up earlier, the temperature had a ramp increase, a fairly slow ramp, rather than a sudden spike, to --

MEMBER WALLIS: I am surprised you didn't throw out that data point as being a glitch.

MEMBER POWERS: What you're missing is the important point on this slide, Graham, which is that at about ten minutes, you're going to have a respite from the operators because there won't be any actuations.

MR. EMERSON: Well, for us the important point of this slide was that there's --

MEMBER WALLIS: Nothing happens between 10 and 20 minutes.

MR. EMERSON: -- time to interdict --

CHAIRMAN ROSEN: That's not true. There's one point they came down in 20 minutes.

MR. EMERSON: For thermoset cables, there's typically time to interdict the fire and take some action to prevent a --

MEMBER WALLIS: This is a spotty plot. I mean, I would think you would plot it against something else, like fire temperature or kind of cable or something, because we don't know what to make out of it. We just see it as a variation.

MR. EMERSON: That's all it's intended for.

MEMBER WALLIS: Well, we don't know

whether it's a random variation or it's something because --

MR. EMERSON: Oh, no. Again, it's over a wide range of fire conditions, cable loading conditions. It's just a report of the time it took for each spurious actuation to occur. You would have to analyze it much more closely to figure out what the determinants for that time were.

MR. HENNEKE: That data is available in the EPRI report by cable.

MEMBER WALLIS: Use the cable again here.

MR. EMERSON: I would refer you to the 400-page EPRI report for the type of detail.

MEMBER POWERS: Is there a reason to select thermoset over thermoplastic in application?

MR. EMERSON: We were trying to look at the types of cables that are typically used.

MEMBER POWERS: Yes. And I understand that, and I understand that you have a variety of them. When a guy calls out the cable and the insulation on it, is there some reason you want thermoplastic, instead of thermoset?

MR. EMERSON: Thermoplastic tends to be the cable used in older plants.

MEMBER POWERS: Okay.

MEMBER SIEBER: It's cheaper.

MR. EMERSON: Yes.

MEMBER POWERS: Cheaper, easier to spring, twist, bend.

MR. EMERSON: But judging from our difficulty in obtaining samples, it's very much in the minority in plant use now.

MEMBER POWERS: Good.

MR. EMERSON: This shows the duration, which was touched on earlier. The maximum duration was 13 minutes for any of the cables that failed. Average for thermoset was about less than two minutes; for thermoplastic, less than three minutes before the faults cleared. Typically the mode of clearing was that it would turn into a short to ground.

This is important in four AOVs and PORVs, indicating that those types of valves will return to their safe state after just a short duration of the fault in general.

MEMBER WALLIS: This is because the fire keeps going? Is that what happened? Is that why this happened?

MR. EMERSON: Was your question because

the fire --

MEMBER WALLIS: It seems to me you would have a short. And then you could quench the fire, and the short would be there forever. Why should the short stop? Because the fire keeps going, and it makes a worse short to ground, which just swamps everything?

MR. EMERSON: Yes, that's correct.

MEMBER WALLIS: Because the fire keeps going. If the fire stopped at five minutes, maybe this longest duration would have been forever or until you went and disassembled the cable.

MEMBER POWERS: Just let the fire burn.

MEMBER WALLIS: Let the fire burn. It will bring you short to ground, which will --

MR. EMERSON: I don't think we will try to do that.

MEMBER SIEBER: That was the real hot spot where the conductor short occurs because there is some resistance there. More often than not, sooner or later, the conductor will fail.

MR. EMERSON: These are the conclusions that we drew. The likelihood is higher than we thought it used to be. Again, if we were an industry that was bent on improving that spurious

actuations are unlikely, we wouldn't be reporting data like this.

MEMBER SIEBER: I'm curious about something you said, that when you remove the hot short, the device goes back to its normal position. I keep thinking of torque valves because that's what the majority of valves are. The control circuits for those, if you have a hot short that says open to the valve, if you open. If you take that hot short away, it won't close.

MR. EMERSON: That's true. And I was careful not to include those types of valves in my statement.

MEMBER SIEBER: That's the majority of the valves, though.

MR. EMERSON: True. And that's why I said AOVs and PORVs.

MEMBER SIEBER: Well, AOVs, you know, have seal and surface. An AOV that is designed when you remove the power and it trips, you're basically opening a solenoid valve that is normally energized when it's closed. And then there is a seal in contact for that. And it won't change state when you take the short away on it.

So I'm not exactly sure that I buy into

anything for valves would say it goes back to its normal state. A hot short on a power cable for the pump, on the other hand, if it's not on the control circuit but on the actual power feed probably if you clear that hot short, the pump motor will stop running.

CHAIRMAN ROSEN: The pump motor will do what?

MEMBER SIEBER: Stop running.

CHAIRMAN ROSEN: Stop?

MEMBER SIEBER: Yes. If the spurious actuation was to start, it will stop if you clear that short. But typically the power cables aren't the ones that will fail first. It's the control cables that will because they're smaller. So I guess I have to take that with a grain of salt.

CHAIRMAN ROSEN: That's the point I made earlier. You have to look at the circuit specifics because even pumps that are running, if you lose power to them, they'll stop, obviously. But if you return power to them, they may not start because they will be permissive certainly, not be made up.

MEMBER SIEBER: That's right.

MEMBER WALLIS: I want to ask you about the times.

MEMBER SIEBER: Cold shutdown in 20 minutes.

MEMBER WALLIS: How long do these tests run for? It seems to me you put these cables in a fire, which must have been about 1,500 Fahrenheit or something, and left them there until something happened.

MR. EMERSON: Well, most of the tests lasted at least an hour, some far longer than that. We just basically tested them --

MEMBER WALLIS: They lasted an hour? And the average time to failure was 30 minutes. Well, that's sort of not surprising because if you only waited an hour --

MR. EMERSON: Well, we tested them until there appeared to be diminishing returns either from most of the failures that already occurred and there was very little point --

MEMBER WALLIS: Do you see my problem here with saying the average time to failure is 30 minutes? If the test was run for -- if it never failed, that's an infinite time. That makes the average time very long. But if you stop the test at half an hour, it's not surprising that you couldn't get an average time to failure much more than 30

minutes.

MR. EMERSON: Well, again, we ran the test to the point where we were trying to produce failures, basically. From the tests that we stopped before failures occurred, we were monitoring the voltage conditions in the individual conductors. And it was quite obvious from the trends that we were going to have to burn it for four or five hours to get any failures at the rate it was going.

MEMBER WALLIS: Do you monitor the temperature in the conductor? You might say if they reach 800 without failing, we'll say they survived, something like that. It seems much better criteria. The time itself isn't really a measure of the thermal stress on the cable. It's --

MR. EMERSON: Oh, no. It's the trays.

MEMBER WALLIS: How hot it gets seems to be the main thing.

MR. EMERSON: How hot, yes.

MEMBER WALLIS: What's the temperature?

MR. EMERSON: That's correct.

MEMBER WALLIS: If it reaches that temperature in two minutes, then the rest of the time is unimportant. If it takes 2 hours to reach 700 degrees, then it's likely to survive. Time

isn't a very important parameter in all of this, is it?

MR. EMERSON: Well, time actually is an important parameter because you are trying to see whether you have time to do something about the fire.

MEMBER WALLIS: It depends on how hot the fire is.

MR. EMERSON: Right. And that's why we were trying to use heat release rates that might be considered typical of the fires you would expect in plants. You could certainly postulate much hotter fires, but we were trying to --

MEMBER WALLIS: You see what I am getting at. You say the time to failure was 30 minutes; therefore, it was okay. This could mean that you ran the test for an hour and half of the time you had a hot enough fire to melt the cable at all. It's just a question of the temperature reached during the test.

And you only ran it for an hour. Half of them failed. So the average time to failure was 30 minutes. Right? Is this the right parameter to use to characterize failure?

MR. HENNEKE: Yes. Fred, there were

only a couple of cables that didn't fail once they got above their temperature. There were two tests we did where the cable didn't get above their temperature. And so we had no failures whatsoever. And that data was not used.

But when it got above its fail temperature, there was one armored and only a couple of thermoset cables. So if you looked at those, you probably could take those out a couple of hours and get those to finally fail at some point.

MEMBER WALLIS: So you progressed to the point where you got a failure?

MR. HENNEKE: In almost every cable, yes.

MEMBER WALLIS: Then how is that you had only 14 percent of shorts? You had some sort of a failure. Okay. I see what you mean. Which mode failed? Okay.

MR. HENNEKE: Yes, a short to ground.

MEMBER WALLIS: So you did progress to failure each time. Okay. Sorry.

CHAIRMAN ROSEN: With only three exceptions.

MEMBER WALLIS: Go ahead. Thank you.

MR. EMERSON: Okay. Obviously, you can

get spurious actuations. That was shown. Cable-to-cable spurious actuations are less likely, especially for thermoset cable. We believe --

CHAIRMAN ROSEN: Would you go back to that just one moment? I wanted to draw a conclusion here. Multiple spurious actuation actuations cannot be ruled out.

MR. EMERSON: True.

CHAIRMAN ROSEN: Now, Mark Salley was here earlier and showed us --

MR. EMERSON: He still is.

CHAIRMAN ROSEN: -- a chart where I guess he admitted the possibility of multiple spurious actuations but said that it was very low, that it was low likelihood. There is an X on one of them. It says, you know, "can't happen."

I am just trying to see whether you think this is consistent with Fred's first bullet. And if not, can you explain the difference?

MR. SALLEY: No. I believe they're actually in alignment.

MR. EMERSON: I think so, too.

MR. SALLEY: What we're saying here in this tank exercise is that if we look above that typical seven-conductor cable, what I'm saying in

that example, number one, one seven conductor trips A, B, and C.

If you look at this and you say that 2 and 3, for example, conductors 2 and 3 are control circuit for MOV A, 4 and 5 are the pull-in for the pump B, and 6 and 7 are the two controls for MOV C, that one cable fails, those three pairs make up, you get this scenario.

And that would agree with what you are saying up there, right, Fred?

MR. EMERSON: Yes.

MR. SALLEY: What we are further saying is that for this start-up of associated circuit inspections, we would postulate two cables. But when we start postulating three cables and everything is starting to fail in together, that's where we put that in bin 2 and we have asked JS and research for help as to how many cables we can do.

CHAIRMAN ROSEN: Okay. I'm focusing on the X on this chart.

MR. SALLEY: Right. That one we would say in the probablistic world, to get three cables, to have them line up, we're starting to get a little further away from where we wanted to be.

CHAIRMAN ROSEN: Right. That's further

away from where you want to be. But his first bullet says it cannot be ruled out.

MR. SALLEY: That's right. It cannot be ruled out, which is why it went to bin 2 for further research.

CHAIRMAN ROSEN: Okay.

MR. EMERSON: But you have to start someplace with an inspection focus. So starting with 2 is a likelier phenomena to produce risk-significant results than 3 or 4 or 5 or whatever.

MR. SALLEY: Let me jump in, Fred. You are talking about a single cable up there, too, which is exactly what I had in this example one. So I think they're in alignment.

MR. EMERSON: Yes.

MR. SALLEY: What we are saying in our example here is the number of cables that you consider to fail. And we are saying that we would stop at two cables giving you the --

CHAIRMAN ROSEN: So where do we find ourselves now, as opposed to where we started this discussion way back when? At least some radical fringe elements thought they can't have spurious actuations. What we found here is not only can you

have them. You can have multiple spurious actuations.

MR. EMERSON: They are possible, yes.

CHAIRMAN ROSEN: They are possible at some frequency.

MR. EMERSON: Again, we think there are thresholds below which cable failures don't occur. That was one of the results of the expert panel. We have covered the conclusions regarding time to failure, the effect of current limiting devices.

MEMBER WALLIS: What are those thresholds?

MR. EMERSON: I'm sorry?

MEMBER WALLIS: You say they exist. Do you know what they are?

MR. EMERSON: If you look at the fragility curve that I put up earlier, basically a little below that is the threshold below which the expert panel postulated that you would not get failures.

MEMBER WALLIS: They deduced from the data?

MR. EMERSON: Yes. That was the expert panel's conclusion from the data.

CHAIRMAN ROSEN: Fred, if you could just

get off this slide, you're clear sailing. The water smoothes out. We don't have this document that you are going to --

MR. EMERSON: The EPRI report?

CHAIRMAN ROSEN: No. The NEI 00-01, the current revision.

MR. EMERSON: Okay. You haven't been given that yet?

CHAIRMAN ROSEN: That's the one we're missing? Oh, the implementation guide we don't have.

MR. EMERSON: Okay. You don't have the implementation guide. Okay.

CHAIRMAN ROSEN: This one we have, yes.

MR. EMERSON: Okay. I am going to take just a couple of minutes literally just to go through my points on NEI --

MEMBER WALLIS: Most of these conclusions are not overwhelming. They're what you might have expected except perhaps the magic number of 30 minutes. Most conclusions are what one might have gone into to test the programs of the thinking you find. I mean, it's not surprising that there is a threshold below which they are and so on.

So I think that in order to reach some

conclusion, we would have to study these reports.

MR. EMERSON: I agree.

MEMBER WALLIS: With the questions we're asking, these reports really should be put into good shape, not too wishy-washy.

CHAIRMAN ROSEN: It remains to be seen exactly how these conclusions are going to be used.

MEMBER WALLIS: That's right. That's right.

MR. EMERSON: And that is reflected in NEI 00-01. We tried to make an attempt to sort through the results of the expert panel and the two EPRI reports that pertain to the results of the testing to try to draw some conclusions for how long --

MEMBER WALLIS: They're to be used within some regulation framework?

CHAIRMAN ROSEN: Well, that's what we're here to find out, whether the staff will adopt them by adopting 00-01 in some purpose in the regulatory guide.

MR. EMERSON: So if you will let me --

MEMBER WALLIS: I've not yet seen a logical framework into which all of this fits that makes any sense to me.

MR. EMERSON: Well, the whole reason for undertaking the testing was to try to add to our store of information that would help us determine whether fire-induced circuit failures were risk-significant and if so, under what conditions are they risk-significant and then try to -- since NEI 00-01 was, at least in part, intended to help you determine the risk significance of particular circuit configurations, it will help you demonstrate with more knowledge than you had before whether any particular configuration is risk-significant or not.

Remember, the likelihood of spurious actuations is only one point in the risk equation. There are a number of other factors, as Mark pointed out this morning, that go into that determination of overall risk as well. But this was the point at which we had the least data, and we were trying to come up with --

MEMBER WALLIS: So someone in a far PRA has some place where he has to assign a probability and he goes to this NEI 00-01 and finds that probability?

MR. EMERSON: Yes, or the EPRI expert panel report.

Okay. I am going to move very quickly

through the presentation on NEI 00-01. Its two major functions are to provide guidelines for the use of the deterministic methods. And these methods generally reflect the licensed commonly used practices that are normally employed in safe shutdown analyses in plants today. It's not intended for a licensee to go in and do a wholesale re-baselining of a safe shutdown program unless he wants to.

It has also risk significance methods that can be used to determine the significance of any particular identified failure or combination of failures. And I particularly call your attention to the last sub-bullet there.

These are intended as a double screening process, which I will get to in a minute. We try to balance the risk screening with a safety margins/defense-in-depth analysis, which we discussed in some detail this morning, before you can screen out. In other words, you look at it from a deterministic standpoint, as well as a probablistic standpoint, before you just screen failures out based on risk alone.

MEMBER WALLIS: I think we asked the question this morning about that, and it turned out

that that was rather difficult parts of the work and that we had to get this NEI document to tell whether it worked or not.

MR. EMERSON: From the standpoint of NEI 00-01, we based the safety margins/defense-in-depth analysis guidance on what is in Reg Guide 1.174, which was probably the best guidance we had at the time we wrote it.

MEMBER WALLIS: So it's a PRA?

MR. EMERSON: No, it's not really a PRA.

MEMBER WALLIS: No, it's not. So the DID is also in there.

MR. EMERSON: I am going to outline without discussing in detail because it would take more time than we probably have, just indicate what changes we have made since the last time we presented NEI 00-01 to you.

In the preliminary screening, instead of looking at core damage frequency as the consequence of interest, we changed that based on a staff comment to look at the inability to achieve and maintain safe shutdown. Again, this is a preliminary qualitative screening with quantitative support, which we have looked at in the pilot that we did at McGuire and another plant. The method is

in the tables that I have indicated on the slide in the NEI document.

There is a quantitative risk screening. The determination of core damage frequency is essentially unchanged from the previous document. We have added consideration of LERF using the risk terms that you see on the slide. This is met if one of the three conditions at the bottom of the screen is met.

We have also added some consideration of uncertainty and sensitivity analysis, again based on a staff comment. And we have provided a great deal of additional support for the argument that multiple high impedance faults don't impose a credible risk if you meet certain requirements. And the requirements are listed in the bullets and sub-bullets on this slide. There is about a 30-page appendix in NEI 00-01 which goes into the MHIF phenomenon in a lot more detail than I could possibly do.

This is the last slide. Licensees are at the point where a number of licensees are reconsidering whether to re-baseline their safe shutdown programs.

Because industry and the NRC have been

discussing, if not outright arguing, over what types of circuit failures need to be considered in the plant licensing basis for the last six to seven years, we are looking forward to a stable set of regulatory expectations on both deterministic analysis and how you measure the risk significance of these terms so that both the licensees and the inspectors can move forward on the same page, especially since we are resuming inspections of associated circuits in the relatively near future.

We sent a letter to the staff fairly recently which made the recommendations that you see there. Those recommendations are that the NRC focus the circuit failure inspections on compliance with the plant licensing basis while recognizing that there may be configurations that are within the licensing basis but still present a safety concern, which is something that the ROP allows for determining and providing as a finding to the licensee that they accept the deterministic methods if the licensing basis is not clear. And we had a long discussion this morning about whether it is or not; and, lastly, that the probablistic methods be accepted along with other risk techniques, like the SDP or a plant-specific PRA analysis, for

determining the risk significance.

That concludes my presentation.

CHAIRMAN ROSEN: Okay, Fred. Thank you very much. I appreciate your patience.

MR. EMERSON: And yours with me.

CHAIRMAN ROSEN: And we'll now turn to Mark Salley and Naeem Iqbal for a discussion of fire dynamics spreadsheets.

MR. HANNON: Excuse me. While we are making the transition here -- this is John Hannon. Just I wanted to point out that the last comments that Fred made about the recommendations, they did send us a letter, a couple of letters, on that subject that we have recently responded to. Sunil, did you want to say any more?

MR. WEERAKKODY: Yes. We received the report in May. And I don't know whether you have received the letter, but I will go back and check. John and I did send you a response giving some observation at a high level on NEI 00-01 and how we do and do not plan to use it integrally for the framework.

MR. EMERSON: Thank you. I'll look forward to looking at it.

MR. WEERAKKODY: All right.

VI. FIRE DYNAMICS SPREADSHEETS

MEMBER POWERS: You wanted equations. By God, they deliver it for you.

MEMBER WALLIS: Are we supposed to talk about this equation? I want to know how you got 6.85.

CHAIRMAN ROSEN: Are you sure it's 6.85, not 6.8?

MEMBER POWERS: Absolutely. If it were 6.8 --

MEMBER WALLIS: Are we supposed to discuss this equation?

MR. SALLEY: Yes.

MEMBER WALLIS: It's very peculiar dimensions.

MR. SALLEY: It's a fundamental equation that we use a lot.

MEMBER WALLIS: Well, Q/Ah has the dimensions of ΔT except that HB looks like a surrogate for a different H. So the power of one-third seems to be all wrong when you have got temperature to the two-thirds.

MR. IQBAL: This is experimental correlations from a fire test.

MEMBER POWERS: But experimental

correlations had better be unit-wise correct.

MEMBER WALLIS: One would hope so. In other words, that 6.85 is a very peculiar unit.

MR. IQBAL: It is a correlation coefficient.

MEMBER WALLIS: Temperature to the one-third or something like that? I mean, it's a strange --

MR. SALLEY: That's exactly correct.

MR. IQBAL: This is fire science.

MR. SALLEY: That's exactly correct. And I wanted to start out with this before we start. You all should have received --

CHAIRMAN ROSEN: Yes, with a paper, with a disk and all.

MR. SALLEY: Yes. See, the idea is if you are having trouble sleeping at night, you just put this in the CD player. It's like Brahms' lullaby. And you get about three pages of this, and you're out.

MEMBER WALLIS: Brahms' lullaby is for kids.

MR. SALLEY: The reading will put you under.

MEMBER POWERS: Hence, appropriate for

the ACRS.

MR. SALLEY: This is a fun topic that Naeem and I have worked on. This is much lighter, I guess, right now than the associated circuits. It's something we have worked on for three or four years now.

The reason I throw that equation up to start this out is that a few years ago, we saw things were changing. When you transition, begin transitioning, into this risk-informed performance-based environment, the inspector's job changes.

And we went out. And we did some training of our inspectors in the regions and basically talked to them and said, "Well, what do you know about fire?"

The first thing you see is that most of your inspectors are not fire protection engineers who are doing this. They are typically electricals, mechanicals, civils. But there is some discipline in engineering other than fire protection.

So the challenge became that as we make the transition to the risk-informed performance base, we have got to understand some fire dynamics. How do we begin to work with our inspectors in

teaching them fire dynamics?

Well, the first challenge you come up against is something like this equation. Now, for a junior-level student over at the University of Maryland, this is what he is studying over there right now. This is an MQH, we call this. It's am empirical one that came out of the National Bureau of Standards. They ran, what, 105 fire tests, I believe, Naeem?

MR. IQBAL: A hundred and fifty fire tests.

MR. SALLEY: A hundred and fifty fire tests. And they backed out this correlation. What this correlation simply tells you is the temperature change of a hot gas layer in a room, the average temperature of that hot gas layer.

Now, if you look at the equation -- and, like I said, this is kind of junior-level fire dynamics -- teaching this to someone, we saw three distinct challenges. I'm trying to lay our problem out for you here before we start. We saw three challenges.

The first thing is it's messy math. What I say is when is the last time that an inspector took his calculator out and took something

to the one-third power. That's not something they do every day.

MEMBER WALLIS: Gee, whiz, the kids do this in junior high school.

MR. SALLEY: Yes, they do, but inspectors don't do it every day. So what I'm saying is the math. there is a little bit of math manipulation. And that leads to potential problems. We can simplify that.

MEMBER WALLIS: You've got to fire all of those guys and get people who understand it.

MR. SALLEY: Okay.

MEMBER WALLIS: This is so trivial, especially with a calculator.

MR. SALLEY: Please go along with me.

MEMBER WALLIS: You don't need to understand math. You can punch these things into a calculator.

MR. SALLEY: And there's still always the potential for error.

MEMBER WALLIS: Okay.

MR. SALLEY: Correct? If I do it, -- different calculators will round differently -- I can still get some error.

The second thing is there are material

properties in here. K(rho)c is something we talked a lot about in fire protection engineering. If you ask an inspector, "What's the thermal conductivity of concrete?" I don't think that is something that he is geared to do every day.

He doesn't carry a reference with him. He says, "Oh, yeah, thermal conductivity of concrete. What units would you like that in?"

So what I am saying is that that is going to take in some time to have to go and find that. Okay. We don't like concrete. It's gypsum. Well, I've got to go find another book. So that was our second challenge.

The third challenge is the real challenge that you're getting to. And that is, let's teach some fire dynamics. Let's focus on that.

MEMBER WALLIS: I think a problem, too, is that T is in seconds.

MR. SALLEY: My T is in seconds.

MEMBER WALLIS: It doesn't say that, but I think it must be.

MR. SALLEY: Right.

MEMBER WALLIS: That's a big number.

MR. SALLEY: Okay. So what I just

wanted to illustrate was that when we approached this problem four years ago, we saw there were three challenges that we were trying to work up.

MEMBER WALLIS: Your message is whether or not this equation is right, it's a big, scary thing for the average inspector?

MR. SALLEY: You got it.

CHAIRMAN ROSEN: So give them a curve.

MR. SALLEY: No, we can't give them a curve. Let's give them a tool that works real nice, though. That's our goal. Curves, we're not going to make it income taxes, where you look and see what you made, see what you --

MEMBER WALLIS: So it's a thing where they can put numbers in and the computer does the math?

MR. SALLEY: Exactly. And the computer has those physical constants for you.

CHAIRMAN ROSEN: So he doesn't have to go to the wrong book --

MR. SALLEY: Exactly.

CHAIRMAN ROSEN: -- and get the wrong number to plug in?

MR. SALLEY: Or he gets, you know, 9.82 for gravity and I get 9.81 and then we fight about

.01 for a day.

MEMBER WALLIS: This can't be totally correct because if there is no area for ventilation, you still take some time to heat up the room. There is no infinite heat and no time. So something is really strange about the equation, but I don't think we have time to go into that.

MR. SALLEY: We'll come back to this for you.

MEMBER WALLIS: Okay.

MR. SALLEY: So having set the stage, that was --

CHAIRMAN ROSEN: You realize you are just throwing meat to the lions.

MR. SALLEY: That's okay.

MEMBER WALLIS: This isn't meat, man. This is a little snack.

CHAIRMAN ROSEN: Snack? Okay.

MR. SALLEY: This is our challenge we were presented with. And I want to tell you how we worked around it a little bit and am going to give you a go at it here.

We would like your comments. I mean, we sent you copies of this. And we would really like to have some input from you on how we go forward

with it.

Okay. Kicking off the presentation, once again, the FDT^s -- we had to come up with a good acronym because if you ain't got a good acronym, you don't have a program. I learned that a long time ago. So we're FDT^s.

MEMBER POWERS: You need a little logo with that.

MR. SALLEY: We'll work on that. The goal of this was using risk insights and the regulation in the reactor oversight process. As we said before, it is a transition period for the inspectors.

If you ask them to go on and look at a three-hour firewall, they can do that. They can get the UL directory out. They can say, "Yes, it's 12 inches of concrete. Yes, it was the right grade of concrete. Yes, they poured it the right way. Everything is good. The right aggregate was there. The fire dampers are three-hour-rated. The door is three-hour-rated." And they can inspect that. And they have done that since the beginning of time.

When we start looking at things in a risk-informed performance base, it's not going to be that simple. They're going to have to be able to

address the fire threat. So this was our step of supporting that transition to the risk-informed performance-based type requirements.

MEMBER POWERS: You hit the objective right on the head.

MR. SALLEY: The second part is with the fire hazard analysis, it's up to this point we used primarily a qualitative approach where we want to give more to a quantitative approach.

Doug always seems to be here whenever I do these presentations. So I've picked on you since day one, Doug. I'll continue this now. We find the fine --

MEMBER POWERS: That's kind of a tradition in the fire business to pick on Doug, isn't it?

MR. BRANDES: It certainly seems like it.

MR. SALLEY: But it will illustrate the point I want to get at. If I'm inspecting a Duke plant and I find a potential violation and the question becomes safety significance, they're going to say --

MEMBER POWERS: You know, there isn't one, --

MR. SALLEY: Oh, yes.

MEMBER POWERS: -- a Duke plant.

MR. SALLEY: But we have a potential fire in there, and that fire could potentially damage a cable. So the question and the safety significance will be okay, "Mark, can they have a fire in this room? Can it damage the cable?"

We have answered this question for years. I said, "Well, yes. There was a pile of transients in the corner. That could start a fire. It could start the cable trays. Of course, it could damage it. So we could have a big fire in that area."

Doug would look at it from the licensee's side and say, "Wait a minute. Transients are controlled. It's not that much. It's only going to be a little fire. The cable won't be damaged."

So Doug and I will basically sit there and fight out the meaning of big and little. And we have done that for a long time. This is our first attempt to try to put some numbers with it.

Will it produce a hot gas layer of 700 degrees or 200 degrees? Let's define big and little with some numbers. That is what we are trying.

This is a first step at that.

Next slide. The current applications for today are, of course, with the SDP. You know, part of the SDP, it tells the inspector to postulate a fire. He can do it qualitatively. He can do it quantitatively. We're giving him some tools to start doing a quantitative approach. This will help with the example that I just said, the significance of noncompliance.

And another thing is with the licensee, this tool is available to the public. If they want to do an exemption-type request and they want to see how the NRC is going to answer the big/little question, they will have this tool available for them.

MEMBER POWERS: Well, your transient combustible example was just a perfect one. Doing the quantitative analysis is really nifty because were there a bunch of transient combustibles or just a little bit of transient combustibles?

MR. SALLEY: Right.

MEMBER POWERS: It makes all the difference in the world to whether it is significant or not.

MR. SALLEY: Sure. You can do some of

the models with "What does the plant's program allow? Do they allow 100 pines uncontrolled or do they allow 10?" And by things like that, we can postulate --

CHAIRMAN ROSEN: Or you can use the existing circumstances. Define circumstances in the field. If an inspector went in and found a wooden table that was in a place that's inappropriate, he could say, "That's the source, that wooden table, the very one that I found there. We weighed it. It weighs 11.4 pounds. It's pine wood."

MR. SALLEY: We can do that.

CHAIRMAN ROSEN: And then you can --

MR. SALLEY: If you give us that --

MEMBER WALLIS: The fire standard is red oak per square foot, pounds of red oak per square foot.

CHAIRMAN ROSEN: I'm just making a point that you can use what you find.

MR. SALLEY: Of course, that was treated wood, though, because a plant is only allowed treated wood.

CHAIRMAN ROSEN: In my hypothetical, it was not. That's in Plant X.

MR. SALLEY: Okay. Moving along here,

our key here, like I said, is when we polled the regions four years ago now, that we had to do some work in the fire dynamics area. We had to make some steps forward. This is what we used to start teaching the fundamentals of fire dynamics.

A. STATUS OF NUREG-1805

MR. SALLEY: Eighteen-o-five. Again, that's the NUREG. The CD contains the spreadsheets that are locked. How to use them and all the backup material as to where we got this is all contained in the NUREG.

Next slide. The evolution is what I am trying to convey on this next slide. In the past -- go back to the '60s, when they were first laying these plants out in a design basis of fire areas.

The way the fire areas were classically laid out was if someone did an estimate on the number of combustibles. The total combustible loading that would be in that room primarily was cable.

And he said, "Okay. If I take that and lay that against an ASTM E119 curve, I can back out." You want to talk about some strange units. That will give you some strange units.

Nevertheless, I can back out an area

under the curve. And that area under the curve will tell me what my firewall bounding needs to be to call this a fire area.

And that's how that was done. And that was an up-front design. It was a pretty conservative approach. However, over time, people started taking that up to the fourth place in decimal accuracy. And you started to have people report 37.22-minute fires.

How did you ever derive that? This is hand grenades. This is not that precise micrometer stuff. Well, they were just backing an area under the curve because you can manipulate mathematics real nice to solve areas under a curve.

Presently, we want to go to this fire dynamics tool that Naeem and I have to act as a start-up. And what we are looking for in the future in the 805 world that Paul Lane described this morning is that firewalls are going to become commonplace.

So we are in that intermediate step where we teach the fire dynamics, the hand equations, if you will, and understand the principles of it so that when someone does use a model down the road, they will have an appreciation

for the terms like "heat release rate" and "ventilation area size" and "material properties," the "loading of the firewall."

MEMBER POWERS: You can have more than that. You know when you have got to go to a more sophisticated tool. If you go through the hand calculation and it tells you there is clearly a big problem here, I don't need a more sophisticated tool to tell me I've got a big problem.

If it comes out it's a "No. Never mind," I don't need a more sophisticated --

MR. SALLEY: Exactly.

MEMBER POWERS: It's when you get something that is just real close to the boundary and your licensee says, "I still want to do it" and you know your hand calculation isn't so good, then you know you've got to call in the pros at that point.

MR. SALLEY: Exactly. We consider this -- for conversation, we call these first-order determinations, first-order approximations.

MEMBER POWERS: That is a great thing because then the guy knows when he needs help and when he can do it by himself just from order of magnitude kind of things.

MR. SALLEY: Right. In the past, it was big or little and who shouted louder, me or Doug. So we'll put a little bit to that.

To give you some origins on this, I would like to take credit for inventing this, but this was not invented here. Some colleagues of Naeem's and mine worked over for the ATF. And they had a similar problem a couple years before us.

And their problem was when they would investigate a case, an arson scene -- they're responsible for the arson across the country. And when they would investigate an arson case, someone would give an eyewitness account.

They would say, "Dana. Okay. So you bought this million dollars in this barrel. How high were the flames?"

"And, oh, man, they were higher than the house."

"Really?"

"Yes."

"And where is all the residual left over?" "Well, it all burned up."

Well, they needed to put tools together to do the exact reversal we do. Okay? They needed to say, "How high would a flame height be for

ordinary combustibles in a 55-gallon drum?" They should be between this range. And they could do a quick calculation to see if the witness or the person was basically telling the truth that matched the physics of it.

So we knew they had this tool. And they were using it. And they were somewhat successful with it was the starting point for Naeem and I to go with our inspectors. Like I said, we worked the problem in reverse. What is the credible threat that they were trying to verify?

The other thing was that the combustibles in the environment we're in, in the power plant, you know, cables are everything. Cables tend to be the big fire hazards. We do have some lube oils. The structure, thick concrete is the norm. So we needed the tools and the equations.

You'll notice the one I threw up this morning. It had two cases: thermally thin and thermally thick. We needed to address that enclosure parameter. They were in pretty much a thermally thick environment. So we needed to do some research and give the best numbers available to give the most accurate input.

Next slide. So what we settled on was

that we could take a user-friendly program, like Microsoft Excel, and that we would put the fire dynamics equations in and it would be all preprogrammed. We would lock the program. We would control what variables you changed. And you could do a simple first-order calculation.

As far as the equations, it's a good point. The accuracy MQH that I laid up here this morning we take no credit for. Is it very good or is it very bad? Is the accuracy of it?

What we're taking is what we'll call state-of-the-art fire protection engineering, things straight out of the fire protection engineering handbook, with the main line fire protection engineers are using across the world. And that's what we used here. We did not invent any questions.

CHAIRMAN ROSEN: And those main line fire protection engineers believe 6.85 is a pretty significant figure.

MR. SALLEY: That's what they're using out there. That's state-of-the-art. And, of course, there is a danger with state-of-the-art. State-of-the-art changes. Your state-of-the-art changes. Then we'll change with it accordingly.

The unit conversions are there. Fire

dynamics tends to work in metric units. We talk a lot, mostly in metric, but the field engineers are comfortable measuring things in feet and inches. So, again and just to play the part of unit conversions, I have seen some serious programs.

Wasn't Hubble Spacecraft the telescope? They had a problem with the conversion?

CHAIRMAN ROSEN: Yes. It got 60 miles too close to the surface.

MR. SALLEY: Exactly. Over a conversion?

MEMBER POWERS: Lockheed slammed a satellite into Mars because it made the meter conversion incorrectly.

MR. SALLEY: Right. We want to prevent our inspectors from making kilowatt to Btu improper conversions. So we captured that. So these were the things we were forward looking trying to cover that we would prevent that. I want to go through these quickly because I want to give Naeem some time to run through this.

Let's go to the next slide. In the training, the textbook part of this is that we have covered a lot of the assumptions, limitations, and bonding analysis.

We have tried to give the user some insights. For example, if you're calculating sprinkler heads and you get a nice program called DTAC free of charge from the National Bureau of Standards off the street and you say, "Hey, look, I can load this in. I can run it. I can tell you when the sprinkler heads go off."

Well, that's true if the sprinkler heads are all on the ceiling. If they're hung three feet down from the ceiling, that's no longer valid.

So we tried to put a lot of the correlations and cautions in there as to how to use these tools properly in the environment that we have them in.

B. INSPECTOR TRAINING

MR. SALLEY: Again, we used to have a quarterly program where we went to the regions and we worked with the inspectors. So we have been training them roughly for three years. So they do have a feel for this.

A lot of their comments were incorporated. When things were too hard -- you mentioned putting in numbers. When they would key in a number, 13.3, somebody put the point in the wrong place and put in 132. Then we sat there for

five minutes figuring out what they did wrong.

They asked for a lot of pull-down numbers. So we incorporated the things. And then we tried to make it as user-friendly as we possibly could.

CHAIRMAN ROSEN: Pull-down numbers?

MR. SALLEY: Oh, yes. Well, pull-down parameters. Okay? And Naeem will demonstrate that for you.

Next slide. Let me go through the conclusion here. And I really want to focus on the example problem and go that way. What we've taken here is a commercially available material program, like Microsoft Excel. And we have programmed it in to applications for the inspectors to do fire dynamics out on their inspections.

It will reduce the mathematical complexities, errors, and promotes greater applications of fire science and engineering in field use. Our user, our customer here, is the inspector out in the field. We're hoping that this makes a positive impact in moving us forward in the SDP, in the risk-informed performance-based arena.

Like I said, I've covered that fairly quick. I'd like to turn it over to Naeem here. I

think the best way of doing this is to see an example as to how this works. It will give you the best feel.

So, Naeem, if you want to take it?

C. DEMONSTRATION OF TOOL

MR. IQBAL: We are just postulating a fire from an oil leakage from a compressor and the compressor has 12^2 oil retention dike. The dike is located one foot from the wall. The unprotected safety-related cable trays are located eight feet above the floor and four feet horizontally from the edge of the dike. A safety-related electrical cabinet is located five feet horizontally from the edge of the dike.

These are the inputs that we need to perform fire hazard analysis. And the dimension of the corridor is 30 feet by 15 feet and 10 feet high and has 2 fire-rated doors, 3 times 7 feet in dimension.

The corridor has no forced ventilation. The wall setting and floor are constructed of one-foot-thick concrete. The corridor has a smoke detection system and a wet pipe sprinkler system.

The nearest sprinkler is rated at 165 degrees F and an RTI of 235 $meter/second^{1/2}$ and

located 6.5 feet from the center of the dike. The nearest smoke detector is 20.5 feet from the center of the dike.

So we will show if there is any credible fire in that area.

MEMBER WALLIS: Now, there's nothing here about ventilation?

MR. IQBAL: We have two fire doors.

MEMBER WALLIS: But they are closed.

MR. IQBAL: We can presume closed/open. We will show that.

MEMBER WALLIS: But if that is closed, there is no ventilation?

MR. IQBAL: But you have some leakages, right?

MEMBER WALLIS: Well, when the area of ventilation goes to zero, my ΔT goes to infinity.

MR. SALLEY: Yes.

MR. IQBAL: You have some leakages from that, from the door.

MR. SALLEY: When we look at it in fire protection engineering, we tend to look at it in two microscopic cases. The first case -- and this is the one we're solving here -- is a natural ventilation case.

For this example, we will probably work with one door open or if you wanted to, no compartment is hermetically sealed. We would take the gaps. There are always going to be gaps between the doors, dampers. You're going to have some in-leakage.

The second style of problem -- and, once again, I'm talking in the macroscopic arena -- is when the HVAC runs. And the HVAC continues to run through the fire. We use a different set of equations for that.

MEMBER WALLIS: This is the plant view, right?

MR. IQBAL: Yes, this is the plant view.

MR. SALLEY: Right.

MR. IQBAL: This oil here, we have 12 feet for a dike. We have a cabinet. We have a cable tray. And we have one sprinkler system, the 6.5, 6.4.

CHAIRMAN ROSEN: That's the detector right there?

MR. IQBAL: Yes.

CHAIRMAN ROSEN: That's the sprinkler. Where's the detector?

MR. IQBAL: The detector is 20 feet.

CHAIRMAN ROSEN: And that's what the RTI is.

MR. IQBAL: RTI for the sprinkler.

CHAIRMAN ROSEN: What does that RTI stand for?

MR. IQBAL: It is response time index. It is a property of the sprinkler.

MEMBER WALLIS: So we assume that the dike is full of oil?

MR. IQBAL: Yes and ignition from a failed compressor. And you have a full fire.

CHAIRMAN ROSEN: What do you assume from the compressor? Additional?

MR. IQBAL: Ignition occurring from a failed compressor.

CHAIRMAN ROSEN: A failed compressor?

MR. IQBAL: Yes.

CHAIRMAN ROSEN: Oh, the oil in the compressor?

MR. IQBAL: Yes.

CHAIRMAN ROSEN: The compressor fails as a result of the fire?

MR. IQBAL: Right.

CHAIRMAN ROSEN: And the oil comes out of it?

MR. IQBAL: Yes.

CHAIRMAN ROSEN: Okay.

MR. IQBAL: And you can see that these are the cable trays. And this is the cabinet, and this is the sprinkler.

MEMBER WALLIS: So there's no wind blowing along the --

MR. IQBAL: You assume there is no wind, no. But if you zoom in --

CHAIRMAN ROSEN: It's an interior compartment, right?

MR. IQBAL: Yes.

CHAIRMAN ROSEN: There's no compression --

MR. IQBAL: But sometimes if you have a sprinkler system on, you can have a tilted flame now. Your flame is built like that.

MR. SALLEY: Do you get the basic idea of what the scenario looks like? Now, we are going to take those numbers, that scenario that Naeem just described, and we'll take our spreadsheets. And instead of saying "big" and "little," "hot" and "cold," we are going to try to put some numbers with it following the simple algorithms

CHAIRMAN ROSEN: Now, is the inspector

going to be able to give you all of this data?

MR. IQBAL: Yes. These are the input data.

CHAIRMAN ROSEN: Most of this is stuff he can do with a ruler.

MR. SALLEY: Yes. I think that everything --

MR. IQBAL: This data is required for the calculation.

So we'll use two types of spreadsheets. We'll show the localized damage. And we'll show the hot gas temperature in the compartment. So first I will just use the spreadsheet to show the localized damage.

MR. SALLEY: This is what you will find on your CD, these spreadsheets.

MR. IQBAL: Every time when we saw this menu, me have to click on macros to activate the programs. This problem, they're just using the lube oil. This is a drop-down menu. You can select the lube oil.

CHAIRMAN ROSEN: So tell us what you are doing as you do it. First you're selecting your fuel type.

MR. IQBAL: Yes, fuel type. See, the

properties are shown in these yellow input cells. Then we will enter the dike area, 12 $feet^2$, and the distance between fire and target. First, we are analyzing the cable cabinet. The cabinet is five feet from the edge of the whole fire.

MEMBER WALLIS: What's the first there about the burning way the fuel was --

MR. IQBAL: Yes. It's a property of the lube oil you take from the table.

MR. SALLEY: I think you missed that. Go back to your select fuel type. And if you click on that, drag down a menu.

MR. IQBAL: Yes.

MR. SALLEY: For illustration, I think --

MR. IQBAL: Crude oil.

MEMBER WALLIS: So it automatically puts that number in?

MR. IQBAL: Yes.

MR. SALLEY: Watch the upper block there.

CHAIRMAN ROSEN: It's just a little hard to read from way back here.

MR. EMERSON: That's the burn rate at which the surface burns.

CHAIRMAN ROSEN: What does that line say, something burning rate of fixed --

MR. EMERSON: That's the burning rate of the fuel.

MEMBER WALLIS: That's meters per second or something. It really burns down the --

MR. IQBAL: Meters per second, kilogram per meter^2 second.

MEMBER WALLIS: Yes. So it burns down. The 20 gallons, does that come in somewhere here, too, the amount of fuel or no?

MR. IQBAL: Yes. That 20 gallon affects the fire duration, not here.

MEMBER WALLIS: Right. It doesn't affect this.

MR. IQBAL: It doesn't affect your HRR, heat release rate.

CHAIRMAN ROSEN: We're here calculating heat release rate.

MR. IQBAL: No. We are calculating the heat flux to the cabinet, what is the hazard to the cabinet from this fire?

MEMBER WALLIS: Are they going to put in all of the geometry of these --

MR. IQBAL: So we'll again select the

lube oil. You have to enter this dike area. This is between the fire and the target. This area between the fire and the target is this area, five feet.

MR. SALLEY: So those are all the critical parameters that the inspector could easily determine.

CHAIRMAN ROSEN: Wait a minute.

MR. SALLEY: Those are the dike area. All you're worried about is the surface, two-dimensional fire with a combustible liquid; the material properties of the fuel. And the third thing is the distance.

CHAIRMAN ROSEN: What's the stuff in the gray there? That's a conversion to meters?

MR. IQBAL: This is meters to -- because all of the equations there are -- we need meters.

CHAIRMAN ROSEN: But the inspector puts it in feet?

MR. IQBAL: In English numbers, yes. If you see this, this is like very complicated math. These are all steps.

MEMBER WALLIS: It must do something about the geometry of the dike. It says 12 square meters. It could be 100 meters by 12 millimeters.

MR. IQBAL: Yes. Yes, it could be. Yes.

MEMBER WALLIS: Something absurd.

MR. IQBAL: We are just showing an example, you know, how to do the calculations.

MEMBER WALLIS: It makes a difference, the shape of the dike, doesn't it, not just the area?

MEMBER SIEBER: Well, when the sprinkler goes off, the dike will flood. And then the whole floor --

MEMBER WALLIS: Makes it worse.

CHAIRMAN ROSEN: Go on, Naeem.

MR. IQBAL: Yes. You can see this equation that we are solving here. We are showing every step.

CHAIRMAN ROSEN: I can't see a thing you've got. It's not in our package. So we're trying to see it on the screen. And it's faint.

MR. SALLEY: Right.

MR. IQBAL: If you see the guide I just passed, those equations are there.

MR. SALLEY: Exactly. The radiation will get us on the B factor algebra to a point. Now, that's something that takes a little time to

solve out. We can run through quite quick here knowing that --

MEMBER WALLIS: That's okay. Just so you get an answer.

MEMBER SIEBER: You can actually use this to figure out when the sprinkler will go off.

MR. IQBAL: We'll show you that sprinkler activation, too, especially.

MEMBER SIEBER: That's an important factor here. The question is, does it go off before you run out of fuel or not?

MR. SALLEY: Or damage is incurred, yes.

MEMBER SIEBER: Right.

CHAIRMAN ROSEN: Have you animated this yet?

MR. SALLEY: No. This is as animated as we are going to get.

CHAIRMAN ROSEN: Well, you are always animated, but I am talking about whether --

MEMBER SIEBER: You can actually print that, right?

CHAIRMAN ROSEN: -- you could have a little cartoon.

MR. IQBAL: Yes, you can print it. You can print it.

MEMBER SIEBER: That would be a good idea if you would and give us a copy so we could study it.

MEMBER WALLIS: Two megawatts. That's a pretty big fire.

MR. IQBAL: Yes, a big fire because the area of the dike is only 12 $feet^2$.

MEMBER SIEBER: And there are 20 gallons in it. So it's pretty thick.

MEMBER WALLIS: A pretty tall fire, too. Is the room tall enough to do that?

MR. IQBAL: Yes.

MEMBER WALLIS: The height of the fire is 3.69 meters in a 3-meter room?

MR. IQBAL: Yes.

MEMBER WALLIS: It spreads along the ceiling, then?

MR. IQBAL: Yes. That means your flame height is touching the ceiling.

MR. SALLEY: What you're doing is the exact key of these spreadsheets. We're not putting in a number, cranking it through a black box. And, all of a sudden, you get two meters out the other side. We're getting --

MR. IQBAL: I was just wondering.

MR. SALLEY: You see the equation work, and then you have to think.

MEMBER WALLIS: What does it do when it says the height is taller than the height of the room? What does it do then? Does it recalculate the spread along the ceiling or something? I don't quite understand.

MEMBER SIEBER: You get a plume.

MR. IQBAL: This calculation is showing you the localized damage to the cabinet. The height --

MEMBER WALLIS: It looks as if the height of the flame is taller than the height of the room.

MR. IQBAL: Yes.

MEMBER WALLIS: So what does the calculation do then? Does it ignore it and assume that it goes through the roof?

MR. IQBAL: No, no. Calculation assumes this flame height in making this heat plus calculation equation.

MEMBER WALLIS: Does it go back and recalculate the flame?

MR. IQBAL: Yes. These are all interconnected in those equations, the flame height,

the heat --

CHAIRMAN ROSEN: But the point is that if the room is 10 meters high, assume it is 10 feet high, and the flame is 10.5 feet high, half a foot of flame is going to be, in other words, a quarter of a foot closer to the target assuming it's distributed equally. It's actually going to get closer to the target. The flame is going to deflect off the ceiling head of the target, at least I part.

MR. IQBAL: This is a 30-foot long corridor.

CHAIRMAN ROSEN: And the question is, does the calculation take into account the fact that half a foot of flame is going to head toward the target? That was Dr. Wallis' question.

MR. SALLEY: Remember, we're in first-order approximations.

MEMBER WALLIS: But you've got a flame height bigger than the height of the ceiling.

MR. SALLEY: Which means you have floor-to-ceiling flame height.

MEMBER WALLIS: And then it just stops it? So there's a column going to the ceiling? It doesn't spread along the ceiling?

MR. SALLEY: Right. And it sees that as

the incident flocks on the target. First-order approximation, that's our level of accuracy.

MEMBER WALLIS: That's okay. It's pretty hot at the cabinet, pretty hot anyway.

MR. IQBAL: Then we have a 8.85 kilowatt per meter^2 heat flux to that cabinet.

MEMBER WALLIS: Which is about --

MR. IQBAL: This is about like 400 degrees C, 300 degrees --

MEMBER WALLIS: This is about 8 times the sun at 40,000 feet or something. It doesn't sound all that scary on that basis.

MR. SALLEY: Take it into the next one, Naeem.

MR. IQBAL: Okay.

MEMBER SIEBER: Yes. Well, that gives you a curve, those temperature versus time.

MR. IQBAL: Okay. The next one --

MEMBER WALLIS: It's useful. It gives an idea of how important it might be.

MR. IQBAL: -- is a cable tray. We have a cable tray now. Cable tray is eight feet high from the floor and four feet from the edge of the pull. So, again, first we select the lube oil.

MEMBER WALLIS: But they're almost done.

MR. IQBAL: Burning rate and heat of combustion. And dike area, 12 feet^2; and length, 4 feet away from the pull; and 8 feet high. That's it.

MEMBER WALLIS: It's still a radiation calculation.

MR. IQBAL: Yes, to that cable tray, that eight feet high from the floor.

MR. SALLEY: So you see how quickly we can just change the parameters to get another answer without having to go through all the iteration process.

Another valuable thing with this tool for the field applications, let's say we didn't have a dike there. Then we get into a fun game of how big is the spill.

Well, if it starts out before ignition, it's three-foot in diameter. It goes to four-foot, five-foot, six-foot. Is there any point where that surface area gives you enough heat release to give you damage to the target?

You can quickly iterate and change into a fuel spill big enough without a confined area.

CHAIRMAN ROSEN: And also the inspector can e-mail this thing to you --

MR. SALLEY: They do. They do that.

CHAIRMAN ROSEN: -- and let you have a look at it and see whether you believe that you made a mistake.

MEMBER SIEBER: But it won't calculate how fast it is spreading, right?

MR. SALLEY: No. We assume once the surface starts on the pull fire, it's pretty much instantaneous.

CHAIRMAN ROSEN: And that's pretty much true.

MEMBER SIEBER: Well, it depends on the viscosity of the fluid. If you take a heavy number 6 oil, for example, it doesn't spread real fast compared to number 2.

MEMBER POWERS: Compared to the point where he is interested.

MEMBER SIEBER: Yes, I guess.

MR. SALLEY: For first-order, it's pretty quick. You can make them hard areas as easy as you want. I know some of the work that EPRI has dome with some of the training -- as a matter of fact, they were just down at Duke.

As you think about it, that compressor is there. Depending upon where that leak is, are

you really going to get a two-dimensional pull? Well, no. Let's make this a three-dimensional, where it spills down the side of the compressor and then to the pull. And then that changes our service area. And it gets real complex real quick.

The question is, at the end of the day, when you look at the number, how much did it change your accuracy? Very little. So for the first-order is where we want to keep this.

Keep going?

MR. IQBAL: This one is for hot gas temperature in the compartment. So we need some input. The width of the compartment is 15 feet. The length is 30 feet. And the height is ten feet. And we have a --

MEMBER WALLIS: Now, he has to put "feet" in there. Otherwise, he's in real trouble.

CHAIRMAN ROSEN: If he tries to do the conversion first --

MEMBER WALLIS: No, no. He must put it into feet. Is that right?

MR. IQBAL: Yes, it's feet.

MEMBER WALLIS: He must put it in feet.

MR. SALLEY: We are going to make a metric version of this, too. And they will just do

the conversions in reverse.

MEMBER WALLIS: You could put it in in the right maybe or something. I don't know how you're going to do it. Put in one or the other.

MR. IQBAL: So we have too doors. We will presume one door is open at three feet wide by seven feet tall. And the top of the vent from the floor is seven feet, the height of the door. And the thickness of the corridor and the boundaries is 12 inches, one feet.

MEMBER WALLIS: So the top of the vent from the floor --

MR. IQBAL: Is the height of that.

MEMBER WALLIS: The height of the top of wherever the hole is?

MR. IQBAL: Right. We will select the corridors into your boundaries. The corridors into your boundaries will have concrete. We will go and select them.

MEMBER WALLIS: But how does he know it's a thermally thick?

MR. IQBAL: Because it's 12 feet thick, just like 12 feet --

MEMBER WALLIS: But he determines if it's --

MR. IQBAL: There is another, especially for thermally thin. If you have one-inch tape, you can use others especially.

CHAIRMAN ROSEN: He doesn't have to do that. He puts in the thickness. And the computer knows what to use.

MR. SALLEY: No. He has to read NUREG-1805 because it tells him, "If you have a single sheet of gypsum, that's a thermally thin case. Use the thermally thin spreadsheet. If you got a foot of concrete, that's thermally thick. Use the thermally thick spreadsheet."

MEMBER WALLIS: It would be good, I think, if this thing figured it out, whether it was thick or thin, which is quite easy to have a criterion put into the program here, where he doesn't have to look it up.

MR. SALLEY: Right.

MR. IQBAL: Then we have to input the fire size. You know, that fire was 2-megawatt, 2,000 kilowatts. That's it.

CHAIRMAN ROSEN: Now, wait a second. What did you just do? I couldn't read the units. It looks like 2,000 megawatts.

MR. IQBAL: No, no. It's kilowatt.

CHAIRMAN ROSEN: Is that a kw?

MR. IQBAL: Kw, right.

CHAIRMAN ROSEN: Okay. It's a k.

MEMBER SIEBER: You're worse off than I am.

MR. IQBAL: It's kw. Hot gas temperature --

CHAIRMAN ROSEN: It's the wrong hair color. What does it say the temperature is?

MR. IQBAL: It gives you like in 2 minutes, 493. I'm sorry. In one minute, 493-degree F. In two minutes, it's 544-degree F.

MEMBER WALLIS: That's the temperature of the ceiling or something?

MR. IQBAL: It's the temperature in the room.

MR. SALLEY: That's the average temperature of the hot gas layer.

MEMBER WALLIS: Which is where, everywhere in the room?

MR. IQBAL: Yes.

MR. SALLEY: No. In the ceiling.

MEMBER WALLIS: The ceiling.

MEMBER POWERS: Everything above seven feet.

MR. IQBAL: Exactly.

MEMBER WALLIS: Anything above seven feet. So that looks worse, more threat to the cables to me than the radiation.

CHAIRMAN ROSEN: Especially if it's thermoplastic.

MR. SALLEY: Let's just say for illustrative purpose, you can see what it does here. What was your fire, two megawatts?

MR. IQBAL: Yes.

MR. SALLEY: Let's make it four megawatts. I want to show you the speed, how fast we can do this.

MEMBER WALLIS: That's 40,000. That's really going. Put a reactor in there. You can really get --

MR. SALLEY: And you can when he pages Doug here, how quick doubling that fire --

MEMBER SIEBER: It makes it hot here.

MR. SALLEY: Right. And you can see that we can quickly step through things to get first-order approximations. So, yes, you can do this all with a Radio Shack and, I agree, with pen and paper, but it would take you a lot of time, where here we can go in and say, "Let's try this,

try that. And you get different scenarios," --

MEMBER SIEBER: You get some idea.

MR. SALLEY: -- quickly ginned out.

MEMBER WALLIS: Do these guys like this?

MR. SALLEY: They don't like fire dynamics. So no. It's a part of --

MEMBER WALLIS: It's a tool for users.

MEMBER POWERS: I would. I mean, some fraction of them are surely going to be motivated to go over to the fire protection handbook --

MR. SALLEY: Oh, yes.

MEMBER POWERS: -- based on this. And they are going to see -- I mean, that's a pretty nicely written book. You know, once you have played with this a little bit, you can say, "How the hell did they get this?" It kind of explains how they got things and whatnot. And you learn a lot.

MR. IQBAL: They were using this for LGP, too.

MEMBER POWERS: But even after you have read it, just having this little tool to do the calculations for you saves you a lot of time.

MR. SALLEY: Yes. Let me characterize. The inspectors realize a change. And it is a pretty significant change to how they have to think in that

most of them have welcomed it.

And after they have worked on it, as a matter of fact, a lot of complaints that come from them, "Hey, I don't like typing in all of these properties for concrete. Can't you make me a pull-down menu?" or "Can't you give me a little graph?" or "Can't you?" So this is largely based on the inspectors' feedback.

Currently this is out in the public domain. And we're getting feedback from the general public. What's interesting is where we have gotten feedback from. A lot of folks who do arson-type work have sent us in some fire marshal association. We have gotten requests from Korea. Some folks in Korea wanted it. Research has it out with Sandia for some of the projects they are working on.

CHAIRMAN ROSEN: Any fire protection engineers that the plants escort?

MR. SALLEY: Doug helped us along --

MR. BRANDES: Yes. I think, as a matter of fact, I wouldn't say a majority. A lot of them have access to it and are what is characterized as practicing with it.

MEMBER SIEBER: Is it on your Web site?

MR. SALLEY: It's all downloadable.

MEMBER SIEBER: What do you look for? What do you look for? Is it a NUREG or --

MR. SALLEY: We announced it in the FRN, and we put it on --

MEMBER SIEBER: I keep those. They're combustible.

MR. SALLEY: Combustible loading.

CHAIRMAN ROSEN: Mark, let's wind it up.

MR. SALLEY: Okay. It's on our Web site. You can download both documents. What was interesting, though, is when they put the spreadsheet on the Web site, everything has to be in .pdf.

Well, Microsoft spreadsheets don't work too well in .pdf. So what we have done is people have downloaded and said, "Hey, this spreadsheet comes out of .pdf." We e-mail them the spreadsheet. So it's all publicly available.

CHAIRMAN ROSEN: I think this is like the next best thing.

MR. SALLEY: To sliced bread?

CHAIRMAN ROSEN: Right after the sliced bread, right.

MEMBER POWERS: And you know what the fundamental question is.

CHAIRMAN ROSEN: What's what?

MEMBER POWERS: What was the best thing before they had sliced bread?

MR. SALLEY: Canned beer.

MEMBER WALLIS: I think the bread before, fossilized bread, was probably better.

MEMBER SIEBER: You're obviously a Pittsburgher.

CHAIRMAN ROSEN: We are now ready to take our 3:00 o'clock break. And we will do so until 20 minutes until 4:00.

MR. SALLEY: Yes. We would like your comments on this, too.

(Whereupon, the foregoing matter went off the record at 3:26 p.m. and went back on the record at 3:41 p.m.)

VII. MANUAL ACTIONS

MR. DIEC: Good afternoon. My name is David Diec. And I am a project manager for the post-fire operator manual action rulemaking effort. With me today are Phil Qualls of the Office of NRR; Erasmia Lois from the Office of Research; and additional people, who are staff, who are sitting in the back, who are also available to answer additional questions you may have as we go through

the presentation today.

Next slide. The agenda for the grouping today, we are going to talk to you a little bit about the current status of the proposed rulemaking plan that we forwarded to the commission in July.

And we talked about a background of the manual action issue a little bit and the objective of our rulemaking plan and the options that we foresee of what the outcomes, possible outcomes that we see for the rulemaking effort and the approach to get there. Certainly we are going to talk about the next steps that we have got to do.

Next, please. We forwarded the commission plan in July 2nd of this year. The commission made it publicly available for information. We also received a number of comments from NEI. And I understand that Fred is going to make a presentation after us. So Fred will expound on that a little bit more.

A FOIA request came in asking for information relating to the developing information that leads to the proposed rulemaking plan. And the staff has partially responded to the requests on this issue as well.

As I was sitting in the background 15

minutes ago, I learned that the commission has voted positively on our rulemaking plan. Let me caution a little bit more here. We don't know the detail of those comments yet until we receive the SRM, but overall we received the positive comment to move ahead with this effort.

On March 6 of this year, we issued the inspection procedure that helps inspectors consistently document the inspection findings related to potential feasibility of operator manual actions.

The inspection findings at this time would indicate the feasibility of the manual action that can be given a green finding and then put in the licensing corrective action program. If findings otherwise will be given non-green, then the SDP process would have taken place. And we have a process to sort out issues.

CHAIRMAN ROSEN: Non-green would be a manual action found not to be feasible. Is that what you said? I'm trying to follow.

MR. QUALLS: What the inspectors are really finding is where the manual action that they're reviewing doesn't meet the screening criteria that's in the inspection procedure, it is

potentially non-green. It automatically is green, green as being feasible, if it meets the inspection criteria, they will screen it green. Okay?

If it doesn't meet this inspection criteria, it goes into the SDP for further evaluation. Further evaluation may well determine if the manual action is green, but it may not.

CHAIRMAN ROSEN: And the kinds of criteria that are in the inspection procedure are that it's accessible, that it's good enough lighting, that there is high-radiation fields, those kinds of things?

MR. QUALLS: Right. I can read them off real quick, but you are there.

MR. DIEC: They are very closely related to the plan that we put forward to the commission.

A. BACKGROUND

MR. DIEC: In way of background, when appendix R was promulgated, it was recognized that strict compliance with paragraph III.G.2 of appendix R, associated with certain blank conditions and configuration, may not provide any enhanced safety level than we provided by the licensees' system configuration.

And certain manual action, relatively

simple set of manual action, work is either acceptable to the licensee, normal licensing action deviation or exemption request. And we have given that exemption request or deviation request.

The recent inspection raised a number of concerns because of the widespread use of manual action as a way to meet one of the requirements in paragraph III.G.2. And the manual action, as we understand it, used was the genesis as part of trying to resolve the resolution of the thermal lag in mid 1990, instead of upgrading or replacing the appropriate protectant barrier, licensee utilizing manual action as a compensatory action to meet those requirements.

However, the requirement, as we understand in III.G.2 does not recognize explicitly manual action. And that's where the issue came about that leads to a better approach to resolve the issue by recognizing manual actions in the context of regulation so long as it can prove and demonstrate certain visibility aspect of it and consistently approach as part of the results.

MEMBER WALLIS: The impression I got from reading the documents you send us was that these manual actions are widespread and relatively

few of them are approved. It's not a question of not all, but relatively few of them are actually approved by the NRC.

MR. QUALLS: That would be probably a very good conclusion. What I found historically in my research was that up until 1992, I searched our database. We had approved on the order of 50 exemptions for manual actions for III.G.2.

At one licensee alone in a recent inspection, they identified 100, on the order of 100, manual actions that weren't approved by the NRC. In other words --

MEMBER WALLIS: Just from one licensee?

MR. QUALLS: At one licensee. And that was pretty much in the recent post-thermal lag era that these came into be, --

MEMBER WALLIS: Right.

MR. QUALLS: -- of which a certain small number are usually we have been finding not properly analyzed.

C. RULEMAKING

MR. DIEC: So the objectives of our approach for the rulemaking effort is to recognize operator manual action and allow the user use so that we can incorporate into the requirement that

everybody can follow and do it consistently.

We will develop a set of generic acceptance criteria for the visible operator manual action so people can understand what it is the expectation from the regulation.

And what we foresee is that so long as the acceptance criteria was followed by the industry, we don't feel that there is a need for them to come in for any license amendment or require approval required by the NRC because this is purely a voluntary approach rule.

As far as the possible outcome for the rule, our current thinking is this. We go back to the intention of paragraph III.G.2. Again, we understand that manual actions are not allowed without prior approval by the NRC.

We can see two different possible outcomes. One is using manual action in lieu of barrier with the combination of existing fire detection and suppression capability already in place or there may be a more limited set of defined manual action with the existing fire barrier and protection and suppression system in place.

MEMBER WALLIS: Shouldn't this be performance-based in that as long as they meet some

required performance, it can be done with a combination of things?

MR. DIEC: At this point, I think that we are trying to stay from the deterministic side of it and using the risk insight to supplement --

MEMBER WALLIS: It can certainly be performance-based without having anything to do with risk as long as you meet some performance criteria.

MR. QUALLS: In one regard, yes. We have performance criteria, which is what we are doing with the manual actions. The other issues, like fire detection and fixed suppression, that may come about as a result of the fact that if we have a one-hour barrier, also it's a defense-in-depth issue.

We also require detection and suppression. If we have 20 feet, no intervening combustibles, we have detection and suppression. Then on III.G.3 of appendix R, where we allow manual actions already as part of our rule, wherever we have alternative shutdown, we also require detection and suppression.

So that may become an issue further in the rulemaking. He's presenting possible outcomes.

MEMBER WALLIS: Well, these are

alternatives in order to achieve some performance objective, aren't they?

MR. DIEC: Yes. By this, either one of these alternatives can become --

MEMBER WALLIS: So if you were clear about the performance objective, you could perhaps determine which combinations were satisfactory?

MR. DIEC: That's our intention.

MEMBER SIEBER: I presume that when you consider allowing manual actions, you look at staff size, minimum staff size?

MR. DIEC: The next slide will explore the key parameter that will influence the acceptance criteria that we have to develop.

MEMBER SIEBER: Because you use operators as fire-fighters. So there is sometimes nobody left to do the --

MR. QUALLS: The answer is yes. One of the current inspection criteria is staffing, to review licensee shift staffing to determine whether adequate qualified personnel are available to perform the required manual actions to safely operate the reactor. That is currently in our inspection guidance.

MR. DIEC: And to go back to a earlier

comment from Mr. Rosen, lighting is also a consideration that we have to look at from the overall approach for the visibility argument.

I am not going into detail, sub-bullets. Clearly they are very self-explanatory but areas that we need to consider to develop the acceptance criteria.

The most important things that I want to have stressed in this point is that the parameter that talks about "time to damage," we need to clearly understand how they came about and what time is available for operator and whether or not an operator can actually carry through given the time constraints that they are having to work within.

The environment is so very important because if the human cannot function in a certain environment, if they don't understand the effects of the fire given the smoke environment or toxic environment, clearly they may get there, but they may not be able to perform the job as they are required to do. So there are things that we have to be really vigilant about.

MR. WEERAKKODY: I would just like to make a comment here. Let me look for feasibility of manual actions, even at the percent we have good

general criteria at a high level, what is feasible manual action or not.

It's not broken down to a number of elements like this here, but our current ROP process has some general guidance that the licensees' programs are about.

What we plan to do is maybe go to some level of detail with some stakeholder discussions to make a rule that achieves the safety objectives without making it so prescriptive that people couldn't adopt it.

So these are things under consideration when we reach that point.

MR. DIEC: Next slide, please. Clearly, as part of the visibility argument, we want to be in a position to understand the visible approach because those manual actions identify need to be. They're verify-invalidated that, indeed, they can be performed and carry out --

MEMBER POWERS: How do you do that? How do you validate an operator action?

MR. DIEC: At this point your question I am going to take back and do study on it because that is one of the things that we have to think --

MEMBER POWERS: Is there any hope? It's

not like you can set up a simulator and test an operator action.

MR. QUALLS: Well, in many cases --

MEMBER POWERS: Send him into a burning building.

MR. QUALLS: In many cases, a JPM would be an acceptable validation, for example.

MEMBER POWERS: A JPM?

MR. QUALLS: A job performance measure. The licensees have in their various --

MEMBER SIEBER: One approach to training.

MR. QUALLS: Well, let's use an example: the manually operated valve. Okay? What are the big issues that we come across as a spurious operation of valves? How do you validate that someone can spuriously operate a valve?

First, you are concerned about the timing issue. That's partially analyses and partially walk down with one of the operators in the plant.

CHAIRMAN ROSEN: I don't understand what you are saying. How can you validate if someone can spuriously operate a valve? Is that what you said?

MR. QUALLS: Well, one of the issues is

if a valve spuriously operates, how do you reposition --

CHAIRMAN ROSEN: Oh, reposition. Okay.

MR. QUALLS: I apologize. I talk faster than I think sometimes.

MS. BROWN: Phil, I just wanted to add that we do during the inspections validate. Sometimes the licensees will actually set up the simulator. And we will use operator-licensing individuals and actually have them go through the job performance measures and do timing and take a look at smoke, light, and those conditions. So we do validate during the inspections.

MEMBER POWERS: How do you do that? How do you simulate smoke, light, fire, ringing bells, fire engines, crazy people running around?

MS. BROWN: In some cases, we turn the lights off. In other cases, we take a look at whether or not there would actually be smoke in the area. If there is, we talk to the licensees about whether or not they have used SCBAs.

We have actually asked them to get a crew out and do some of these. And we have had inspection findings from that they were --

MEMBER POWERS: But you don't simulate

the smoke.

MS. BROWN: We don't simulate smoke, no.

MEMBER POWERS: You don't simulate --

MEMBER SIEBER: Some licensees do.

MS. BROWN: Well, they will practice in SCBAs.

MEMBER POWERS: We don't even find them practicing in the simulators with breathing protection.

MEMBER SIEBER: That's pretty rare.

MS. BROWN: But then they don't get credit for the manual action either. I mean, that's part of the criteria. If operators have to do it and that means that part of the current SDP criteria, that they have trained under the conditions that they have to perform in. So if they need an SCBA, they haven't used it, then they don't get credit by the inspection staff.

MR. QUALLS: SCBA is pretty easy to verify on site during inspection that someone --

MEMBER POWERS: I agree.

MR. QUALLS: -- is qualified in its use.

MEMBER POWERS: I agree with that. The question that I was giving to David was, what constitutes a validation? Now, if it is adequate to

say yes, the guy can go turn the valve with a SCBA apparatus on, that's one thing. Okay?

We might interrogate him fairly closely on why he thinks that is valid or not.

MR. DIEC: That's one of the key parameters if you go back to the previous slide, where we talked about training needs to include some sort of simulation that is part of the --

MEMBER POWERS: Well, the question, then, is, when you say some sort of simulation, how close to reality must be the simulation? And how do you know what the reality is?

MR. DIEC: Certainly your question is valid. And I don't have the answer for that. One of the things is we developed the rule we need to consider that.

Do we have any other comments from the staff on this question at all?

(No response.)

B. INSPECTION

MR. DIEC: Okay. The Office of Research is also working as part of the team here and helping to review a number of sources to attract insights from updated PRAs, from IPEEE reports, fire requantification project, insight from that, and

certainly inspection-related sample plants that we used to review and to extract information, whether or not types of manual action were credited by the licensee and how they were credited, the fact that they were considered in assessing the likelihood of success of those manual actions, and certain important factors and conditions that can influence the visibility of the manual action. Those kinds of things we are trying to extract from reviewing, from a number of sources.

CHAIRMAN ROSEN: Would you go back one slide, please? To reinforce this question and talk for a moment more about validation and operator manual actions, on the next to last line on this slide, is the complexity of operator manual actions. So the question there would be, how complex is too complex?

It would seem to me that one might get a handle on that by looking at some error-forcing functions and have some sort of threshold, some numeric threshold, that says if it gets below 20 percent likelihood or 30 percent or 50 percent likelihood that the guy will succeed when you go through the human factors analysis, that you simply are going to allow that complex of a manual action.

In other words, you can go into some existing techniques and establish some sort of quantitative threshold for complexity based on the error-forcing functions. In other words, rather than just use, "Well, it seems too complex for me" --

MR. QUALLS: We agree. We have been in discussions with the folks in our human performance group and with research concerning these types of issues. This is stuff that is going to be addressed in the rulemaking process and in the public meetings and stuff.

You know, some of the manual actions I have run across in the past inspections include local manual start of a diesel without control power. Another utility had someone opening 16 breakers with no lighting and actually opening the back of electrical panels and reaching in with no lighting and doing this kind of stuff to manual actions.

CHAIRMAN ROSEN: In SCBA gear.

MR. QUALLS: In SCBA gear. Actually, yes, in SCBA gear with 30-minute bottles, which is good for 20 minutes.

CHAIRMAN ROSEN: Have you been in SCBA

gear? If you have, you know that it's a little harder than --

MR. QUALLS: I realize that. I realize you really have 15 or 20 minutes maximum and you're in a bad situation and we didn't credit the manual action.

CHAIRMAN ROSEN: My point is only that there are adjacent technologies that one can use to assess this. And I would point towards doing as much as you can using those technologies to quantify this some so that licensees as well as the staff and the inspectors can all have a common frame of reference that says this is too complex or you take a given circumstance, perhaps like the one you just laid out, and recognize right up front that it is too complex until the licensee would choose to do something about that.

MR. QUALLS: I agree. I agree completely.

CHAIRMAN ROSEN: Okay.

MR. QUALLS: We're going to be looking into that as the rulemaking progresses. We're getting help from the various groups and from the agency.

CHAIRMAN ROSEN: I will look for that

because I am also chairman of the Human Factors Subcommittee.

MR. QUALLS: Oh, good.

MR. DIEC: Certainly your recommendation, perhaps we are going to use it in the context of a screening tools approach.

CHAIRMAN ROSEN: I would be less impressed with opinion on either side, either from the staff or the licensee, than an analysis that actually looks at the error-forcing context.

MR. WEERAKKODY: One of the things that -- I think I understand what you're saying, but are you saying that we should consider numerical thresholds as the definition for feasibility --

CHAIRMAN ROSEN: For actions.

MR. WEERAKKODY: -- for every --

CHAIRMAN ROSEN: Wherever you can, you should consider --

MR. WEERAKKODY: Well, yes, that --

CHAIRMAN ROSEN: Quantitative --

MR. WEERAKKODY: To the possible because --

CHAIRMAN ROSEN: To the largest extent possible.

MR. WEERAKKODY: Because I could enter

some constants where there is -- I wouldn't say impossible, but that is very --

CHAIRMAN ROSEN: On the borders, you can always do that. But I think if you are talking about a human being taking a specific action, you can identify the error-forcing context and do some quantitative reasoning and place that against the thresholds which you establish, reasonable thresholds.

One that comes to mind right off the bat is 50 percent probability. Anything below that certainly wouldn't be allowed. Sometimes he does it, and sometimes he doesn't. And if you are going to take credit for something, it has got to be better than that.

MR. WEERAKKODY: Chairman Rosen, I shouldn't just right of way react to that, but one of the for instances that I have used, if you get into more of a holding to a strict numerical criteria, given the variability that you -- I mean, if you are chairman of the Human Factors Committee, you know if you look at an operator error probability, there is a lot of variability in that.

E. RES SUPPORT

MR. WEERAKKODY: The one thing that we

want to do is get the benefit of all of that research but not have the rules be held hostage to the variability, which is why I think it is a good idea, but it should be more to the extent practical.

CHAIRMAN ROSEN: I will leave you with the details, but the idea is that one should do better than just arm-waving. One should use quantitative approaches as best you can.

MR. WEERAKKODY: This I fully agree with, yes.

CHAIRMAN ROSEN: Fred?

MR. EMERSON: A quick question. The last two sub-bullets on your slide there are not currently part of the feasibility inspection procedure. Are these things that are going to be added to the inspection procedure? Because right now the inspectors aren't asked to assess the complexity.

MR. QUALLS: No, because the inspection procedure, the current -- what we have currently is III.G.2, which doesn't allow manual actions. If the inspector goes out and he finds manual actions in lieu of a barrier that had not had prior approval by the NRC, he calls it a finding.

The inspection criteria is criteria that

is free net finding, green, or non-green, or potentially non-green for further SDP evaluation. Okay?

Now, these are things that are going to have to be evaluated and discussed publicly at public meetings during the rulemaking process because they may become issues because it becomes a rule for saying, "These manual actions are okay. It's not a finding. It's not a problem. These are good. These are as good as a three-hour barrier. These are as good as a one-hour barrier with detection and suppression."

Is there a total number that is too many? I don't know. Is there a certain probability of failure of each manual action such that the sum is too high? We don't know. There are issues that are going to be discussed at further meetings and such.

MR. EMERSON: Okay.

MR. DIEC: I think we've pretty much discussed this slide. If you don't have any questions, we are going to move to the next slide.

D. SCHEDULE

MR. DIEC: Our next steps, clearly once we receive the SRM, which we are anticipating

receiving soon on this one, we are going to engage in more discussion with industry to help understand and determine a little better what feasibility means and the kind of limitation that we have to confront with when we develop acceptance criteria for manual action.

Our expectation is that we will develop the acceptance criteria and associated guidance as part of the package for the publishing of the final rule.

The proposed rulemaking plan that we have in front of the commission does have the request for exercise of discretionary action regarding the inspection findings.

Since we received the approval, perhaps our first primary goal is to go forward with this approach in the context of a SECY paper requesting approval from the commission before refraining ourselves from taking any regulatory action against findings associated with manual actions.

We will also issue the regulatory issue summary and conveying our position and our direction where we are going to go from here and what we will expect from the rulemaking effort itself.

Our next step is to share the draft rule

language with the public and stakeholders consistent with the commission approach regarding about making the regulatory action transparent to the public. This can be done in a number of ways. We can publish in the rule forum discussion, where everybody is having equal access. And they can also make comments on that. So that is our immediate milestones ahead of us once we receive the SRM.

In your slides, there are two additional slides that I have, one of which is the definition of the operator manual action. Go to the next one. This is just for the background information. It has nothing to do with the part of the presentation. It's the way that we define operator manual action versus the current manual actions that are being received by NEI as a point of reference.

The next slide is simply telling you what is the current regulation in paragraph III.G.2 that has the three options if the licensee can meet one of those provided that they follow the requirements.

That concludes my presentation. Are there any questions that we can --

MEMBER POWERS: I guess here's my misgiving. We have for a long time, since I've been

on this Committee, had people come in here and say, "We want to put into this reg guide this criteria for how you decide when there is sufficient time for manual action, as opposed to automated action, under accident conditions."

And it's mostly associated with a switch-over to recirculation, but there are a variety of other things, too. And they say, "We've got this huge database that comes from simulators that we can use for this."

And this committee has rejected that thing. I think three times now we have bounced that out of here because we cannot relate the criteria that people have come up with to the database, nor can we see the database, which was an EPRI database.

We can see it, but the public can't see it. So it pretty much kills it right there. In other words, they would have a tremendously difficult time. What you are proposing to do seems far more difficult than what they are proposing to do.

I mean, what I don't see in your plan is anything that addressed the top parts of it. I mean, what you have got is somebody coming along saying, "I am going to do X, and I am going to do Y

and Z," but the trouble is X is just fraught with enormous numbers of difficulties, I mean, things like what is an adequate validation of a proposed manual action.

How much simulation do you have to do to persuade me that the action which under simulated conditions involves modest amounts of stress, in reality involves huge amounts of stress, and things like that?

The hard part is not planned out here. That's the trouble.

MR. WEERAKKODY: In this comment, you started out with the recirculation to sump and how that operator action is validated or --

MEMBER POWERS: I forget what I --

MR. WEERAKKODY: I am trying to understand.

MEMBER POWERS: It's a reg guide that has been in draft since the dawn of time, as far as I am concerned.

MR. WEERAKKODY: I am not sure that I will be directly answering your real questions, but if I look back at the experiences I have had in terms of determining whether a particular operator action is feasible or not, we go to licensees and

sometimes for certain actions, they have timing. They record the times. And they compare that to the time available based on that scenario. And that is the basis to accept or reject feasibility, at least in that example.

Now, I know in our ROP, we say that the feasibility should be established for the accidents under that same condition you postulated. I'm not using the exact right words, but we do factor the accident for which you are relying on this particular manual action and demonstrative feasibility for that accident.

Now, in terms of how much depth you go into, whether you simulate more, I think that is a matter of practicality. I don't think for every manual action, we go that far.

MEMBER POWERS: Here's one of the challenges that I see in all of this. We are looking at power uprates for a lot of boiling water reactor plants. One of the questions that comes up with you do power uprates is you shorten the time that you have to scram the plant in the event of ATWS. And so we ask people, "Gee, what did you conclude on this risk?"

And he says, "Well, we have read

simulators, and all of our operational crews do so regularly, unscramming the reactor in the event of an ATWS signal. And every crew does this exactly correctly every single time," and they do it in 32 seconds, certainly less than 52 seconds.

But when they go into the PRA, we still give them a .015 probability of failure. Okay? What that says is, here is something that is just routine, practiced all the time, simulator. And we still don't trust them enough to give them any better than a little less than 99 percent probability of success.

Now you're talking about a much more complicated operation. How many simulations, how many trainings do they regularly have to set up for the PRA folks to give them more than a 50/50 shot on this?

And the whole thing boils down to simulators are simulators and events are events. And events are just different than simulators.

MS. LOIS: I guess from a human reliability/PRA perspective, the concept of combining hardware bias with potential human actions should be entertained. The idea of using just human actions for every scenario, considerable scenario,

probably is not a realistic one.

As Mr. Rosen suggested, we can use some techniques to kind of create some bounding cases or values as to how many human actions, what combinations of human actions, what are the potential scenarios, and yes, to verify or to validate the ones that are potentially under-defined as logic to be included in the rule. It would be very difficult.

On the other hand, the case is right now, we are operating plants -- this is the state of conditions. We are using those human actions. And what the rule will do is at least create some criteria that will help the implementation of these human actions and considerably make them more reliable. So it's how do you balance the ideal situation with the reality we are dealing with?

And this is the rulemaking we are proposing. And I hope that this what we have been through looking at error-forcing conditions, et cetera, will help us how to develop some criteria will get us close, if not in the ideal place.

MR. GALLUCCI: This is Ray Gallucci from the Fire Protection Branch.

I think two of the techniques that have

already been described might be helpful towards this validation idea. As the inspection has mentioned earlier, the plants currently do run some sort of simulation, whether SCBA gear, et cetera, et cetera. It may be possible to enhance these somewhat.

Maybe if they had a training center or something, you could actually simulate smoke conditions, et cetera. So you could make the simulation somewhat more realistic short of setting off a fire. You could actually have enunciators going off, et cetera, do it during shutdown.

That would give you a little better simulation. And you would enhance that with some of the analytical techniques currently being developed in the human reliability analysis area, whether it be the stress factors, et cetera, because I know some of the tools NRC and EPRI are putting together in the HRA guidelines hopefully will be able to take the best of the existing techniques and refine them to a level where a combination of these actual simulator scenarios, on-the-job-training-type scenarios, combined with some analysis may get you as close as you possibly can to the validation without actually setting off a fire in the plant.

CHAIRMAN ROSEN: What we are talking

about here is trying to set up the regulatory framework where a given proposed manual action is either accepted or not.

And the question is, what are the criteria for acceptance? And how does one do the analysis? And that is all I am suggesting is that that be explored, that that is not something that is beyond the current technology.

And then once you have this thing, if you apply it conservatively, maybe a few more of the manual actions that you would have accepted fall out as being unacceptable because of uncertainty, for example. But there will be a class of them that everybody agrees can be done because the conditions are benign.

It's a simple procedure. The operators are trained. It's easily accessible. It's not radioactive. There will be a class of them that way that reasonable people will be able to agree that manual action is likely to be successful.

And then there is going to be a class where everybody will agree it's not acceptable, it's just too hard, conditions are too harsh. So you won't see anybody asking for acceptance of those or getting it.

And then there's going to be in the middle be a gray zone. And that will be the area where you will have to apply some considerables.

MR. WEERAKKODY: I think we agree that --

CHAIRMAN ROSEN: Well, when you came here earlier today, Sunil, you asked us for review and feedback. You have gotten quite a bit of that.

MR. WEERAKKODY: Yes. In fact, let me -- I'm sorry.

CHAIRMAN ROSEN: And I don't know if you're done with this particular piece of it. So I'm just pointing out that we have given you quite a bit of review and feedback. Have you completed this discussion?

MR. DIEC: Yes, we have.

CHAIRMAN ROSEN: Okay. I guess we have one more shot by Fred Emerson to try to convince us otherwise?

MR. EMERSON: Was that a shot at Fred or a shot for Fred.

CHAIRMAN ROSEN: We'll give you one --

MEMBER POWERS: If there's shooting going on, Fred, you know it is headed in your direction.

MR. WEERAKKODY: Chairman Rosen, before the committee adjourns, I do have one. You asked me questions, but I have a question to ask you because this idea of defense-in-depth you discussed in two sessions. I want to --

CHAIRMAN ROSEN: Well, why don't you sit here? Fred, how long do you need? Do you have 15 minutes' worth? Oh, you have 15 or 20 minutes. Why don't you stay up here and let Fred do his thing. Then we have a kind of a little bit of a colloquium here to wrap up the session.

MEMBER POWERS: Fred's usually controversial enough it will probably be an hour and a half.

CHAIRMAN ROSEN: Only if you are picking on him, Dana.

MEMBER SIEBER: He's an official victim.

MR. EMERSON: I'm looking for the presentation.

F. NEI DISCUSSION

MR. EMERSON: Okay. The last presentation today, at least that I am aware of, is the resolution of manual actions issues or perhaps, to use an earlier phrase, the re-solution of manual actions issues.

What I would like to do is to provide a little bit of background, industry perspective on the issue, what we see as the need for resolution of the issue, which, according to David, is getting much closer with the perspective SRM almost out; provide a slide about the industry views on the feasibility criteria; and just some final recommendations.

Now, these are recommendations that we provided to the commission after SECY-03-100 was issued and we were contacted by one of the commissioner's offices since we had expressed an interest in it and we offered comments on it. So I guess we will see to what extent our comments were considered.

The basic issue, as David just explained, is how the regulator should treat manual actions for redundant shutdown, III.G.2 for the appendix R plants. It had its origin in NRC inspection findings.

There was an NEI survey -- and all of these I am going to pursue in a little bit more detail -- of the industry views and practices, which I will elaborate on a little bit.

There was an industry-NRC meeting on

June 20th last year, where we I think reached a watershed with regard to how this issue should be treated, which was later embodied in the rulemaking and the inspection guidance, and what actions have taken place since this meeting.

Our understanding of this was that this whole thing started when the inspection findings were noting as a finding the licensee use of manual actions without NRC approval being a violation of appendix R, section III.G.2.

I think the first such inspections were not quite two years ago. And that is when this issue began to surface.

MEMBER WALLIS: How long had it been going on before it was surfaced?

MR. EMERSON: I'll get to that, but the short answer is many years.

MEMBER WALLIS: Yes. It has been going on for a long, long time and surfaced a couple of years ago.

MR. EMERSON: Yes.

MEMBER SIEBER: Since 1980.

MR. EMERSON: Yes. And I will touch on that a little bit more. When the issue surfaced, it became apparent to us that this was potentially a

generic issue. We sent the staff a letter indicating our preliminary view was that manual actions should be considered acceptable for redundant shutdown as long as they were feasible. We sent that letter more than a year and a half ago.

After that point, there were discussions back and forth with the staff. So I personally conducted a survey of practically every licensee to see to what extent manual actions were used for redundant shutdown.

The result of that survey, in very brief, was that most use them to some extent, a number use them to a large extent, and the licensees have consistently over the last 20 years interpreted this practice as being acceptable and that numerous inspections during the 1980s and beyond had not identified any need for prior approval until the issue surfaced a couple of years ago.

MEMBER WALLIS: This is strange to me that it seems to be categorical in the NRC view that this practice is a violation of appendix R. And, yet, how much the licensees believed it was allowable because it's a long time?

MR. EMERSON: Well, the --

MEMBER POWERS: Especially since it's

the explicit words of appendix R. I mean, it definitely says "without prior approval."

MEMBER WALLIS: "Thou shalt not" is appendix R, and it has been going on for a long time.

MR. EMERSON: Well, the words in the regulation don't say, "Thou shalt not." They don't say, "You can." And that has been interpreted as "If it doesn't say you can, then you can't." In our meeting on June 20th, we cited some other regulatory guidance, which led us to believe that it was considered and --

MEMBER WALLIS: So it's not explicitly forbidden, then?

MR. EMERSON: Not explicitly forbidden. I don't want to spend too much time dwelling on that because I think we have gotten past that issue. So I would like to focus on where we are going in the future.

In the meeting, we presented our views informally. As a result of that meeting, the staff agreed that they should focus on whether the actions were feasible, rather than whether the prior approval had been achieved. And that began the chain of events, which led to the rulemaking and to

the changes in the inspection procedure.

MEMBER POWERS: Let me ask you a question. When they made this decision, did they make it from a risk perspective; that is, an automated action I can make have a reliability of 10^{-3} probably? It's pretty easy to do for an automated action; whereas, it is very difficult for me to make a human action reliable better than 10^{-2}.

MR. EMERSON: I'm not really in a position to speculate on why the staff made their decision.

CHAIRMAN ROSEN: Well, Dana, let me just ask you, is that 10^{-2} for every action or is there --

MEMBER POWERS: No. I'm taking a round number, but you can imagine if I have to go do something in a plant under stressful conditions, you go through THERP. And you can do it, but it's difficult.

CHAIRMAN ROSEN: My argument is only about how stressful. In other words, if you tell me that a fire alarm comes in and I have to go down to a room remote from the fire and turn around, which is a new procedure to open something that is needed and that is in a procedure, not very far from the

control room, and it's a clearly accessible space, that's not very stressful for an operator. As a matter of fact, the adrenaline he gets pumped from that makes him more likely to succeed.

So there are some actions that are well within the capability of trained operating --

MEMBER POWERS: The proof is --

CHAIRMAN ROSEN: A one percent success rate for some actions is not correct. I mean, it depends on --

MEMBER POWERS: No, no.

CHAIRMAN ROSEN: It depends on the action.

MEMBER POWERS: Yes. But you go through. Pick anybody's human reliability model.

CHAIRMAN ROSEN: Sure.

MEMBER POWERS: It's just very difficult to get human -- I mean, you have to go to some length to get --

CHAIRMAN ROSEN: Very stressful. It's a stressful circumstance. I agree 100 percent. But there are some circumstances that are not stressful. They're simply responses to indications that operators can and should do with --

MEMBER POWERS: In just the transfer of

numbers from one page to the other, a totally non-stressful operation, the general rule of thumb software developers use is one mistake in 100.

CHAIRMAN ROSEN: One mistake in 100; in other words, 99 successes.

MEMBER POWERS: Ninety-nine successes.

CHAIRMAN ROSEN: I agree.

MEMBER POWERS: And one percent. It's just very difficult to get reliability down to .01.

MR. QUALLS: Well, I can tell you in answer to your first question about what the staff considerations were about risk, the staff had evaluated, not specifically in the risk context, because appendix R, when you go back and read the original documentation preceding appendix R and the statements of consideration and there was a petition by I think Union of Concerned Scientists about that time and the commission ordered commission order CLI-80-21, I think the number is, where the commission chose specifically at that time not to incorporate the state-of-the-art risk into the appendix R program. They said the fire was not predictable at that time. They didn't have the fire modeling techniques. They didn't have the computer techniques. We have developed a lot of technology

since then.

But appendix R is not a risk-informed rule.

CHAIRMAN ROSEN: I understand that.

MEMBER POWERS: It doesn't matter.

MR. QUALLS: Statistically it does matter.

MEMBER POWERS: You've still got a policy to take into account risk to the extent that it is practicable today.

MR. QUALLS: And during the process of the '80s, if you look at the exemptions -- I did research on the exemptions -- you will find on the order of 50 or so exemptions that were reviewed and approved. And that does not count the manual actions that were reviewed as part of the newer licensees where the fire protection program actually submitted the manual actions as part of their original submittal and the manual action might be approved in an SER. I am only counting the appendix R exemptions for the 379 plants. We had on the order of 50.

When I looked at the bases for many of the exemptions, at least in 2 plants, the exemptions were based on no manual actions for the first 30

minutes of a fire assuming that the licenses that operators had were time-critical and most of them were things on the order of manual transfer of fuel to the diesel day tanks, something that is not time-critical, it's done 2 to 4 hours into an event. It's fairly simple.

The operators do it occasionally anyway so that they'll know how to do it. And if they fail the first time, it's no big deal because they will get another shot. Those were the types of things that were typically reviewed and approved by the exemption process in the 1980s.

CHAIRMAN ROSEN: I think that's called use your engineering insights and your knowledge of the plants to analyze this manual action realistically and then apply conservatism. Don't use a criterion that basically says manual actions aren't allowed for 30 minutes. That was okay then, but this is now.

Because some actions may very well be capable of being taken within 30 minutes with a very high reliability, but it remains for the licensee to show that. And if they do and they should meet the criteria you set and they do the work correctly and well, I see no reason not to credit operators.

The operators in our plants are our very significant line of defense. And anyone who doesn't think so needs only to look at the history.

MR. QUALLS: I'll tell you what the inspectors were finding. They were not taking issue with the simple manual action that was not questioned, the local transfer of the fuel oil from the day tank. They were taking issue with local manual start of a diesel generator, which was time-critical without control power. All right? And that is something that involved several --

CHAIRMAN ROSEN: If you go --

MR. QUALLS: You went through this already. Those were the types of things they were finding on some examples. Now, how do you separate the examples?

CHAIRMAN ROSEN: Because you do human reliability analysis using the error-forcing context. In the example you just gave, you get a very low reliability. You get one percent or 10 percent likelihood of success; whereas, in the cases where you would credit manual action, you would get 90 percent likelihood of success or 99 percent likelihood of success.

I want you to use your brain and to look

at the conditions and to either say this manual action is acceptable or it's not using some conservative threshold. That's all I would ask you to do.

I think the industry would -- well, I can't speak for the industry, but I think the industry ought to accept that as a reasonable approach because that would protect their asset. If they're going to rely on a manual action in the event of a fire, industry is going to want it to be highly reliable.

MR. HENNEKE: Yes. I guess I have a comment on that. There is one other consideration that hasn't been discussed. Fred can kind of confirm this from the survey results.

Most manual actions, especially the ones that have been added, are either as a result or to prevent failures, like spurious operation, either single or multiple spurious operations.

So what you have is a less likely or an unlikely event, especially, say, for armored cable that we know can happen in a fire area. And now we have an operator action to prevent that spurious operation.

Well, that is a different issue than

having to change the recirc from the sump valves because that is an in-line function versus something that may or may not occur, something that is low likelihood.

We also have manual actions because we couldn't qualify our fire wrap. And so most fires, the fire wrap is going to work fine. And for maybe a very, very low probability of fire, fire wrap won't. And then you have manual actions for that.

So these types of manual actions, really, you have to take that into consideration what it is really needed for. And you might have different criteria for different manual actions.

If you had a manual action where it's an in-line function that is absolutely required to perform the safe shutdown function, that's one thing. If it's prevent or to react to a low-probability event, such as spurious operation, that's another thing. And all of that has to be considered in with the probability.

CHAIRMAN ROSEN: I think it should. It should be considered, just as you suggest.

MEMBER WALLIS: These very high probabilities of success assume that nothing else happens. And there are times when people make

mistakes. Even though they are very, very reliable, there has been something unexpected intrude. And they get distracted.

And you can never be sure of what that might be. I mean, it could be a wasp flying around or something. There are all kinds of things that can happen, even for the most reliable people.

CHAIRMAN ROSEN: That's why you never get 100 percent.

MEMBER WALLIS: Never get 100 percent, right.

CHAIRMAN ROSEN: That's right.

MEMBER WALLIS: You shouldn't.

MR. EMERSON: Okay. After the meeting --

MEMBER POWERS: Except pushing a scram button at an boiler in an ATWS.

CHAIRMAN ROSEN: Well, you don't get 100. You get very high.

MEMBER POWERS: It's 100 percent.

MR. EMERSON: David earlier outlined the steps that the staff has taken in the last year or so. I'm not going to elaborate on that.

The criteria that David listed were not exactly the same list as the criteria that are

listed in the inspection procedure currently, which are these. And I'm again not going to go over them in detail.

Again, since the meeting, the view that was espoused in the rulemaking plan, SECY-03-100, I thought it was best summarized in the statement which is a quote from that SECY. And I would say we're in agreement with that that feasible operator manual actions constitute a safe and acceptable means of protecting --

CHAIRMAN ROSEN: I am not sure, but I don't think anybody disagrees with that.

MR. EMERSON: That's right.

CHAIRMAN ROSEN: But the question is what is feasible.

MR. EMERSON: Okay.

CHAIRMAN ROSEN: At issue is feasibility and how you assess that.

MR. EMERSON: I understand.

MEMBER POWERS: It seems to me that it is -- I mean, I will take issue with the statement that the fact that something is feasible through heroic efforts by brave men --

CHAIRMAN ROSEN: Well, you are just playing with words.

MEMBER POWERS: I mean, what you want is something that is risk-effective; that is, it is a wash.

MR. EMERSON: We are in vigorous agreement, violent agreement. We're issuing --

MEMBER POWERS: I think the word "feasible" is the wrong word up there.

MR. EMERSON: I'm interpreting it broadly as being something that can be done. And how you can assess what can be done with a high reliability is the issue in front of us.

MEMBER WALLIS: What you really need is reliable operator manual actions.

CHAIRMAN ROSEN: Yes, highly reliable.

MR. EMERSON: Seeing that we're in agreement with the staff position on the feasible manual actions are a safe means of accomplishing this, then what are the current issues? The biggest issue --

MEMBER WALLIS: It's rather superfluous, I mean, the word "feasible" utterly to say the use of "infeasible." I mean, it doesn't add. Obviously, if you're relying on operator action, it must be feasible. Feasible adds nothing.

CHAIRMAN ROSEN: You're right. It

should say "reliable" or "highly reliable."

MR. EMERSON: The current issue, as we see it, is not so much where the staff is going, which we agree with, but what happens between the time now and the time we get there.

There is a gap, as has been pointed out, between what the NRC's intent is and what the current rule language allows. Now, looking at it from an inspectee's perspective, the inspectors rightfully are inspecting against what the current rule says, not what has been espoused in a SECY document.

This creates difficulties in terms of expectations for both the licensees and to some extent the inspectors. And, as has been said, the green findings are issued, even when the manual actions are deemed feasible. And, at least in my opinion, there is something wrong with that because it says that if something is safe and something is feasible, why should there be a finding at all?

Now, I understand why it is being done is because the rule hasn't been changed yet, but this gap is an inherent difficulty that needs to be closed.

So what do we need to do? Well, we need

to close the gap. I just discussed what the gap is. I don't need to elaborate on that.

Going to the feasibility criteria for a moment, generally our view is that the feasibility criteria are generally appropriate, as laid out in the inspection guidance.

We have a task force that has gone over those criteria and the supporting language in the inspection procedure. And we will in the near future be recommending some changes to the language from the licensee perspective, which is probably more of a tweak than substantive revisions. But we think the licensee perspective ought to be reflected in the guidance that the inspectors use to assess feasibility.

I mentioned that we sent a letter to the commissioners in August. The principal recommendations from that letter were in order to address this gap issue that I mentioned, to speed up the rulemaking process, if possible, through implementation of a direct final rule.

I realize that there are limitations on the NRC's ability to do that, but if we can, the length of time where you create a situation where there is a difference between NRC expectations and

NRC rules is always a difficult one that you need to get through as rapidly as possible.

CHAIRMAN ROSEN: Help me with this, Fred. I don't know the protocol for direct final rule. What does it do to speed up the rulemaking? What happens if someone were to agree with you? What's the difference?

MR. EMERSON: Well, I can give you my limited understanding of it, but it would probably be better if somebody from the staff who understands the process better answered your question.

My understanding of it is that when the rule is published, if there is no substantial disagreement with it -- Eileen is going to.

MS. McKENNA: Yes. This is Eileen McKenna. I'm from NRR, the Policy and Rulemaking Program.

The idea with the direct final rule is you publish it. Essentially, you publish a proposed rule and a final rule at the same time, the idea being if the proposed rule -- you put out the final rule. And if there are no significant adverse comments, then it becomes effective.

If there are comments, then you have got to revert back to the proposed rule process so that

if you think there is a high likelihood that the rule not be controversial, then the direct final was faster because this is more of a one-step process.

CHAIRMAN ROSEN: And I understand that NEI has petitioned for that and in a letter recommended that the NRC issue a direct final rule and that that is under advisement. Is that correct?

MR. DIEC: This is David Diec from the staff.

Clearly, yes, the answer is that we have to wait for the SRM to come down, whether or not it addresses that issue or --

CHAIRMAN ROSEN: You have to do what?

MR. DIEC: We have to wait for the SRM to see whether or not the SRM talks about that issue. So we have to go back and do the justification to make a decision whether or not the direct final rule is appropriate and recommend it to the commission.

CHAIRMAN ROSEN: So what you are waiting for, what you expect is an SRM that will respond to the NEI request.

MR. DIEC: We would hope that it addressed one of those elements in the context of the overall approach from the rulemaking.

CHAIRMAN ROSEN: I understand that. Thank you.

MR. EMERSON: The other piece of our recommendation was the staff had recommended in a SECY document enforcement discretion and we recommended that it go a step further and have a moratorium on inspecting that issue until the rule is in place, again eliminating the difficulty with citing green findings for perfectly valid, perfectly feasible manual actions, however you define that term.

We realize that it might be a big step to take to completely suspend inspections. So we had also proposed in our letter that to fill that gap, the staff could conduct audits, as opposed to inspections, to gather information on this practice and that if there were an observation of a difficulty, then inspections could continue at that point and enforcement discretion could be applied. And, again, these recommendations were to help bring the rule in line with the intent as soon as possible.

Now, let me just say one more word about this. there has been some discussion as to what the difficulty is with being cited with a green

inspection finding. To a licensee, that's not a small deal.

Any inspection finding is reviewed seriously by management and because it indicates a weakness with a licensee's program. It's either a safety problem or it's a compliance issue or maybe both. But licensee management cannot understand why you need a citation if something is perfectly okay just as a placeholder.

In summary, manual actions safely support plant shutdown if their feasibility is demonstrated. It sounds like we're pretty much in agreement on that. The key issue is demonstrating feasibility.

MEMBER WALLIS: I'll make a plea again for not using the word "feasibility." To me, feasibility means it's possible. I mean, it's feasible that this student might pass the course. It probably means that I am expecting a C- or a D.

You have to say something different. And the manual action by definition is almost feasible, the fact that you consider it at all. You need a word like "effectiveness" or "reliable" or something that --

MR. EMERSON: I understand.

MEMBER WALLIS: -- means that it works, not that it just can't be done.

CHAIRMAN ROSEN: Works in most cases, something like that.

MR. EMERSON: I understand your concern.

MR. DIEC: This is David Diec with staff.

Dr. Wallis, I think that your thinking is pretty much what we are trying to define, what feasible means. And in the --

MEMBER WALLIS: Don't use the word.

MR. DIEC: That's right. But we probably were thinking along the line that it is attainable, achievable, and reliable, that kind of thing.

CHAIRMAN ROSEN: There really isn't anything wrong with the English language. It's really how we use it that gets us in trouble. So I'm sure you can find the right set of words to better characterize than what we have been talking about.

MR. EMERSON: That concludes my presentation.

CHAIRMAN ROSEN: Well, very good. We should be beginning a general here. At 5:15, I will

from us just saying, "Gee, it seems great." I mean, you can read the --

MR. WEERAKKODY: I understand.

CHAIRMAN ROSEN: You can read the transcript, but --

MEMBER WALLIS: You want a letter at this stage? It would seem to me an awful lot of this was preliminary education of the subcommittee about some of the things going on. But nothing much had come to a conclusion yet. And so I don't see how we can endorse something --

MEMBER POWERS: The committee is not going to give you a letter without a document that they can endorse that is not going to change very much.

CHAIRMAN ROSEN: So you see where I think the difficulty is. While we could present the summary of this to the full committee -- and I think I have a little time on Friday to do that, maybe 30 minutes.

MR. WEERAKKODY: What the subcommittee decides will be what you decide. But when I said "endorsement," I know you have a lot of feedback on the details. But one question, one high-level question, that I had I was hoping to get feedback

point out we are 25 minutes early. So, Dr. Powers, would you like to wax poetic or any other members would like to have this open pulpit to talk about any subject?

VIII. GENERAL DISCUSSION

MEMBER POWERS: Should I wax poetic over the entire day?

CHAIRMAN ROSEN: Well, I would say that I would go back to Sunil's earlier request. He asked us for the three bullets. He wanted out review of what they're doing. He wanted any feedback we had, which we certainly haven't been shy. And he wanted endorsement of future direction.

Now, I don't know how that would be done. I would suspect that we would go to the full committee. To get an endorsement, you need an ACRS letter. To get an ACRS letter, you have to go to the full committee.

And the subcommittee has to recommend something, provide some sort of draft document usually to the full committee or draft letter. I presume that is what you are asking for, an ACRS letter.

MR. WEERAKKODY: Yes.

CHAIRMAN ROSEN: You get no endorsement

and endorsement with, in your opinion, is the start going in the right direction?

In other words, I said in my outline that if you look for the common thread in the four different issues presented today, the common thread is trying to risk-inform all our efforts to the extent possible. You see that, whether it's manual actions or risk-informed inspections or adopting a rulemaking 805.

So I was only seeking an endorsement at that level.

CHAIRMAN ROSEN: Well, I would say that my failure to provide endorsement would be against commission policy. That is the commission policy to move in a risk-informed performance-based way.

So, first off, I agree with the policy. Secondly, even if I didn't, I would have to salute it. So yes, of course, you should be risk-informing this as well as all of the other activities of the agency in accordance with commission policy, as I said.

And then I would make the obligatory speech. I think you're doing the right thing. I thank.

MR. WEERAKKODY: I think the question

needs to be rephrased as, in your opinion, are all of these efforts with all of those directions that the commission has set --

MEMBER WALLIS: In order to risk-inform it, you have to be a bit more systematic about what information you need in order to evaluate risk. Go back to the discussion we had about these cables.

It seems that some sort of studies of what happens to cables and so on needed to be specifically asking some risk-informed questions and saying, "How much do we need to know in order to make risk-informed decisions?"

It might have helped design the experiments in a different way or something. I didn't see that. It's a logical tie-in. If you want to risk-inform something, you need certain specific information? How are you going to get it? How good does it have to be? What are the uncertainties and so on?

You have to face up front what that information is. I think you are just beginning to find out what you might need to know in order to do some of this risk-informing.

MR. WEERAKKODY: I thought if we could compare where we are today to three years ago, if

the inspectors did inspections three years ago, they were just evaluate or inspect any circuit without any consideration for their failure probability.

I think what did happen these last three years is that we know and we have communicated to the inspectors what are most likely to be the risks.

So I think we may not be 100 percent there, but I thought the experiments and capturing those experiments into the inspection proceeding is taking a big step in that direction. That's just my personal --

MEMBER WALLIS: Well, I didn't see the risk. I mean, I could see that yes, you have done some experiments and certain things are more likely to happen than others. Certain failures are now credible, and they weren't before. That's useful information. But this doesn't really have anything to do yet with evaluating risk.

MR. WEERAKKODY: If you mean "risk" by in terms of doing the actual PRA quantification, I guess I do --

MEMBER WALLIS: Does it matter from the point of view of risk whether this fails at 600 degrees or 800 degrees or melts or chars and so on? I don't know because I haven't seen the risk

analysis.

CHAIRMAN ROSEN: Well, I propose that we get anything off our chests that we and kind of go around the table and give Sunil and his staff and Fred whatever kind of feedback we have got.

But recognize that it is not likely that we would be able to give you an ACRS letter. There is nothing in front of us to agree with or disagree with, really, in hard terms.

Jack?

MEMBER SIEBER: I was thinking as we went through the day. I have been on the Fire Protection Subcommittee starting my fifth year. And my overall comment is that we're moving at glacial speed on a lot of things.

I am glad to see that NFPA 805 is still alive and moving forward. I was also glad that Mr. Emerson told us that about 15 plants may adopt a risk-informed fire protection approach. And to me, that is good news.

So I would encourage further pursuit as rapidly as a rulemaking can be, which is the reason for the glacial speed, bringing that to a close.

The circuit analysis, we have heard about this before when we were given the preliminary

results. I think the results are not surprising. And I have been concerned that inspection of associated circuits had not been done for some time.

Now that we are close to resolution of exactly what happens in the associated circuits area, I think that there is a feasible risk-based approach toward evaluating what is reasonable and what is not.

The fire dynamic spreadsheets, I got a copy of the disk. And I am going to calculate tonight why every time my wife broils something, she sets off all the smoke detectors, which I think I may be able to find out why.

MEMBER WALLIS: What is she broiling?

CHAIRMAN ROSEN: Do you know the heat release rate for lamb chops?

MEMBER SIEBER: I don't know what it is. When I do it, they don't go off.

MEMBER POWERS: It's about the same as lube oil. In fact, maybe you just --

MEMBER SIEBER: Well, it's one of the three basic.

MEMBER POWERS: The lamb chops you could get cheaper by just frying that blue off.

MEMBER WALLIS: Deep fry in red oil.

MEMBER SIEBER: Well, at any event, I think that is an advance for the inspectors. I think it's a good tool. And I am going to try it out and look through it. And if there are comments that I can make that are useful, I will make this. And so I was glad to see that. And I think it's a better process than what has been used in the past.

As far as manual actions are concerned, I concur with the direction that the staff has taken at the present time. So overall my presentation other than the speed at which things are happening, my impression overall is positive from the presentations today.

And that would be it for me.

CHAIRMAN ROSEN: Okay. Thank you, Jack.

Dana?

MEMBER POWERS: Well, let me say that the overall objective of having more risk information in connection with the fire protection regulations is inherently hampered because we just don't have the risk information that we do for normal operations. We have not done the kinds of studies of representative plants that were done for operations. And that inherently drags on the system.

On the specific topics we heard about today, I believe the staff has underestimated the resources and an effort will be required to adequately review the methods and fire protection documents retained at the site by the licensees making the transition to NFPA 805.

Their current plans that they have seem destined to impose a burden on each of the regions that the regions are already yelping about because they don't have adequate resources and limited expertise.

The staff has developed guidance and plans training. It's not apparent that they have established that these will be adequate, nor has the staff assured itself that they have an understanding of the rates of change among licensees to NFPA 805. I think they have some indication.

The staff has made the argument that they are not going to pre-approve methods because there really isn't a standardized method now. So they have to look at them fairly well on a case-by-case basis anyway.

I think this makes it even more important and staff should inspect these methods and the documents that the licensee has produced using

these methods on a fairly timely basis.

I would point out that the circuit analysis area has been around with us for a long time. It's a source of contention. It seems to me there are some opportunities for the research program to assist the staff in their review of a licensee's circuit analysis by computerizing a lot of this.

And I wonder why we don't have a research program to do that. We have talked about it for a long time. It looks like it's feasible. There are parts of it that just have to be done by hand. That's figuring out where the cables are and where they go to, but once you have that, the circuit analysis itself ought to be something that is computerized.

Furthermore, on the research, it seems to me as the staff goes through and examines the data on fire effects on cables, they should also be developing a list of the database they would really like to have in the hopes that the research program can establish some sort of an international collaboration to start getting some of that additional data.

We have seen how tremendously helpful

the NEI tests were. And I will point that the staff participated extensively in those NEI tests. They have been helpful to us in a very qualitative and perhaps even quantitative step.

But I think what they did was just enlighten us to the amount of information that we don't have. We have pretty good databases and growing databases on fire frequency. We just don't have very good databases on fire effects. It's clearly an area that the research may want to move more aggressively on to perhaps international collaboration.

And with respect to the NEI tests and with respect for the NEI tests because I understand how those tests came about and what their objectives were, on any test program, I think we absolutely must have some understanding of what the experimental error is. And that calls for replicate tests.

So when we think about designing future test programs, I think a measure of the experimental error is essential. I know that lots of people come in and make the argument that, "Well, we haven't got much resources." We want to get as much information as possible so we're not going to do a replicate

test.

In fact, I think there is a strong consensus within the community designing, developing experiment designs that when your resources are constrained and when you can't do very many tests, that it's even more important that you do a test to measure the experimental error. Otherwise, you're looking at noise when you're trying to find trends in a sparse database.

We didn't talk much about it, but I will point out that in that multi-factor formula for LERF that appeared in some of the later slides from the NEI presentation and, in fact, in several of the presentations where there were factors multiplied by each other to develop probabilities, that kind of multiplication is acceptable only when you've established that the two things that you are multiplying together are independent. And we have not seen that establishment of independence up until now.

MEMBER WALLIS: Well, Jack has been here for five years on this subcommittee. And I am relatively new.

On the risk-informed fire protection rule, it makes sense to tie it in with the NFPA 805

standard. The thing I found interesting was what is RES doing in support on this use of CFD and fire analysis and dynamics and so on. I think it might be useful to have a presentation of that at some time for our researcher purposes. We can say, "Is this appropriate research? And how well is it going?"

So that was really the only thing that struck me about that. Otherwise the rest of it is a good thing to do. But what is the support that RES is providing?

In the circuit analysis, very interesting description of phenomena and a few quantitative results. What I didn't see was how it all fit together logically and quantitatively in their risk analysis. And perhaps we can see that sometime.

What is one trying to get from the evidence, which actually we can agree is real? And how does it fit into whatever it is used as measure of risk?

The spreadsheets for inspectors, again, this sounds good stuff, but it's all for some customer, presumably the inspectors themselves. And without knowing to it and whether they find it

useful or not, I'm not sure how to evaluate it.

It sounds like a useful tool, but it's a tool for a certain user. If the user isn't going to use it or doesn't like it or misunderstands it or something, then it's not a very good tool. So we need that side.

It makes sense to give credit for these manual actions which have been going on for a long time anyway as long as they're effective. It really wasn't clear to me, in spite of all the talk and listing of criteria and so on, what the clear basis for a decision was about when these things were feasible, when they weren't feasible, how feasible they are.

It still seems we're talking about what we mean by feasible, rather than getting definite about it. And that's where the staff will presumably become more definite and certain and perhaps use better words.

CHAIRMAN ROSEN: Thank you very much, gentlemen. Most of what I have been thinking about you all touched on. Let me just go down whatever else I can add.

I was also struck by Doug Brandes' comment that 15 licensees, his estimate, will adopt

NFPA 805. I was worried from the beginning that it would be too hard, that the staff would, for whatever reasons, make the barriers to entry too large.

MR. BRANDES: Excuse me. Let me be sure that I properly characterized that. Fifteen is the number of my personal count based on licensees and sites that I know that are going through reanalysis right now that I believe would benefit from having this risk-informed rule available.

And if it were available today, my opinion is it would be the best option for those -- I can only speak for the Duke plants, that if, indeed, the final rule were available essentially in the form that we see it and the implementing guidance was essentially acceptable and the NEI 00-01 was acceptable, as I have last seen it submitted, it would make sense for the Duke plants to go forward or it would appear to to me right now.

These other dozen or so sites in my opinion would benefit from having it available to them.

CHAIRMAN ROSEN: That's your opinion. It's not what the representatives of those sites have said.

MR. BRANDES: That's correct.

CHAIRMAN ROSEN: Well, I appreciate that clarification. That's an important difference.

Let me just talk for a minute about the circuit analysis resolution. We on the committee haven't seen the implementing guidance. And, Marvin, you are going to get that to us and probably the latest version of NEI 00-01. I don't know what revision that is. Is that D or C?

MR. EMERSON: It's Rev. 0.

CHAIRMAN ROSEN: It's Rev. 0. The last one I saw was C, I think, Rev. C.

MR. EMERSON: Right.

CHAIRMAN ROSEN: So maybe I have skipped a revision here, which is a good thing. They are two separate documents. Am I correct about that?

MR. EMERSON: What were two separate documents?

CHAIRMAN ROSEN: NEI 00-01.

MR. EMERSON: Yes.

CHAIRMAN ROSEN: That's Rev. 0. That's one document.

MR. EMERSON: Yes.

CHAIRMAN ROSEN: And the implementation guidance --

MR. EMERSON: Two separate documents. That's correct.

CHAIRMAN ROSEN: Two separate documents. And I haven't seen either one. I saw an earlier version of NEI 00-01, I think Rev. C.

MR. EMERSON: Right.

CHAIRMAN ROSEN: So I think it will be useful for the committee members and certainly for me to have a chance to look at those as we go forward.

I think the fire dynamic spreadsheets are great. It is very important if you're working in an area -- is Mark still here?

MEMBER SIEBER: Mark is here, yes.

CHAIRMAN ROSEN: There he is.

-- if you're working in an area like this and trying to get some sort of physical feel for phenomena that you really don't understand very well intuitively. Not many people really know how hot a fire is because we try to stay away from them as human beings. And so it's important to have a tool that could teach us if we have to be involved in these subjects.

These spreadsheets are very good for that. They're a great heuristic tool. And I

applaud their development and wish I had some time myself to work on them.

Let me comment on the manual actions thing. I've probably said this before, but what we're looking for is effective manual actions, as Dr. Wallis has suggested.

Our question is about how does one get on the same page, how to get the industry, the licensees, and the staff on the same page as to what is effective. I think you do that by agreeing on a technique for doing the analysis.

There are many different techniques. We just need to settle on one that is reasonably current and has some of the more advanced parameters in it and then say, "This is the technique we are going to use to assess manual actions."

It has these 8 or 12 or 19 parameters we're going to look at. And here is how we are going to look at each of those parameters. And here is how we are going to sum them up and add them up, dice them and slice them.

And then when we get the answer for that manual action, we are going to compare it to a threshold that we will set. And we'll set it conservatively, not very, very conservatively but

plenty conservatively. So if your action is deemed to be more reliable than that threshold, then you can take some credit for it. If not, then you can't.

And anyone can argue about that. And maybe you should have some arguments about that, how you do the analysis and how you set the threshold. But after a while, it is going to be a matter of judgment. Then the staff should set it conservatively. And everybody should say, "That is how it is analyzed."

That is just like how we used to do appendix R. Everybody knew you couldn't take credit for manual actions theoretically. So you shouldn't. You shouldn't. Okay? That was the rule. Nobody knew. That was the way you did business.

Well, I'm suggesting a new way to do business. And it's that agreeing on a technique and setting a threshold and everybody moving forward from there.

MEMBER WALLIS: Doesn't it depend on the context, though? You can't just say it's a reliable action. It depends on all the context.

CHAIRMAN ROSEN: That's right, of course, the context or the error-forcing context for

each in my view, in my mental model, to go out there and know whether or not you have got time, whether it is something you have done before.

A lot of times, routinely or not, whether you are following procedure or you are in a knowledge-based space or in skill-based space or rule-based space. It should be different. The error likelihood will be different for each of those in terms of --

MEMBER WALLIS: But it should be performance-based. It's replacing some hardware. There is going to be hardware plus manual action that is equivalent to hardware itself. So you have got to have some performance criteria which one or both, each of them, has to satisfy.

CHAIRMAN ROSEN: You're trying to achieve a function. You are trying to do something in the plant, --

MEMBER WALLIS: Right. That's right. That's right.

CHAIRMAN ROSEN: -- like isolate a given fire. How well do you achieve a given function is the question.

MEMBER WALLIS: That's right.

CHAIRMAN ROSEN: And so there you simply

look at the error-forcing context. Where does a person have to go to do it? What does he have to do? How much time does he have? Is it proceduralized, all of those kinds of things? I mean, that's not brain surgery right now.

And then you set a threshold. And you do those calculations, set a threshold and compare your answer in the calculations of the threshold. I think that's well within our capability and the right way to go.

And, with that, if you really want to hear what we are going to say on Friday, I've only got 15 minutes to say it. I looked on the agenda.

MEMBER POWERS: These folks aren't presenting anything on Friday. Is that right?

CHAIRMAN ROSEN: No. I am just inviting them to be there. If you look at the current agenda for Friday, it is that there is a report by the subcommittee chairman of fire protection scheduled for 11:15 a.m. on Friday, September 12 in this room.

MEMBER SIEBER: And the full committee keeps schedules just as good as the subcommittees?

CHAIRMAN ROSEN: Right. Be prepared to listen to it after lunch.

MEMBER SIEBER: Or first thing in the

morning.

CHAIRMAN ROSEN: Or Saturday morning.

MS. BLACK: Dr. Rosen, if I could make a comment because I missed part of the meeting today?

CHAIRMAN ROSEN: Please?

MS. BLACK: This morning there was a question about why we had separated --

CHAIRMAN ROSEN: Suzanne.

MS. BLACK: Oh, sorry. Suzanne Black, director, DSSA.

There was a question this morning about why we separated the regulatory guidance from this rule. And instead of relying on my memory, I went back and got the piece of paper that we brought you the copy of.

This was back in 2001 when the decision was being made about whether we would actually forward in trying to adopt this regulation or whether it was just a useless exercise because nobody in the industry was going to use it.

So we came to the agreement with NEI that we would go forward and they would support this by preparing the implementation guidance. But at that time they said they couldn't finish the implementation guidance until December 2002. It's

not December 2002 yet, is it?

Anyway, we also had a schedule here for the rule. But we told the commission in this commission memorandum that we were separating the schedules because we didn't want to hold up the rule for the guidance document at that time.

I think we wanted to keep the impetus behind getting the rule out. We also realize that there are some people, like perhaps Duke, that has already done some of this piloting, that could pick it up in advance of our reg guide that was endorsing one way of implementing the rule. So it was a conscious decision, although an unusual decision, to separate them.

And the final rule that you heard described today is essentially identical to the draft rule that you reviewed a year ago. So I think our position would be that we would prefer to have the rule go out in advance of the reg guide. That's been our management position anyway and as agreed to by the fact that they didn't disagree.

We didn't put this up for a vote, but we informed them that was out path. And we didn't get any disagreement from the commission in that. So that would be --

MEMBER WALLIS: This happens in other areas, too, where there is an issue and a decision has to be made to what you do. It seems that the staff should never be in the position for waiting for NEI to do something if there is an issue.

MS. BLACK: Right.

MEMBER WALLIS: You should go out and issue a rule or whatever it is that has to be done. And this will provoke NEI to actually get on and finish up that part of the job.

MS. BLACK: Exactly. And in this case, it's a voluntary alternative, so if it's to their benefit to pick it up. And we are going to review the first couple just as a trial to make sure that the implementation guidance is perfectly understood, as well as can be.

MR. WEERAKKODY: Can I have a minute?

CHAIRMAN ROSEN: Yes, of course. It's feasible, but make sure it's effective.

MR. WEERAKKODY: Actually, that is the item I wanted to mention. I have been taking notes down, but I am going to rely on this constant to look at your feedback; in fact, the communication plan.

The one item that I am looking at the

feasibility and some of the alternative words suggest that in the area of manual actions, I am looking at the high-level guidance that you shared in talking in terms of using the state-of-the-art to the extent practicable, I think that we fully agree and we want to adopt.

But the other I wouldn't say contradictory but other constraints we would come under that I wanted to share with you because if you have a proposal to the point where we create numerical thresholds for the manual actions and try to use them as additional criteria, we may have practically trouble doing that for all manual actions.

One of the items I gave Marvin was the award sheets. It's pre-decisional. He's going to make copies for you and pass out. And there you would see some comments that, actually, all three of the commissioners made.

So when we made the plan, obviously we want to listen to your advice and follow it, but there are some numerical constraints there when you really do find out what they are because I know maybe a year from now or six months from now, we will be back here. And then you would want to know

how we comment on did we use the word "feasibility" or did we use a different word that is more number-oriented?

CHAIRMAN ROSEN: I hope it's not a year. I will respond to Jack's comment about the glacial pace of all of this. To the extent that we could help you move it along more quickly, I think the Fire Protection Subcommittee ought to give you more opportunity to come and talk to us. I hope it's not a year. Marvin will do his best to try and schedule you in here before next September comes.

MR. WEERAKKODY: Okay.

MR. HANNON: Just to follow up on that thought. Earlier -- this is John Hannon -- we had asked that maybe there would be a way the subcommittee could help us expedite and facilitate some of the actions that we are trying to take; in particular, with regard to the 805 rulemaking.

We heard a pretty good synopsis of the status of that effort this morning. I am wondering if there is a way you could reconsider the potential for providing us an opportunity to come back and brief the full committee on that rule to try to get an endorsement for what we are doing there.

CHAIRMAN ROSEN: Well, I will ask the

staff to look into that. I think that it is not likely that it will be possible in October, but November or possibly December, we might be able to do that.

But we would need a subcommittee meeting again if we are going to actually go to the full committee with a recommendation of some kind.

MR. HANNON: I understand.

MEMBER WALLIS: Do you have to have ACRS endorsement for this? Is it stipulated that we have to do it? Why can't you just proceed because it's a good thing to do without having the whole committee involved?

MEMBER SIEBER: I think they are just trying to expedite the process.

MEMBER WALLIS: This would help you, you think?

MS. BLACK: I don't know that it is a requirement. I was asking Eileen McKenna, but, unfortunately, she is no longer here, whether a letter was needed.

And I can't recall whether you wrote a letter on the draft rule last year because since it hasn't really changed, if you did write a letter, I don't know that another letter would be needed. I

can find out the answer.

CHAIRMAN ROSEN: I think we wrote a letter that said we agree with going with the risk-informed --

MEMBER SIEBER: Yes. I think I wrote it.

MS. BLACK: I think you did, too. And since it hasn't changed, I don't know why another letter would be required. And you could just say, "We don't think we need to write another letter because nothing has changed from the draft."

MR. DIEC: This is David Diec from the staff. I could talk to that a little bit from Eileen's perspective.

Clearly, the recommendation letter from the committee would help expedite the process as we go through and brief the CRGR because typically they will ask, "Have you gone through the whole process?" and see what people are having any opinions on this issue and whether or not we are consistent with the approach.

MS. BLACK: Of course, this is a voluntary alternative. So CRGR is not as crucial is --

CHAIRMAN ROSEN: Yes, the CRGR. And you

could point to the June or so letter from last year, --

MS. BLACK: That's correct.

CHAIRMAN ROSEN: -- in which we said, yes, voluntary alternatives to appendix R are a good thing. Let's get 50.48 revised.

MS. BLACK: Right.

MEMBER SIEBER: Is CRGR involved at all for voluntary?

MS. BLACK: We have to give them the opportunity to get involved, but they could decline, too, considering they don't have to.

MEMBER SIEBER: Right. Okay. Thank you.

CHAIRMAN ROSEN: All right. With that, unless there are comments from members of the public or the staff or my colleges?

(No response.)

CHAIRMAN ROSEN: If not, we are adjourned for the day six minutes early.

(Whereupon, at 5:25 p.m., the foregoing matter was adjourned.)

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.

Rebecca Davis

Rebecca Davis
Official Reporter
Neal R. Gross & Co., Inc.

FIRE DYNAMICS TOOLS (FDTs)
NUREG-1805

Naeem Iqbal and Mark Henry Salley, P.E.

Office of Nuclear Reactor Regulation
Division of Systems Safety and Analysis
Plant Systems Branch
Fire Protection Engineering and Special Projects Section

Presentation at the Advisory Committee on Reactor Safeguards
Meeting of the Subcommittee on Fire Protection
September 9, 2003

United States Nuclear Regulatory Commission
Washington, DC 20555-0001

NRR
Office of Nuclear Reactor Regulation

PURPOSE of FDT^s

FDT^s are a series of Microsoft Excel® spreadsheets issued with **Draft NUREG-1805, "Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program."**

- To support the NRC **Goal** of using **Risk Insight** with the Regulation in the Reactor Oversight Process (ROP).
- To advance the **Fire Hazard Analysis** (FHA) process from a primarily **Qualitative Approach** to more of a **Quantitative Approach** by applying fundamental **Fire Protection Engineering Principles.**

REGULATORY APPLICATION of FDTs

- To support **Significance Determination Process (SDP)** to evaluate inspection findings required by the **ROP**.
- To evaluate the **Significance** of non-compliance fire protection issues.
- To support evaluation of fire protection exemption requests.

BACKGROUND and STATUS of FDT^s

- NRR developed FDT^s as a part of the Quarterly Regional Inspector Fire Protection Training workshop program to train Regional Fire Protection Inspectors in fundamental of **Fire Dynamics.**

- FDT^s provide a tool that can be quickly used to assess potential for a credible fire scenario during NPP fire protection inspections on site.

- Draft **NUREG-1805** was developed over a 3 year period, is currently published for public comments.

EVOLUTION OF QUANTIFYING FIRE SCENARIOS IN NPPs

PAST

- Fire load expressed in (BTU/ft^2) does not consider other factors which greatly affect the compartment fire intensity such as, compartment volume, heat transfer characteristics of the enclosure boundaries, and ventilation openings.

PRESENT

- **FDT^s** is a training tool that can be used to teach **Fire Dynamics** and develop **First Order Fire Dynamics** evaluation in actual NPP applications.

FUTURE

- **NFPA 805,** Performance Based Standards for Fire Protection for Light Water Reactor Electric Generating Plants will use detailed **Fire Modeling Calculations.**

ORIGIN OF FDT^s

- FDT^s are modeled after the **U.S. Bureau of Alcohol, Tobacco, and Firearms (ATF)** Fire and Arson Investigation Program.

- Selected a series of state-of-the-art **Fire Dynamics Correlations** from *SFPE Handbook of Fire Protection Engineering*, *NFPA Fire Protection Handbook*, and other relevant fire dynamics text.
  - Customized for NPP applications
  - Appropriate physical properties

FEATURES OF FDTs

- User-friendly, Microsoft Excel® based on **Fire Dynamics** equation/correlations, **Pre-Programmed.**
  - Quick application of **Fire Dynamics** principles found in the Handbooks
  - Spreadsheets are protected to prevent tampering.
  - Automatic unit conversion.
  - Related material fire properties data for materials found in NPP listed within each spreadsheet.
  - Reduces input errors from inaccurate manual entries pull-down menus allow user to select the input from the material fire property data table.

REGIONAL INSPECTOR TRAINING

- Training covered basic principles of Fire Dynamics, **Assumptions, Limitations**, and **Bounding Analysis.**
- Quarterly training led by NRR staff **Fire Protection Engineers.** New spreadsheets were presented at each quarterly training session.
- Inspectors independently develop fire scenarios and solve realistic problems.
- **NUREG-1805** text addresses the **Technical Bases** for **FDTs** and covers many aspects of **Fire Dynamics.**

CONCLUSION

- By taking a commonly available computer spreadsheet software (like Microsoft Excel®) and creating a series of computational spreadsheets, **Complex Concepts** like Fire Dynamics can be taught to inspectors and put into reliable field application.

- The use of the **FDTs** further reduces mathematical complexities and errors, and promotes greater application of fire science and engineering in **Field Use.**

- **NUREG-1805** and **FDTs** can make a positive impact in the NRC's **Fire Protection Inspection Program**, specifically risk-informed fire protection initiatives such as **SDP** and risk-informed Inspection of **Associated Circuits.**

EVALUATING FIRE SCENARIO USING FDTs

Following example demonstrate how to perform a quantitative FHA using FDTs.

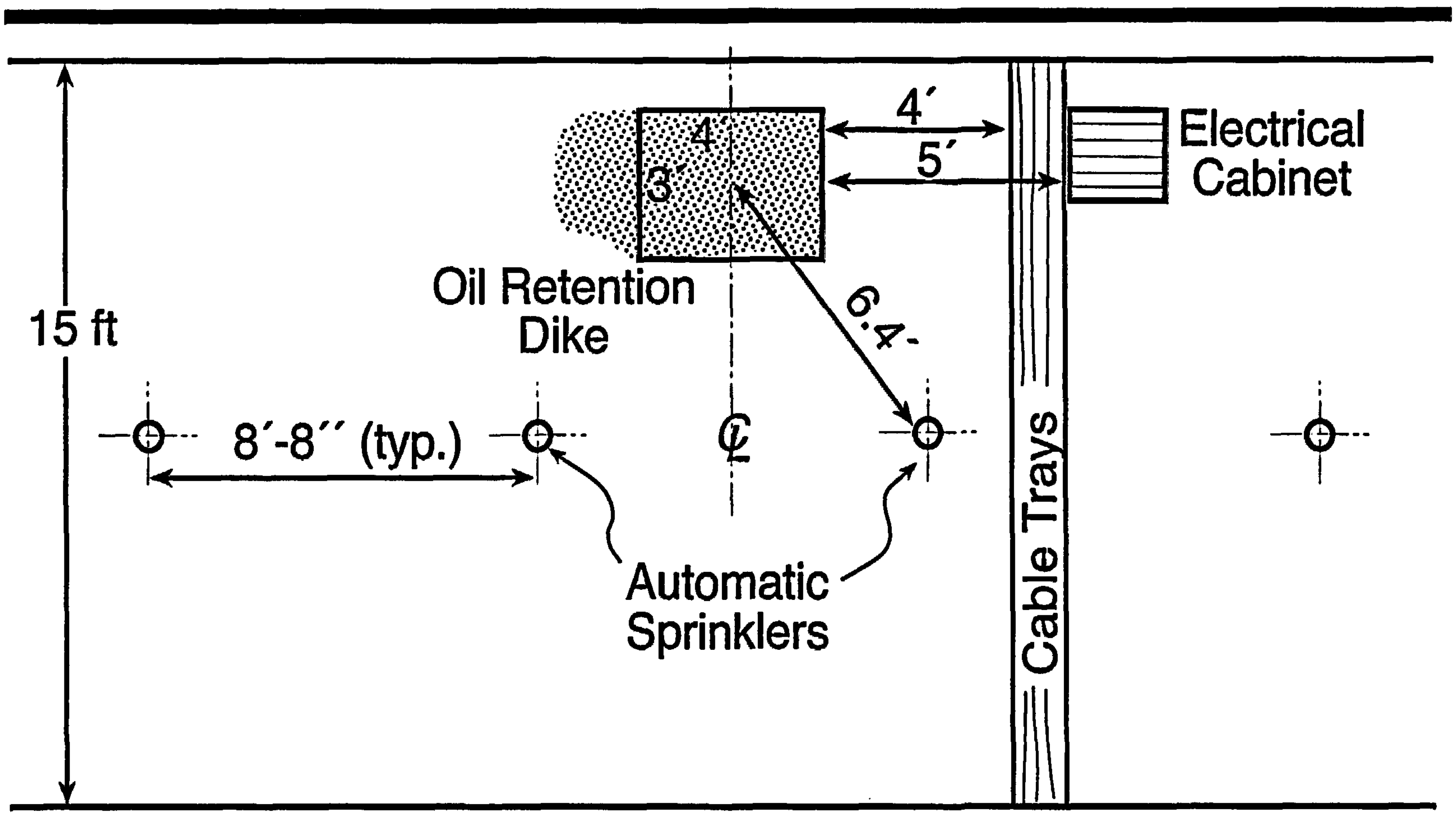
PROBLEM STATEMENT

During a routine fire protection inspection, an NRC inspector discovers an significant oil leak in a station air compressor in an access corridor in the auxiliary building. Compressor has a 12 ft^2 (1.12 m^2) oil retention dike. The dike is located 1 ft (0.3048 m) from the wall. The unprotected safety-related cable trays are located 8 ft (2.45 m) above the floor, 4 ft (1.2 m) horizontally from the edge of the dike. A safety-related electrical cabinet is located 5 ft (1.52 m) horizontally from the edge of the dike.

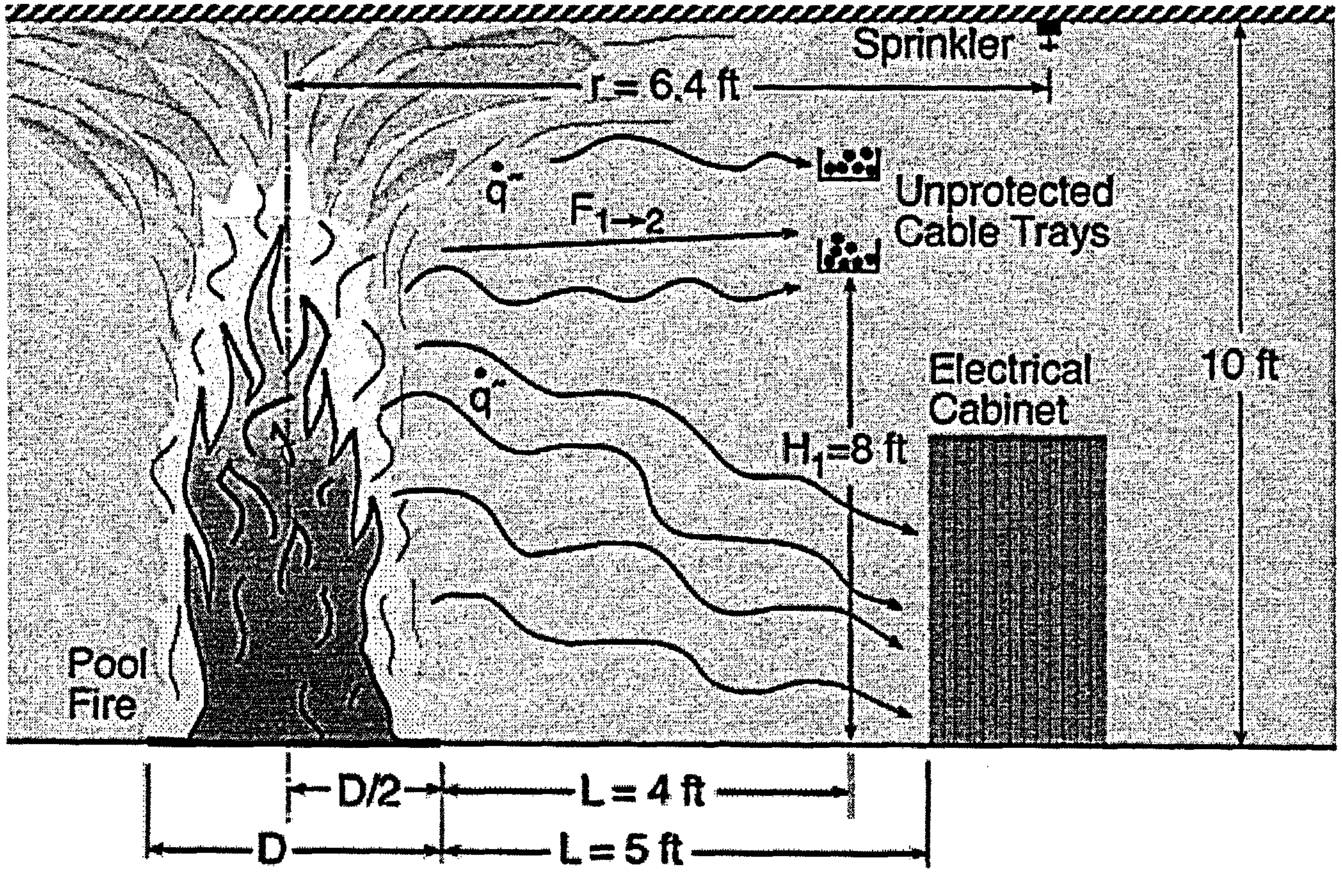
The corridor has a floor area of 30 x 15 ft (36.6 x 4.6 m), a ceiling height of 10 ft (3 m), and has two fire rated doors of 3 x 7 ft (0.914 x 2.15 m). The corridor has no forced ventilation system. The walls, ceiling, and floor are constructed of 1 ft thick concrete. The corridor has a smoke detection system and wet pipe sprinkler system. The nearest sprinkler is rated at 165 °F (74 °C) with a RTI of 235 $(m\text{-}sec)^{(1/2)}$ and is located 6.5 ft (1.98 m) from the center of the dike. The nearest smoke detector is 20.5 ft (6.25 m) from the center of the dike.

Determine if there is a credible fire hazard to the unprotected safety-related cable trays and electrical cabinet. (Assume no ventilation effects on the fire.)

FIRE SCENARIO



FIRE SCENARIO



SOLUTION

ANALYSIS

Fire damage resulting from spills of flammable and combustible liquid fuels depend on the fuel type, the size and shape of the fire, the duration of the fire, its proximity to the target, and the thermal characteristics of the target. Combustible liquids that have relatively high flash points (e.g., lube oil or diesel fuel), require localized heating to ignite. However, once ignited, a pool fire rapidly spreads over the surface of the liquid spill. To perform a FHA, FHA, assume that the 20 gallons of lubricating oil spills into the diked area and is ignited by the failed compressor.

SPREADSHEETS (FDT[s]) INFORMATION

Use the following FDT[s] to determine:

- Heat flux to the target (electrical cabinet) Heat_Flux_Calculations_Wind_Free.xls (Click on Solid Flame 1)
- Heat flux to the target (cable trays) Heat_Flux_Calculations_Wind_Free.xls (Click on Solid Flame 2) Target above ground level
- Hot gas layer temperature in the corridor Temperature_NV.xls (Click on Temperature_NV Thermally Thick)
- Sprinkler activation time, $t_{activation}$ Detector_Activation_Time.xls (Click on Sprinkler)

RESULTS

The summary results of FHA calculations are:

- Heat flux to the target (electrical cabinet) = 8.90 kW/m^2
- Heat flux to the target (cable trays) = 16.40 kW/m^2
- Hot gas layer temperature in the corridor = 450 °F (232 °C) doors open
- Hot gas layer temperature in the corridor = 545 °F (285 °C) one door open only
- Sprinkler activation time, $t_{activation}$ = 1.2 min

Heat fluxes to the electrical cabinet and cable trays are high enough to damage them. The FHA calculation demonstrates that a pool fire with a 12 ft^2 dike area in a corridor could damage remote unprotected safety-related cable trays and electrical cabinets.

For this analysis the sprinkler system, if operable, should quickly activate and mitigate damage to the safety-related cable tray and electrical cabinet.

OVERVIEW OF FIRE PROTECTION ACTIVITIES

Presentation to the ACRS Subcommittee on Fire Protection

September 9, 2003

Sunil Weerakkody, Section Chief
Fire Protection and Special Projects
Office of the Nuclear Reactor Regulation

Staff Introduction

Discussion Topics

- 10 CFR 50.48 (c) or NFPA 805 Rule Making
- Risk Informing Associated Circuits
- Development of Fire Dynamic Tools
- Manual Action Rule Making

- Later date by PRA Branch – Significant Determination Process

Challenges and Overall Path for Solution

- Legacy
- Questions on licensing basis
- Achieve safety without undue burden to stakeholders

- Solution: Performance-Based Risk-Informed approaches

ACRS Support

- Review
- Feedback
- Endorsement of future direction

RISK-INFORMING ASSOCIATED CIRCUIT INSPECTION RESOLUTION

Sunil Weerakkody, Chief

Office of Nuclear Reactor Regulation
Division of Systems Safety and Analysis
Plant Systems Branch
Fire Protection Engineering and Special Projects Section

Presentation at the Advisory Committee on Reactor Safeguards
Meeting of the Subcommittee on Fire Protection
September 9, 2003

United States Nuclear Regulatory Commission
Washington, DC 20555-0001

Office of Nuclear Reactor Regulation

NRC ACTIVITIES

- Preparing to retract the Memo halting Inspections by end of November 2003.
- Inspection will focus on most Risk Significant cases.
- Most effective use of Inspection and Licensee Resources.

NRC ACTIVITIES

- Public Workshop at NRC Headquarters, Rockville, Maryland November 2003.
- Published a Regulatory Issue Summary (RIS) for comments.
- Will Publish a Staff NUREG-1778 on Knowledge Base for Post-Fire Safe Shutdown Analysis for public comments (November 2003).
- Will Revise Inspection Procedure (November 2003).
- DSSA/SPLB working to revise the SDP.

NRR
Office of Nuclear Reactor Regulation

ESTIMATING HOT GAS LAYER TEMPERATURE METHOD OF McCAFFREY, QUINTIERE, AND HARKLEROAD (MQH)

Natural Ventilation Compartment Fire

$$\Delta T_g = 6.85\left[\frac{\dot{Q}^2}{\left(A_v\sqrt{h_v}\right)\left(A_T h_k\right)}\right]^{\frac{1}{3}}$$

Where:

ΔT_g = upper layer gas temperature rise above ambient (T_g - T_a) (K)

= heat release rate of the fire (kW)

A_v = total area of ventilation opening(s) (m^2)

h_v = height of ventilation opening (m)

h_k = heat transfer coefficient (kW/m^2-K)

A_T = total area of the compartment enclosing surfaces (m^2), excluding area of vent opening(s).

THERMALLY THIN SOLID

$$h_k = \frac{k}{\delta}$$

THERMALLY THICK SOLID

$$h_k = \sqrt{\frac{k\rho c}{t}}$$

Where:

ρ = density of the interior lining (kg/m^3)

c_p = thermal capacity of the interior lining (kJ/kg-K)

k = thermal conductivity of the interior lining (kW/m-K)

NRR

Office of Nuclear Reactor Regulation

RISK-INFORMING ASSOCIATED CIRCUIT INSPECTION RESOLUTION

Mark Henry Salley, P.E.

Office of Nuclear Reactor Regulation
Division of Systems Safety and Analysis
Plant Systems Branch
Fire Protection Engineering and Special Projects Section

Presentation at the Advisory Committee on Reactor Safeguards
Meeting of the Subcommittee on Fire Protection
September 9, 2003

United States Nuclear Regulatory Commission
Washington, DC 20555-0001

NRR
Office of Nuclear Reactor Regulation

BACKGROUND

- 10 CFR Part 50, Appendix R/NUREG 0800 SRP.
  - Provide reasonable assurance that **Fire-Induced Circuit Failures** that could adversely affect the ability to achieve and maintain post-fire safe shutdown will not occur
- Information Notice 99-17, Problem Associated with Post-Fire Safe Shutdown Circuit Analyses.
  - Recent problems with associated circuits at a number of licensees
- November 2000, NRC **Suspends** associated circuit inspection.

BACKGROUND (cont'd)

- NEI Fire Testing.
  - May 2002, EPRI published, "Spurious Actuation of Electrical Cables to Cables Fire: Results of Expert Elicitation."
- June 2002 ACRS Fire Protection Subcommittee.
  - Provide recommendation on NEI 00-01
- February 2003, Facilitated Public Workshop.
  - Consensus on most Risk Significant Scenarios
  - Identify most Risk Significant Cable Configurations and Attributes
- August 2003, Draft Regulatory Issue Summary (RIS).
  - Technical input for Risk-Informing Associated Circuit Inspections
  - Public Comment

ASSOCIATED CIRCUIT RISK

- Risk = (Fire Frequency) x (Likelihood of fire effects & cable attributes that contribute to failure) x (Likelihood of undesired consequences).

  - Fire Frequency established in other programs
  - Creditable Fire Threat
    - Fire Dynamics
  - Cable Attributes
    - Thermal Failure Mechanism
  - Severity of Consequence

NRR
Office of Nuclear Reactor Regulation

CABLE ATTRIBUTES

- Fire Testing.
  - Past Research Work (Sandia National Laboratory, Factory Mutual, etc.)
  - NEI 00-01 Fire Testing Program
- Results.
  - Thermoplastic vs. Thermoset Jacket/Insulation
  - Intra vs. Inter Cable Failure

SEVERITY OF SPURIOUS OPERATION

- Most Risk Significant.
  - Failures that impede hot shutdown within the first hour of event

NUMBER OF CABLE FAILURE TO CONSIDER

- Two "cable" failures per scenario.
  - Intra – cable failure for Thermoset and Thermoplastic
  - Any number of conductors/combinations possible within the cable
  - Inter – cable failures possible for Thermoplastic cable

ISSUES REQUIREING FURTHER RESEARCH – MODERATE RISK

- Moderate Risk
  - Inter – cable shorting of Thermoset cables
  - Three or more cables for scenario
  - Effects of control power transformers
  - Duration of hot shorts

ISSURES REQUIREING FURTHER RESEARCH – LOW RISK

- Low Risk

  - Open circuits

  - Inter – cable shorting involving conduits and armored cable

  - Multiple high – impedance faults common power supply

  - Three-phase failures occurring with proper polarity

  - Reversible DC–motor power cable

NRR

Office of Nuclear Reactor Regulation

REMAINING ACTIVITY

- Issue final RIS.
- Issue staff NUREG-1778 for public comments.
- Conduct public workshop in November 2003.
- Revise Inspection Procedures as necessary based on Research Results.

CONCLUSION

- Inspections will focus on most **Risk Significant Cases.**
- Most effective use of Inspection and licensee Resources.

RES SUPPORT FOR SELECTED FIRE PROTECTION ACTIVITIES

By

J.S. Hyslop, RES/PRAB

RES SUPPORT – RISK INFORMED FP RULEMAKING

- Develop review guidance to support evaluations of:
  - Fire models
    - V&V: Five Rev 1, FDTs (Empirical), CFAST (Zone), FDS (CFD)
    - Utilize ASTM standard 1355-97 (and supplement)
    - Includes scenarios identified by NRR
  - Inputs to fire models, e.g. heat release rates
  - FRA methods, tools, and data, including
    - Frequency / severity
    - Circuit analysis
    - Detection / suppression

RES SUPPORT – CIRCUIT ANALYSIS RESOLUTION

- Participated in Omega Point tests
- Supported expert elicitation panel
- Authored chapter on risk in draft NUREG-1778, "Knowledge Base for Post-Fire Safe Shutdown Analysis"
- Participated in 2/03 public meeting to identify important circuit issues for planned inspections
- Will participate in upcoming public meeting on associated circuits
- Will address User Need: Identify any other circuit issues which should be added to inspection

NFPA 805 RULEMAKING

ACRS Fire Protection
Sub-Committee Briefing
September 9, 2003

Paul Lain, Plant Systems , NRR
Joe Birmingham, Rulemaking, NRR
J. S. Hyslop, PRA Branch, RES

NFPA 805 - Performance-Based Standard for Fire Protection for LWRs

- Background
- Advantages
- NFPA 805 Structure
- Implementation
- Rule Structure
- Status of Rulemaking
- Related Research

NFPA 805 - Background

- 1975 - Browns Ferry Fire
- 1980 - Appendix R
- 1998 - Reg. Guide 1.174, PRA
- 1998 - SECY 98-058, RI/PB FP Std
- 2000 - SECY 00-009, Rulemaking Plan
- 2001 - NFPA 805 Published
- 2002 - Proposed Rule Published

NFPA 805 - Advantages

- Reduces regulatory burden
- Endorses a National consensus standard
- Stakeholder involvement
- Voluntary
- Sets performance goals and criteria
- Focus on risk significant issues
- Maintains safety margin & defense-in-depth

NFPA 805 Structure

- Maintains a core FP program
- Requires an analysis to establish a fundamental fire protection program
- Allows transition of existing licensing basis including exemptions and GL 86-10 evaluations (Grandfathering)
- Guidance on performing nuclear safety analysis, fire modeling and fire PRAs

NFPA 805 Structure (Continued)

- NFPA 805 Chapter 3 "Fundamental Fire Protection Elements"
  - Fire Protection Plan
  - Fire Prevention (e.g. control of combustibles)
  - Fire Brigade
  - Water Supply
  - Standpipes and Hose Stations
  - Fire Extinguishers
  - Fire Alarm and Detection Systems
  - Water-Based Fire Suppression Systems
  - Gaseous Fire Suppression Systems
  - Passive Fire Suppression (e.g. building separation, fire barriers, penetrations)

NFPA 805 Structure

- Differences from App. R
  - Cold shutdown
  - Emergency lighting
  - Alternate/dedicated shutdown
  - Analyzed shutdown method
  - Recovery Actions
  - Adds radiation release criteria

Implementation

- PB FP Regulatory Guide
  - NEI Implementation Guide
  - NEI Circuit Analysis
- License Amendment SRP
- Enforcement discretion during transition
- ROP monitors future changes

Rule Structure

- Incorporates NFPA 805, 2001 Edition into 10 CFR 50.48 as an alternative to Appendix R
- Identifies 6 exceptions to the standard
- Requires license amendment to adopt NFPA 805 including identifying any license revisions
- Requires licensee to complete a plant wide evaluation before changing fire protection program

Rule Structure

- Licensees document evaluation and retain records on site
- Alternatives to 805 and changes to Chap. 3 elements require a license amendment
- NRC approval of methods is not required
- Decommissioning plants may also comply with NFPA 805
- Allows NRC to review new RI/PB methods in the future

Current Status

- Proposed rule was issued November 2002
- Comment period ended January 2003, comment resolution was developed
- FRN package in concurrence with OGC
- Rev D of implementing guidance was provided by NEI April 2003
- Staff has prepared comments on Rev D

Schedule

- Office concurrences planned for October, 2003
- Final Rule to ACRS, CRGR December, 2003
- Final Rule to the Commission, Spring 2004
- Final Rule Published one month after SRM

Risk Informed Fire Protection

ACRS Fire Protection Subcommittee Meeting
September 9, 2003
By
Doug Brandes
Duke Power

NFPA 805

- Current Status
- Pilot Project – McGuire
- Comments Concerning Rulemaking

Current Status

- Draft Rule language available for comment
- Draft Implementing Guidance submitted to NRC for comment
- NEI 00-01 NRC comments addressed and resubmitted

Implementing Guidance Outline

- Chapter 1 – Introduction
- Chapter 2 – Responsibilities & Qualifications
- Chapter 3 – Applicability
- Chapter 4 – Regulatory Framework
- Chapter 5 – Process & Options
- Chapter 6 – Transition
- Chapter 7 –Use of "Tools" in existing Licensing Basis
- Chapter 8 – Documentation & Configuration Control
- Appendices

NFPA 805 Pilot - McGuire

Basis

- NFPA 805
- Draft Rule
- Draft Implementing Guidance
- NEI 00-01

NFPA 805 Pilot - McGuire

- Six discrete topics
  - Licensing
  - Classical Fire Protection
  - Safe Shutdown
  - Shutdown Operations
  - Radiological Protection
  - Configuration Management, Performance Monitoring

Licensing

- Produced three documents
  - Draft Letter of Intent
  - License Amendment
  - Transition Plan

Classical Fire Protection

- Map current licensing basis to NFPA 805 Chapter 3

Safe Shutdown

- Draft Sample Fire Area Safe Shutdown Analysis
- Deterministic – "drop in CLB"
- Risk Informed
  - Safe Shutdown Logic Diagrams
  - NEI 00-01 Circuit Analysis

Shutdown Operations

- Analyze Additional Systems
  - Residual Heat Removal
  - Spent Fuel Cooling

  Appendix R type Analysis

  Can be incorporated in Safe Shutdown Analysis & shutdown risk management programs

Radiological Protection

- Protect Fire Fighters to 10CFR Part 20 requirements
  - Existing program satisfies this requirement
  - Update documentation and add to CLB

Configuration Management and Performance Monitoring

- Existing Programs are can be used
- Modify Programs for new licensing basis

Resource Requirements

- Directly dependent on the initial documentation
  - Work hour estimate 2,000 to 6,000 hours
  - Skill sets:
    - Compliance
    - Fire Protection
    - Safe Shutdown
    - PRA
    - Fire Brigade

NFPA 805 Pilot - McGuire

- Conclusion – "It might actually work" HDB

Rulemaking Comments

- Rule language needs clarity with respect to need for license amendments for "alternate methods"
- License amendment should not be required for use of "alternative methods"
  - Non Power Fire PRA
  - New computer Fire models

Resolution of Circuit Failure Issues

Fred Emerson, NEI

Advisory Committee on Reactor Safeguards
Fire Protection Subcommittee
September 9, 2003

1

Topics

- Summary of topics addressed previously to ACRS Fire Protection Subcommittee
- Current status of resolving fire-induced circuit failure issues

2

Summary of Topics Addressed Previously (June 2002)

- Results of EPRI/NEI circuit failure testing
  - Observations only
- Results of expert panel development of
  - Probability of cable damage due to fire
  - Probability of spurious actuations given cable damage
- Results of pilot evaluations of NEI 00-01 at two plants
- Summary of issues remaining to be resolved with NEI 00-01 (early draft)

3

Topics to be Addressed Today

- Conclusions from EPRI/NEI testing
  - EPRI report 1003326, "Characterization of Fire-Induced Circuit Faults, " December 2002
- Summary of NEI 00-01 Revision 0
  - Intended use
    - Deterministic methods
    - Risk methods
  - Multiple high impedance faults
- Recommendations for closing fire-induced circuit failure issues

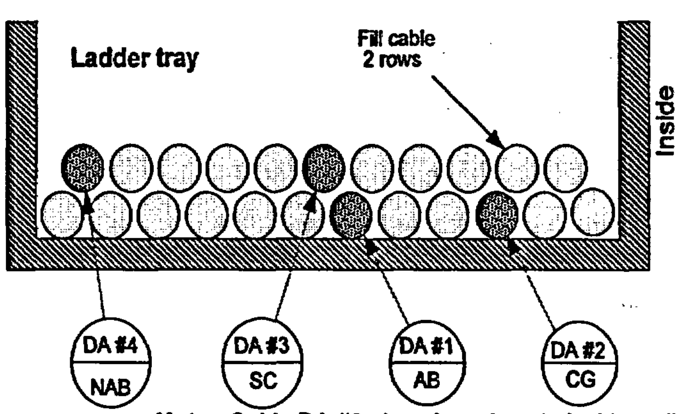
4

EPRI Test Report Includes...

- Detailed description of all tests
- Test-by-test review & analysis
  - Test arrangement & parameters
  - Temperature profiles
  - Electrical profiles
  - Sequence of events

5

Tray Configuration (Typical)



Note: Cable DA #2 placed as close to inside wall as possible without violating cable bend radius.

6

Test Results...

- Temperature & electrical profiles
  - Developed for all cables tested
  - Graphical depiction of cable performance
  - Helpful in identifying patterns and trends
- Key observations & conclusions
  - Fault modes - hot shorts, ground faults, open circuits
  - Characterization of spurious actuations

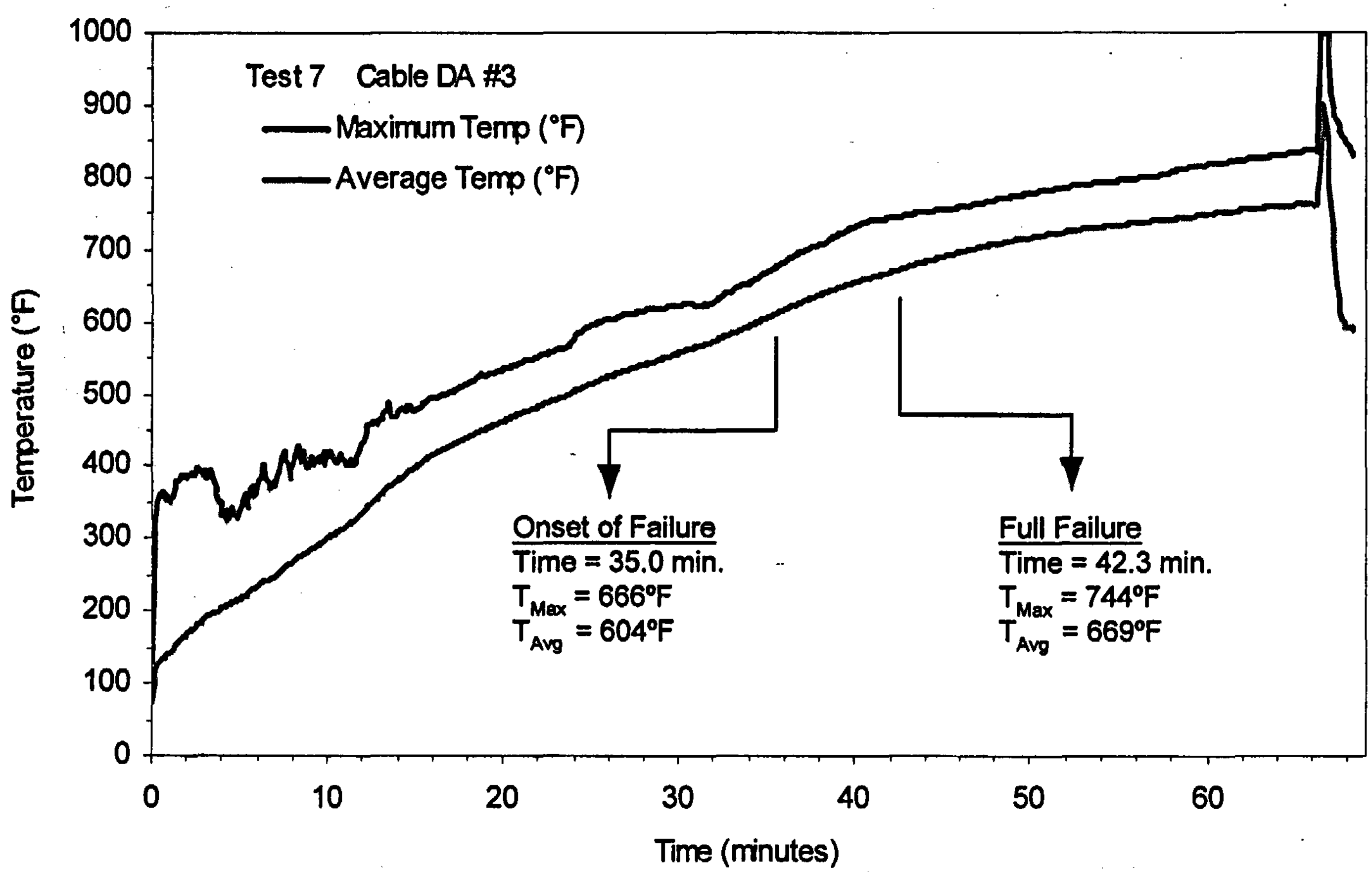
7

Example Profiles

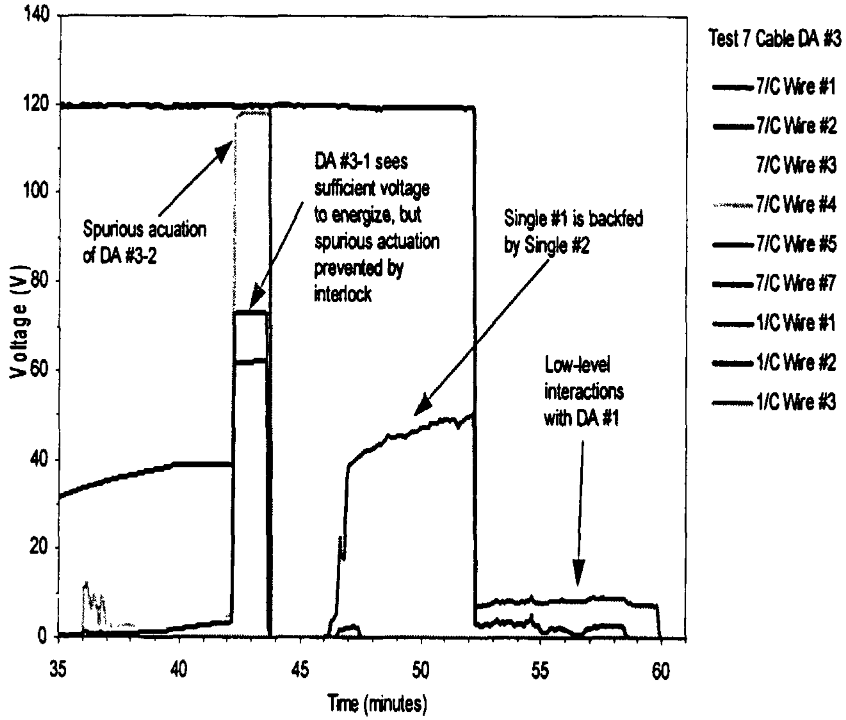
- Test 7 cable bundle DA #3
  - 7/C & 1/C thermoset cable
  - 350 kW HRR with cables in HGL
  - Located in bottom row of tray
  - Laboratory power supply

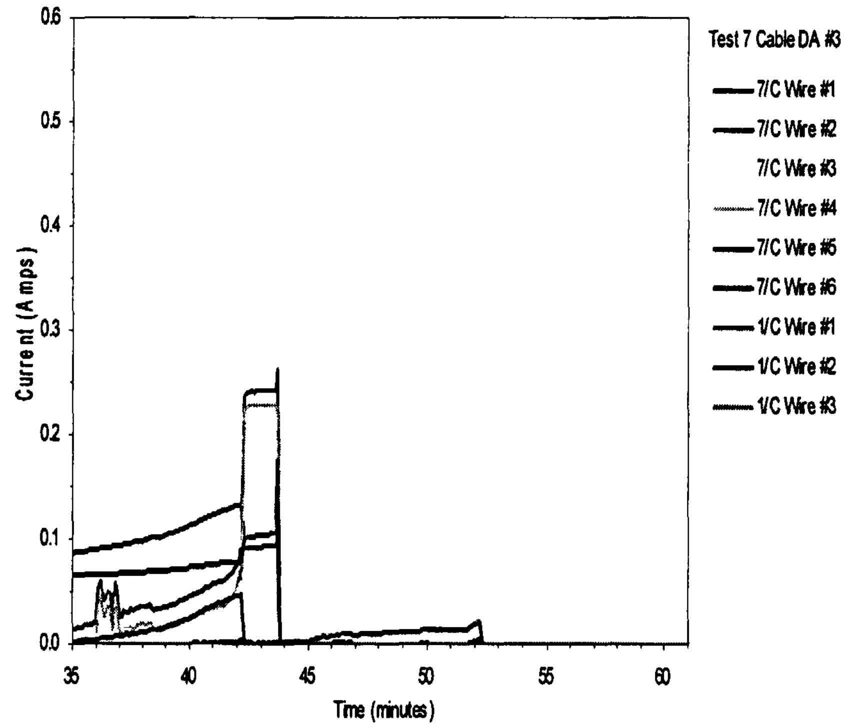
8

Temperature Profile (Typical)



Electrical Profile (Typical)





Overall Results Summary

11

Failure Mode Summary by Cable Type

	Armored Cable		Thermoset Cable		Thermoplastic Cable		Total	
Open Circuits	0	0%	0	0%	0	0%	0	0%
Ground Faults	6	85.7%	47	69.1%	25	64.1%	78	68.4%
Hot Shorts	1	14.3%	21	30.9%	14	35.9%	36	31.6%
Total Failures	7	100%	68	100%	39	100%	114	100%

12

General Observations

- Pretest concept of 1,000 ohm threshold impedance did not prove viable
  - Many shorts exhibited a near zero fault resistance
- Statistical characterization is achievable
  - General trends predictable
  - Better understanding of primary influence factors
  - Probability values still carry relatively high uncertainty

13

General Observations

- Definitive predictions not supported
  - The specific behavior and characteristics of any one fault cannot be predicted with full certainty
  - A full understanding of the fault dynamics and interdependencies is beyond the current state of knowledge

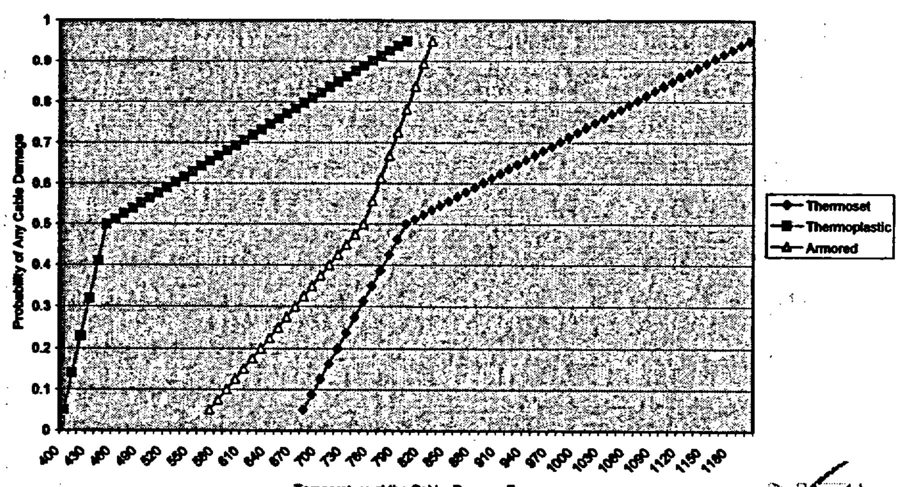
14

General Observations

- Two tests with no failures
  - Thermoset cable
  - HGL at 200 KW
  - Plume at 70 KW
- Refer to "Cable Fragility Curve" for temperature correlation

15

Fragility Curves



16

Important Influence Factors

- Cable type
- Tray fill
- Power source characteristics

17

Cable Type

- Thermoset cable has much higher damage threshold than does thermoplastic cable
  - Time
  - Temperature
- Occurrence of hot shorts about equal (30-35%) but likelihood of spurious actuation higher for thermoplastic cable (see table), given cable damage

18

Tray Fill

- Interior cables shielded against damage
- Interior cables have higher incidence of hot shorts if damaged

19

NIEL

Power Source Characteristics

- Power source characteristics had little influence on failure mode but substantial influence on spurious actuation likelihood
- CPTs (low energy devices) had fewer spurious actuations

20

NIEL

Second Order Influence Factors

- Orientation
- Exposure Type
- Water Spray

21

Internal vs. External Hot Shorts

- External hot shorts do occur, but overall likelihood is much lower than internal hot shorts
- External hot shorts occurred in thermoset cable, but NONE resulted in spurious actuations
- Thermoplastic cable showed significantly higher propensity for externally generated spurious actuations (47% from external shorts)

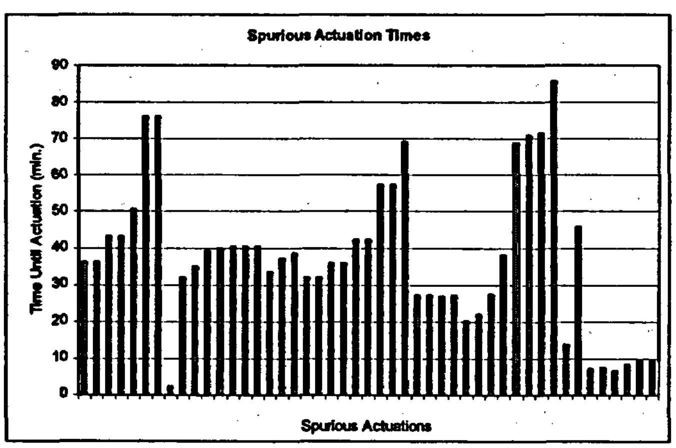
22

Multiple Simultaneous Hot Shorts

- Given that a hot short occurs in a multi-conductor cable, it is highly probable (over 80%) that multiple target conductors will be affected (i.e., multiple simultaneous dependent hot shorts)
- Multiple independent (different source conductor) hot shorts occurred for a specific cable bundle, with some occurring simultaneously

23

Time to Spurious Actuation



24

Spurious Actuation Duration

	Armored (min.)	Thermoset (min.)	Thermoplastic (min.)	Overall (min.)
Longest Duration	0.9	13.0	10.1	13.0
Shortest Duration	0.7	0.1	0.1	0.1
Average Duration	0.8	1.8	2.8	2.1
Standard Deviation	0.1	2.8	3.2	2.9

25

Key Conclusions

- Given cable damage, single spurious actuations are credible and multiple spurious actuations cannot be ruled out
- External cable hot shorts are credible, but none resulted in spurious actuations for thermoset cable
- The overall likelihood of spurious actuations (given cable damage) for thermoplastic and thermoset cable is higher than previously thought (NUREG-2258)

26

Key Conclusions

- There exist predictable thresholds below which cable failures do not occur
- The overall average time to cable failure was more than 30 minutes – early time critical actions can significantly reduce risk for high consequence failures/spurious actuations
- Current limiting devices (e.g., CPTs, isolation transformers) reduce the likelihood of spurious actuations
- The average duration (< 3 minutes) indicates that AOVs and PORVs will return to a safe condition when the fault clears

27

NEI 00-01

- Revision 0 submitted for NRC review in May 2003

28

Use of NEI 00-01

- General guidelines for use of deterministic method
  - Typically licensed, commonly used safe shutdown analysis methodology
    - Assumptions/guidelines similar to those currently used
  - Not intended for wholesale re-evaluation of safe shutdown analysis
    - Approved safe shutdown analysis assumed

29

Use of NEI 00-01

- Use of risk significance methods
  - Can be used with any deterministic method
  - Can be used to address identified single or multiple spurious actuation issues
  - Must consider all fire areas where combination exists
  - SM/DID analysis must be performed before screening out any combination

30

Changes in NEI 00-01

- Preliminary risk screening
  - Analysis considers
    - Risk: Frequency of undesired fire-induced circuit failure
    - Consequences: Inability to achieve and maintain safe shutdown
  - Method:
    - Table 4-1 provides for screening based on frequency and consequences
    - Tables 4-2 provides supporting information for assessing frequency and consequences
    - Table 4-3 provides supporting information for crediting mitigation and hot shutdown

31

Changes in NEI 00-01

- Final risk screening
  - CDF determination essentially unchanged
    - Spurious actuation probabilities taken from testing and expert panel results
  - Consideration of LERF:
    - $F_f * P_E * P_{SA} * P_{AS} * P_{DM} * \Delta P_{LERF} < 1E\text{-}7$ (all areas)
    - Met if
      - Quantitative LERF analysis meets above criterion
      - Qualitative LERF analysis shows containment function remains intact and LERF event unlikely
      - CDF < 1 E-7 all areas

32

Changes in NEI 00-01

- Final risk screening
  - Uncertainty and sensitivity analysis should consider
    - Sensitivity of the results to uncertainty of the factors in the screening formula, including
      - initiating event frequency
      - suppression probabilities
      - severity factors
      - circuit failure probabilities
      - factors affecting LERF
    - Fire modeling uncertainty
    - Uncertainty of physical location of cables and equipment

33

Changes in NEI 00-01

- Multiple high impedance faults (Appendix B-2)
  - MHIF do not pose credible risk if:
    - Power supply conforms to base case requirements:
      - Voltage 110v (AC or DC) or greater
      - Adequate coordination between load and supply side protective devices
      - Minimum size ratio of 2:1 supply:load breakers for 202VAC and 120VDC
      - Fault current sufficient to allow predictable operation of overcurrent protective devices
      - Overcurrent protective devices applied within rating and are listed or approved by recognized test lab
      - Proper maintenance, testing, Etc. for overcurrent devices
    - De-energized power supply will not cause opening of high/low pressure interface valve

34

Recommendations for Fire-Induced Circuit Failure Issue Closure

- Well-understood set of regulatory expectations needed to provide a basis for inspections and licensee actions
- NEI recommends
  - NRC focus circuit failure inspections on compliance with plant licensing basis
  - NRC accept plant use of NEI 00-01 deterministic methods if licensing basis not clear
  - NRC accept NEI 00-01 probabilistic methods along with SDP or plant PRA analysis for risk significance determination

35

Post-Fire Operator Manual Actions Rulemaking Plan

David Diec
Erasmia Lois
Phil Qualls

September 9, 2003

Post-Fire Operator Manual Actions Rulemaking Plan Briefing Agenda

- Current Status
- Background
- Objectives
- Alternatives
- Approach
- Next Steps

Post-Fire Operator Manual Actions Rulemaking Plan Current Status

- Commission Released Rulemaking Plan (SECY-03-0100) to Public on July 2, 2003
- Fire Protection Inspection Procedure IP-71111.05 Issued on March 6, 2003

Background

- Questions about compliance with Paragraph III.G.2 of Appendix R to Part 50 arose as a result of recent inspections of licensee fire protection programs
- Appendix R, III.G.2 does not recognize manual actions
- Principal concerns are associated with the use of operator manual actions to provide capability to achieve and maintain hot shutdown
- Not all manual actions implemented by licensees have been approved by NRC

Post-Fire Operator Manual Actions Rulemaking Objectives

- Permit the use of operator manual actions as an alternative to existing requirements in paragraph III.G.2 of Appendix R to Part 50
- Develop generic acceptance criteria for feasible operator manual actions
- Use of manual actions that comply with established acceptance criteria would not require NRC approval

Post-Fire Operator Manual Actions Rulemaking – Current Thinking

- Current Rule (Appendix R, III.G.2)
  - No manual actions allowed, without prior approval
- Alternatives:
  - Manual actions, in combination with fire detection and fixed fire suppression systems, or
  - Limited set of defined manual actions, in combination with fire detection and fixed fire suppression systems, and existing fire barriers

Post-Fire Operator Manual Actions Rulemaking Approach

- Key parameters which influence manual action acceptance criteria
  - Time to damage
  - Environment encountered by operators
    - Temperature
    - Fire effects (smoke and toxic gases)
  - Instrumentation available for detection
  - Effectiveness of protective equipment (i.e., SCBA,...)
  - Accessibility of all locations where manual actions are required
  - Specific procedures identifying the required actions
  - Available and accessible special tools required for the action
  - Training program to include the use of simulation
  - Communication capability
  - Complexity of operator manual actions
  - Total number of manual actions

Post-Fire Operator Manual Actions Rulemaking Approach (cont.)

- Operator manual actions must be validated
- RES review of insights from sources such as, Plant Updated PRA, IPEEE report, Fire Re-Quantification project, and inspection findings related to sample plants
  - Factors considered in taking credit for manual actions
  - Potential limits on the feasibility of implementing operator manual actions in lieu of plant design features that might otherwise obviate the need for such actions
  - Ability of operators to perform multiple duties

Next Steps

- Engage public discussion on feasibility and limitations of operator manual actions
- Develop acceptance criteria and associated regulatory guidance
- Implement Commission SRM once released
  - Exercise enforcement discretion
  - Publish Regulatory Issue Summary conveying NRC position and direction
- Develop proposed draft rule language

Operator Manual Action Definition

NRC

- Those actions taken by operators to perform manipulations of components and equipment from outside the main control room to achieve and maintain post-fire safe shutdown. This action is typically performed locally by the operator at the equipment

NEI

- Operation of safe shutdown equipment on the required safe shutdown path using the control room devices (e.g., switches) in the event that automatic control of the equipment is either inhibited based on plant procedures or unable to function as a result of fire-induced damage
  - Remote Manual Operation: Operation of safe shutdown equipment on the required safe shutdown path using remote controls (e.g., control switches) specifically designed for this purpose from a location other than the main control room
  - Local Operation: Operation of safe shutdown equipment on the required safe shutdown path by an operator when automatic, remote manual or manual operation are no longer available (e.g., operating of a MOV using the hand wheel)

III.G.2 Requirements

- Separation of the redundant system by a passive barrier able to withstand a 3-hour fire; or
- Separation of the redundant system by a distance of 20 ft with no intervening combustible material, together with fire detectors and auto-suppression system; or
- Separation of the redundant system by a passive barrier able to withstand a one-hour fire, together with fire detectors and auto-suppression system

Resolution of Manual Actions Issues

Fred Emerson, NEI

Advisory Committee on Reactor Safeguards
Fire Protection Subcommittee
September 9, 2003

1

Topics

- Industry view of issue
- Issue resolution needs
- Industry views on feasibility criteria
- Recommendations

2

Industry View of Issue

- Basic issue: Regulatory treatment of manual actions for redundant shutdown
  - NRC inspection findings
  - NEI survey of industry views and practices
  - Industry – NRC meeting June 20, 2002
  - Actions since this meeting

3

NRC Inspection Findings

- Licensee use of manual actions without NRC approval constituted a violation of Appendix R Section III.G.2

4

NEI Survey Results

- Most licensees use manual actions to some extent for redundant shutdown
  - Some use them extensively
- Licensees interpreted the regulatory guidance as allowing this practice
- Inspection of many licensee safe shutdown programs since the 1980s had not flagged the need for prior approval until the last 2 years

5

Meeting June 20, 2002

- NEI presented the industry views and the results of the survey
- NRC staff agreed that the focus should be on whether the manual actions were feasible
- NRC initiated steps to implement this view

6

Actions Since the Meeting

- Informal staff criteria for determining whether manual actions are feasible
- IP 71111.05 revised to include feasibility criteria (March 6, 2003)
- SECY 03-100 recommended rulemaking plan to Commission

7

Actions Since the Meeting

- Inspection procedure 71111.05 feasibility criteria
  - Diagnostic instrumentation
  - Environmental considerations
  - Staffing
  - Communications
  - Special tools
  - Training
  - Accessibility
  - Procedures
  - Verification and validation

8

Actions Since the Meeting

- SECY 03-100 view:

  "The staff has concluded that amending Appendix R and associated guidance to allow the use of feasible operator manual actions is a safe and acceptable method for protecting safe shutdown capability from a fire (in lieu of fire barrier separation)."

- Industry concurs with this position

9

Current Issues

- Gap between NRC intent (SECY 03-100) and current rule language
- Inspections review against current rule
- Green findings are to be issued even when the manual actions are deemed feasible

10

Issue Resolution Needs

- NRC developing rule to bridge gap between current regulation language and intent
  - Current rule: exemption required to implement manual actions for redundant shutdown
  - SECY 03-100 intent: Focus on feasibility/safety rather than existence of exemption
- This gap creates difficulties for inspectors and plants and results in unnecessary inspection findings

11

Industry Views on Feasibility Criteria

- Criteria are generally appropriate
- Industry will recommend changes to the IP 71111.05 language

12

Industry Recommendations

- Letter to Commissioners August 18, 2003
  - Implement a direct final rule (speed up rulemaking process) if possible
  - Suspend inspections until new rule finalized
  - Implement enforcement discretion if inspections not postponed
- These recommendations will help address gap between current rule and the NRC intent for a revised rule

13

Summary

- Manual actions safely support plant shutdown if their feasibility is demonstrated
- Recommended steps should be implemented to eliminate inspector or licensee uncertainty about use of manual actions

14