ACRST-2005

ORIGINAL

OFFICIAL TRANSCRIPT OF PROCEEDINGS

TR04 (ACRS)
RETURN ORIGINAL TO
B.J.WHITE, ACRS-P-315

THANKS! BARBARA JO
#27288

Agency: Nuclear Regulatory Commission
Advisory Committee on Reactor Safeguards

Title: Auxiliary and Secondary Systems Subcommittee

Docket No.

LOCATION: Bethesda, Maryland

DATE: Wednesday, June 8, 1994

PAGES: 1 - 243

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PUBLIC NOTICE BY THE

UNITED STATES NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

DATE: June 8, 1994

The contents of this transcript of the proceedings of the United States Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards, (date) June 8, 1994, as Reported herein, are a record of the discussions recorded at the meeting held on the above date.

This transcript has not been reviewed, corrected or edited, and it may contain inaccuracies.

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Auxiliary and Secondary Systems Subcommittee

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Nuclear Regulatory Commission
7920 Norfolk Avenue
Conference Room P-110
Bethesda, Maryland

Wednesday, June 8, 1994

The above-entitled meeting commenced, pursuant to notice, at 8:30 a.m., I. Catton, Chairman, presiding.

PRESENT FOR THE ACRS:

Ivan Catton

James Carroll

Peter Davis

William Lindblad

Carlyle Michelson

Charles Wylie

William Shack

Robert Seale

DESIGNATED FEDERAL OFFICIAL:

Douglas Coe

P R O C E E D I N G S

[8:30 a.m.]

MR. CATTON: The meeting will now come to order.

This is a meeting of the ACRS Subcommittee on Auxiliary and Secondary Systems.

I am Dr. Ivan Catton, Chairman of the Subcommittee.

The ACRS members in attendance are: James Carroll, Peter Davis, William Lindblad, Carlyle Michelson, Charles Wylie, and Bill Shack and Bob Seale.

Dr. Karydas will be, I hope, in attendance as a consultant to the subcommittee.

The purpose of this meeting is to review recent NRC Staff and industry actions taken to improve fire protection to nuclear power plants and, in particular, Thermo-Lag.

Mr. Douglas Coe is the Designated Federal Official 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 May 25th, 1994.

A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice. It is requested that each speaker first identify himself or herself and speak with sufficient clarity and volume so that he or she can be readily heard.

We have received no written comments or requests for time to make oral statements from members of the public.

I guess you understand what we have to do. We will have to write a letter to the Commission to help them come to some conclusion about which of the many options that have been laid on the table by the Staff, of which there are four.

Near as I can tell, Option 1 is kind of nothing but fix-it. Option 2 to me makes sense -- you actually will determine what the threat is you have to deal with and act accordingly. Three is a case study that's based on performance-based risk. Four is a new rule. Somehow we have to come to grips with that and offer some advice, if we are able to.

Are there any comments from any members of the Subcommittee? Jay?

MR. CARROLL: I guess it will come out in the discussion but I am very curious about what I read about the Chairman's position on all of this, which seems to be that regardless of what you do, you've got to deal with Thermo-Lag, the Thermo-Lag issue under the present rule.

Am I misreading what he is saying?

MR. CATTON: I think he's a little bit nervous about performance-based regulation. While these people are making their presentations, I have passed out paper that I received in the mail, "Regulatory Issues and Mathematical Modeling in Fire Risk Assessment," and I think you ought to read it.

There's some difficulties in my view with Options 3 and 4 and I think your reading of the Commissioner is correct, but Option 2 allows them some leeway.

MR. DAVIS: There is also a combination of options being considered, as I understand it. Maintain "1" in the interim and pursue "2" as a longer term solution so I think it is more complicated than just selecting one of the options.

MR. CATTON: Well, I don't know how you do that, Pete, because if you do "1" you don't have to do "2."

MR. DAVIS: You could do "1" on an interim basis.

MR. CATTON: You could do one slowly and hope that "2" will save you before you get to the end?

MR. DAVIS: The fire watches -- you don't want to do that indefinitely. That will respond to "1."

MR. LINDBLAD: Are we holding the discussion after the meeting?

MR. CATTON: No, no. No, the reason I am doing this is I want the people who are going to be making the presentations to understand some of our concern. That way maybe the questions we have will be answered in the interim.

MR. LINDBLAD: May I ask a question of the Chairman and maybe it will be responded to on the presentations. Much of what we are talking about sounds like Research but the presentation is by NRR.

Is Research involved in this in any way or are we going to hear about that?

MR. CATTON: We will let somebody speak.

MR. VIRGILIO: Marty Virgilio from the Staff. Research is involved in Option 4. We are working with them but we will talk about that in some detail during Steve West's presentation about the performance-based rule and how we are working under a new process that is described in a Commission paper, 94-090.

We are working with industry on their proposed rule. Research has the lead by NRR staff is providing a tremendous amount of support to that effort. I'll let Steve West describe that in his portion of the presentation.

MR. LINDBLAD: I have one other question that may be semantic but we keep referring to this by the name of a proprietary product and is it strictly because it is a proprietary product that we call it that or are there some generic lessons that can be learned about this as well?

MR. VIRGILIO: I am not sure I understand the question. What is being referred to as proprietary?

MR. LINDBLAD: Thermo-Lag.

MR. WEST: This is Steven West with NRR. The Thermo-Lag product itself is a proprietary product. It's owned by the Thermal Science --

MR. LINDBLAD: And everybody else's fire prevention material is claimed?

MR. WEST: All of the individual products are considered proprietary by the vendor that owns it but we are learning lessons from the Thermo-Lag issues that we can apply to other barriers.

MR. CATTON: We can hardly hear you. Maybe just hold it a little closer, I guess.

MR. WEST: Does that answer your question?

MR. LINDBLAD: I will ask the question later in the day.

MR. SHACK: The question is whether other three-hour barriers are really three-hour barriers.

MR. WEST: I will address that during the presentation.

MR. CARROLL: And I guess I also read a memo I would like to hear more about in terms of what the practice is overseas.

Are you going to cover that today?

MR. CATTON: We had not intended to. I believe you will find the memo you have is proprietary. It is not for an open meeting.

MR. CARROLL: Okay.

MR. CATTON: I would like to make a comment about Research. I think one of the problems has been that there is no home for the fire part of it. You either have severe accidents or thermal hydraulics and when we have commented in the past that maybe they ought to be spending a little bit of time on other kinds of transport processes like heat transfer and they have said what for, because apparently the Staff had not asked for it. They have no letter. They may now but they didn't then.

MR. MICHELSON: If you recall, and I am sure you do, a few years back we put on long and valiant fight to keep some fire research going.

MR. CATTON: Yes, we did.

MR. MICHELSON: At which time they zeroed it all out.

MR. CATTON: We were thwarted at every turn.

MR. MICHELSON: And now we are just going to pay the price.

MR. CATTON: I think I would like to get started now. The first speaker is going to be Conrad McCracken and he is going to turn it over to somebody.

MR. VIRGILIO: I am going to start out with a few opening remarks. Again, good morning. My name is Marty

Virgilio. I am currently acting as the Director of the Division of System Safety and Analysis.

With me today I have Conrad McCracken, who will be the first speaker and he will give an overview of where we stand today on current fire protection requirements and talk a little bit about defense-in-depth to put the discussion on barriers in context.

Steve West will talk about the options that we proposed for the resolution of the Thermo-Lag issue. We presented these options in a paper to the Commission last month, SECY 94-127, and we presented them to the Commission at a meeting on May 20th.

We also have Patrick Madden with us, who is a Senior Fire Protection Engineer, who will speak later this afternoon on proposed fire protection for shutdown operations.

With respect to Thermo-Lag, although there is an adequate level of safety provided today by the defense-in-depth concept that Conrad McCracken will talk about and through the compensatory measures that are being taken in response to recognition that the Thermo-Lag barriers do not meet their design basis rating, the Staff has been working aggressively to resolve the issue.

Senior management have been meeting with industry leaders on almost a monthly basis, to ensure that we continue to make progress in resolving the Thermo-Lag issue.

We issued a generic letter toward the end of last year specifically requesting information from each licensee that uses Thermo-Lag on the amounts, configurations and key parameters associated with the configurations that they have in their plant.

In our Commission paper we -- actually we issued two Commission papers right about the same time, 94-127 and 94-128 -- 128 basically provides all the information that we gleaned or a summary of the information we gleaned from the 50.54(f), the generic letters that we sent out to all licensees and gives a good overview of where we stand today on the other issues related to this particular problem.

SECY 94-127 was focused specifically on Thermo-Lag and the four options.

The one underlying assumption or one conclusion we came to as a result of all the test programs in our analysis is that the Thermo-Lag barriers that are in use in the field today can reasonably be upgraded to meet a one-hour requirement. However, we don't see that they can be reasonably upgraded to meet a three-hour rating.

Right now we are awaiting Commission guidance in response to SECY --

MR. CATTON: On the upgrading of the three-hour barriers I gathered from what I read that if they were to do that they run into amperage problems.

MR. VIRGILIO: It's a combination of weight problems, amperage problems. There are a number of issues that come in. It's not -- it's a matter of practicality. It's feasible but it is practical? Probably not, in our view.

There are a number of things that you would have to do --

MR. CATTON: I was asking for a little more.

MR. VIRGILIO: The rating factors are also a significant issue, as you wrap additional insulating material around these cable trays.

We are currently awaiting Commission guidance in response to SECY 94-127. I think we are resource limited. I'll be quite honest with you. It is impractical for us to consider going down multiple paths at the same time. Although it may be attractive from a technical point of view to pursue these various options in parallel, that would come at a tremendous cost that we currently don't have resources allocated to do.

That is one of the reasons why we chose to go forward to the Commission and clearly outlined in our Commission paper are the resource implications associated with each of the options.

Clearly, we are currently funded and budgeted and aligned to go with Option 1. Going with the other options would have some impact.

With respect to shutdown risk, we spent two days with the ACRS last month on our proposed rule to resolve the issue of shutdown risk, and in those presentations we did focus somewhat on fire protection requirements. Pat Madden will review that for us again today. I'll also have Mark Caruso here with us who made the presentation on shutdown risk to respond to questions that may come up as a result of Mark's presentation related to the fire protection issues.

Operating experience has found that we see increased ignition sources and transient combustibles in the plants during shutdown operations. Neither NRC requirements today nor NUMARC guidelines 90-106 for outage planning specifically address five protection for shutdown conditions. It is too soon to tell what NEI will propose in the rule that we expect to come in some time between this summer and this fall under that process I talked about earlier, outlined in SECY 94-090.

Our PRAs have found fires to be a significant contributor to shutdown risk and accordingly the Staff has proposed an outage planning requirement to ensure the fires cannot disrupt the ability to remove decay heat. Again, Pat Madden will talk more about that this afternoon. That pretty much completes my introductory remarks and unless you have any questions for me, I'd like to have Conrad McCracken --

MR. CATTON: Does Appendix R cover shutdown?

MR. VIRGILIO: No. Today it does not.

MR. DAVIS: No, but there is another rule or proposed rule that would require fire assessment during shutdown.

MR. VIRGILIO: That is our shutdown risk rule that we presented to you last month. It wouldn't -- I'm sorry. Go ahead with your question.

MR. DAVIS: Well, I am just wondering, are these being handled separately or is the Thermo-Lag issue part of both of these initiatives?

MR. VIRGILIO: We are working them within the same section but we are resolving Thermo-Lag independent of the shutdown risk rulemaking issue.

MR. DAVIS: Okay, thank you.

MR. VIRGILIO: With that I will let Conrad McCracken give you the overview on fire protection.

MR. CATTON: Conrad?

MR. McCRACKEN: It's good to be down here again. It's been a little while. I enjoyed the brief discussion you had at the beginning and I would like to encourage you -- we provided Option 1 through 4 to the Commission. I don't think that you are constrained from using your own thoughts, ideas, and coming up with any other options you think is a better idea. I mean I think you've got to comment on the options we have given you but I also think if you look at it and come up with something better, you could advise the Commission and us and we are willing to listen.

If there is a good idea out there that we haven't thought of, we don't think we are the only people around who know what's going on.

What I have attempted to do today and we are trying to do more of, instead of having me talk like I have a lot of times in the past about fire protection, trying to get some other people doing it. We will have Steve West talking next, who is the Section Chief for Fire Protection, who is a professional fire protection engineer. Pat Madden will also be talking, who is a professional fire protection engineer, and we will probably hear occasionally from Ed Connell, who is sitting back there, talking during the day, who also is a senior fire protection engineer.

So we have attempted to increase the level of fire expertise, professional fire expertise on the Staff over the years and we are finally getting to that point.

[Slide.]

MR. McCRACKEN: What I intend to go through is a brief overview without getting into chapter and verse of which rules and regulations apply and whether Appendix R does or does not apply at all to plants, and so on.

If we've got detailed questions on that, I really want to hold those for Steve's presentation but I want to go over the broad categories of what we have tried to accomplish with fire protection.

The basic rules says minimize the probability of effects of fires on explosions. That is what we are trying to do. We are trying to protect safety-related equipment. that is in the rule. That is part of it.

We also discuss in there that we try to prevent inadvertent spraydown wetting of equipment from fire protection systems. That is also part of the rule.

We have two basic objectives in doing it. We want to achieve and maintain safe shutdown and we divide that between hot and cold shutdown. Hot shutdown, you are not allowed to have repairs. You have to be able to protect one train so you can achieve hot shutdown.

Then the rule said you're allowed to have 72 hours for repairs with onsite capabilities to achieve cold shutdown.

It's simple, the way it was stated. The implementation took a little more work and it got a little more complex as we tried to tell people exactly how to achieve that.

MR. CARROLL: What does onsite capabilities mean?

MR. McCRACKEN: What it basically means is you can't say I am relying on going elsewhere to buy a pump or to have something delivered. The assumption was that the site is isolated at that point and it's got to be -- whatever you say you are going to achieve we need to be able to look at it and say okay, yes, you've got that in the warehouse.

MR. CARROLL: So that rules out bringing in a skid mounted diesel?

MR. McCRACKEN: Unless you have the skid mounted diesel sitting over at the warehouse. The intent was to make sure that people did try to do that, that they had the capability existing so when you reviewed it, it was onsite.

MR. CARROLL: Why were we collectively, the Staff, ACRS and the industry, so dumb we did not consider shutdown when all of that was formulated?

MR. McCRACKEN: As a matter of fact, we weren't all that dumb. Some of us actually did mention the issue and the attitude at that particular time was look, once they are shut down, they are safe. It's like the issue of decay heat -- you know, if you can get it shut down and keep it shut down for 24 hours decay heat goes so far down you've got plenty of time to resolve issues.

As we have looked at some of these things like spent fuel pools in recently history and shutdown risks we said, hey, some of that initial judgment, which was just judgment and it didn't have some PSA to it and some real numbers and people looking at it, it may not have been as good as it should have been, so now we are going back and looking at it.

[Slide.]

MR. McCRACKEN: Now in fire protection we did something a little different than we do in most of the things that we try to regulate as an agency. What we normally do when we see a problem is we look at it and say, okay, I want to design something that will simply take care of it, and it goes away and it's no longer a problem, unless you got down to extremely low probabilities, like if you design a containment. You design a containment to withstand virtually any accident that occurs unless you get down to such a low probability you can look at it and say, okay, I don't need to go that far, it's ridiculous.

In fire protection, we didn't try to do that. We didn't try to put any one device as the simple thing that gives you protection in fire protection. We tried to put a combination of devices in and a combination of backups that would give you the total protection you needed but not do it all at one particular place.

We had to minimize fixed combustibles. Part of what you do. You design it so you don't have a lot of combustibles around. You put administrative controls on transient combustibles. You put in fire barriers and separation. You put in fire detection alarm systems. You put in automatic suppression in some areas. You have to have a train fabricated. You have to have shutdown procedures and you have got compensatory measures such as fire watches or you can line other pumps or so on to give you flow, to give you water for suppression systems to replace any of these that are down.

But we didn't try to take any one of these and say, okay, we are going to put in a fire barrier and that fire barrier will withstand anything. We didn't create a design basis fire and say you will put in this fire barrier that will be rated for that load and this plant and it will take any fire and we don't need the rest. We didnt try to do that.

MR. CATTON: Before you take that off, Conrad, there seven -- I guess there's seven things up there, then compensatory measures.

Has there been any effort to try to determine what the effectiveness is of any one of those seven?

MR. McCRACKEN: Yes.

MR. CATTON: For example, Carl and I went to St. Lucie -- actually we went with Pat.

MR. McCRACKEN: Yes, a couple years ago.

MR. CATTON: And there wee 1800 alarms and not a one of them was for a fire.

MR. McCRACKEN: Correct.

MR. CATTON: And the several fires that they did have were not found with the alarm system. That tells me that there is a research project out there. Somebody ought to figure out how to detect fires.

MR. McCRACKEN: They have figured out how to detect fires -- the human nose.

[Laughter.]

MR. CATTON: Well, that's true.

MR. McCRACKEN: The majority of fires are detected by people.

MR. CATTON: That's true -- well, all in this particular case.

MR. McCRACKEN: Yes. I mean across industry and across wherever it occurs.

If there is a fire in this room it is going to be detected by a person before you hear an alarm or before one of those suppression system go off unless everybody here's got a real bad cold. I mean it is -- but to model that and to take credit for that, if I came down here and told you I was going to take credit for the human nose to detect fires in control rooms and eliminate a fire alarm system, some people here might laugh at me. Others would give me a hard time.

MR. CATTON: On the other hand, it seems to me fires can be detected and we'll have to figure out how.

MR. McCRACKEN: Yes, we can, but they have to get hot enough to be detected either thermally or create enough smoke to be detected by a smoke detector and usually the human nose will pick it up before you get to that point if there is anybody around.

All that says is that people are picking them up quickly before you have to get to the alarms, but we do get alarms that are real.

MR. CARROLL: I don't know anything about St. Lucie's fire detection system.

MR. CATTON: I don't either -- 1800 false alarms and four real fires and they found them.

MR. CARROLL: I misunderstood. You said there were 1800 false alarms?

MR. CATTON: Yes.

MR. DAVIS: False fire alarms.

MR. CATTON: And the for or five fires that they actually had were found by people who saw them, or smelled them or whatever.

That, to me, is unsettling.

MR. CARROLL: A nuclear plant I am familiar with probably was had one false alarm a year or something like that.

MR. LINDBLAD: At less than five, certainly more than one a year.

MR. CATTON: Continue.

MR. McCRACKEN: There are other areas in the defense-in-depth. There were other factors. I did not try to list everything we do.

[Slide.]

MR. McCRACKEN: Now looking at the regulations and again I don't want to get into numbers and sit here and talk about which particular regulations. It relies on defense-in-depth. That is the concept that I was trying to get across what we did.

We don't have a design basis fire. There is not a one-hour fire barrier in a plant or a three-hour fire barrier in a plant that is designed for that fire load in that room and will last for whatever that fire load gives it. That wasn't the intent.

The regulations as they were put out were promulgated in their entirety. If you look at the regulatory history on it, we didn't look at fire barriers and decide what they should be. We looked at fire barriers, fire brigades, suppression systems. We looked at the whole thing and we came up with a combination to give you the right level of fire safety.

With that combination it is important that as you start looking at these issues that you consider if you change one that you are going to impact the others because they all rely on each other.

MR. CATTON: So there have been a few fires and one of them that made particularly interesting reading was a fire in Spain.

What happened there? Which one of these things that are your defense-in-depth went awry that the fire got so exciting?

MR. McCRACKEN: Now the one in Spain we had a presentation down here and the last time I recall there were a few things we still hadn't answered and you are still trying to go for a visit over there, so there are a few things we don't know about that particular fire.

The reason that fire, we think, got exciting is we think there were certain electrical redundant trains that were too close to each other because they got lost simultaneously almost. We think one fire wiped out everything when it should not have.

MR. CATTON: And they don't have the requirement for fire barriers when that is the case, like they do here, in this country?

MR. McCRACKEN: We don't know. We haven't been there and done that examination.

MR. CATTON: Okay.

MR. McCRACKEN: That is something we want to do and we have been hoping and we thought that ACRS had wrangled an invitation to go over and we were trying to see if we could participate in that.

MR. CATTON: Oh -- I didn't know we had the lead in this.

MR. McCRACKEN: We are not talking about having the lead. We are talking about safety and if you got over there we would try to go with you.

MR. CATTON: If you get over there, let us know.

MR. McCRACKEN: If you get over there, you will find out what we find out.

MR. CARROLL: You are talking Spain and not India?

MR. McCRACKEN: India.

MR. CATTON: Well, I was talking about Spain, which is a boiling water reactor.

MR. McCRACKEN: I'm sorry, I was answering a question I didn't hear.

The one in Spain was a different issue, which was really plant design. That was a big fire. The reason that got close is because there was access between nonsafety and safety through a door that had been open and you could have got flooding through with burning oil and caused a problem.

We don't have that particular design anywhere.

One of the thing that we have done is go through a study of turbine building fires. Pat Madden has done that. He has visited a bunch of our plants. He has got a report on his desk which he has promised me faithfully for two years will be out next month. He is now saying it's on Steve West's desk.

We have done a fairly thorough study of that issue and how it applies to U.S. plants and we do have a report prepared in draft that we plan to get at as soon as we quit working on so many other fire issues.

MR. CATTON: Maybe a draft copy would be fine.

MR. CARROLL: Is there one on a merit increase this year, to be able to go on vacation?

MR. McCRACKEN: Certainly a recommendation from the ACRS that he get a merit increase.

MR. CATTON: If he supplies the report.

MR. McCRACKEN: If he supplies the report, it would certainly be welcome, I am sure.

[Slide.]

MR. McCRACKEN: What I want to do now is get into the specifics of what we did when we came up with the regulations on fire barriers so you understand this when you are going through and deciding what you want to recommend that we do in the future.

The Commission knew, and we looked very thoroughly at the issue of three-hour barriers. We knew it was conservative in most cases to have a three-hour barrier. However, we considered it appropriate foı potential consequences. And to try to give you a little bit of a ballpark number as to what that meant, the Commission was just trying to allow ample time for suppression activities. That's what they really wanted to do.

If you look at the background and regulatory history of the role, that's all they were trying to accomplish. In doing that, when they put in a three-hour barrier, they knew that it would probably take about 15 minutes for a fire brigade to respond. That is not a bad number. In most cases, they can respond by then. Some will take longer, but 15 minutes.

So that is roughly if you have got a fire load which could challenge that barrier, it gives you a factor of 10 in time safety for the fire brigade to get there.

MR. MICHELSON: Does that include the response time of the instrumentation telling you there is a fire?

MR. McCRACKEN: You're trying to get down to too narrow. It is a factor of 12. If I throw in response time instrumentation, it is 10.

MR. MICHELSON: How many minutes after the fire is ignited before you even know you have a fire?

MR. McCRACKEN: It depends on the fire and where it is.

MR. MICHELSON: What is your assumption?

MR. McCRACKEN: My assumption, any fire, it will take five or 10 minutes for something to get hot enough that people will start smelling it

As Dr. Catton pointed out, you are usually getting fire indication by people as opposed to alarms. By the time you have got an alarm, it has been in progress at least five or 10 minutes. But if you take five or 10 minutes out of a three-hour barrier and 15 minute response, it does not make much difference. It is still about a factor of 10. That is all they are trying to accomplish. We were not trying to be exact here and say that it is three minutes for this and two minutes for that.

The other thing they knew they were doing is they knew in the vast majority of cases the fire loading in the room was far less than the barrier. You had a 15- or 20-minute fire load in most of the rooms. So with the 15- or 20-minute fire load, you also had a factor of 10 in safety for the fire load burning out before you used up the barrier.

So if you looked at those and multiplied them by PRA people, today you would say that is a factor of 100 in safety. Probably for some of the areas it was that high. But the other fact that was in there, which was the X factor, was the way you test fire barriers.

The fire barrier was tested to a known industry standard, ASTM E119. That was for a standard test fire. Some fires will be less than that, some will be more. The intent was not to come up with a fire that was tested for whatever application you were at the power plant. The intent was to put in a standard barrier with conservatism to allow for detection, automatic suppression of fire, brigades to respond and give enough time for the total package to work.

MR. MICHELSON: Conrad, I would like to ask my question one more time a little differently.

In the case of three-hour barriers, there is no requirement for automatic detection, is there?

MR. McCRACKEN: There are some areas that do not have automatic detection.

MR. MICHELSON: In an area without automatic detection, how often is there going to be a human detector go by?

MR. McCRACKEN: With the ventilation systems, you will pick it up.

MR. MICHELSON: Pick it up how?

MR. McCRACKEN: By smoke going through ventilation systems.

MR. MICHELSON: If it gets to be dense enough, you certainly would.

MR. McCRACKEN: You will start smelling it.

MR. MICHELSON: The detectors are inaccurate?

MR. McCRACKEN: The regulations do have in them the option of not having automatic detection in some areas where there are three-hour barriers.

MR. MICHELSON: I am trying to figure out in those cases how long might the fire burn before it is detected.

MR. McCRACKEN: I agree with you. That is an area, if I went back with 20/20 hindsight, I might put detectors everywhere. In practicality, most people have very few locations where you go in the fire plans where you don't find fire detectors. There are some but very few.

MR. MICHELSON: It is not a requirement?

MR. McCRACKEN: Correct.

MR. CARROLL: Is it common practice to put them in ventilation system ducts?

MR. McCRACKEN: No. I was talking about smelling them.

MR. WEST: This is Steven West. I just want to add to the detection.

With respect to the question on detection, it is true that the requirement for the protection of the safe shutdown capability that allows the installation of the three-hour barrier does not address detection. However, we have other guidance that suggests that detectors be installed in all safety-regulated areas.

As Conrad mentioned, there are going to be very few areas where there is not detection. There is probably an area where there are no combustibles at all.

MR. MICHELSON: Requirement to do it or some guidance that says it is a good idea?

MR. WEST: It is guidance.

MR. McCRACKEN: That is why I did not give you that response, because I knew you were after a requirement. It is not there.

MR. MICHELSON: I just want to clarify in the case of where there are no detectors, it's going to be more than five or 10 minutes before you realize that it is burning.

MR. McCRACKEN: The other thing the Commission did at the time is it looked at the three-hour barriers and concluded that you could not put those in everywhere due to space limitations and so on and said that one hour with automatic protection and suppression is equivalent to three hours. And that is really not a bad assumption.

If you look at the reliability of automatic suppression systems, they are pretty good. They work in the vast majority of cases. I have seen different numbers. I don't really want to go around quoting, but I think 95 percent is not bad for expecting one of those to work and suppress a fire. Now, it may not totally extinguish it but if you can't suppress it until the fire brigade responds, you have still accomplished what you need to accomplish. And these are attested to the standard fire-time-temperature curve.

MR. CATTON: That was not required in Appendix R, was it? Isn't that one of the reasons that the Thermo-Lag sort of got by you?

MR. McCRACKEN: You just lost me.

MR. CATTON: When I read SECY-93-143, in it it said that NRR really had no requirement for the testing on how the testing was to be done.

MR. McCRACKEN: We always did. And the Thermo-Lag, according to the test reports were tested to ASTM E119.

MR. CATTON: So you did have a requirement from ASTM E119?

MR. McCRACKEN: Yes, that's part of the regulatory history. Did we send out a copy of the statement of considerations on that?

MR. WEST: I don't think so.

MR. McCRACKEN: The statement of considerations clearly says ASTM E119. Unless you have the tie to ASTM E119, the three-hour barrier means nothing.

MR. CATTON: I agree.

MR. McCRACKEN: That was clearly there. And we have always required that they meet up. I don't think we should talk a lot about something which is involved with investigations and grand juries.

MR. CATTON: Okay.

MR. DAVIS: But, Conrad, on that issue, would it be acceptable for an applicant to show that he could meet the three-hour requirement on the basis of not having a significant combustible material?

MR. McCRACKEN: No. I am splitting hairs with you. I am going to respond very precisely to it.

What we permitted and what we allowed in the rule were exemptions. And what we said is, if you can come in and show that you meet the level of safety we want and equivalent level of safety, you can do it. And a lot of people came in and that's why we granted about 1,600 exemptions to Appendix R because people would come in and say, look, there is no fire load in this area. Therefore, I cannot have a fire. On that basis, I don't even need a barrier at certain locations or I can live with a two-hour barrier.

MR. CARROLL: Is that the issue of transient combustibles?

MR. McCRACKEN: Sure. They have to show this is a place we are not going to have transient combustible buildup. There are administrative controls on it. We went through the whole defense in depth issue each time. So we went through every one of these exemptions and each exemption had its own written exemption. We did not say there are 20 areas and we are going to address them all this way. We said, area one is defined this way, two is this way, and went through and processed an exemption.

So we very closely controlled that process to be sure that we were convinced that they had the same level of prior safety.

MR. CARROLL: Your example is a case where there is no combustible load in an area. Did you also issue exemptions where somebody said, yes, there is some combustible loading but it would burn out in five minutes?

MR. McCRACKEN: Yes.

MR. CARROLL: So you have done that kind of thing?

MR. McCRACKEN: There were some where they had minimal combustible loadings. We would look and say, with that amount of combustible loading, we agree that you've got no more than a 10-minute fire and with the distance and what you've got here and a two-hour barrier, you're okay. That is what the exemptions were.

They were individual fire protection engineers reviewing on a technical basis, is this safe.

MR. DAVIS: Could an exemption be granted on the basis of no ignition source?

MR. McCRACKEN: I do not recall any since I have been involved in this where we ever granted a no ignition source exemption. I will not say that nobody ever has, but I do not recall ever having done it.

MR. DAVIS: That would not be excluded from the process?

MR. McCRACKEN: Even though I personally do not feel that self-ignited cable fires and safety-related equipment is a very high probability, I still probably personally want to grant an exemption on that. If there were energized cable on there.

MR. DAVIS: If. But if not --

MR. McCRACKEN: If not, I would consider, you know. I mean, we are trying to achieve safety but not be ridiculous. I would consider anything.

[Slide.]

MR. SHACK: There is a comment in the document that the Sandia PRA studies said that somehow the three-hour barriers seemed rather sensitive, you know, rather than conservative. They had something that was a 90 percent chance that you'd make -- you know, that the three-hour barrier would fail, the core damage frequency would go up by a factor of 10.

What makes it so sensitive, you know? Somehow in your discussion it makes it sound as though there is lots of margin built in here and yet that kind of result would seem to me to make it very sensitive to that.

MR. McCRACKEN: You are leading me into my conclusion, which I really appreciate. We did that without rehearsing.

MR. DAVIS: He was looking ahead.

MR. McCRACKEN: He does that.

The fire PRAs demonstrate that particular aspects of fire protections are important. What they are saying in the Sandia study is that when the Commission decided that we needed fire barriers and/or separation of redundant trains, we did a smart thing that was necessary.

Even though PRA didn't exist back then, if your barriers don't exist or if they have been breached for some reason, then you've got your redundant trains totally susceptible and you can lose them in a matter of minutes. I mean, it doesn't take long.

If you look at some of the fires that have occurred, you're talking five to eight minutes, you've lost those trains. That's before you can respond to fire brigade, before you're basically going to get anything done, you lost both trains.

So that's why the PRA comes up and shows you that it's high. If there's anyplace where you've got a pinch point, where you've got redundant systems together and that occurs at a number of places in power plants, if for some reason you don't have the separation you thought you had and you get a fire in those, if they aren't 100 percent reliable, you're probability of core melt is going to go up very rapidly.

MR. CATTON: What you are suggesting, and I am going to interpret what you both said, is the PRA ought to have had some probability associated with time failure of the barrier and then the results would not have turned out so bleak because you're probably sure it's going to last 20 minutes.

MR. McCRACKEN: If you had asked me that question, a few years ago I might have said they're going to last longer than that. But you're sure you're going to last some period of time. But you need that barrier. You have got to be sure that barrier is going to last longer than it takes the fire brigade to respond.

MR. CATTON: But there are probabilities associated with the fire brigade also. You need both.

MR. McCRACKEN: Sure, so you need both.

MR. CATTON: Without the one -- in the PRAs, it is either go/no-go. That 10 percent, it fails in zero time.

MR. SHACK: You need the two-hour barrier to see how that affects it.

MR. CATTON: You need a distribution.

MR. McCRACKEN: Clearly when you look at these and look at a curve of fire brigade response time versus barrier, there is the point where that would just drop off the end because the barrier will not last long enough for the fire brigade to get there. So you have to have a barrier of sufficient duration to protect you long enough, for the fire load you have, for the response time to get it suppressed. If you do not have that, then you go to what the PRA people show, which does not exist basically.

MR. CATTON: So if you would go to performance based, which is your Options 3 and 4, you need that kind of information?

MR. McCRACKEN: Yes.

MR. CATTON: I don't know that it exists.

MR. McCRACKEN: It becomes a lot more work. You're going to have to look at each location and come up with some real numbers.

Right now if you get -- we have three professional fire engineers. If you get them to tell you how long this is going to burn and what it's going to be, I guarantee if they do it independently, you'll get three different answers. So you need some margin. I mean, it isn't just a standard answer because it's going to be impacted by the ventilation system, the fans on or off. Here you've got one fan running instead of two, the other fans could be on.

Depending on ventilation, whether the doors are open, that door's open a crack, you're going to impact it, how fast it burns, what the peak temperature is.

So there are enough variables in analyzing one of these that you've got to put enough conservatism in it when you go that route so that you know you can still maintain safety.

As I said before, if we were looking at the three-hour barrier for the typical fire area, we probably had a conservatism factor of about 100 if you looked at the fire load plus response time of the fire brigade. That's probably overconservative. And that's one of the reason that fire protection came up on the lists of marginal safety a while back. Some aspects of it may be marginal safety, maybe we did go overboard. But other aspects, like pinch points, are not marginal, they are very critical.

We have to ensure that as we come back from something that was too conservative that we don't go relax something in the wrong place.

MR. MICHELSON: Conrad, are there any places where Thermo-Lag is being required in a diesel compartment or a fuel oil storage area or that sort of thing?

MR. McCRACKEN: You will have to get that from one of the three of them.

MR. MICHELSON: For the record, let's say yes.

MR. MADDEN: Yes.

MR. CATTON: Maybe we can hold the Thermo-Lag until we get to the next topic, otherwise we will have Conrad up here all day.

MR. McCRACKEN: We don't want to do that. You're supposed to get me off and them up here. I am almost done.

The other item I would like to get across, the current fire protection regulations considered in their entirety are adequate. I firmly believe that.

MR. CARROLL: Or more than adequate.

MR. McCRACKEN: In some cases, more than adequate. From a safety perspective, they do their job. They do what they need to do. This was not something haphazard that we got with. We can modify them. We can go through Options 2, 3, 4 or whatever else you want to come up with as a good option and try to modify them. But when we are doing that, we need to consider defense in depth, what we're doing, how the entire fire protection program works and not modify one little piece without understanding what we're doing to the rest.

That's all I have.

MR. CARROLL: An awful lot of where we are today, I guess, at least my perception is, came from work Sandia did in the PRA area. And I have not looked at that stuff for some time. But I came away after reading it a couple of years ago very impressed with the amount of conservatism that they put in there.

I mean, they, for example, on the probability of fires, it seemed to me were saying -- not making any distinction between a waste basket fire that somebody puts out with a hand fire extinguisher and a significant fire.

Am I off base in saying I think that has sort of misled us into being more conservative in our thinking than perhaps we already would suggest?

MR. McCRACKEN: I think in some cases they did go a little overboard in putting conservatism in where they shouldn't have. And that's a discussion I've had back and forth with Sandia for as long as I've known Sandia existed. They tend to go conservative.

But they at least have addressed most of the issues, so it's then up to us to say okay, we know that was too conservative and this is where we can use the data you provided anyway.

So, yes, some of the cases, if you just look at their bottom line numbers, I always have to go back through and find out where they got to it and I invariably come up where they use one where I say, I just don't believe that. Like, you know, one thing they don't account for is the human nose. It's there. And I know as a practical matter that fire is going to be detected by people in almost all cases before it is detected by anything else.

MR. DAVIS: I have a related comment, Conrad, based on your last bullet in Mr. Carroll's comment. It seems to me that we must keep in mind that there is always a downside when we look at these issues by themselves. I know that in the case of Appendix R there were cases where applicants had to provide barriers around their RHR pumps, for example. And that then required active ventilation for those pumps which was not needed before.

What you are now doing is introducing another active failure potential for an important safety system. You solve one problem and create another. We need to make sure we are not doing this in isolation of these other problems.

I hope the people who have put in these barriers have looked at the need for ventilation and have properly accounted for that. There are other problems, too.

If you start packing cables with a lot of fire protection materials, you now have a heat loss problem and if you put in sprays everywhere, you now have the inadvertent actuation problem that can create a safety problem.

So it seems to me we have to look at this in the entire context of what we are doing. And when we go conservative, we make these problems even more important.

MR. McCRACKEN: Sometimes conservative for that particular part of the issue was not the right answer because it impacted something else. I fully agree with you.

Are you ready for Mr. West now? We are way behind. I think the Chairman should try to hurry him up a little bit.

MR. WEST: Just hold all questions.

MR. CATTON: He looks eager.

MR. McCRACKEN: He is.

[Slide.]

MR. WEST: Good morning. Can you hear okay with this microphone?

I am Steven West with NRR. The last time I was here to talk about Thermo-Lag fire barriers was February of 1992 and at that time, I was a member of the NRR Special Review Team that had just completed a comprehensive review of Thermo-Lag fire barriers and identified the issues that we are still working with today and industry is working on resolving.

Between February of '92 and I think December of '93, we provided a lot of documentation for your reading pleasure. But I don't think we met with you again until December when we wanted to discuss some acceptance, fire test acceptance criteria with you. And I think everybody has some understanding of what the Thermo-Lag issues are. I am hoping to move into the options and --

MR. CARROLL: Before you do that, for at least my edification and possibly others' --

MR. WEST: Sure.

MR. CARROLL: It was indicated that you are a certified fire protection engineer? What are the words?

MR. WEST: I am a degreed fire protection engineer and I have been working for the Agency since 1985 doing fire protection. Before that, I was in other industry doing fire protection engineering.

MR. CARROLL: Isn't there some sort of professional registration and you are or are not that?

MR. WEST: I am not a professional engineer.

MR. CARROLL: But there is a professional fire protection --

MR. WEST: You can become a professional engineer in fire protection engineering. In fact, Ed Connell is a PE in fire protection engineering.

MR. CARROLL: That is a state registration or a national registration?

MR. WEST: State.

MR. CARROLL: So in the State of Maryland. It is the same exam no matter which state you take it in. The PE registration for fire protection is a national exam but it is given by the individual states. You are licensed by the state. I am licensed in the State of Maryland; that's where I live.

MR. LINDBLAD: But in addition to an examination, there is an experience requirement?

MR. CONNELL: You have to have four years of professional practice. You have to pass the fundamental engineering exam and then the specialty exam like any other professional engineering discipline, mechanical, civil, it is the same.

MR. CATTON: Usually the other exams, for example, fire seems to me is a big heat transfer problem and then combustion problem.

MR. CARROLL: Among other things.

MR. CATTON: Among other things. As well as a whole bunch of rules. The fundamental engineering exam does not test that?

MR. CONNELL: No, the fundamentals does not. That is generic, you know, statics, dynamics, engineering economics, physics, all that kind of stuff. The PE part of the fire protection exam --

MR. CATTON: That's why we used the word in our last letter, "fire science," as well as fire regulation. Regulations are one thing, rules are one thing that so many sprinkler heads per square foot or whatever it is and seeing to it that it's done.

The other side of the coin is understanding the physical processes. And --

MR. CONNELL: I have the same degree Steve has. I took a lot of Dr. Quintiere's courses in fire dynamics and fire science. And I am pretty well -- I did a lot of research for the Naval Research Lab on fires in submarines and all that kind of stuff. So I consider myself well versed in fire dynamics. I don't have any problem practicing in that area at all and there are questions on the PE -- on the PE exam, there are questions on fire dynamics and fire modeling.

MR. CATTON: Okay.

MR. WEST: I also, when I was going to college, worked at -- at the time it was NBS, working on fire modeling. So the fire protection engineer is not just the guy who says you need 10 sprinkler heads in this room.

MR. CATTON: That's comforting.

MR. CARROLL: So how many professional, registered professional fire protection engineers are there on the Staff?

MR. WEST: There is one in NRR. That's all I can speak to.

MR. CARROLL: Why don't you get your registration?

MR. WEST: I will take that as a rhetorical question.

MR. McCRACKEN: Steve is the section chief in that section. I expect him to do a lot of management functions as opposed to technical review functions, so if he wants to get his PE, that's okay, but I would be interested more in him taking management courses, looking at the future.

MR. LINDBLAD: And we know that federal employees have an exemption from state regulation requirements.

MR. McCRACKEN: Correct.

MR. CATTON: Most state agencies do not promote them until they have their license.

MR. LINDBLAD: Federal employee have an exemption from state registration requirements.

MR. WEST: Our time is just about up. I would add, since there seems to be some interest, I am the first degreed fire protection engineer that has been made the chief of a section responsible for fire protection. So the Agency in the last year to 18 months has made a concentrated effort to bring together a group of fire protection engineers.

One reason we hired Ed was because of his potential to become a professional engineer, and there are a couple of other degreed fire protection engineers sitting back in Rockville working as we speak. They all contribute to this.

[Slide.]

MR. WEST: There appears there is a fairly good understanding of what the options are from the opening remarks this morning. So just very briefly, the first is to require compliance with existing NRC requirements.

The second is to study the feasibility of developing new guidance for rating fire barriers based on potential plant fire hazards.

MR. CARROLL: Going back to one, I see the word "limited." If you scratch that out --

MR. WEST: I am going to discuss each one of these in great detail. The focus of my presentation will be on these options. I will get to your question.

Option 3 was this idea of the plant specific, what is being characterized as performance-based approached, and 4 is the development or continued development of the performance-based rule.

MR. CATTON: Before you leave this --

MR. CARROLL: Such a rule would make Appendix R inoperative?

MR. WEST: No, sir.

MR. VIRGILIO: It is outlined in the SECY paper I referred to earlier, 94-090. It would allow them voluntary adoption of a new rule.

MR. CARROLL: Right.

MR. CATTON: So you would grandfather Appendix R?

MR. WEST: We can discuss that under Option 4.

MR. CATTON: I understand. Before you take this off, 3 and 4 are basically the same?

MR. WEST: No, sir.

MR. CATTON: Am I reading 3. You are just going to take a plant and go through the process?

MR. WEST: They are not the same, and if we get through the presentation, I will be happy to it discuss in detail.

I would like to discuss the process behind developing each option, and we can discuss in detail what the difference are. It would be a little bit easier if we moved through.

MR. CATTON: I want to contrast them while they are in front of us. Number 2 says "study;" number 1 says "require." So how can you do a study that does not do you any good in resolving the issue?

MR. WEST: One of the options we looked at was the -- that we considered when we decided we needed -- actually, the Commission directed us to look at options.

One of the things that floated to the surface was this idea that the standard time temperature curve specified in ASTM E119 may be more sever than would be expected if you had a fire involving the typical fire hazards in a nuclear power plant.

So the options float to the surface that maybe we can develop new time temperature curves that represent those plant hazards, and then we can use those to qualify the barriers. Not only these raceway barriers, but maybe the walls and everything else in those areas of the nuclear power plant.

The more we thought about it, the more we thought that in the time we had available to present options to the Commission, we did not feel comfortable with saying these curves can be developed and implemented by industry.

We said we need more time to study the feasibility. If the Commission asks us to study the feasibility, we would do that over the next six months or so, and if we decide it is feasible, then we may continue with the development and implementation of those curves. That is why it is limited to a study at this point.

MR. CATTON: So if Option 2 is selected, that means there is a six-month hiatus before you can decide?

MR. WEST: That's right. We think it would take us at least six months. We would do our best to complete the study in six months and make a recommendation. We just did not feel comfortable saying, you know, we had a couple of months to develop these options.

We did not feel comfortable saying this is a way that we can go.

MR. CARROLL: What is the timeframe for 3 and 4?

MR. WEST: The timeframe for 3, we did not -- I am not sure that we specified a specific timeframe for 3 in the SECY paper. I believe that if we had a lead plant come forward, if we were to go with this, my personal feeling, it would probably take, say, a year working with them to develop an acceptable approach, and then some more time to implement it.

MR. CARROLL: So during that year, we would be, sort of, on hold as far as the rest of the plants are concerned?

MR. WEST: There are some plants that are moving forward. I would expect any plant that had a significant amount of Thermo-Lag to sit back and wait if they thought something was going to come along that could help them resolve the problems.

MR. CARROLL: How about 4?

MR. WEST: The schedule for 4 is specified in SECY 94-090, and right now the projection is that that rule could be completed by August of 1996.

MR. CARROLL: Jay, according to the 090, a draft of that rule should be available in August of this year.

MR. WEST: I think NEI is going to talk about that schedule with you later, but it is my understanding that they are preparing a petition for rulemaking that will have a draft rule, and I think their schedule is late summer to early fall. I will let them address that.

MR. CATTON: 090 says August '94, ACRS says late spring '95, the Commission is June '96, and on the street, August '96. I think that is roughly right.

MR. WEST: Right. That is roughly the schedule. I think there has been a slight slip in NEI schedule, but Research is telling us that a couple of months delay has not impacted the overall schedule.

MR. CATTON: I think we would like to get involved much earlier than a month or two before it hits the street.

MR. WEST: I believe they are planning to talk to you about it today, actually, but because of the scheduling conflicts, I think the principles are out of the country. But we will tell you a little bit when we get to Option 4 when we know.

[Slide.]

MR. WEST: We have reviewed a range of options, and we in the SECY paper informed the Commission that Option 1, which is to return plants to compliance with existing regulation, was the preferred option. That is the option the Staff would like to proceed with industry on to try to bring the plants into compliance with the existing Appendix R.

This has been the objective of the Thermo-Lag action plan which we developed a couple of years ago. It is what we have been working with industry on.

Just to note -- Conrad has been through this -- but since Appendix R was implemented 13 years ago or so, there has been extensive industry effort to come into compliance with Appendix R. There has also been extensive Staff effort in reviews on inspections and that kind of thing, and until the Thermo-Lag issue came up, I would say that industry was nominally in compliance with those requirements.

Every once in a while a plant will find an area that was unanalyzed and they fix it, but those are very rare today. And it has really been the Thermo-Lag issue that has raised the consciousness of the regulation and we have started looking at it.

There is a great deal of satisfaction with the existing regulation, particularly with the public. There is some perception that we may be overregulating in fire protection, and I think that is being addressed to this performance-based ruled Option 4, which we will get to.

But really there is no -- we have not seen any real technical basis for questioning the adequacy of the current rule.

MR. CARROLL: Now you guys always confuse me when you use the word "units," like 22 units. Is that units or plants?

MR. WEST: That would be units -- or plants.

[Laughter.]

MR. CARROLL: What?

[Laughter.]

MR. WEST: Units, not sites.

MR. CARROLL: That is 22 units of 100, whatever it is?

MR. WEST: Right.

MR. CARROLL: Conrad is shaking --

MR. WEST: Of 80, 80 with Thermo-Lag. In other words, two unit sites. We are saying there are two units, not one site, excuse me.

MR. CARROLL: Okay.

MR. WEST: So in other words, a two-unit site, we are saying there are two units, not one site?

MR. CARROLL: Yes. Yes, okay.

MR. WEST: Some sites that have two, have that multiple units, may use Thermo-Lag only in one units, so we have always had the count by unit.

MR. CARROLL: Okay. So it is 22 of 80.

MR. WEST: Right.

MR. CARROLL: And then of the residual, your statement was that before Thermo-Lag came along, all plants were nominally in compliance, so you are not worried about the residual?

MR. WEST: We haven't identified any specific concerns with the residual.

MR. CARROLL: That goes to what Bill was raising earlier. You are satisfied those other 20 some odd plants that have used something other than Thermo-Lag, that those materials are okay?

MR. WEST: We are looking at the other material. We felt that as a result of identifying the problem with Thermo-Lag, we treated, obviously, the Thermo-Lag problems as and issue in and of itself.

But we did, in a review of that, identify areas where we thought we needed to go back and see if the Staff had done an adequate review of the other materials. And we are doing that. We have not completed that, but we have completed some aspects of it.

For example, we have taken the other materials and have NIST do small-scale testing to get some idea of the thermal performance of the systems.

We have not identified any real problems with those materials.

MR. CARROLL: So there are no show stoppers today?

MR. WEST: No show stopper today, that's right.

MR. SEALE: What about the other 58?

MR. WEST: The other 58 are the ones that we are recommending that we continue to work with to achieve compliance.

MR. SEALE: So they are the kernel of the problem?

MR. WEST: They are the plants that have the issues left to deal with.

We had some discussion in the SECY paper about what we have learned about Thermo-Lag to date, and there has been an awful lot of work done over the past three years.

One thing we do by staying the course on this option is we continue to take advantage of all of that work. That is not to say that some of the work could not be used in other options, but it has always been, as I said, our focus and objective to reach compliance, and there has been a lot of work done by individual licensees and by new NUMARC or now NEI.

For example, we believe at this time that one hour fire rated Thermo-Lag barrier for those that are supposed to be one-hour rated can probably reasonable upgraded with additional Thermo-Lag materials.

We say that based on the results of tests that NEI has performed for the industry through their program, tests performed by TU Electric and tests performed by TVA.

Now, there are some loose ends because despite all these tests that have been done, no one has come to us yet and said, you know, based on this body of test data -- and we are probably talking 40 or 50 configurations that have been tested: different raceways, cable trays, conduits, junction boxes, and all that -- nobody has come to us and said, "NRC, we have done all this testing; we have all this data, and we think based on that here is a generic or a couple of generic upgrades that could be applied by industry."

The Staff position is that we would be receptive to that kind of -- if someone were to approach us with those designs -- to try to get out of the loop of continually testing one-hour barriers. Come up with a generic fix or fixes, agree to it, and quit testing one-hour barriers.

Now, with respect to the three-hour barriers, they continue to be a challenge. But we are not convinced at this point that the problems and efforts to develop fixes or alternatives have really been fleshed out by industry.

Clearly, the tests that have been done to date, particularly by NEI who has done the three-hour testing, has shown that you probably cannot reasonably upgrade a three-hour Thermo-Lag fire barrier with additional material, additional Thermo-Lag material.

It appears that when you start adding, you have to add some much material that weight becomes a problem, say, of seismic consideration; you start affecting all the supports on your raceway systems; empacity may be a problem;

there may be other operation problems; problems with clearances and that kind of thing.

MR. CARROLL: Now, do other vendors provide three-hour barriers that you are satisfied really work?

MR. WEST: Yes. Well, let me back off of that yes. As I said, we have started. There are other three-hour materials. They are being used by industry. We have done some preliminary reviews of those, and like I said, there are no show stoppers.

We have had communications with those vendors, and they swear to us that their products will work for three hours. Until we have actually done a formal detailed review, I would not want to give you an unqualified yes, but we believe that there are other barrier products out there that will work for three hours.

MR. CARROLL: When we talk three-hour barriers, one-hour barriers, this is a standard that is used throughout industrial applications? It is nothing unique?

MR. WEST: The test standard themselves?

MR. CARROLL: Yes.

MR. WEST: You're right. It is used to design this building, just like a nuclear power plant or a plant or an offshore oil well.

MR. CARROLL: Do any industries have their own?

MR. WEST: For some high hazard area or

occupancies like the petroleum industry, the standard itself is similar, but they have a higher or a different time temperature curve, which is geared toward the higher hazard. And they sometime will require higher rating using the higher curve. They may require four-hour rating using the high hazard curve.

That's the only example I am aware of where a different curve or standard is applied. It is a very unique situation.

MR. CARROLL: Strictly in the petroleum industry.

MR. CATTON: Mobil Oil, for example, has its own standards for fire barriers, and that is because petroleum fires have a higher radiation heat transfer.

MR. WEST: Even Mobil and other corporations that develop their own standards, they typically do like the NRC has done with the generic letter, which says, this is our expectation for testing these things, and they refer or rely on industry standards like the ASTM high hazard curve to implement it.

MR. CATTON: As long as we have Option 1 and Thermo-Lag is on the viewgraph, I understand Thermo-Lag burns. Could you comment on that?

MR. WEST: The Staff believes that it is combustible based on testing that we have done through NIST.

MR. CATTON: Then it is really not much better than fire retardant plywood?

MR. WEST: I'm sorry. Did you say it is not better?

MR. CATTON: It is not much better than fire retardant plywood. That is a statement that I have heard made.

MR. WEST: To try and characterize the burning characteristics, we have tried to identify some materials that it would be comparable to so that a layman could attempt to understand.

And I think one of the comparisons that we have made is that if you take the test data from the combustibility tests that we have conducted, it is about comparable to fire retardant plywood, which is fire retardant but will burn.

Now, Thermo-Lag works by burning. It reaches its temperature of sublimation, the material, and releases the gases and they burn, and that keeps the surface cool. As long as you have the material there, theoretically, you have a fire barrier.

MR. CATTON: I have heard that the number -- actually, Carl told me that the number is 1000 degrees F. Is that the spontaneous ignition temperature or the flashpoint or what?

MR. WEST: I think the temperature of sublimation is probably less than -- I think it is like between 6 and 700 degrees and then the ignition temperature may be a couple of hundred degrees higher.

MR. CATTON: What is the temperature where I would get spontaneous ignition?

MR. WILSON: After you get through the temperature of sublimation and have sufficient release of the --

MR. CATTON: I'm just looking for a number, not the explanation.

MR. WEST: I can't tell you. Say, 1000 degrees.

MR. CATTON: What?

MR. WEST: 1000 degrees fahrenheit.

MR. CATTON: And what kind of temperatures are expected? I mean, what is it suppose to be barrier against?

MR. LINDBLAD: You have to distinguish whether 1000 degree is material temperature, or is the temperature that the sublimating gases --

MR. CATTON: I am looking for spontaneous ignition, the materials that are going to combust.

MR. LINDBLAD: So the sublimation is a cooling process.

MR. WEST: To get a spontaneous ignition, you would need a sustained temperature above the temperature of sublimation to drive off the gases, and then you would need to reach the ignition temperature of those gases, which are about 1000 degrees.

There is no -- I mean, if somebody holds a torch to a Thermo-Lag barrier, it is eventually going to burn in that area when all the conditions are right.

To have a barrier run through this room and say it is going to spontaneously ignite, but the time you do that, you know, the room is flashed over.

MR. CARROLL: But what you are interested in is the temperature of what is inside that barrier, Ivan.

MR. MICHELSON: Depends on what the barrier is.

MR. LINDBLAD: It is a heat transfer process that you ought to be able to calculate on the back of an envelope if you are a fire science specialist.

MR. KARYDAS: The flashover conditions he explained, yes, are designed conditions; at 600 degrees C considered flashover. So the general temperature of the room should be considered at that particular time at 600 degrees C.

MR. CATTON: Does this make for a very good fire barrier?

MR. KARYDAS: Flashover conditions, you agree with that?

MR. WEST: I agree.

MR. MICHELSON: The question asked was does that make a good fire barrier.

MR. KARYDAS: I cannot answer that. It is what is the fire condition from -- what is the temperature you have to fight?

MR. CATTON: See, that is the problem in using the deterministic approach that they have, is that that question really hasn't been answered, at least I don't think.

MR. WEST: What the spontaneous ignition temperature is?

MR. CATTON: No, no, no. I understand the answer to that now, 600 degrees C.

The next part of that questions, if you are going to use Thermo-Lag as a fire barrier, is 600 degrees C high enough for the flashover?

MR. WEST: Well, the --

MR. CATTON: And that is yes or no.

MR. DAVIS: He said it works by burning. That keeps it cool. The off gassing keeps the fire away from the surface.

MR. CATTON: There are some materials, if you keep supplying external energy, the thing will continue to burn. As soon as I take away that source of energy, then it just sort of waffles and goes out.

What does the Thermo-Lag do? If I get it up above the flashover point, will it continue to burn or will it stop?

MR. WEST: It will continue -- it you have the flashover in a room, it is probably going to, if the room continues to burn, it will continue to burn.

But we have observed from fire testing where we actually stick these in a furnace and burn them, that after you take them out of the furnace, the flaming will eventually die off within a couple of minutes.

MR. CATTON: And that is a strong function of orientation, among other things.

MR. DAVIS: And oxygen availability.

MR. CATTON: Well, sure.

MR. WEST: It is a function of that and how much virgin material is left when you remove it.

MR. MICHELSON: Are you saying the material, once ignited will not continue to propagate a flame if you remove the ignition source; is that what you are saying? That's what "going out" means.

MR. WEST: I am reluctant to answer because we have some additional test plan which will answer that question directly. We believe that it will go out if the heat source is removed.

MR. CATTON: The combustion is not self-sustaining?

MR. WEST: Absent an external heat source, I believe that to be true.

MR. CATTON: Okay.

MR. MICHELSON: Now, your bullet about exemptions, if you scratch the word "limited" you could deal with the other through options through the exemption process. Is that a fair statement?

MR. WEST: The other three options? Options 2, 3 and 4 through the exemption process?

MR. MICHELSON: Well, I mean you could accomplish what they would accomplish.

MR. WEST: I'm not sure we could.

MR. MICHELSON: I could come in with a performance-based analysis for the problem areas I have in my plant, and you could grant me exemptions?

MR. WEST: Theoretically, that's true, but I don't think we would do that. You are talking about Option 3 in this case. Or, if a licensee went out and developed his own time temperature curve, he could say I am going to test these, and I want you to review it and accept it.

MR. DAVIS: Does the word "limited" suggest that the 600 exemptions that have already been granted, you would be more restrictive now?

MR. WEST: No. It does not mean we would be more restrictive. It means we would apply the same standard to new exemptions, and we would not be marked liberal just to get everybody out of the Thermo-Lag fix.

MR. DAVIS: I don't understand what "limited" --

MR. WEST: It is obviously subject to definition and a qualitative word. What we had in mind is we don't want to just open the door to exemptions, and have every plant that has Thermo-Lag come in with a technical basis for why whatever they have is acceptable in the plant.

MR. CATTON: Pete, as I understand it, there are many cases in a plant to put the Thermo-Lag rather than argue. Fight rather than switch. And they would now like to come in and say, look, we did not need it there anyway; why did you give us an exemption for that particular cable tray? There is nothing to worry about.

Is that the kind of limited exemption you are talking about?

MR. WEST: If the case truly is they put it in and did not need it, they could make that determination on their own. They would not require exemption from NRC to do that.

MR. CATTON: Could you give us some examples?

MR. WEST: Yes. I will give you an example similar to what you are talking about. There could be a licensee that was trying to get his license. Appendix R came along, they needed to comply. They thought Thermo-Lag was a good product. They went out and they put it -- whenever there was doubt, they put it in. Okay? So they have a lot of Thermo-Lag in the plant, and in a lot of those

-- most of those places they need it.

Now, if they had had the luxury of the time to come in to the Staff on a case-by-case basis in those areas, they may have been able to make a legitimate case that in this area we really don't need a fire barrier because there is no combustible loading, it is outdoors, it is along the exterior wall or whatever. It may be in pump room with no combustibles, no chance of combustibles being put in there.

That's the kind of thing we would look at today. In fact, some licensees have submitted some exemption requests like that.

MR. LINDBLAD: We are trying to distinguish between the one where the licensee can make his own determination. It seems to me that in the descriptio you just made, they could make that determination.

MR. WEST: I'm talking about to achieve compliance with the rule you need a barrier in this room. If you just want to achieve literal compliance; you install your barrier.

But if the licensee at the time had submitted an exemption request because there is no combustibles in the room -- and we look at a number of factors when we look at these exemptions -- maybe the space is continually occupied, maybe there are no combustibles, there is a detection system and the fire brigade is parked right next door.

He may have, before he put that barrier in, request an exemption but not done it for whatever reason. It may be that now he could come back and request an exemption for that area, and using the same standards that we have applied in the past, we would review that and maybe grant it. He couldn't make that decision on his own because he can't exempt himself from the rule.

In the other case, when there was doubt in his mind if he needed the barrier or not, he may have just put it in and said, I am not going to worry about the NRC coming in and inspecting me. I am going to put a barrier there and I have it whether I need it or not. A lot of the licensees or some have told us now that they are going back and they are looking at those cases, relooking at their analysis, and making a decision, do we really need the barrier to meet the NRC fire protection requirements, and the population of barriers is being reduced in industry by that type of analysis.

MR. CARROLL: Are they actually physically removing it in those cases?

MR. WEST: Most are retiring it in place that I have heard of. A lot of this is anecdotal from phone calls and that kind of thing with licensees. In most cases, it is easier to retire it in place, and that is what they are doing. Some have taken it out, some have replaced it, some have rerouted cables and relocated components. There is a range of actions that are being taken by some licensees now to resolve these problems.

MR. CATTON: Carl?

MR. MICHELSON: A few clarifications I need on geometry just so that I understand what the test may even mean. Are there any cases where we are trying to protect stack trays, in other words more than one raceway vertically, for instance?

MR. WEST: Yes.

MR. MICHELSON: That is quite a different geometry than the test geometries unless you are going to do that test geometry.

MR. WEST: That is a --

MR. MICHELSON: I don't want to get into the detail. I just want a clarification now to understand what we really have out there in the real world.

MR. WEST: Yes, those configurations exist in the industry.

MR. MICHELSON: The next question is, are we running into configurations wherein we have cross-conduits or cross-pipes between the stack trays and how are we handling the penetration, in other words, of the fire-lag barrier? Are there any cases where that happens?

MR. WEST: I don't believe that you would find the case where you have a pipe penetrating a Thermo-Lag barrier itself except for maybe fire protection system. There are some cases where large vaults are built and they may have a sprinkler system inside the vault.

MR. MICHELSON: I am not too concerned about what is in the pipe, I am concerned about the presence of the pipe and its affect on the qualification of the barrier.

MR. WEST: If you are talking about a fire protection pipe -- I don't know if you mean a steam pipe, you are saying there is no difference?

MR. MICHELSON: I am not going to ask about what the pipe is, but are we qualifying barriers with penetrations?

MR. WEST: Industry is qualifying barriers with penetrating steel items to see how the penetration affects it.

MR. MICHELSON: I hadn't seen those, but eventually when we have such cases there will be tests.

MR. WEST: But it is not for pipes. It is for things like supports.

MR. MICHELSON: Are there any walls being qualified as thermal barriers made out of Thermo-Lag?

MR. WEST: There are walls in industry. The workshop with NEI a couple of -- actually a month or two ago, there was a small industry group that made a presentation that said they are planning to do some tests of walls.

MR. MICHELSON: Now the walls, do any of those walls, are there planned penetrations of those walls and will that be a part of the test?

MR. WEST: We don't have the details on the test.

MR. MICHELSON: For instance, is there a door through the wall, and if so how is that being treated? It becomes very important when we start talking about combustibility of the material on the backside of the wall depending on what it is made out of.

MR. WEST: Sure.

MR. MICHELSON: These are compartments. I understood a little earlier that you do have diesel compartments wherein you are considering using Thermo-Lag for separation purposes; is that correct?

MR. WEST: Well, we are not considering it, but industry has used it.

MR. MICHELSON: Therefore, you have to consider it.

MR. WEST: Right.

MR. MICHELSON: Of course there the thermal history of the fire might be quite different because the sources are quite different. The E119 is nonconservative in that case, I suspect. It is a petroleum fire.

The question on combustibility, you said that the flame goes out when you take it out of the furnace. Your SECY 94-128 kind of led me to a different conclusion. I will read you the sentence that bothers me. It says: The barrier material burns throughout the fire test and continues to burn after it is removed from the furnace. I think now you are saying it doesn't continue to burn?

MR. WEST: No. My observations from the tests I have seen, when you take it out of the furnace, it continues to burn and the flames die down and eventually, before the hose stream is applied, they are pretty much --

MR. MICHELSON: It would be nice to say, but extinguishes within X minutes or something of that sort.

MR. WEST: We haven't really --

MR. MICHELSON: I was worried about self-propagation because now I can talk about a 15-minute fire and the fire-lag burns for an hour.

MR. McCRACKEN: We haven't tried to make that determination because in most cases we were hitting it with a hose stream shortly after we brought them out of the furnace.

MR. MICHELSON: Well, in the case of the 15-minute fire, you are saying people are trying to say that we have a source, and it is only five minutes under the Thermo-Lag and, therefore, I don't need to worry about it beyond 30 minutes. Well, the fire extinguishes in five minutes but the Thermo-Lag burns for 30 maybe. I don't know.

MR. McCRACKEN: Which is why we are going to run that flame spread test that we were talking about.

MR. MICHELSON: Okay, but until we know that, we don't know whether this is self-propagating. Then you get into further questions about propagation of fire within these barriers once ignited by electrical faults inside the barrier, things of that sort, which usually reaches 1,000 degrees. There is no problem getting a very high temperature on faults.

MR. WEST: Well then, if the fire is within it, you still have a barrier separating redundant trains. You just have the fire on the other side.

MR. MICHELSON: It depends on what that fault does to the barrier in the process.

MR. WEST: Yes.

MR. CATTON: I would like to move along. We have two more options to talk about.

MR. MICHELSON: I would like to have my time too.

MR. KARYDAS: Can I ask a quick question in terms of the test that you are planning about the flammability parameters. Do you know currently what is the minimal heat flux and critical heat flux to ignite Thermo-Lag?

MR. WEST: I think we did. I don't know off the top of my head. I think the tests we did -- did the tests we do do that, Pat?

MR. MADDEN: Well, we did a cone calorimeter test on some samples of Thermo-Lag, but I don't have the results with me, but I can get back to you.

MR. KARYDAS: Is part of the test also the fire propagation index?

MR. MADDEN: I don't know.

MR. KARYDAS: In other words, I am asking because there are a number of well established tests now in terms of flammability materials, in terms of the minimal -- the critical heat flux for ignition, the minimal energy for ignition as well as the fire propagation index in terms of orientation and other parameters, basic parameters of the material.

MR. MADDEN: [illegible] like I said, some combustibility tests, and also NEI has done some tests in the combustibility area. Like I said, we can make those results available to you.

MR. WEST: Let me just add on that that NIST is helping us as we speak with the review of combustibility. They are relooking at the tests we did, the tests that NEI did, and some other information that NEI put together to try to characterize and assess the combustibility hazard. I guess it is the staff's general feeling that the combustibility of the material itself is not something that we need to be overly alarmed about. It is under review.

MR. CATTON: I do gather, however, from the discussion that there are still some residual questions about the adequacy of Thermo-Lag as a fire barrier material; would that be fair?

MR. WEST: Technically, we are satisfied, at least in the case of a one-hour barrier, that it can be made to be an effective fire barrier. We have approved this at Comanche Peak. We are reviewing the TVA program now, and I think we feel very confident in saying --

MR. CATTON: But there are several parts to tne question. When you say one-hour and three-hour, you have certain criterion about temperatures and so forth, but these other questions are a little bothersome, things like the fire propagation index that Dr. Karydas mentioned. If you don't have answers to these questions, it seems to me that you have residual questions about its effectiveness as a thermal barrier material. What are you going to do if it comes back a little bit negative from these tests that you are having NIST do for you?

Shouldn't the decision point be postponed until you have this information in hand?

MR. WEST: We feel that as a fire barrier itself, at least as applied at Comanche Peak Unit 2, that it will function as intended and will protect the safe shutdown function in accordance with our requirements.

The questions of combustibility, again, if you back to Conrad's presentation on the defense in-depth, it is something we look at as part of the overall fire protection program. You want to minimize combustibles, and we may find, as a result of all this ongoing work that maybe we do need to do something else.

In most cases where there is a one-hour barrier there is also sprinklers. In that case, I don't think there is probably going to be a problem. Sprinklers are very reliable and we would expect them, as Conrad said in his discussion, to actuate, if you got a fire large enough, and put the fire out, even if it is Thermo-Lag burning.

MR. CATTON: Okay.

MR. WEST: But as a fire barrier, it appears that it is okay. We have made that decision. We have moved beyond that.

MR. CATTON: I understand you have made that decision. I am just trying to figure out whether it is a correct one.

MR. McCRACKEN: I want to make clear, we consider the tests that we are trying to get done up the street to be a confirmatory test. We believe, based on everything we have seen, and I think Steve said that he believes if you take it out of a fire and leave it sit there long enough that it will go out, and we are trying to do the flame spread test just to demonstrate whether that is the case.

We haven't seen anything at all that would tell us that we need to remove Thermo-Lag as a fire barrier product from these plants.

MR. WEST: Just a closing comment on that, in the case of Comanche Peak, what they did is said, okay, we have a fire barrier, we agree that it is a fire barrier. They put them in. Then they also considered the hazard introduced by putting Thermo-Lag in as a combustible in their fire hazards analysis, and assured themselves that they had adequate detection and suppression and everything else in those area. A lot of licensees have gone back now and they are redoing their fire hazards analysis to consider the presence of the Thermo-Lag material itself.

MR. CATTON: So somebody knows the burning characteristics of Thermo-Lag or else they couldn't do those studies?

MR. WEST: Right. I am saying, yes, we know about the burning characteristics ourselves. I just, off the top of my head, can't give the specific data he wants. We can give you the test reports.

MR. CATTON: I would like to see one of these fire hazards analyses at some point. Why don't you continue.

MR. MICHELSON: How widely used is Thermo-Lag in other industries?

MR. WEST: In other industries, I couldn't tell you. I mean I know it is used in other industries, but I couldn't really give you a good answer. I mean it is used in the petrochemical industry on offshore oil wells. It is used to protect raceways in high-rise buildings and that kind of thing. I really couldn't give you a good answer.

MR. KARYDAS: It is not at least approved by Factory Mutual. Therefore, in a wide range of industries, industrial facilities other than nuclear, it is not an approved product.

MR. WEST: It is approved for some applications. I believe UL has actually approved it for the protection of the structural steel, which is a little bit different.

MR. KARYDAS: I didn't say but UL, though.

MR. CARROLL: Why does Factory Mutual not approve it?

MR. KARYDAS: It has not been submitted for approval.

MR. WEST: They haven't tested it.

MR. CARROLL: How about some of the other products that we use in nuclear power plants in the same application we use Thermo-Lag, are those products approved by Factory Mutual?

MR. KARYDAS: There is a big list, there is a big book of items that have been approved. I don't know them by heart, but there is a number of lists that have been approved.

MR. CARROLL: The 3M material that some plants use may or may not be approved.

MR. KARYDAS: Gypsum wallboard, one billion products. I have a number of things here.

MR. WEST: These things are generally, these types of products are generally tested and approved by UL and Factory Mutual and other approving organizations for specific applications. If you just say 3M as you all list it, that doesn't tell you a whole lot. You have to know for what application. For Thermo-Lag, too.

TSI will tell you that Thermo-Lag is UL listed. Well, it is for structural steel, but the criteria for acceptance are much different than for raceways. That is a subject for an whole other meeting.

[Slide.]

MR. WEST: Option 2, as we discussed in the introduction, is a feasibility study. There is some feeling that the standard time temperature fire that is specified in ASTM E119 which is used to test, as we said, these barriers, it is used to test the walls in this building, and across the country for any number of applications, that standard time temperature fire may be more severe than what you would expect in a lot of nuclear power plant areas because of the defense in-depth, the control of fixed combustibles, the control of the transient combustibles. So it is really a matter of the combustible loading or fire hazards in the area like lube oil, and that kind of thing.

So, therefore, we thought that one possible approach or option for resolving these issues may be to take a more sophisticated look at the fire hazards in representative nuclear power plant areas and develop new or nuclear power plant specific time temperature curves. Like I said, we didn't feel comfortable with just saying, this is an idea we should proceed with. We did a little searching around and we said, this is an idea we should study, if the Commission would like us to.

So really we were asking them for a policy decision on, would you consider this, if these curves are feasible, would you consider this as an option for resolving the Thermo-Lag issue.

There is some talk, and I don't think there is total agreement on this, I think it would be part of our study that if you develop these new curves, you can actually redefine what a one and a three-hour barrier is, and by redefining it, you still need the Appendix R requirements because Appendix R itself doesn't say in the body of the rule that you need to test the E119, but clearly from the statement of the considerations the Commission said, when you are complying with this rule and you want to use a one and three-hour barrier you will use E119.

So that is something I think maybe something that you are not concerned with, but I think that is something that we need to look at. Can you redefine what these barriers are and then still meet the rule.

MR. CATTON: From the write-up, I guess it is SECY 94-127, you indicate that you feel that the industry could develop a high, medium and low E119-type time temperature curve within a year. If they were to do that, it seems to me that they could come in and deem these various time temperature curves are adequate for the nuclear power plant, that they could come into compliance quicker than they would with your Option 1 once those time temperature curves are on the table.

MR. WEST: I am not sure we went quite that far.

MR. CATTON: No, you didn't say that. I am saying that, and I am just looking for you to tell me that what I am saying is wrong, or there is a possibility.

MR. WEST: I can tell you that as part of the study we would look at the process for doing this and develop some time line.

MR. CATTON: 127 says that you believe the industry could come up with the curves within a year.

MR. WEST: Right, and I think we stopped there.

MR. CATTON: Given that I have new time temperature curves in hand, how long would it take for the industry to come into compliance?

MR. WEST: Given that industry develops them in a year and we have them in hand, then we validate and verify them. We stopped at the year, so you are talking six months for us to do our study. If we think it is feasible, and I think part of the study we will be working with industry because we would like their input on this also. But say everybody agrees it is feasible, so we have done that in six months, then we could go out and actually see if we can do it. So say we do it in a year, say we work with industry but they have the lead and they develop these new curves.

MR. KARYDAS: Are those curves time temperature curves that you are considering in coordination with the structural elements? In other words, is the problem only thermal or is it also structural?

MR. WEST: Well, the test method itself would be the same. I mean the only thing we would vary would be the time temperature curve used to test it because we are saying we would use a new curve to test this component. So to the extent that that new curve tests thermal and structural aspects of the assembly, it does both.

MR. KARYDAS: Because you explicitly refer so far to the temperature curves but I haven't heard yet -- I believe the problem is more structural than thermal, or more accurately is a combination of the two?

MR. WEST: It is a combination of the two.

MR. KARYDAS: I mean the E119 is strictly thermal?

MR. WEST: No, maybe we are on a different wavelength. The E119, I mean the test these Thermo-Lag fire barriers are being subject to challenge the barrier thermally and structurally. I mean there is a change in the Thermo-Lag system and it is susceptible to structural failure.

MR. KARYDAS: Of a plate or an assembly?

MR. WEST: An assembly. I mean these are three dimensional assemblies.

MR. KARYDAS: So you are alluding implicitly to structural elements here, so you are going to do fine experimental curves of some kind of different but the same nature where you are going to test both thermal and structural integrity?

MR. WEST: To the extent that the fire challenges the system structurally, it will but these are --

MR. KARYDAS: So it is most likely, I guess, that there is no way that you cannot challenge that structurally.

MR. WEST: Right. But I mean it is just whatever structural challenge that is presented by the curve itself. It is the standard time temperature curve we come up with. Under 119, that test standard itself, which specifies the test methods for different building components, walls, and floor/ceilings, and that kind of thing, you can load the wall where you have a load on the wall, or you can have non-bearing walls, and they are tested with or without a load. These are typically, for all the tests we have done, have really been nonload bearing. We consider it equivalent to nonload bearing wall.

MR. CATTON: I may not understand the words you are using. It seems to me that the development of a fire severity curve is certainly feasible. Why do you choose the words that you use. Is there something that I don't understand about what you are trying to say?

MR. WEST: I guess we are just not as certain as you are. I mean it is -- well, let me give you some examples. Somebody mentioned downside risk earlier today. I get the sense when we talk about this with different groups that there is a feeling that when you do this you are going to come up with some curves that are lower than the E119, or higher, and the ones that are lower are going to apply to most nuclear power plant areas.

Then if you have a lower curve, you are going to have less challenge to the barrier and it is a higher probability that it will pass the test because, let's face it, these things are failing because they get too hot and either all the materials were consumed during the test so they burned through, or they failed structurally because the material is consumed and the seams open up. So if you have a less severe fire, you have a better probability of it passing.

So there is a sense that this is a good thing. If you can identify the plant areas that have the lower fuel loads and maybe use a lower curve. As you said, there may be areas like diesel generator rooms where you are going to find you have a much higher curve, and you may find out or industry may find out that if you are just going to use if you are going to redefine the three-hour barrier, you may need a better barrier.

MR. CATTON: So what you are saying, you really don't mean feasible. You may find something you don't like.

MR. WEST: No. What I mean is, suppose the Commission asks us to do the study, and we go out and we start surveying nuclear power plant areas. We may decide there is so much variation we really can't come up with a new curve, or the curve is going to look like the standard curve, so we should w do any more. The standard curve is good enough. Those kinds of studies have been done in the past. Not quite as focused as this one, but people have looked at the -- Sandia has looked at the 119 curve and test standard. That is what I mean by feasibility.

We don't want to just say, it is feasible to do this. There are the other questions of, does it really get us to the solution we are looking for. Do you really meet the rule if you redefine the barrier. So it is not all technical questions we have.

The three curves idea, that is off the top of our head. We said, gee, it looks like we may have three curves. One may be the standard E119 curve. One may be lower, one may be higher.

MR. CATTON: I understand, so feasible is really not the word that you should be using.

MR. LINDBLAD: When we are talking about these actual plant fire hazards, do they contemplate that within a three-hour period there will be fire suppression activities going on?

MR. WEST: The fire endurance tests themselves do not consider other fire protection features. They are only testing a fire resistant component and how it responds to a standard fire.

MR. LINDBLAD: And so actual plant fire conditions would probably include suppression?

MR. WEST: No, I don't think so. We haven't really fleshed this out, what it would include or not, but if you start taking credit for a suppression system early, you are never going to have probably a major fire.

MR. LINDBLAD: I guess that is what I am speaking of. Three hours is a very long time to go without any suppression activity?

MR. WEST: Well, that is one of the things we need to look at. That is why we are not sure technically feasible or whatever word you want to use, because you may find, with the exception of maybe diesel generator rooms you can't get a fire to burn for three hours anywhere.

MR. CARROLL: Well, diesel generator rooms are separated, so you don't really worry about them too much, but there wouldn't be any Thermo-Lag if they were truly separated. So there wouldn't be any Thermo-Lag to worry about, but apparently there is and so the statement is not quite --

MR. CATTON: It would have been better to have said, may not be very helpful.

MR. WEST: The other thing --

MR. CARROLL: Ivan, you never got your question answered.

MR. CATTON: Which one?

MR. CARROLL: If time zero is now I have in hand these new curves, assuming that it all worked out, how long would it take industry to get in compliance?

MR. WEST: Yes, we got sidetracked.

MR. CATTON: If it turns out that has some curves that are higher than E119, he is really in trouble. It is going to take him a long time.

MR. WEST: Let's stay sidetracked for just a second because I wanted to bring up one of the downside risks we mentioned to the Commission when you do this, when you start looking at these curves, you are playing with fire.

[Laughter.]

MR. WEST: You have the standard time temperature curve and I think we all know what it looks like. You start looking at the actual hazards in an area and you develop a new curve for that hazard.

You may find that you have a fire that is less severe if you just look at the area under the curve. You may find that the fire's severity early in the fire is much higher and then you have a more steep degradation of the fire. And when you do that, you play havoc with anything that has been tested to the E119. You may find very early failures of barriers. And that has been done in tests.

MR. CATTON: Then maybe we ought to know about that, I think.

MR. WEST: That's why we're saying we need to study this. We had a couple of --

MR. CATTON: That has nothing to do with feasibility. That is something we really ought to know and ought not be hidden.

MR. WEST: The reason it is not a significant fire safety concern because of the defense in depth, we have all of these defense in depth features, fire suppression, fire detection, minimization of combustibles and all these other things. And one of the basic principles of defense in depth is that when you have these other weaknesses, whether you know what they are or you don't, they are generally compensated for by the remaining depth, defense in depth.

MR. MICHELSON: If I have two diesel compartments for my plant and I have to use thermal lag to protect the fire in one compartment from losing the diesel in the other, I am getting awful close to the coupling --

MR. WEST: I don't think you are going to have that --

MR. MICHELSON: That's why I asked to begin with, do you have any Thermo-Lag and the answer ought to be, no, none is required in the compartments.

MR. McCRACKEN: There is no Thermo-Lag separating one compartment from another.

MR. MICHELSON: I hope that is not the case.

MR. McCRACKEN: I would like to --

MR. MICHELSON: There must be conduit that is associated with the other compartment. That's why you need Thermo-Lag.

MR. McCRACKEN: I would like to answer the question on timing. If we don't answer, you will sit there and worry about it.

MR. CATTON: You're right.

MR. McCRACKEN: If P-0 is the time and we verify we're all happy and we agree with each other, because we are changing the standard that all nuclear power plants are meeting, we are certainly going out for public comment with this. We are going to come down here. That is going to cost us -- you know, coming down here is six months at least.

[Laughter.]

MR. McCRACKEN: Then we go out for public comment. That's going to be several months. You are talking similar to a reg guide. By the time you do that, a reg guide process to get it out, reviewed and approved, everybody can now go forth and implement, it is a couple of years.

MR. CARROLL: And then there is the implementation.

MR. McCRACKEN: To get to time zero for a utility to start implementing is a couple of years from the time you develop the curve. And then it is whatever length of time it takes after that to go through and do your analysis.

MR. WEST: You're talking about retesting some of these barriers to see how they respond to the new curves and that kind of thing.

MR. CATTON: The reason I asked the question is I continually hear from everybody how the fuel loading is so low in these places and I hear that from you all the time, Conrad. It is so low that it is grossly overdesigned.

If that is the case, then implementation ought to go quite quickly once you have the curves.

MR. McCRACKEN: A discussion that I gave right back, way back when we got into Thermo-Lag, and I always said before when we had one- and three-hour barriers with the fuel loadings we had, with the real one- and three-hour barrier, I think things are conservative. When these barriers start lasting 17 and 20 minutes and I have got a 17 to 20 minute fuel load and a 15 minute fire brigade response time, I am not that conservative.

MR. CATTON: Okay.

MR. McCRACKEN: Now, all my curves are coming together in one point and the amount of margin I have has gone to a very small amount. Certainly, based on everything I know about fire modeling and fuel loading and what exists, the margin is not enough to make me comfortable. That's why at a lot of plants, they have fire watches out there.

MR. WEST: I will use the word "feasible" again.

And what I will draw from Conrad's overview is we want to make sure that if we do something like this, is it feasible or appropriate to look at this as one piece of the overall fire protection program and do something with it without looking at the program across the board?

MR. CATTON: How do you look at the program across the board without having this information?

MR. WEST: We are doing that under Option 4.

MR. CATTON: You still need this information, whatever option you look at.

MR. WEST: Not necessarily.

MR. CATTON: How can you do a performance-based fire evaluation without this information?

MR. WEST: Without having three new time temperature curves?

MR. CATTON: No, without having the information that could be used with the new time temperature curves. Once you have the information in hand, you can decide what to do with it. You can exercise it through Option 2 or you can use it to help you with Option 3 and 4. So whatever you do, you have to have the information.

MR. WEST: I am not suggesting that this information would not be useful for Option 4. What I am suggesting is this information may not be useful for fixing the thermal lag issue today.

When you have a program that is looking at the integrated fire protection program, things like this and things like are covered under Option 3 where you are going to start at the beginning and go to the end through a process that is going to give you a new method for meeting -- to achieving a fire-safe plant. So that's what I mean.

I am not saying we may or may not look at this under Option 4. It will depend on what the petition looks like from NUMARC or NEI.

And I am just going to go ahead to Option 3 then.

MR. CARROLL: Are you going to give us a break between Option 2 and 3, Mr. Chairman?

MR. CATTON: He is over his time a little bit -- we are. Some of his answers have gone more lengthy than needed.

Yes, why don't we take a break. We will come back at 20 of, by the clock up there on the wall.

[Recess.]

MR. CATTON: I am glad you changed the viewgraph before you walked away.

MR. WEST: Right as we were leaving Option 2, we were talking about you may want to do Option 2 and Option 3 to get to 4. That is possible, 2 and 3 may be elements of Option 4. But they may not. It could be you could come up with a performance-based approach that would not require you, ahead of time, to go out and do this kind of survey of plants to develop new curves and all that stuff.

MR. MICHELSON: You are saying then you could write a rule under Option 4 without ever doing the studies called for in Options 2 and 3?

MR. CATTON: It must be true, Carl, because the rule is written and apparently will be on the street in August, this summer.

MR. MICHELSON: I have not seen it; I don't know what it is.

MR. WEST: We have not seen it either.

MR. MICHELSON: Well you haven't -- the answers argued as to the state of the art. I had great difficulty believing the rule as written.

MR. CATTON: Ready it may be. Acceptable, it may not. Why don't you continue.

MR. WEST: Option 3 is what is being characterized as plant-specific performance based approaches or solutions. We picked up that terminology principally because that is what the individual licensees are calling our approaches. Because they are based to some extent on fire modeling to help you understand the fire hazards in the area and how a fire will progress in a particular plant area and also using PRA or PSA insights to help ensure that you have an adequate level of fire protection based on probabilities that you are not going to have a problem.

When we sent out the request for additional information to all of the licensees that used Thermo-Lag, we got back responses from the AD plants and 22 sites or 35 plant/units indicated in very terse terms that they were planning to use a performance-based approach. And none of them really gave us a real good concise or understanding of exactly what they were going to do except for Florida Power and Light and they took the extra steps of coming in with additional letters that outlined their approach and the NRR management felt it would be worthwhile meeting with them to try to understand their approach and try to get a feel for whether we thought it would be an idea for an acceptable solution.

And when you get into using the fire models and the PSAs and the PRAs to -- in the context of regulatory compliance, it is fairly a significant departure from anything we've done before. If you look at the exemptions we've granted and the reviews we've done for compliance, we haven't really -- we have not at all relied on fire models or PRA argument to approve or disapprove an exemption, for example, or to decide if some area was safe enough.

So that is what precipitated our review of these approaches and we met with Florida Power and Light a couple of times and then we heard from some other licensees and they said, well, we're going to use this approach too but it's different and here's how it's different. We started getting a little bit concerned -- a couple of concerns.

One is that we were potentially going down the path of reviewing any number of different performance-based solutions. Everybody was focused on Thermo-Lag fire barriers and we had that concern that Conrad has raised. Is it appropriate to look at Thermo-Lag fire barriers and start applying these types of approaches or some different methodology or should we look at the whole fire protection program like we are doing under the performance-based rule.

And after very careful consideration by the Staff and the senior NRR management and the EDO's office, we decided that we shouldn't be looking at these approaches as a solution to the Thermo-Lag problems. And that's what we told the Commission in SECY-94-127. We said, we've done a little bit of work in these areas, we don't think we should go any further with it and we are not planning to go any further with it unless you direct us to do so.

MR. CARROLL: Isn't this though, in a sense, an exemption approach that you are saying you will allow under Option 1?

MR. WEST: A licensee could come in with this approach and we were having these discussions with Florida

Power and Light and they could say, we want an exemption for all of these barriers and our technical basis for the exemption is a result of our fire modeling, the results of our PSA and we want you to grant the exemptions based on that.

MR. CARROLL: All I am trying to get at, this almost seems to me to be a subset or an implementation of Option 1 or a potential implementation.

MR. WEST: It could be considered a subset of Option 1 but it is very specific, it is the kind of thing where really what we are saying to the Commission is, we need a policy decision on this because these approaches do not meet Appendix R and we know that you don't want to grant wholesale exemptions.

We have 22 sites now or 35 plants today saying they want to use it. It is not Appendix R compliant, so if we do it under the current rule, we are talking about a lot of exemptions. We are talking about an area that we have not reviewed before.

MR. CARROLL: But you are already a little bit pregnant here in that you have granted exemptions in the past.

MR. WEST: Certainly we granted exemptions in the past. I would say we are not a little bit pregnant; you are either pregnant or you are not.

MR. McCRACKEN: I think there is a subtle difference unless you sit there writing the exemptions you want notice that in Option 1 we said limited exemptions based on what we've done before. We have really not granted exemptions before for barriers that were less than one hour. We have granted exemptions for no barriers. We have granted exemptions for less than three hours. But we have not said, if you have a barrier that only lasts 22 minutes, we're going to give you an exemption.

Under Option 1, we would not be granting exemptions for those reduced barriers, we would say upgrade those to one hour.

Under this option, we'd be granting exemptions for virtually everything that you could be convinced was technically safe. So here I think you are talking exemptions of a number which is irrelevant, but say 50 per plant versus one or two under Option 1.

So it really isn't being a little bit pregnant; they are two separate issues.

MR. DAVIS: This sort of expands the envelope of exemption territory, I guess.

MR. McCRACKEN: It expands it significantly beyond what we have ever done in the past. It still may be safe and it may be a technically achievable way to go but we have not done it in the past.

MR. DAVIS: That's good.

MR. KARYDAS: What is the performance parameter or parameters that you set as the basis for the performance-based methods?

MR. WEST: That is the rub. These approaches, when you contrast this approach with the research work on the performance-based ruling, they are really a lot different. I mean, this is not what we would call a performance-based approach in that context.

MR. KARYDAS: Can you define this approach? I am not quite sure I understand. What is this performance-based approach?

MR. WEST: The reason these are being tagged as performance-based approaches by the individual licensees, they are saying principally because they are using fire modeling to define the level of protection they should provide in an area, they will base the fire protection to be provided when the fire hazard's in the area and what barrier performance do you need to ensure safe shutdown capability given the output of that fire model.

MR. KARYDAS: Still, there must be some performance criterion here that they are suggesting. What is that? Time, reliability, risk?

MR. CARROLL: The fire won't --

MR. WEST: The risk comes in at the end. What they are doing, they are going to go into this room, they are going to run their fire model, they are going to come up with a time temperature profile for the room. It is going to look like the standard time temperature curve, except it is going to be the time and temperature curve for that room from that model and then they are going to compare their actual barrier ratings to that curve.

Now, they did some tests and they think their one-hour barriers will last 28 minutes.

MR. CATTON: But if you are using fire models, that implies someone has done the appropriate V and V with the fire models so it can be accepted. I would like to know if there are any fire models that have been V and V'd.

MR. WEST: We believe this would be technically challenging. One of the biggest challenges for us would be this question.

They took the model, COMPBRN 3-E which is used by the five methodology and then they modified it, they said, in a way that represents their plant. They did a plant-specific modification.

MR. CATTON: Has there been a report submitted on that?

MR. WEST: Not with any details of the model. It has been described qualitatively.

MR. CATTON: If and when that happens, I would like you to keep Doug posted and get the reports to us if you could.

MR. MICHELSON: Just to follow up on your explanation, if you are doing an averaging of temperatures to try to arrive at a temperature curve for the room, how do you relate that to the actual proximity of the particular fire to the particular barrier? It may be right on top of it, for instance, and be quite difference if you integrated the whole room and look at that rise. How do you account for this?

MR. WEST: Again, that is some of the challenge inherent in this kind of a solution.

MR. MICHELSON: You are telling me that you have to look at the fire relative to the barrier that you are examining? Is that what you're saying?

MR. WEST: They picked the area and the room where they predict that with the postulated fire they are going to have the worst response relative to the barriers. They may run the model a couple of times and move the pilot fire around until they are satisfied that the output of their model is the worst case for the postulated fire in that room.

MR. MICHELSON: Relative to the barrier you are going to examine?

MR. WEST: Right.

Under their model, the barrier can catch on fire. Remember, it is Thermo-Lag so they model that. They even model the barrier burning and they take that output from the model and compare their actual barrier rating. And if it is below the time temperature curve, they have a success and they say the existent barrier is adequate for that area. If it is not adequate, they may have to take an action. They could upgrade the barrier, they can install a sprinkler system or they can do something else.

MR. MICHELSON: By "below," you mean below at all times or just integrated.

MR. WEST: For the worst case.

MR. MICHELSON: They have to stay under the curve at all times?

MR. WEST: Right.

MR. MICHELSON: If they're going to use them.

MR. WEST: Right. And they give themselves credit if there are sprinklers in the room and for some other things. But there are a lot of technical challenges there.

Marty mentioned the resources this morning. You can imagine if we tried to V and V 22 or more plant-specific fire models, I mean, it is very challenging.

What we said to the Commission was, if you think this is, from a policy standpoint, a way we should go or give more consideration to, we think the only way to really do it is to get agreement with industry that we work with the lead plant and come up with one way instead of 22 or 35 or whoever else jumps on the bandwagon as we pursue this thing.

MR. CATTON: The fire models or whatever result from the lead plant would become the standard for the industry?

MR. WEST: Presumably.

MR. CARROLL: Has FP&L said, "We would like to be a lead plant"?

MR. WEST: They told us they would not like to be a lead plant but that's before we said we do not want to work on these at all.

MR. CARROLL: Why did they say that?

MR. WEST: Well --

MR. CATTON: Not if they can get someone else to do it.

MR. WEST: When they came in with this approach, they thought it would be a matter of the Staff reviewing it and accepting it and can go on with business. Getting involved with lead plant, it is a little more complex because you have to consider the needs of the other users.

MR. CARROLL: I am not sure that FP&L does. I think the Staff does.

MR. WEST: It is an interactive process.

MR. CARROLL: I guess I agree.

MR. WEST: Even given this, we come back to the fundamental Staff concern about looking at these, focusing on the barrier and forgetting really about the rest of the defense in depth or the integrated fire protection program.

MR. CARROLL: To say nothing of shutdown fires.

MR. WEST: Everything that is involved in the whole morass.

We started looking at this. We were saying, we have this Option 4 which is really not an option. I mean, the performance-based rule, this idea of pursuing it and going ahead with it was documented -- I'll just move to Option 4. I think we're running out of time.

[Slide.]

MR. WEST: We call this Option 4, but really in SECY-94-090, the Staff laid out its action plan for developing a performance-based or performance-oriented risk-based fire protection rule with the schedule and everything. And this had been preapproved by the Commission in earlier SRMs.

And what we were saying is, this makes sense because this looks at fire protection across the board and we can look at this and if we want to look at new time temperature curves, we can do it. If we want to look at PSA and PRAs, this is the place to do it. If we want to look at fire models, this is the place to do it.

I don't know that the rules are going to specify what fire model you have to use, and I suspect it won't. It is going to establish performance goals and acceptance criteria. The reg guide may have more detail in implementing.

But we said, why don't we -- you know, we're doing this, we have a plan to do this, industry is on board, why don't we just go through the performance-based rule and skip 2 and 3 as a Thermo-Lag solution. So remember, we're -- the Commission is looking for a way to resolve Thermo-Lag and that's the way we tried to organize our options is if we continue with compliance with the current rule, certainly a number of licensees are doing that.

And then we have this rule which we're planning to do. You know, we have a schedule for it, we have industry planning input, we have been meeting with industry. We could go into this and we will capture all this stuff and it makes more sense to us to do that as an integrated approach.

MR. CATTON: You're going to do what was in 94-090 anyway?

MR. WEST: Right.

MR. CATTON: If you exercise Option 1, why do I need this at all?

MR. WEST: I think industry wants it.

MR. CATTON: What is industry going to do with it if you already settled the Thermo-Lag issue?

MR. WEST: They are going to look at it --

MR. CATTON: Maybe I should wait and ask industry. I will.

MR. WEST: We touched on it this morning. I will just mention -- who knows what this is going to look like when we're done or how it is going to be implemented? But the way it is set up now, if you read the SECY paper, we are going to have Appendix R and it is going to exist and it is going to continue in place and the licensee that meets Appendix R today can continue to meet that. This would be an option or another fire protection rule which a licensee could implement.

And the feeling is that according to the SECY, if you want to go with the performance-based rule it is going to be an all or nothing. It is not going to be, I want to do performance-based in this fire area and I will stick with this in the other fire area.

MR. CARROLL: Wouldn't this certainly have an application for advanced reactors?

MR. CATTON: They are going to be certified, Jay, before this is in place.

MR. WEST: I don't think so.

MR. CARROLL: Why is that?

MR. McCRACKEN: We have already completed that review for the advanced reactors. They have already been designed to the 90-016 criteria which were the enhanced fire safety issues and, basically we have just gotten more deterministic, gone to three-hour barriers everywhere. And what we did with the advanced reactors is already done.

MR. CARROLL: It is not done for SPWR or AP600?

MR. McCRACKEN: The time schedule for their review to be completed versus the time to get this out and finalized, they will be past that point.

MR. CARROLL: Is it the thinking that this performance-based rule will deal with shutdown fires?

MR. WEST: Yes. Oh, absolutely. You really fall back to the GDC-3, which was performance based. And you draw from that one of your major performance goals is going to be you have to be able to maintain safe shutdown following a fire.

Now, I suspect that even with a performance-based rule which is going to give you -- the licensee an approach which he can go to to decide what fire protection he needs, you are going to find you need a lot of these fire barriers and protection systems, suppression systems and all that that exist today.

But there may be areas of relief. For example, the rule today does not give you any credit for -- and I am going to give you an example off my head, because I don't know what this thing is going to look like either.

The rule doesn't give you any credit for a space that's continually occupied, like the control room. Maybe instead of getting an exemption from us for not having a suppression system in there, licensee can go through a performance-based approach and through its own -- through that methodology, come to the conclusion that you don't need a suppression system in the control room.

MR. KARYDAS: Is part of this option to benchmark Appendix R? In other words, if I comply with Appendix R today, do I have a performance acceptable or not?

MR. WEST: The SECY paper says -- and I will just stick to the script because this is what it says -- it says if this rule comes about and you, Mr. Licensee, want to use this rule, before you may use this rule, you must already be in compliance with Appendix R.

I think that for most plants the only problem with the Thermo-Lag barriers is are they in compliance or not.

MR. CARROLL: Why would that be necessary?

MR. WEST: Unfortunately --

MR. CATTON: Maybe that is something we ought to address in our letter.

MR. KARYDAS: I don't know if you are familiar with the Australian model, the Australian building code where, you know, they have an existing -- not Appendix R but their own building code, and they require compliance for that.

Now, they came up with performance-based standards and codes that says if you cannot meet the particular requirement of the existing deterministic code, prescriptive code, then you have to prove that you have alternative solutions that are equal or better. Which means immediately that you have to benchmark your Appendix R so that you can prove that any other solution is equal or better based on performance parameters that you need to clearly establish.

MR. CARROLL: That does not make sense either.

MR. VIRGILIO: I've got the SECY paper here, and it was just as a matter of policy. And it says, and I quote, "The plan of action for this rulemaking, particularly for submitting a proposed rule to the Commission, is contingent on the resolution of the current Thermo-Lag issue by licensees.

And later it goes on to talk about plants that currently not in compliance need to achieve compliance. It was just a matter of policy.

MR. WEST: Anybody that has been involved in this in this room with rulemaking, I mean, I can, as Marty did, read you the script today or a script from a month ago, but things can change.

I mean, as Conrad says, you know, we are open to ideas. I think if it is a policy decision and the Commission wants to stand by that decision, it will remain so if they can be convinced that this rule could be used even if you aren't in compliance because you will be complying with the new rule.

MR. VIRGILIO: That is the crux of Option 4. It is going back to the Commission and saying, here is a new policy decision for you to make; can we use this new performance-based rule to resolve the Thermo-Lag issue.

MR. CARROLL: But your notion that one must benchmark a new rule, a new rule based on risk and performance, against an old rule based on arbitrary, deterministic determinations --

MR. KARYDAS: As long as you require the implementation of Appendix R you need to benchmark this Appendix R because you have lived with 80 plants or 100, so many sites, so far, and you accept that if you make no changes that this is acceptable.

And some people come here and say, I cannot comply with Appendix R currently because I have these deficiencies, the Thermo-Lag or something else. So instead of asking for an exception, you prove that you are on the safe side equally compliant with what the Appendix R requires.

MR. CARROLL: But Appendix R may have been way too conservative in some respect.

MR. KARYDAS: Right. Then you have --

MR. CARROLL: You have to state that.

MR. KARYDAS: Yes, you have to state that.

MR. CATTON: And you have to state that, and to state that you have to go through this equivalency process, and I believe that is amended in regulatory law.

MR. McCRACKEN: That is exactly what we do in every exemption that we process.

MR. CATTON: That's exemptions.

MR. CARROLL: Now you are going to create a new rule. I think it is a different ball game.

MR. LINDBLAD: Which would replace Appendix R. Wouldn't that replace Appendix R.

MR. CARROLL: If a licensee wanted to do that.

MR. VIRGILIO: On a voluntary basis.

MR. WEST: It would be two rules, the Appendix R and this new on.

MR. CATTON: But you cannot regulate unevenly. You have to regulate evenly, and I think that is where you get caught up in this.

MR. CARROLL: I don't have to regulate evenly.

MR. WEST: The process of implementing the new rule is part of the rulemaking process we went through. We had a meeting with NEI and we discussed how would this be implemented. There is no consensus, and certainly any suggestions I am sure Research will welcome, but it is something to be done.

MR. McCRACKEN: If we go that route, we will be down here looking for advice.

MR. WEST: It is a good question, but you are a little bit ahead of the curve in terms of the answer. It is something that will be considered as part of the rulemaking: how do you implement it, do you have to do this?

MR. CATTON: Well, we are not ahead when you write "option" in front of this because if this is one of the options for the Thermo-Lag question, then these are relevant questions today.

If it is not an option, that this is something in the future, then you are right, we are ahead of the game.

MR. WEST: I didn't say the question wasn't relevant. I said we don't have the answer today. It is a good question.

MR. CATTON: So selecting the option may be premature? We are kind of caught between a rock and a hard place.

MR. McCRACKEN: The choice here clearly is, do you intend to use Option 4 as a means of resolving the Thermo-Lag issue, which means you are going to change the rules to resolve the problem, or are you going to resolve the problem by another method first, fixing it, say Option 1, and then go to performance based rules, Option 4, and do what you need to for all fire barriers, all fire issues.

Remember, Option 4 is not just fire barriers; it is the whole concept of fire protection.

MR. CATTON: I understand.

MR. McCRACKEN: When we went to the Commission the Chairman has made statement about we are not going to use changing the rules to solve the problem, and that is a good position, perhaps.

Technically, you may say you would like to change the rules to solve the problem, and you are still as safe. That is an issue to consider.

MR. CATTON: That's the equivalency.

MR. McCRACKEN: So we are asking the Commission their advice on which way we should go with this. It is not an easy choice.

MR. LINDBLAD: But, Conrad, as I have heard Option 4 described, there is a Catch-22 in it that says, before you get to the performance-based rule, first you have to resolve the Thermo-Lag problem.

MR. McCRACKEN: That's what the paper that went up from Research a month ago or so ago said. The options paper went up after that and we are saying this is another way of addressing it.

MR. WEST: That decision should be reconsidered.

MR. McCRACKEN: You would remove Catch-22? That is one option. Use Option 4, and obviously the problem with that is going to be, number one, we will still have to make sure it is technically the right way to go. We may take an adequate level of safety, but in doing that you are certainly going to create a perception that the purposes of changing the rule is to solve a problem, and that does not look good.

So it is going to be a tough fight to go through that kind of an option and show that you are really doing your job the way you are supposed to. Perception is a lot of what we do.

MR. CATTON: I think that is the reason that when they go to performance based people talk about equivalency so that you don't get the impression that you are reducing -- going to performance-based will reduce safety. You do an equivalency.

MR. McCRACKEN: Correct.

MR. CATTON: Evaluation of some kind.

MR. McCRACKEN: And that is the challenge of trying to go with that option at the same time that you are trying to solve the Thermo-Lag issue.

MR. CARROLL: What is equivalency? Somebody arbitrarily says I need three-hour fire barriers in a deterministic world, and you come along in a risk-based world and say --

MR. WEST: You are not trying to get equivalency.

MR. CATTON: Appendix K and best estimate are a good example. Appendix K, you really didn't know where you were at except you knew you had a lot of margins. So then you went through the exercise of best estimate, and you say, gee, the temperature is only getting to 1400 degree; best estimate is fine because we are so far away from a problem, the change in -- safety is minuscule. Forget it, don't worry about it.

I think the same kind of exercise would be necessary here. You are so far conservative, assuming that you are, with Appendix R, you now come along with your performance-based and you compare the two.

You say, gee, I am so far down in both cases, it really doesn't matter. If you don't do that, you don't know where you are at.

MR. CARROLL: There is a difference.

MR. CATTON: What is the difference?

MR. WEST: You are not looking at the equivalency of the three-hour barrier to something else. You are looking at the fundamental safety objectives; those are equivalent, and there are different ways of achieving the same objective. So you don't even mention -- the new rule probably won't even mention three-hour barrier.

MR. CARROLL: That would be okay. I don't like your analogy because in both cases you are okay. You do not have to go out and spend millions of dollars. In this world there are utilities --

MR. CATTON: But you are starting to push the margins that best estimate is giving you, and you are going to save millions of dollars. Sometimes it is plus and sometimes it is minus. I think it is the same.

Here, the incentive was different. Here, I think, the incentive is to save the millions of dollars, whereas, with the LOCA the incentive was to earn millions of dollars.

MR. WEST: The new rule should allow more innovation.

MR. CATTON: Can you crank your thing up a little bit.

MR. WEST: The new rule should allow innovation and new ways to meet the safety objective without specifying specific methods or hardware to achieve the objective. Like I said, there are things that the new rule does not consider that a performance-based rule probably would, and so, although you will find you are still going to need a lot of this stuff in the plant, there may be areas for relief in hardware and operations and that kind of thing.

MR. CATTON: Are you close to the end, I hope?

MR. WEST: Yes. In fact, I can end.

[Slide.]

MR. WEST: The same thing we have told the Commission, we recommend a continuation with Option 1 -- 4 also, but 1 first -- continuation with Option 4 to take advantage of all the work that has been done, continue to work with industry, maybe develop a generic upgrade for one-hour barriers, continue work on three-hour barriers, grant exemptions where technically justified.

MR. CATTON: If you use Option 1 and come into compliance with Appendix R, is there any incentive for Option 4?

MR. CARROLL: That is about what I was about to ask.

MR. CATTON: What does it do for me?

MR. WEST: NEI may be able to give you a better industry perspective on what the advantages will be. We have touched on some. The current rule is prescriptive.

MR. CATTON: But it is there and people have complied.

MR. WEST: There might be a lot of licensees, and if they have complied, they are not going to want to spend the money and the time to do the analyses under a performance-based rule. They may be perfectly happy with what they have.

MR. CARROLL: I don't see why any of them would.

MR. DAVIS: Let's say that an applicant chooses to use firewatches to comply.

MR. CARROLL: You cannot do that indefinitely.

MR. DAVIS: That's what I mean. And then when Option 4 -- they would have an incentive to implement Option 4 to eliminate the firewatches. Would that be one case?

MR. McCRACKEN: Option 4 was coming along before there was a Thermo-Lag issue. Option 4 was there under the marginal safety program because there are a lot of areas that industry believes can reduce the amount of fire protection they have without any reduction in safety.

So Option 4, I think, would still proceed -- I would be surprised if it didn't -- regardless of how we resolve the Thermo-Lag issue because there are a lot of incentive for them to change some of the things.

MR. DAVIS: That's all I wanted to know.

MR. WEST: So we recommend a continuation with Option 1. And with respect to Option 2, we said if the Commission wants us to do the study, we will do the study and see what comes out of it and decide whether we should pursue further these new time temperature curves.

We said with respect to the plant specific proposals to use plant specific performance-based approaches and fire modeling. We didn't see the value in that, and we were not going to proceed further with that option and with those reviews unless the Commission directed us to do so. We haven't done anything with those since.

And then Option 4, we said this is an ongoing program that was started before Thermo-Lag as Conrad mentioned. We will continue with Option 4 and it may be appropriate to consider the use of this rule, since it is apparently going to happen, to resolve the Thermo-Lag issues at some plants.

MR. CARROLL: Let me get it clear. So Pete is right. You are telling me I can use firewatches until the performance-based rule is in effect, and then I can take advantage of it?

MR. WEST: If the Commission so decided. Firewatches, remember, before there was an Appendix R -- when there was a Appendix R there was a long period of time for plants to come into compliance, and firewatches were the compensatory measure that were put in place until they could come in compliance.

It is analogous that where you have firewatches in place now because of one degraded fire protection feature, and they could remain in place until you get the new rule and come into compliance.

MR. CATTON: Does a firewatch put them in compliance?

MR. WEST: No, they would be out of compliance. The safety aspect would be okay because we accepted firewatch as an adequate compensatory measure for this type of degradation.

MR. CATTON: Is there a time limit on that?

MR. WEST: No. Certainly, it is intended to be temporary, but we haven't defined temporary.

MR. DAVIS: Are these firewatchers required to be non-smokers?

[Laughter.]

MR. WEST: No.

MR. McCRACKEN: They're not?

MR. WEST. [illegible], they're not. I'm sure they would have to adhere to whatever smoking policy was in effect in the area they're guarding, but there is no requirement that they be non-smokers.

MR. SEALE: That is not the point. A non-smoker is a much more sensitive fire detector than a smoker. His nose is better.

MR. CARROLL: In radiation areas there is no smoking anyway.

MR. DAVIS: But there are non-radiation areas where there is safety equipment.

I had a question on your Option 3. You said you are not going to proceed further, and yet there are 22 units coming in with --

MR. CARROLL: That say they are going to use it.

MR. DAVIS: That say they are going to use Option 3. It seems like there is a disconnect here. Is there some useless work going on or expensive work going on that you are not even going to consider?

MR. WEST: We don't know exactly how much work has physically been undertaken and performed. Our feeling is that this has been floated by us as a potential option. We ask the licensees to tell us what options you feel are appropriate for resolving issues. We do not think that a lot of licensees have done a lot of work.

MR. DAVIS: Florida Power and Light has obviously done a lot of work. Are you abandoning the review of their proposal?

MR. WEST: Yes.

MR. McCRACKEN: Unless the Commission tells us to proceed with it, we are not now reviewing it. We did that to make sure licensees understood it -- we keep getting phone calls: we want to come in and tell you how we are going to resolve this issue.

With this number of plants out there having their own individual ideas and everybody has a better idea, we would never get done. So we can't review them all independently. So we said until we get direction from the

Commission, we are not entertaining any more of those.

MR. DAVIS: Thank you.

MR. SEALE: But you are going to respond to them and they know that?

MR. CARROLL: They will know it after the Commission makes a decision.

MR. McCRACKEN: They have seen the proposal.

MR. WYLIE: As I understand it, if you were to go with Option 3, you were going to use Florida Power and Light as a model. Is that true?

MR. WEST: Florida Power and Light was not interested in being a lead plant or the model plant.

MR. WYLIE: I see.

MR. WEST: We are saying if the Commission really thinks there is merit in this option in the performance-based approaches, we cannot review 22 or however many coming in. We really are going to have to pick a lead plant and work with them.

MR. WYLIE: Once you have the lead plant, you would use those as the guide for the others.

MR. CATTON: How does Florida Power and Light avoid being the lead plant? If they are first, they will be lead.

MR. DAVIS: It sets a precedent for future review.

MR. CARROLL: You would like to get a volunteer as opposed to --

MR. WEST: We asked them if they would like to be lead plant. They said, no, thank you, we would not like to be a lead plant. We asked them again; they said, no, thank you, we would not like to be a lead plant.

MR. CARROLL: You were in the Army.

MR. CATTON: There are 22 standing around the door waiting for one of them to walk through.

MR. McCRACKEN: Let me emphasize what Marty said earlier about resources. The one thing that we tried to get across to the Commission, it would be nice to be able to go do Option 1, 2, 3 and 4, and look at a lead plant, even a couple of lead plants, and look at all of these.

From a technical point of view, it would be, perhaps, even a useful process to go through. But the resources don't exist to go through all those simultaneously. We are going to have to pick and choose. If a plant comes in and says, I want to be a lead plant, and the option says we want to go with -- and the Commission says go with that option, then the one that says they want to be the lead plant gets the resources.

Anybody else who comes in with a similar option on their own who is not identified as a lead plant will sit on the shelf until we are done.

MR. CARROLL: And use firewatches.

MR. MICHELSON: And use firewatches.

MR. KARYDAS: In terms of this election of the lead plant, I understand that Florida Power and Light is outdoors? Has many outdoor installation or fire barriers?

MR. McCRACKEN: They have both outdoor and indoor.

MR. KARYDAS: And indoor.

MR. McCRACKEN: They have a lot of applications.

MR. KARYDAS: Is that representative of the rest of the industry?

MR. McCRACKEN: No.

MR. WEST: That is unique to Florida Power and Light.

MR. CARRO''. The outdoor stuff, but the indoor stuff --

MR. WEST: The indoor stuff is indoor stuff.

MR. CATTON: When you say "outdoor," the Thermo-Lag is actually exposed to the weather?

MR. WEST: Yes.

MR. CATTON: Is there any UV degradation of this stuff?

MR. WEST: I'm not sure. They have a slightly different system where it is top coated with, I think, a rubberized product, and they have the regular surveillance and maintenance.

MR. LINDBLAD: Can you tell me what research need has been identified to Research by NRR with regard to fire protection?

MR. WEST: Yes. They've got the need on developing the new performance-based rule. They have a request from us to do that, and we are working with them on a relatively frequent basis, as matter of fact.

MR. LINDBLAD: That's it?

MR. WEST: Yes. The other ones we are looking at through NRR.

MR. CATTON: So all you have done is identify the need for Option 4?

MR. McCRACKEN: That was identified under the marginal safety program a long time ago, and we are proceeding with that independent of anything else we do.

MR. CATTON: What about all of the ancillary things that are needed if you are going to exercise the rule, like fire modeling and all of these kinds of questions?

MR. McCRACKEN: That is part of the total effort.

MR. CATTON: And you have specified that? The reason I ask this is because in the past the ACRS has recommended that there be fire research programs, and the kinds of things that would feed into the ability to do performance based we have been told there is no need to do that. We have not been asked.

So I just want to make sure I understand what you have asked them to do.

MR. McCRACKEN: We have asked them to work on a performance-based rule. Right now what they are doing is waiting for an application from industry. Once we receive that application with whatever supporting documentation it has, we will start a review process to see if we agree with that, if it has the necessary basis and background, and, if not, start going through what is needed to develop a performance-based rule.

MR. LINDBLAD: That sounds more like a NNR approach rather than an RES approach.

MR. WEST: Research, in parallel with waiting for NEI petition, is doing their own front-end work where they are going out with their contractor NIST and Brook Haven to establish the state-of-the-art and fire modeling and find out what is out there, and they are looking at the PRAs and the existence of the performance-based approaches in other industries and countries.

So there is an effort that they are undertaking along these lines. Everything they need to do to support the performance-based rulemaking. And it could be that they are going to have a fire modeling research program. I can't speak for them.

MR. CATTON: Somebody needs to. I would like to hear more about what Research -- is anybody from Research here? No?

MR. WEST: All of their principles are on foreign travel this week, I believe.

Any other questions on our options for Thermo-Lag?

[No response.]

MR. WEST: I think -- is NEI next? Alex, are you going to do the presentation?

MR. CATTON: I guess it does say Alex Marion, doesn't it?

MR. WEST: Alex Marion is going to talk about the industry Thermo-Lag program.

[Pause.]

MR. CATTON: Who is the contact point in Research? Moni Bey? He has the project lead for that.

MR. MARION: Good morning. My name is Alex Marion. I am a manager in the technical division of the Nuclear Energy Institute. That division is basically the old NUMARC, if you will.

I have some prepared presentation material that basically addresses three particular areas. The first is general status update of the testing program we have been sponsoring, the second deals with the petition for rulemaking effort, and the third is just some brief comments on shutdown risk.

I don't know if I want to take a minute before I start and answer any specific questions. There were a number of items that were identified this morning, or if it is okay with you, Dr. Catton, let me just proceed with the presentation and pick up the questions or what have you as I progress.

MR. CATTON: If you have a planned presentation, and the questions to address, I think you should just go ahead.

MR. MARION: Okay. Very good.

In terms of the update of the program, let me identify a couple of items. First of all, the objective of the program.

There was some discussion this morning relative to the problem. What is the problem we're trying to fix? How big of a problem is it? And, what is the best fix, or the best solution?

From our perspective, I have to go back to the specific chronology. I think it was back in 1992, maybe, late '91, where the NRC staff declared all of the existing tests of the Thermo-ag materials indeterminate. And the reason they did that was because of concerns they had with the performance capability of that fire barrier system in trying to demonstrate a one or three-hour rating.

So, consequently, the industry had no choice but to start from ground zero, if you will.

But, essentially, what it resulted in is an effort to reestablish the technical licensing bases for use of Thermo-Lag fire barrier system, and one and three-hour applications as required by the regulation.

Now, as you heard this morning, there is a cold-blooded compliance issue, if you will, where the regulation clearly indicates that in certain instances, you will have a one or a three-hour fire barrier system.

If you fundamentally cannot take credit for tests to demonstrate that, then you're clearly not in compliance.

Now, the NRC staff had addressed the obvious safety concern through the defense in depth process that Conrad described this morning where compensatory actions were put in place by individual licensees that included fire watches, included enhanced surveillance through the use of TV cameras, as well as some other items.

Now, our position and the position from the Commission was that, okay, this is all well and good, but it's a good short-term interim approach. We really need to come up with a long-term resolution to this issue.

So we're looking at the compensatory actions taken by utilities as a short-term interim measure. The ultimate resolution of Thermo-Lag issue will evolve and become clear to you as I finish my presentation.

But, we think there is a resolution path available now and we are proceeding on that path to bring this issue to closure such that the industry will be back in compliance with the regulation.

A couple of questions were raised about combustibility. Let me take a moment and just give you a quick update.

We have conducted some tests in September -- August-September -- of last year, and we published a report in October. That report was issued to the NRC staff. I don't know if the ACRS has a copy of that report. I will be more than happy to mail you a copy.

But, that combustibility testing was conducted by Underwriter's Laboratory in Chicago, and the risk-specific data on heat flux as well as ignition temperatures of the Thermo-Lag material.

And the testing was conducted consistent with an ASTM standard that's used for combustibility evaluation of materials.

So, sometime today, you let me know if you'd like to have a specific copy. We can send one to you.

MR. KARYDAS: I'd like to have a copy.

MR. CATTON: Oh, yes, I would like to have that copy.

MR. MARION: Okay. We'll take care of that.
Alex, you get it to Doug, please.
Now, just for a sense of the magnitude of the problem, or the scope of the problem, if you will, Thermo-Lag is the predominant material that was used for Appendix R, compliance relative to the one and three-hour rated system.
Here is a scope of application in terms of linear feet across the industry as a result of the survey that we had conducted in 1992.
MR. MICHELSON: Excuse me. What's the predominant material? I thought that wasn't the case. I didn't think there was that much Thermo-lag out there, it's called the predominant material.
MR. MARION: It's predominant from the standpoint of '77-'80 plants using Thermo-Lag to some extent.
MR. MICHELSON: By "predominant," you mean more than half of the barriers or --
MR. MARION: -- half of the industry and -- right.
MR. MICHELSON: More than half the barriers in a given plant are that way?
MR. MARION: I don't have that information --
MR. WEST: That's for raceway barriers.
MR. MICHELSON: Yes, raceway barriers.
MR. WEST: Yes, that's true for raceways.

MR. MICHELSON: Okay, more than half the raceway barriers in a plant. Okay.

MR. MARION: Okay? Now, as I mentioned before, the key thing in terms of dealing with the scope and problem of what we had taken on as a challenge was the starting point, ground zero as I indicated previously, where the staff had declared all of the prior tests of Thermo-Lag as being indeterminate, so we had to reestablish the performance capability of that material.

That essentially was the basic fundamental purpose our program. And in doing so, we tested baseline configurations as well as upgrades using Thermo-Lag material. And we had proposed, but we have not conducted yet testing of upgrades using other materials.

And the scope of the testing program that we've completed is 13 tests -- six tests in phase one, seven in phase two, and further tests are going to be undertaken.

There was a question raised about walls this morning, I believe, by Dr. Michelson. There is a small group of utilities who have wall applications of this materials and we're helping coordinate those utilities in a testing effort.

There's also about 22 plants that have what we refer to in a general category as boxed applications where you have stack trays. And the utilities did not install individual barrier schemes around each individual tray; they rather installed a large box, as well as some other configurations, but into this box mode.

And we are working at pulling that effort together. And that appears to be much more generic.

MR. KARYDAS: Could you please explain what is the configuration in the linear feet?

MR. MARION: I don't have that information. Biff Bradley is the senior project manager at NEI, and has lead responsibility for this program.

I don't recall. I don't know if you do.

MR. BRADLEY: The question was --

MR. KARYDAS: When you say linear feet, what is the configuration? Why do you describe that in linear feet?

MR. BRADLEY: We describe the configurations of cable trays and conduits in linear feet. Boxes, obviously, would have to be described in terms of square feet. And I don't have that figure with me.

It's a fairly significant one.

MR. KARYDAS: So how is the Thermo-Lag applied in those raceways? As a box, or as a blanket, or how?

MR. BRADLEY: It's applied by putting free shape sections around and troweling it together and --

MR. KARYDAS: Like a box?

MR. BRADLEY: Yes.

MR. KARYDAS: Like a duct?

MR. BRADLEY: Right, although what Alex is talking about is building what we've tested as a box built around an individual tray. There are other box applications that don't involve an individual single tray, and have different thermo characteristics and would need to be evaluated separately.

MR. MARION: Yes. We have some 35 mm slides that we hope to show after lunch that gives you a really good sense of what this looks like, and how it performs in the test.

MR. MICHELSON: Are there any cases where pipes or conduits snake through cable tray arrays that then require the box go-around -- or that the pipe penetrates the box?

MR. MARION: If I understand the question --

MR. MICHELSON: Yes. You've got a pipe coming perpendicular to the cable tray.

MR. MARION: You have the cable tray and there's a box installed around the --

MR. MICHELSON: No, no, there's a conduit coming through from one side to the other. I've seen many cases where people run conduits between cable trays where you've got stacks.

MR. MARION: If there's no requirement to separate those two circuits, or sets of circuits, if you will -- the one in the tray, the one in the conduit -- what you're suggesting is this is a cable tray, and you've got a conduit in this area.

MR. MICHELSON: Precisely.

MR. MARION: And if they built the box, what did they do with this conduit?

MR. MICHELSON: Yes.

MR. MARION: I'm not aware of any configuration like that that's been identified to us. I don't know if Biff --

MR. BRADLEY: There are a number of items that can penetrate the cable tray enclosures, and that could include conduit as well as support steel, or other things.

MR. MICHELSON: And you're testing each of these possibilities, or you're trying to qualify it

MR. BRADLEY: What we've tested -- we've put in representative pieces of steel that will act as a heat sink into the envelop. And as part of the installation of Thermo-Lag, they have what's called the 9 and 18-inch rules, which basically require you to protect those intervening members out to those distances away from the envelop.

And what we've tested is in accordance with that installation.

MR. MICHELSON: In other words, it is not becoming a heat conductor to the inside.

MR. BRADLEY: Correct.

MR. MICHELSON: Okay. And that's a part of your test program?

MR. BRADLEY: Yes.

MR. MICHELSON: Thank you.

MR. MARION: Yes. We discussed that to some extent in the application guide, which I'll get into in some detail later on in terms of interfaces.

Right, Biff? Okay.

MR. CARROLL:: Alex, your previous slide, you don't have to put it up, one of the things you were looking at is upgrades using other materials.

Does that imply the use of other materials around existing Thermo-Lag, or does it --

MR. MARION: Yes.

MR. CARROLL: -- imply --

MR. MARION: Upgrades on a Thermo-Lag baseline. Other manufacturers' materials, yes. And we deferred those tests.

MR. CARROLL: Right. I could read it to mean ripping out the Thermo-Lag and using something else, but that's not what you meant?

MR. MARION: No, that's not what I meant in terms of our program.

I'll just briefly overview the phase I tests.

These were essentially upgrades that were designed by the manufacturer of Thermo-Lag. TSI is the acronym, Thermo-Science, Incorporated, using the 330-1 material.

Essentially, the configurations that exhibited acceptable performance are identified here. For the three-hour systems, it became clear to us that the limiting factor would be the physical space limitations in your plant to actually implement that configuration.

The results of these tests were transmitted to the NRC, as well as to the industry, as we completed the test activity.

With regard to the performance of the material out of the phase I program, phase I portion of the program, this essentially summarizes the type of thermal performance relative to using the ASTM E119 curve.

And within one to 13 minutes of meeting in this particular case the 1-13 minutes of the three-hour rating, or the one-hour rating, depending upon which one, we had acceptable performance.

And the details of that, as I indicated earlier, have been forwarded to the NRC.

The upgraded configurations that did not demonstrate good performance are identified here -- the medium, the large conduits, which represents the three-inch and five-inch diameter, and the air drop assemblies.

MR. MICHELSON: Have you done any testing of stack trays, yet?

MR. MARION: Stack trays? No, not yet. That's part of the box configuration --

MR. MICHELSON: Yes.

MR. MARION: -- effort I mentioned earlier. We will be.

MR. MICHELSON: That's all coming later.

MR. MARION: Yes.

MR. MICHELSON: These are all so far single cable trays?

MR. MARION: Yes.

MR. CARROLL: What is an air drop assembly?

MR. MARION: An air drop assembly is where you may have a cable tray going in one direction, another cable tray in the general vicinity right above it, or right below it, going in another direction.

And you want to get the circuit in the top tray to follow this path. So you would drop the conductor -- all right? And if you didn't seal the entire configuration and you sealed one or the other tray, you'd have to pick up the air drop, depending on your safe shut-down analysis.

MR. WEST: On this coming down?

MR. MARION: No, that's more confined.

MR. WEST: This is Steven West. On the stack tray question, Texas Utilities did test a stack tray configuration one hour barrier, and I believe it was successful.

MR. MICHELSON: No, not one-hour barrier.

MR. MARION: No. Now, a couple of points that you need to keep in mind in terms of the baseline installations and what contributed to the limited performance in some case of the Thermo-Lag material.

And that's essentially that we were extremely conservative in our construction, if you will, the baseline assembly.

We basically developed a worst case installation based upon input provided us from the industry representing their installations. And the two key areas were material thickness and other construction attributes. And I'll get into some of those attributes a little bit later.

But, the key thing that we learned from that phase I effort was a reasonably good understanding of the failure mechanisms relative to temperature, as well as structural considerations.

Structural considerations from the standpoint of how do you really configure and construct the assembly?

What's important, and what's not?

And a lot of good useful information was developed from the phase I effort, and we factored that into phase II.

Now, let me also just briefly touch upon the last briefing that we gave this subcommittee, which I believe was in December of last year. And there were two points of concern, if you will, or two differing opinions between us and the NRC staff.

And they dealt with the installation of cable in the test assemblies; and the second dealt with the location of a Thermocouple underneath the cable tray rungs.

For the phase I test, we did not have that thermocouple; for the phase II test, we added that thermocouple as basically an engineering data point.

And what we found out of the phase II test is that bottom thermocouple does provide you an expeditious indicator of a breach in the underneath part of the cable barrier system.

In other words, if you have a separation at a joint, whether it's structurally induced because of the weight of the material, or whether it's induced by the expansion contraction of the Thermo-Lag during a fire exposure, you have the sufficient separation. The bottom thermocouple will pick up that heat entry into the system, typically followed within a few minutes -- I believe, six to eight minutes -- by the side rails.

Now, absent a breach of the barrier material at the bottom of the cable trays, we found that the side rail temperatures, or the side rail thermocouples will lead the thermal performance of the system.

MR. MICHELSON: In the Texas tests, they did pass their test all right?

MR. WEST: Well, they did a number of tests, and some of them passed and some --

MR. MICHELSON: On the stack tray?

Did they pass that one hour?

MR. WEST: Yes.

MR. MICHELSON: And how did they position their thermocouples?

MR. WEST: They had a different thermocouple placement. They had thermocouples on the cable tray side-rail nd also on three of the cables that ran in the cable tray.

MR. MICHELSON: Is this a vertical one-foot spacing between the raceways?

MR. WEST: I'm not sure what the spacing was. I doubt if it was a foot.

MR. MICHELSON: This is the whole problem of trying to test where you've got a lot of space and not much heat sink in between. That's where the problem will get in, I think.

And I just wondered if they really monitored.

MR. WEST: I think the trays would have been closer than a foot because that would be the typical field installation.

MR. MICHELSON: Oh, you end up with about a foot between layers of cable in one tray and layers of cable in the other. Isn't that right, Charlie?

MR. WYLIE: It varies.

MR. MICHELSON: I've seen it vary all over the map.

MR. WYLIE: Generally, they try to get them as close as they can.

MR. MICHELSON: Close as they can, right. You know, the depth of the tray is four inches, and so forth. So the cables have got to be --

MR. MARION: The next couple of slides basically summarize the results of our phase II effort. I'll just quickly go through this:

(Slide.)

Recognize the limitations of our construction. These are basically the non-upgraded fire barrier systems, or the baseline assemblies attempts to meet the one-hour requirement.

And these are the times at which the acceptance criteria in terms of thermal performance were exceeded.

Now, from the standpoint of performance-based approaches and evaluation against the hazard, it seems to us, if one can identify that, if licensee can identify that these configurations, or let's talk more specifically, that the four-inch conduit configuration applies to what they have in the plant, and the construction attributes of our test assembly are more conservative or equal to the way that utility installed them.

And they have a 10-minute hazard in that particular area. Okay. Then this should be a reasonable item to conclude in terms of adequacy of margin because you're talking about 4 to 1.

If I'm not mistaken, I think, on some of the exemption requests that the staff had considered in the past, they generally used the 2 to 1 margin for some of these types of considerations.

One of the things we need to thrash out in future discussions is whether 2 to 1 is sufficient, or do we want to come up with some higher level of margin.

But, this is the kind of data that is currently available, and is being incorporated in our application guide, and has been communicated to utilities.

Now, if you think about the point Conrad made about the 20-minute brigade response time, it should be rather straightforward for these. You may have to do something else for this one, where you only have 21-minute performance. Here, 27-minute performance may or may not be enough.

But, there's data coming together now that allows us to determine and establish some kind of framework of how we proceed further.

MR. DAVIS: Mr. Marion, remind me now. These are results from the thermal load based on E119 curve?

MR. MARION: Yes.

MR. DAVIS: Okay. Thank you.

MR. MARION: Now, this basically captures the three-hour, non-upgraded or baseline system, and you'll notice in all cases it exceeds an hour.

And this is the baseline without the addition of any further material.

And in some cases, it exceeds an hour. In some cases, it goes up to an hour and a half, or more.

Now, these are the assemblies for which we were able to achieve acceptable performance for the full duration of one hour.

In other words, we applied the ASTM E119 criteria thermally and structurally; the system held together for the one-hour duration. So, these provided a one-hour rated system.

MR. SEAL: Were there any configurations that were nominally upgraded that did not give you satisfaction at this point?

MR. MARION: No. For the one hour.

MR. SEAL: Yes. I mean, there aren't things you did that were left off that list, is what I'm saying?

MR. BRADLEY: No. All the one-hour upgrades we tested in phase II were successful in terms of meeting the one-hour performance.

MR. MARION: Yes. So we agree with the staff's conclusion that a one-hour upgrade, or establishing a one-hour system at a plant is workable and reasonable because what we found just by applying a coating of trial grade material and checking the seams to make sure you don't get into those structural failure modes, you should be fine.

And you should be able to adequately demonstrate a one-hour rating.

MR. CARROLL: That's what upgraded means.

MR. MARION: Yes. Yes.

MR. BRADLEY: The one caveat I'd like to make on that, a lot of the plants supplied a finished coat of trial grade over their assemblies such that the joints cannot be located -- at least, there's no technique that's been identified so far that can locate those joints.

So the upgrade we identified was typically putting stress around the joint s for about, you know, considerable inches on each side of the joint.

Those plants that can't find the joints, it might not be that practical or simple unless some technique can be identified to locate those under the trowel grade.

MR. MARION: Yes. Biff brings up a good point of the detailed nuances you have to get into, and the type of direction guides we're giving to utilities is:

If you can't establish what you have across those joints, assume the worst case if you feel that you still need to take credit for that barrier, in that particular application. Okay?

Now, this is something we have provided, shown you before. This gives you a sense of some of the nuances of the installation attributes for this material to make it successful or non-successful in a test.

And we've learned a lot from the two phases of our testing program, and the nuances of this is being captured into a document that we refer to as an industry application guide, which essentially pulls all the test results together from our effort, includes the TU test results, will include the TVA test results, et cetera. Address the limitations or boundary conditions for these various parameters in terms of where it's a success, where it's a failure, if you don't do it right, et cetera, and pull that together and communicate it to utilities.

This is a great lead-in to the next portion of this material.

As I said, the application guide essentially is a mechanism for utilities to quickly assess bounding framework, if you will, for what's been tested so they can evaluate that to their particular installations, and proceed in crediting or reestablishing the performance bases for their Thermo Lag fire barrier systems that they're using for compliance with Appendix R.

We are doing everything we can to achieve agreement with the staff on the content of the document. We've had a couple of iterations with them in writing, and also in a meeting. Our basic objective at this particular point in time is to finalize the document and get it out to industry as soon as possible. And we're working at doing that by June 17th, or around June 17th.

The reason for such an -- I'm sorry?

MR. LINDBLAD: Alex, do you consider that those criteria, or those parameters have any aging characteristic? Or, are they good for 30 years? Doing it right once is good enough for 30 years?

MR. MARION: We haven't looked at aging, per se, on this material. I don't know if Biff has something on this.

MR. BRADLEY: Well, there are a couple of --

MR. LINDBLAD: I guess I'd point to the joints more so than just the material.

MR. BRADLEY: We haven't tested aged joints, per se. We have tested material that was out of warehouse stock that was old. And we've also performed chemical evaluations of old versus new material and have not identified any discrepancies in the chemical makeup of the material.

MR. MARION: Yes. This isn't the type of material that kind of disintegrates or crumbles over time, at least not that we're aware of. Okay?

As I indicated, our objective is to get this out. One of the reasons we're pushing that so hard is because last -- at the end of last year, the NRC sent out an information request under the provisions of 50.54(f) asking utilities to identify their installations and more specifically identify those installations that are not bound by the NUMARC program and provide some kind of an action plan and schedule of what those licensees are going to do.

So we feel an integral part of key information that needs to be communicated to utilities is this application guide so they can move forward with their commitments with the NRC.

As I said, the guide will take advantage of all the test data that's been provided thus far. It also addresses the evolution of the test acceptance criteria and it has evolved. Hopefully it's achieved some point of stability. We will continue to update that document. As I mentioned, TVA is scheduled to be conducting some tests this summer. And our document will address both the baseline configurations as well as the upgrade configurations.

I mentioned briefly the fact that we have interacted with the NRC Staff on the application guide. I am not going to go through this guide in detail, but we had a meeting. The NRC provided us written comments. What I do want to stress though for a second is the April 20 and 21st industry meeting. We have had meetings with the industry, probably on the order of about every seven or eight, nine months for the past couple of years and one of the things we kept stressing is that there is no silver bullet solution.

The point is that the application guide is not going to be the type of thing, document if you will, where a utility would send in a letter to the NRC and say we are bounded by the application guide issued by NUMARC in June, 1994, therefore we are in compliance with the rule. It doesn't work that way.

MR. CARROLL: That's because NUMARC doesn't exist on June 7th?

MR. MARION: Well, NEI, I'm sorry, NEI -- just force of habit.

The message that we have been continually impressing upon utilities is when this document comes out in final form, you have got a lot of work to do to demonstrate that what is in that document addresses your installations and if you are enveloped, fine. It gives you some approaches.

If you are not enveloped, you have to think about some other things, okay, and that is the purpose of the document.

Quite frankly, I had a sense from some of the comments from the Staff as we interacted on this that they had a perception that maybe it was more than what we had intended it to be. I think we have cleared that up to some extent.

MR. CATTON: What is WG?

MR. MARION: Working Group. We established a working group to help integrate the fire protection issues. The issues that exist are the Thermo-Lag issue, the rule-making effort, and thirdly -- I'm sorry, I am just drawing a complete blank. It is embarrassing.

MR. CATTON: There are more issues.

MR. MARION: Yes.

MR. BRADLEY: Those were the two we're looking at now.

MR. MARION: Yes, those are the two biggies, anyway, and we thought that we were getting this in policy level questions strategically from the standpoint of the perception of petitioning for rulemaking under the marginal-to-safety program, the perception being that that is what the industry wants to do to fix Thermo-Lag and that is not the approach, and I will get into that in a little bit more detail later on.

How much of the industry do we envelope in our test program? There's no way we could pick up 100 percent but at what point do we get a policy decision that says 80 percent of the industry for these types of configurations is good enough -- we can't afford and it makes no sense to spend the time and effort to pick up another 5 percent. These are some difficult questions that we need some leadership on.

The Working Group is chaired by Bill Cavanaugh of Carolina Power & Light, Oliver Kingsley from TVA is on the Working Group as another executive as well as Don Hintz from Energy, and then we have fire protection experts and licensing individuals as well as engineering technical managers, including some individuals from the fire protection community.

MR. CARROLL: How large is it? How many people are on the Working Group, total?

MR. MARION: Oh, 20. 15 utilities are represented.

MR. CARROLL: Now what happens or you said a licensee will look at your application guide and there may be things that are not enveloped by it. What does he do then?

MR. MARION: The utility has a couple of options. At this April 20th workshop we provided the utilities with a draft of the application guide, so they could get a heads-up of what is coming down the road in a couple months, what it is and what it isn't, and they can start thinking about what they are going to do.

One option is to -- let's say they are not enveloped by what is in there and this is a good lead-in to the next part of the presentation where I'll lay out the resolution strategy because that captures the options available.

MR. MICHELSON: Before you lead in, I have a question on this.

MR. MARION: Okay. I would like to hold that question until I get the flow chart.

MR. MICHELSON: You did not really tell me anything that you are going to do about the Thermo-Lag walls. This is all addressing conduits and raceways and boxes around electrical components.

What is your approach on walls?

MR. MARION: There are half a dozen utilities who have wall installations. They are currently developing a test plan. They have developed bid proposals for a test laboratory and they are planning to proceed with testing.

MR. MICHELSON: This initiative will not cover the walls? It's going to be a separate initiative?

MR. MARION: Right, the walls will be a separate effort. Once our results come in, we'll consider whether or not we need to incorporate those results in the application guide.

MR. MICHELSON: This guidance won't help you on the walls, as I understand it?

MR. MARION: No. No, because primarily it is a small group of five utilities and the Working Group decided that is not a big enough group. However, they want the NEI, former NUMARC staff, to help that group in coordinating that activity and that's essentially the point.

MR. MICHELSON: Another question relates to where we might have more severe conditions than the standard temperature curve indicates, such as the diesel compartment if they are fuel oil fires. How are you approaching the possibility you may have a more severe fire situation than the standard fire?

MR. MARION: We are not dealing with that specifically.

MR. MICHELSON: How do you intend to approach it?

MR. MARION: There was a lot of discussion this morning on the options that were presented to the Commission for guidance.

MR. MICHELSON: Good enough. Right now you are taking the attitude if we need Thermo-Lag in the diesel compartment it is the same standard fire that you would have elsewhere in the plant.

MR. MARION: Yes, the utility is going to demonstrate that their hazard is bounded by the rated barrier.

MR. MICHELSON: They have to demonstrate what they think the time-temperature curve is for a diesel fire.

MR. MARION: Right, and I'm sure if they haven't they likely will for that particular application, right?

MR. LINDBLAD: Can I pursue Carl's question about walls? I consider walls to be load-bearing and a structural member. Are you saying that that is what they were proposing or was it a partition or a radiation shield?

MR. MARION: Most of them are partitioned radiation shields. There may be a structural aspect to one of them.

MR. BRADLEY: The wall we are going to test would have a structural steel frame and it is made up of two nominal one-hour Thermo-Lag boards. It will include some penetrating items, some typical penetrating items. It will be a E119 test with a 325 cold side acceptance criteria.

MR. LINDBLAD: What structural loads center on the material?

MR. BRADLEY: I can't answer that question. I don't know if it is a loaded wall or if that frame is just to support the weight of the wall itself.

MR. MICHELSON: Are any of the penetrations doors?

MR. BRADLEY: No.

MR. MARION: No. None of the penetrations are doors.

MR. MICHELSON: Electrical ventilation?

MR. MARION: I think one of the penetrations they are thinking about -- they have not decided on the final configuration. They are thinking about a duct and maybe a conduit and something else.

MR. MICHELSON: That leads me to assume that there are not any Thermo-Lag walls out there that have doorways through them; therefore, you don't need to test it. Is that the correct assumption?

MR. MARION: In this small group the answer would be no because they have not brought it to our attention. I don't know that that addresses everyone --

MR. MICHELSON: Are there any Thermo-Lag walls with doors?

MR. WEST: I cannot answer that questions. Doors and walls are always tested separately.

MR. MICHELSON: This test standard says you must also take into account what his your wall lit in deciding how to do this.

MR. KARYDAS: Are there any Thermo-Lag materials used for fire stops in fire walls?

MR. WEST: Yes.

MR. KARYDAS: And that is part of this test, part of this approach?

MR. WEST: No.

MR. KARYDAS: So you are not using any testing for fire walls? What percentage of them -- I'm talking only fire stops on fire walls.

MR. MARION: I don't know.

MR. WEST: Very small.

MR. MARION: I should have said this in the beginning. Our program primarily focused on cable trays and raceways. That is the generic NUMARC/NEI program. We are coordinating the wall group. We have some additional trays and conduits that we are going to deal with in terms of box applications.

We may proceed with some of these either things in the future. I just don't know at this particular point in time.

I notice the hour is late --

MR. CATTON: Before we break for lunch, there are two who will not be back. Bill already asked any questions he might have Bob? No? Ok.

MR. MARION: This takes about a half-hour or 45 minutes to walk through so this is a good breaking point.

MR. CATTON: I think you should wait.

MR. MARION: I wanted to show this for Jay Carroll. This is where I pick up on the alternate resolution strategies if you are not bounded, and when we get back after lunch I will go through this detail.

MR. CATTON: Okay. Let's break for lunch and come back at 1:10 p.m.

[Whereupon, 12:10 p.m., the meeting was recessed for lunch, to reconvene at 1:10 p.m., this same day.]

AFTERNOON SESSION

[1:10 p.m.]

MR. CATTON: Alex, you're on.

[Slide.]

MR. MARION: This flow chart represents a conceptual approach to resolution of fire barrier issues specifically on Thermo-Lag. There were some questions raised today that I think as I walk through this flow chart will likely be addressed in the next few minutes.

Essentially, and this is a draft, this is something that was developed by and reviewed by our Fire Protection Working Group who had discussed it with NRC Senior Management, basically a straw man for a discussion, and with Working Group they provided some ideas for thoughts and changes and we're working on those changes right now.

You will be seeing further variations of this, I would imagine, over the next several months.

These large arrows represent starting points into the process and you can see immediately there are five entry points, if you will. Let me just take a second and touch on them.

From a standpoint of the existing regulation, the key point is whether or not that fire barrier is required. What we tried to capture in this process was some of the activities that are being pursued by utilities in addressing the compliance question with Thermo-Lag.

Some utilities have concluded that they are not going to re-do any of their analyses for compliance with the regulation and they are going to conclude that the barriers that are currently installed are indeed required, so their entry point is a kick-out of this decision block. Yes, they are required.

Other utilities are re-doing individual elements or combination of these elements, updating their safe shutdown analysis, which is one of the fundamental aspects of Appendix R, updating their fire hazards analysis or doing both, looking at newer technologies, if you will, with fire models. Some folks are using "5" methodology.

Originally -- and a point needs to be made that some of these new modeling techniques were not available when the rule was promulgated. There was a conservative modeling technique in NFPA that a number of utilities have used, so some people are using "5" and they are going to do an evaluation of the differences between the more conservative NFPA approach that had been used previously and these new techniques -- then of course the output of the individual plan examination.

The combination of these would help you in making the decision on whether or not the fire barrier is required.

One of the softer considerations in terms of the work effort and what is important and what's not, what the priorities are, et cetera, from the standpoint of key areas of the plant where you need to apply fire protection, more specifically in that area, barriers for key circuits that are necessary to support the safe shutdown activity.

For example, you don't need all these analyses to tell you that your switchgear room is important or to tell you that your cable spreading room is important. You should have already come to that conclusion based upon your fundamental design approach at the plant, so the idea in this area is to capture some of those important priority ranking considerations in combination of this to conclude whether or not the barriers are required.

If you conclude it is not, it is a barrier that is in place, you can remove it or retire it in place and I think Steve in his presentation this morning mentioned that there are some utilities who are considering this option.

If you conclude that the barrier is required and you have determined the level of importance or priority for those barriers in those areas and you come out into the S-route of this decision element, and the key thing that you really get into is the evaluation of the application guide.

This is a fundamental building block, if you will, of this entire process and as I mentioned earlier with the utilities making commitments in their 50.54(f) responses to the NRC it is important to us to get this out to you, industry, as soon as possible so that the utilities can proceed with these evaluations.

Now as they proceed with the evaluation, get into this decision point of whether or not the generic test results imply, and these are the test result from our program or the results from TU electric tests or TVAs.

If you have got direct applicability for your installations and you get kicked out in this route, you have a number of alternatives to consider. If they don't apply, you need to do some additional engineering evaluation that takes into account some of these other considerations from that previous block but it is going to lead you one of two ways.

One is an extrapolation of the data, reasonable extrapolation using latest techniques to allow you to conclude that you are covered by the test program or if you are not, then you go the additional testing route.

For example, the wall application group we talked about earlier comes out here because wall installations of Thermo-Lag are not covered in our program. Only, well -- I'm sorry, we concentrate on cable trays and raceways. We did not to wall applications. We also did not do the boxed applications I have referred to earlier, so those two specific areas are being addressed in this route.

Now from the standpoint of resolution alternatives, and I am going to keep sliding this up, the cleanest thing that can happen is if the test data shows a configuration, installation details, construction details, et cetera, that envelopes what is in your plant, so you can conclude that your installed configuration is acceptable, come down here and you are in regulatory compliance with the rule.

If your installation does not meet the test information captured in the application guide and you decide that you don't want to go through additional testing, then you remove or replace with an alternate material and you heard about the 3M product, et cetera. There are a number of products that are out there that are purported to meet the three-hour rating, for example, but I don't believe that we are aware of the test data that represents that yet, Biff, are we? We haven't seen any test data on the 3R system?

MR. BRADLEY: Depends on whether you are talking about earlier tests. Certainly to the new criteria there is no test data to support that.

MR. MARION: A number of the manufacturers are conducting a test program right now and there are a number of companies that are essentially start-up organizations where some product development needs to be pursued but an option nonetheless for utilities if they are not covered by the test program.

If, for example, you have got a baseline installation for which one of our demonstrated upgrades is effective, then you can upgrade that baseline installation with the addition of, for the sake of discussion, a skim coat of Thermo-Lag material and some treatment of the joints. We are developing an installation guide that will be sent out to utilities also.

Both of these will lead to modification of the existing fire barrier installations.

One of the other alternatives is this defense-in-depth approach. In Conrad's presentation this morning he identified a number of considerations that come into play there.

A good example here is if you have been taking credit for a three-hour system and you can't demonstrate a three-hour system using Thermo-Lag and you decide for whatever reason not to do this, then you have got to comply with the rule that's currently written. You can credit that as a one-hour system with the addition of detection and suppression.

One of the things we hope to do is to determine what additional defense-in-depth measures may need to be considered to provide you a good effective overall balanced fire protection program given that one variation from the criterion.

Clearly it was brought up this morning that the exemption route needs to be sustained because that is allowed in the provisions of the regulation.

A number of the utilities, and this is one of the action items that we have at NEI staff, to close with the working group at some time in the future, a number of the utilities have asked us to consider a generic framework for an exemption package that would pick up on some of these concepts, okay, and that is an area that we would want to entertain some detailed discussions with the NRC Staff on what an acceptable framework is.

We are pleased to hear that the Staff is developing this database that essentially captures the history of the 1600 or so exemptions that have been issued since the rule was promulgated and I think those insights would be very helpful in establishing a framework for future exemptions.

All of these lead to regulatory compliance, compliance from the standpoint of what is written in the rule and I think it was made clear this morning that from a standpoint of overall plant safety and the adequacy of the fire protection program as a comprehensive effort that the NRC has already concluded that the plants are safe with the addition of compensatory actions that are in effect at each of the licensees that have Thermo-Lag.

So this is basically in a nutshell --

MR. MICHELSON: Before you leave that slide --

MR. MARION: -- a quick and dirty review of the strategy that we are pursuing.

MR. MICHELSON: Before you leave that slide, in the case of upgrades, I would think that ability of the upgrade to pass the test would be dependent in part upon what was there to begin with and there is quite a variety of things there to begin with.

Are you going to do a test for each variety, an upgrade test for each type and each joint configuration and each fabrication and so forth?

MR. MARION: No, we are bounding the configurations of joints that are sensitive or affected by the ASTM E119 test criteria.

MR. MICHELSON: Do you think the other ones don't need upgrading? Is that the idea?

MR. MARION: The idea is to get this information to utilities so they can do the evaluation and demonstrate that this is the viable approach they are going to pursue.

MR. MICHELSON: The test result that you are using to decide that particular upgrade will work was dependent upon what was underneath.

MR. MARION: Right.

MR. MICHELSON: On that first layer that was then upgraded.

MR. MARION: Right.

MR. MICHELSON: And do you have much information about -- you know, the utility now may not have a test result I guess that is comparable to what he did.

MR. BRADLEY: Maybe I can take a shot at that.

We did two extensive surveys of the industry to learn all we could about the construction techniques and we selected the limiting, worst case construction techniques such that our upgrade would apply to those as well as people that have something better.

MR. MICHELSON: Your best judgment, you think you took the worst possible case and you provided an upgrade for it.

MR. BRADLEY: Yes.

MR. MICHELSON: And therefore it should bound all others?

MR. BRADLEY: That's true.

MR. MICHELSON: Has that been reported in something a person could read, a report of some sort?

MR. BRADLEY: The application guide discusses -- well, it discusses in detail --

MR. MICHELSON: The Staff has reviewed the test results and they are happy with them? Is that the case for these upgrades?

MR. WEST: They are under review. The review has not been completed. We are waiting for the application guide.

MR. MICHELSON: You are not yet prepared to say?

MR. WEST: We are not ready to pass final judgments.

MR. MICHELSON: You understand the basic approach like they describe it?

MR. WEST: Conceptually when we discussed the program with NUMARC at the time we went thought this concept of testing the least conservative construction parameter and we agree that that is conservative.

MR. MICHELSON: Thank you.

MR. MARION: When we get this document out in final form there is a lot of work to be done by utilities themselves in demonstrating to their satisfaction and more importantly to the satisfaction of the NRC that this test program or this data captured in the application guide applies to their installations.

We have been communicating to them that they better get prepared to deal with that because that is where we are going to demonstrate success or failure, if you will, of our test program. That is quite frankly the bottom line in that regard.

The utilities will be carrying all this forward.

One of the things that we have been thinking about is for these various elements in this flow chart, which elements are amenable to further detail, further guidance to support the utilities in this effort.

I mentioned the defense-in-depth measures, the exemption request. We are going to get an installation guide out. Those are some of the things we are developing a little more detail on. Back up into the more analytical concepts that are played out to demonstrate compliance with the regulation, there are some modelling techniques being developed by other industries.

For example, even on the government agencies, the General Service Administration has got a contract with NIST to develop a code for modeling the actual hazards and buildings, et cetera. That coat is going through some form of beta testing right now, but the idea is to apply modeling approaches as opposed to deterministic approaches for all the buildings under GSA purview.

Internationally I think Australia and United Kingdom are moving forward to a performance-based approach where they are applying new technologies and modeling techniques to allow, to assess the actual hazard and allow sufficient time through prevention, detection, suppression to that you can successfully get the people out of the building and at the same time strike a balance to minimize damage in the building, to which you are exercising the fire code.

So a lot of the other industries are looking at these modelling techniques to determine what is really needed from the standpoint of understanding the fire performance or the hazard and what you need to do to envelope that hazard in terms of your protective features, and we are hoping that within the nuclear power industry that we can kinc of proceed in the same way over some point in time.

That is essentially it on this flow chart.

Any other questions?

MR. CARROLL: Now this is all directed towards compliance with the Appendix R. Have you looked at the question of -- the question I would have is if I comply with Appendix R, do I also take care of shutdown fire risk?

MR. MARION: Shutdown fire risk? No, because that regulation, the current regulation applies to the plant at power.

MR. CARROLL: I understand.

MR. MARION: We have just recently forwarded a letter to Chairman Selin expressing industry's point of view relative to regulation in the shutdown risk management arena, more specifically, on fire protection.

We feel that it does not make sense to have two regulations, one dealing with the plant at power and dealing with the plant while it is in an outage in the shutdown condition. We hope that under this regulatory improvement program, which is an extension of the safety effort, whatever considerations the Staff has when that petition is submitted for shutdown risk that we would use that process towards finally define what additional requirements may be necessary.

We are not at this particular point in time going to address shutdown risks in our petition for rulemaking.

Based upon some preliminary discussions with a number of utility folks, going back several years when the NUREG-1449 was published by the NRC on shutdown risk activities, a number of utilities have indicated to us that they do not stop their administrative controls on combustible materials, et cetera. They still maintain some level of firewatch activities during an outage because they realize with all of the maintenance work that there is an ingress in transient combustibles and you can't ignore that, and they feel that that is the right thing to do from a property loss perspective.

The real question gets down to whether that needs to be regulated. And I am sure we will have all kinds of opinions on that question over the months to come.

Any other questions on this?

[No response.]

[Slide.]

MR. MARION: I would like to briefly move on to the last portion which deals with the petition for rulemaking. This has a little bit of a history. It goes back to 1992 time frame when -- I'm sorry, the end of '91, early '92, there was an executive order from the White House indicating that -- basically charging all of the government agencies to review regulations that were overly prescriptive and a burden and did not really accomplish the intent.

A couple of months after that was an initiative by the NRC for identifying requirements or regulations that are a marginal to safety. Basically, those regulations that do not provide any kind of safety benefit but essentially are a burden to industry and implementation. And this occurred back in the February 1992 time frame as I recall.

In July 1992, the Chairman attended at the time a NUMARC Board of Directors meeting and challenged the industry to identify to him specific areas where not only the regulations but the regulatory process are a burden and does not necessarily contribute to maintaining current levels of safety or performance or enhancing safety and performance.

So NUMARC, through the Board of Directors, was charged with being responsive to the Chairman's request and I believe in December of 1992 we sent a letter in to the Chairman identifying a number of areas and we built on the public comments that were provided in the marginal safety effort, et cetera.

And, quite frankly, Appendix R was identified as a regulation for improvement back in the late '91, early '92 time frame. So the point was made this morning that that effort was under way before Thermo-Lag became a problem. And that's true from a chronological point of view.

Our approach has been a parallel path. We are committed to proceed with these, of which Appendix R is one of the regulations. But we are sensitive to the perception of the industry appearing to use a petition for rulemaking to address the Thermo-Lag problem.

MR. CATTON: Could you cite a few examples of the benefits of the rule, aside from Thermo-Lag?

MR. CARROLL: Who is going to use it? How is it going to be used?

MR. MARION: That is an excellent question. We have been trying to capture some of the cost benefit data that is necessary to support a position. And in some areas we are finding that implementation of fire protection is so institutionalized in a utility where the accounting process is such that it is all lumped together and you cannot discretely pull out we are spending this much money in the maintenance area to address fire protection or we are spending this much money in the operations area, we are spending this much money in design. It is basically institutionalized in all of the functional areas of the actuai.

But on some of the hardware aspects, we think that we can identify some cost improvements. Fire barriers is one. Some of the testing --

MR. CATTON: But they are already there.

MR. CARROLL: Presumably, everybody is going to be in great shape for fire barriers before this can ever happen.

MR. MARION: The question becomes whether or not you want to develop a well-structured regulation to provide long-term stability. And that is a question that we have yet to decide internally. But we are sensitive to the institutionalization of fire protection and whether or not there is a true benefit to proceed with a petition. And that is still being discussed and reviewed internally.

But regardless, we are planning to proceed with our petition later this year. We will have an answer to that question.

MR. CATTON: You would intend to pursue it even though you don't find the benefits?

MR. MARION: We will not pursue it if we do not find the benefit. We are pulling the information together right now and trying to be open-minded in that approach.

[Slide.]

MR. MARION: We developed some structure of a proposed rulemaking package, if you will, through an ad hoc advisory committee in the October '92 time frame. And this restructuring of the existing regulation was developed in March.

Conceptually, we are trying to satisfy the intent of fire protection to the extent that it applies in a regulatory regime, and that is to safely shut down the plant and prevent, protect and detect, performance-based approach, which essentially allows you to take advantage of some of the new modeling techniques to evaluate your hazard. What we have developed thus far, we are hesitant on identifying five, for example, as a methodology because there may be another tool that's out there that we don't know about yet.

The idea is to say that you can use these tools if they are acceptable to the NRC and if they are applicable and properly used by you as a licensee to define your hazard and demonstrate how you are going to meet that hazard.

We have had a number of good discussions with NRC Research Staff including Steve West and Pat Madden from NRR.

I am really surprised that no one from Research is here to talk about these great meetings and discussions we have had. But they have been constructive.

MR. CATTON: We are also surprised they are not here.

MR. MARION: Our current schedule is to get all of this together, make a decision on the true benefit of the effort and be prepared to submit a petition in the September time frame.

MR. McCRACKEN: I do not want to be accused of defending Research -- don't tell me I said it -- they are overseas trying to learn foreign experience that you keep telling them they need to know to be able to do this. So they are trying to do what you asked them to do.

MR. MARION: But we are all disappointed for not being with them, right?

At this point, I would like to have Biff Bradley go through some slides that we have from the test that we have conducted. I think you will find them extremely useful and beneficial in your understanding of what this stuff looks like before it is burned, while it is being burned and after it has been burned. I think that will be extremely helpful.

Are you ready, Biff?

MR. CATTON: Jay just has to move out of his way.

[Pause.]

MR. BRADLEY: What I have got here is a set of slides that we showed at our April industry workshop. This gives you some idea of what the test environment is like and how these tests --

[Slide.]

MR. BRADLEY: This is a typical cable tray assembly that we tested. It has got a steel test deck. The assembly is suspended, as you can see. This is a one-hour test. The reason you can tell that is the supports are not protected the full length, which they would be in a three-hour test.

This is basically what it looks like before it goes into the test furnace. The large overhead crane is used to lower this whole assembly into the furnace.

[Slide.]

MR. MICHELSON: Is there a Thermo-Lag in this case?

MR. BRADLEY: Thermo-Lag in this case would be half-inch thick. This is a one-hour barrier.

MR. MICHELSON: It is a very deep tray. The scale is difficult --

MR. BRADLEY: The tray depth is about four inches.

[Slide.]

MR. BRADLEY: We talked a lot about the

flammability and combustibility of Thermo-Lag. This is a shot right after removal from the test furnace. You can see here some of the flaming that takes place.

MR. CATTON: That is a fire up there in the corner, the vertical surface --

MR. KARYDAS: In the vertical orientation, you have fire which is propagated at this time.

[Slide.]

MR. MICHELSON: That all goes out in two minutes.

MR. BRADLEY: This is a shot of the cables after we pulled the barrier off after the test.

[Slide.]

MR. BRADLEY: A lot of this is just Thermo-Lag that -- trowel grade that fell down while we were putting the barriers on.

But as you can see here, the condition of the cables in this particular test was quite good. There is basically no visual cable damage. This also gives you an idea of the type of fill we used in these -- this is a single layer cable fill with a mix of power, control and instrumentation.

MR. MICHELSON: You did also do an empty tray, didn't you?

MR. BRADLEY: We have not tested an empty tray yet.

MR. MICHELSON: Somebody has, haven't they?

MR. BRADLEY: TVA will be testing an empty tray. All of the conduits that were tested were empty, but the trays did all include --

MR. MICHELSON: Empty try, yes.

MR. BRADLEY: This is a thermal couple string here that runs on top of the cable. There is also another one underneath.

MR. MICHELSON: I assume those are nylon tie raps.

MR. BRADLEY: That's correct.

MR. MARION: It may be useful if you take a couple of seconds and describe the environment in the furnace.

MR. BRADLEY: It is the E119 time temperature environment. It takes you up to 1800 degrees at the end of an hour, most of which is a sharp rise at the beginning and it sort of plateaux off and in a three-hour test you're up close to 2000 Fahrenheit at the end of the test.

[Slide.]

MR. BRADLEY: This is another cable tray assembly. This is an upgraded three-hour assembly. It has also got a vertical air drop into it. Here you can see the supports protected for the full length. You can obviously tell that you've got a lot more Thermo-Lag material on because of the greater thickness.

MR. MICHELSON: How thick do you have to get in a typical upgrade?

MR. BRADLEY: The upgrades we were using in one hour did not involve much thickness addition, except for small conduits.

MR. MICHELSON: This is three hours.

MR. BRADLEY: Right. This particular test I believe did include an upgrade layer. This is a Phase I test, actually, and this included basically a one-hour installation on top of a three-hour installation, so a total thickness of about 1-1/2 inches.

MR. CATTON: Where is the heated surface in this picture?

MR. BRADLEY: In the furnace, there is an array of burners right underneath the assembly.

MR. CATTON: These are open burners?

MR. BRADLEY: Yes, propane.

MR. KARYDAS: Open burners?

MR. BRADLEY: I would assume that's what you call them.

MR. KARYDAS: You put the whole thing in an enclosure?

MR. BRADLEY: Right.

MR. CATTON: And when they measure the temperature to see that it is tracking E119, where do they measure? Is it just a thermal couple, a thermal couple in the air space?

MR. BRADLEY: There is a whole set of thermal couples that are required at various places in the furnace that you have to measure.

MR. CATTON: This looks good.

MR. BRADLEY: I am trying to see what I am looking at.

[Slide.]

MR. BRADLEY: This is a shot of the same assembly we showed. This is immediately coming out of the furnace. This is about as severe a flaming effect as you will see. What you see in the three-hour test due to the 2000 F end point significantly greater heat flux and significantly greater flaming immediately upon pulling out of the furnace.

As you can see, the bottom is not fully out of the furnace yet.

MR. DAVIS: Had this been in three hours?

MR. BRADLEY: Yes, this is a full three-hour exposure.

MR. MICHELSON: Did this pass the test?

MR. BRADLEY: This passed the test on the tray but the air drop did not pass.

MR. MICHELSON: One criterion in passing the test, I guess, is that there are no visual penetrations?

MR. BRADLEY: No openings in the barrier.

MR. MICHELSON: What is an opening? Visual?

MR. BRADLEY: No opening through which the cable or the raceway or the cable can be seen.

MR. MICHELSON: How do you decide if there are openings or not?

MR. BRADLEY: We have some good shots that will help you with that. Obviously, you cannot tell at this point.

MR. MICHELSON: That's all flame on the outside because you passed the test.

MR. BRADLEY: This is the same assembly after it has been fully lifted out. You can see the flaming is starting to go down. This is probably 30 seconds after it is out of the furnace and you start to see some decrease. On a three-hour test, we will see a fair amount.

MR. MICHELSON: There's no application of any fire mitigants?

MR. BRADLEY: Nothing here.

MR. MICHELSON: This is just leaving it sit?

MR. BRADLEY: Basically, we take it out of the furnace and we have to run it down on the crane to get to the hose stream area, so this is right at that point.

[Slide.]

MR. BRADLEY: This really isn't a very good shot but this shows basically what the material looks like after the test and after the hose stream and just a lot of charring and obviously not a real pretty site.

MR. MICHELSON: Is the die-down of the flame due to the cooling effects of the atmosphere or what?

MR. BRADLEY: I would attribute it to the fact that when you don't have a large radiant heat flux on it, it doesn't want to continue burning and when you pull it out, it is just a matter of several minutes that you'll see the flaming start to go down. And usually by the time you apply the hose stream, there is very little --

MR. MICHELSON: If you had a fire in a compartment and you were using this as a protective medium, even after the fire is out, there is still a great deal of heat in t he compartment. And always the question is how hot will the compartment be to cause this to continue to propagate. I don't know whether that's a test one has to do.

MR. MARION: The combustibility report that we are going to send Doug Coe, we're going to provide the parameters to allow you to address that.

MR. BRADLEY: We ran a lateral ignition and flame travel test that quantified the propagation aspects.

[Slide.]

MR. BRADLEY: This is similar to the previous shot, just showing the cables. Despite the fact that this looks sort of nasty, there is no real cable damage here. If I recall correctly from this test which was done some time ago, mostly this is just debris and stuff that is falling down.

MR. MICHELSON: Is this where you explain whether you knew there was a penetration or not?

MR. BRADLEY: Not quite yet. I will get to it.

MR. CARROLL: I again see a lot of stuff flowing down on the left side of that picture. That stuff up above.

MR. BRADLEY: This?

[Indicating.]

MR. CARROLL: Yes.

MR. BRADLEY: When the fire barrier was applied by the installers and they buttered the joint, some of the material fell down in the tray.

MR. MICHELSON: How much of that kind of stuff has to happen before you screw up the capacity ratings?

MR. BRADLEY: I don't think that's ever been looked at.

Typically, you know, this is about as -- I mean, in the test we ran, this is about as much of that kind of thing as you would ever see.

MR. CARROLL: But in the real world, there must be a lot of that.

MR. MICHELSON: This is a laboratory-assembled job. In the real world, it is probably not quite as good, is never quite as good, probably.

[Slide.]

MR. BRADLEY: This is another three-hour cable tray. It has a section that has been fire-stopped off here and again there is no air drop or anything on this. But, again, this is an upgraded three-hour assembly.

[Slide.]

MR. BRADLEY: The same, similar shot right after removal from the furnace.

MR. MICHELSON: What was the -- why did you do a T-section like that?

MR. BRADLEY: The reason you do a T-section, because structurally that can be more limiting. You cannot really see it from this angle. But if you are looking from above, what you will end up with is a wider span from here to here than you would have on a straight tray run.

MR. MICHELSON: The C's have got angular, circular -- it goes into the next tray. And that's all in this simulation but we just can't see it very well.

MR. BRADLEY: You generate some new potentials for structural failures with the T-section that you don't have with a --

MR. McCRACKEN: And you had those fully loaded with cable? Is that the test --

MR. BRADLEY: A single layer. What we did on these is we just looped some of the cables out into the T-section to simulate the thermal mass you would have there. And this is just fire stopped off here.

[Slide.]

MR. BRADLEY: Again, what we saw before.

[Slide.]

MR. BRADLEY: This is application of the hose stream. It is probably difficult to see from the back of the room, but this is the fog nozzle hose stream being applied. And as you can see at this point, obviously there is no flaming going on. There is a lot of steam generated and smoke.

MR. DAVIS: When this material actually burns, is there a lot of smoke produced?

MR. BRADLEY: There is not a lot of opaque smoke. Whatever is being produced, you do not see smoke, dark smoke coming off.

MR. DAVIS: Is it toxic, do you know?

MR. BRADLEY: It is toxic in the nature that most materials are toxic. You would not want to breathe it in a confined environment, like a lot of materials when they are burned.

MR. DAVIS: What is this chemical composition?

MR. BRADLEY: That is proprietary. We know there is a lot of fiberglass in it. There is a lot of ammonia.

MR. DAVIS: So far, that's not too bad.

MR. BRADLEY: The testing that has been done shows some limited HCN that's generated through combustion, similar to what you have with a wool blanket or something, you do get some hydrogen cyanide but not an inordinately severe amount compared to other combustibles.

MR. CARROLL: I noticed the technician did not have a supplied air mask on.

MR. DAVIS: He's still alive?

MR. BRADLEY: We're still alive. A lot of us in this room have been through a lot of these tests. We use amide cartridges. We did look into the need -- you know, whether we needed air packs but the lab people determined that we could protect ourselves with the right equipment in the respirators.

[Slide.]

MR. BRADLEY: This shot doesn't show a whole lot except this is typical of what you see. This is basically what we call unreacted Thermo-Lag and a lot of the -- getting this material to work right, you want it to react chemically. And what you see here is basically Thermo-Lag that is still in the virgin state.

Typically, you get a lot of trying at the outer layers that are more exposed to the flame. But, on the inside, the material would be pretty much in the virgin state.

And the one thing -- some of the things we've discovered are certain types of upgrades may actually inhibit the performance of the material by constraining it and making it stay in its unactivated state.

So, putting additional stuff on top of it does not always make it work better. It can actually make it work worse.

[Slide.]

This is a similar picture. It shows how the cables were looped into the T-section. Again, you see extensive thermocouples. This is all thermocouple wire, and there's thermocouples every six inches on all of these strings.

There were tremendous amounts, tens of thousands of dollars of thermocouples in these tests.

Another one-hour cable tray test similar to the others.

This is a good shot. This is either during or immediately after the hose stream test. And this is a three-hour test. And you only see this effect in the three-hour test where some of the fiberglass in the material actually comes out in the form of glass nodules that form on the outside of the assembly.

Typically, you'll only see that in a three-hour test.

MR. MICHELSON: Structurally, there's not much left there, is there?

MR. BRADLEY: Well, looking from the outside, it's mostly Charlie.

MR. MICHELSON: Now, the hose test of course is they use the fog nozzle, probably.

MR. BRADLEY: Right.

MR. MICHELSON: In what? 15 degrees, or something?

MR. BRADLEY: Yes. Is that correct -- what's the -- 15 degrees, correct.

MR. MICHELSON: 15 degrees. And what distance, then?

MR. BRADLEY: Five feet. Five feet from the nearest edge of the assembly.

MR. MICHELSON: You didn't give it any good physical pounding with the hose test?

MR. BRADLEY: No, not compared to, say, a solid nozzle hose stream.

MR. MICHELSON: Right.

MR. BRADLEY: Now, this gets to your question about a barrier opening. Here is a classic barrier opening, and you can see the cables. This is on the underside of a cable tray test. This is something we have categorized as a structural failure because what happened is during the performance of the test, or possibly ι .ing the hose stream itself -- I'm not sure on this particular test -- the weight of this material basically pulled the joints apart.

And this is probably an unreinforced joint. Some of the upgrades we're looking at involve putting stress skin in additional trial grade so that these joints are held together better.

But, an unsupported joint, typically, this is a typical failure mode you'd see in a wide tray at the bottom.

MR. MICHELSON: I assume you have some rather long vertical runs in plants that are being Thermo-Lag protected.

MR. BRADLEY: Right.

MR. MICHELSON: What do you do about the structural problems, then?

MR. BRADLEY: Well, we do have vertical runs in the test X, as you saw.

MR. MICHELSON: Yes, but those are very short.

MR. BRADLEY: Well, there is -- I don't remember the length.

MR. MICHELSON: I'm talking about 15-20 foot risers.

MR. BRADLEY: Yes.

MR. MICHELSON: What do you do then on a Thermo-Lag?

MR. BRADLEY: The runs we have cover the longest unsupported span distance you could have. These panels are a certain size, and if you have 20 feet, it's going to be made up of a number of smaller panels.

So, while we can't do a full 20-foot run, we will take it out to one full panel.

MR. MICHELSON: That weight is not necessarily uniformly distributed.

MR. BRADLEY: That might be. I would note that the tests we've run, and this has been I think pretty consistent on cable trays, there have been a lot of tests run by TU, TVA -- or TU and ourselves.

And the failure modes on cable trays are typically either in the radial bins where you have a large number of separate sections that are put together, or on the very bottom like this, where you have a lot of weight trying to pull the joint apart.

You'll also see this --

MR. MICHELSON: What weight do you have there? This is not the weight of the cables or anything?

MR. BRADLEY: No, it's the weight of the Thermo-Lag itself.

MR. MICHELSON: And that's a quite short span you showed me in your picture. I'm talking about a large vertical run now.

MR. CARROLL: Yes, but he's saying you can only get this stuff in certain lengths.

MR. MICHELSON: When you stack it up, the weight is distributed all the way down unless you provide some kind of a special fabrication or installation process to hold a given panel in that position, and not distribute any dead weight further down.

Stacking blocks up is what you're doing.

MR. CATTON: When you have a long vertical run I would think that the thermal attack would be stronger at the top than at the bottom.

MR. BRADLEY: Yes, that is another --

MR. CATTON: Particularly, looking at the flaming process.

MR. BRADLEY: One of the effects we have noted is the --

MR. MICHELSON: Yes. You can probably get nicely on the vertical runs.

MR. BRADLEY: The most severe exposure in the furnace is usually right at the top, right at the interface between those vertical panels and the upper deck.

MR. WEST: TVA is planning some tests of risers.

MR. CATTON: How big -- how high are the risers that they're going to test

MR. BRADLEY: I'm not sure how big. They'll be limited by the furnace size, but they'll be maybe 8-10 feet, I would say.

MR. MICHELSON: That probably is good enough.

MR. CATTON: It gets stronger as you go up.

MR. MICHELSON: Yes. Yes, but the phenomenon ought to start showing up in 10 feet.

MR. BRADLEY: Same thing we saw before here.

(Slide.)

Again, there's really no cable damage in this particular picture.

Now this is a little different. This is a conduit test. This is a three-hour conduit test. Looking at it from the end and you have four conduit assemblies, you also have a large junction box mounted.

And we also have what we call lateral bins, which are basically just 90 degree elbow type -- or, basically, elbows that we mount.

And we have four different sizes of conduit in this one large junction box.

What you get in this type assembly is a pretty wide variety of structural attachments.

MR. MICHELSON: How big is the conduit? I'm looking at the man and the stepladder, and I'm looking at what I think you say the conduits are.

MR. BRADLEY: This is confusing because that's just -- he's not really that small. This is much smaller than it looks.

MR. MICHELSON: Well, it certainly is.

MR. BRADLEY: I would say this is probably, from here to here, is probably five feet.

MR. CARROLL: What is the diameter?

MR. BRADLEY: Of the conduit itself, six inches. These are probably three-inch aluminum. Three-inch, two-inch and three-quarter inch.

MR. MICHELSON: It looks like the outside of the installation is eight or nine inches.

MR. BRADLEY: That is correct. We talk about upgrades being impractical. A three-hour, three-quarter inch conduit upgrade can become eight inches wide and weigh a fair amount per linear foot.

MR. MICHELSON: There are also a lot of vertical conduit runs that might be 20 or 30 feet tall. And, again, if you had to Thermo-Lag them, it would be quite a problem. But I don't know that you have any like that.

MR. BRADLEY: This is another view of the same assembly from the side. Again, you can see the four runs of conduit that are vertical, horizontal and the L.D.

MR. CATTON: As a part of this process, are we going to see some kind of justification for not -- or a basis for not testing the 20-foot?

MR. BRADLEY: That's something that, to be honest with you, that we haven't addressed, that has not been raised as an issue prior to today.

MR. CATTON: Has TVA been asked to justify eight foot instead of 20 feet? Running the eight feet as a --

MR. WEST: I'm not sure you could do a 20 foot. I don't think there's a 20-foot furnace. They're limited by furnace size. And, typically, all fire-resistive components that are tested, there's limits on the size.

MR. CARROLL: You can simulate 20 feet by putting some kind of loading on the eight-foot section.

MR. CATTON: I'm concerned about the build-up of the gases that evolve from the heating and then burning them higher up.

There is an interesting example of this. I'm a little surprised that you made the comment that you did. And that is Emmons' paper in Scientific American, some years ago, where he showed 10 or so different materials as tested in a half a dozen countries, and it looked like a shotgun blast.

In one country, the poor material looked good. I think the vertical run is important. And if you're only going to do eight feet, there ought to be a basis for just doing eight feet.

I don't think you can just accept it because that's the only size furnace you've got. That, to me, is not a good reason.

MR. MICHELSON: You may have to put collars or something on the vertical stacks to kind of break up the gas connection currents or something.

MR. CATTON: It doesn't work, Karl. What happens is if you take -- and people have done these things. You put like a fin. And what happens is it just comes right back around. The boundary layer just reattaches to the surface and the gases go right on up.

Are these gases that come off of this combustible? They must be because that's what we see flaming.

MR. BRADLEY: Yes. But, again, we have looked at the combustible, or the propagation aspect of this. And we'll get you a copy of that report. And it doesn't -- it's not a strong propagator. I don't have the units and the numbers, but --

MR. MICHELSON: You have the vertical configuration propagation, as well.

MR. CATTON: We have the -- it is a different kind of process.

I don't know how you did your propagation tests, but you can take and rotate a material from horizontal to vertical and, in one case, it burns; and in another, it doesn't.

MR. BRADLEY: Right. Yes. And our test was done in accordance with the standard ASTM methods for a lift test. But I don't have the information in front of me, so -

MR. MICHELSON: The ASTM says you test your configuration. It doesn't try to prescribe your configuration. You have to pick your -- whatever your configuration is, then you have to --

MR. KARYDAS: Have you considered more fundamental testing under the products collectors so that you can define basic properties? So that you could really extrapolate all those questions? Not necessarily to refine them, but measure basic quantities which can lead you to, you know, fire indexes, combustible indexes, what you get out of that.

What is the specific gravity of this material, as well? Do you know?

MR. BRADLEY: I don't know off the top of my head. You know, we can -- we know what it is, but I don't know --

MR. KARYDAS: Is it light? Heavy?

MR. BRADLEY: It's about like -- it's not that different from gypsum board, I would say. Maybe, a little heavier.

MR. KARYDAS: Oh, okay. Heavy enough, then?

MR. BRADLEY: Yes, it's fairly heavy. I mean, a panel is fairly heavy. I don't have the -- I don't remember the density off the top of my head.

MR. WEST: I think it is about 60 pounds per square foot for a half inch thick panel.

MR. MICHELSON: Is that a fiberglass based wrapping?

MR. WEST: No.

MR. BRADLEY: There is no wrapping. Basically, the --

MR. WEST: No? I thought there was a skin you put over.

MR. BRADLEY: It's a -- it's just a skin coat of the trowel grade material. It's not a --

MR. WEST: Oh, it's not a --

He's referring to the joint reinforcement with stress skin.

MR. BRADLEY: Right. Now, for upgrades, we reinforce with stress skin, which is just a mesh, a carbon steel mesh, sort of like chicken wire.

MR. MICHELSON: it is metallic?

MR. BRADLEY: Yes.

MR. CARROLL: And that is butted over with the --

MR. BRADLEY: Correct. With the trowel grate. And it's what they call a skim coats, just enough to visually cover the stress skin. About an eighth of an inch, or less.

Once again, flaming.

MR. CATTON: I want you to notice how the flaming gets stronger as it -- no, it's dying out horizontally.

MR. BRADLEY: This is a shot from underneath after the fire exposure, again, just showing the general condition of the -- there's no obvious openings in these assemblies.

MR. MICHELSON: How do you know there's no obvious opening?

MR. BRADLEY: We crawl over every square inch of it, with a whole team of people, right after the test.

MR. MICHELSON: Looking from the outside?

MR. BRADLEY: Right, with flashlights. And the criteria is --

MR. MICHELSON: Do you put a light inside so you can see if --

MR. BRADLEY: No, but the criteria is that you can't visually see the raceway or the cable from the outside.

MR. MICHELSON: How can you see it? It's kind of dark in there.

MR. BRADLEY: Well, once you shine a light in there. I mean, it's --

MR. MICHELSON: Well, if it's a hole to shine a light in, there's no doubt there's a hole. And I assume you don't think there's a hole, and you didn't find one you could shine a light through.

Now, that is a pretty big hole to shine a light through.

MR. BRADLEY: Well, maybe I have another shot.

MR. MICHELSON: Looks to me like, you know, they have to light the inside somehow and then look to see if the light's coming outward. Not trying to look inward.

MR. BRADLEY: Do we have another shot of a good opening somewhere, here?

[Slide.]

This particular set of slides that show an opening. But, any opening, and I think, you know, the NRC staff and the lab people and everyone's there. I mean, we do a very thorough inspection of these things.

MR. MICHELSON: I was just trying to figure out how any of you knew there was an opening without some kind of a light inside.

MR. BRADLEY: Well, you --

MR. MICHELSON: Unless it's so big that --

MR. BRADLEY: Yes. I mean, you have to do a visual inspection, obviously, first. Like Biff said, with the lamps. Flashlights and lamps looking for openings.

MR. MICHELSON: That's from the outside.

MR. BRADLEY: From the outside. And then you dissect the assembly piece by piece, and you look for evidence of burn-throughs on the conduit or the cable tray itself. And then you also visually inspect all the cables for any evidence of --

MR. MICHELSON: I understand the process. It's kind of hard to dissect this and preserve the interior surface.

MR. BRADLEY: No. The interior is fairly well-preserved when you dissect it.

MR. DAVIS: Is failure defined as an opening in the material?

MR. MICHELSON: Visual opening.

MR. DAVIS: That does not mean that cable would have failed, by any means, I guess.

MR. WEST: Biff also showed pictures earlier where they folded back the -- yes, like that. And you can see, if there's a burn-through, you can usually see a pattern through the unreacted material where there's evidence of a burn-through. There'd be a trail there.

MR. MARION: With the level of instrumentation that you have within the assembly, if you had a thinning of the material, or a separation internally of the material such that you had a very minimal amount between the fire source and the cable tray, the thermocouples will set you off.

So, you'll get that indication of a weakness in the coverage of the material.

MR. MICHELSON: I was thinking of after the test when you apply your hose stream, and so forth, and then you say it's still physically intact. And I just wondered then how do you know, when you're looking at all this wet material, and whatever, and you're trying to decide whether you've had a burn-through.

That was what I was trying to find out, which is when you do the inspection.

MR. BRADLEY: You can't always attribute the opening to whether it's the hose stream or the fire exposure. Sometimes, you just know there's an opening there.

I think most of these other photographs are pretty much redundant to what you've seen already. So I'll just briefly go through these.

These are typical of the steel bands that are used to secure the material, and these have been intentionally cut so this could be pulled down.

Again, this is showing the -- this is the inside of the panel. These are the support ribs, and the orientation of these ribs has been shown to be important structurally.

You can also see the stress skin on the inside of the panel here. And, again, this is pretty much unreacted Thermo-Lag on the inside.

MR. MICHELSON: Is that a burn-through on the left hand corner? The black spot?

MR. BRADLEY: No, I don't believe that was a burn-through.

MR. MICHELSON: That's just a black spot.

MR. BRADLEY: Yes.

Another conduit assembly. This is a three-hour assembly, as well. You can tell by the significant thickness of the material.

Another shot of that.

[Slide.]

Again, pulling out of the furnace. As you can see, this entire assembly is glowing. At the end of a three-hour test, the entire thing is extremely hot and glowing, with --

MR. MICHELSON: It is only glowing on the outside surface.

MR. BRADLEY: Right. That's correct.

MR. DAVIS: What is the vertical distance that we're looking at there?

MR. BRADLEY: From here to here is about, I would say, about six feet.

MR. DAVIS: Six feet?

MR. BRADLEY: Right.

MR. DAVIS: I don't see any indication there that it's burning more vigorously at the top.

MR. CATTON: I don't either, but some of the earlier ones --

MR. MICHELSON: Not at that particular one, no. But, on some of the others, it was quite obvious.

It depends on the time after your removal, and all that, which we don't know.

MR. KARYDAS: Have you weighted the material before and after? Do you know the mass loss?

MR. BRADLEY: No, we have not done that.

This doesn't show a lot, just that this is after the test and it's a whole big char layer. And it, really, again, it's not a very pretty sight. But this is the way the material looks when it works the way it's supposed to work.

This is a Rameck insulator we use up here to insulate the test deck.

This is a lateral bin box post-test after all the Thermo-Lag has been removed, just showing the general condition of the conduit in the box.

Again, you can see thermocouple wires along here, and here [indicating]. That's a mess. I'm not even sure what I'm looking at.

MR. KARYDAS: It is a mess, no doubt.

[Slide.]

MR. BRADLEY: This is another box. Again, you can see a very good shot of this stress skin. This is a carbon mesh, weave this on the inside. On three hours, it's on the inside and the outside, and one hour it's only on the inside. And, in here, the support ribs.

This is typical of the box you'd build around an LB.

MR. MICHELSON: Why does it get blackened on the inside?

We're not talking about very high temperatures.

MR. BRADLEY: This right here [indicating].

MR. MICHELSON: I was looking at the surface of the Thermo-Lag there that had been peeled off, the black spots on it.

And what am I looking at?

MR. BRADLEY: Right here?

MR. MICHELSON: Yes. For instance, a long streak over on the other side.

MR. BRADLEY: That could possibly be stuff that just came off the gloves of the person peeling it back. I mean, typically, these are not burn-throughs that you're looking at here. This is pretty much unreacted material.

MR. CARROLL: How about on the other side?

MR. BRADLEY: It is charred layer or carbon on the inside.

MR. MICHELSON: How does it get on the inside during the test?

MR. BRADLEY: This is during the disassembly, not during the test, itself.

MR. MICHELSON: You are real sure of that?

MR. BRADLEY: Yes. There may be some tests where there are burn-throughs and where you would see something on the inside. In this particular test, this is clearly --

MR. MICHELSON: By the time this guy's peeled this off, and so forth, you're still going to convince me you know where the burn-throughs are

MR. BRADLEY: They take about probably at least a hundred photographs of every stage of, you know, peeling it off. And it's all videoed and everything else.

MR. MICHELSON: I think we should have seen a clean one instead of a dirty one.

MR. BRADLEY: These are conduit sections after they've been peeled off. Again, you're looking at pretty much a lot of unreacted material here. You can see this is a small conduit. This must be a three-quarter inch conduit -- and you can see that most of the material is unreacted.

There is a char layer on the outside here.

MR. MICHELSON: Is there a joint through --

MR. KARYDAS: Yes, but there is discoloration of the whole thing, the internal surface, which means that the core of the material is white but the internal surface is discolored. It is not because of what you were saying.

It is apparently the conduit overheated.

MR. WEST: The stress skin is painted. The stress skin is not white. It is painted.

MR. KARYDAS: Painted?

MR. WEST: Painted with a primer, so the stress skin, the inside surface is not the same color as the thermo-lag material is.

MR. KARYDAS: Is that the original color? What you see is what you had before the test?

MR. WEST: Well, it's darker. I can't say that's the original color. I'm not sure how well the photograph reproduced the colors. But it's not -- the inside surface is not virgin white.

MR. KARYDAS: No matter what you say, there is a difference.

MR. WEST: There is a difference in color.

MR. KARYDAS: What is that attributed to?

MR. WEST: You have the stress scan that is painted with the primer and the Thermo-Lag when it is in its mastic form is laid onto that, so you have some extrusion through the skin.

So what you are seeing is the colored screen with some Thermo-Lag material extruded into it, but the screen is embedded into the Thermo-Lag.

MR. MICHELSON: Is it stainless steel?

MR. WEST: It is part carbon steel.

MR. KARYDAS: If you had a cross-section of something that was not exposed to that to compare, how would they look like, exactly identical or would there be some difference?

MR. BRADLEY: If this had not been exposed at all to any fire, you would not seen any darkening here, but I don't think this darkening is indicative of any type of burn-through or anything.

On this particular test, I believe, this was a test that had a pretty good result. You can tell here. I mean, the thermocouple wire and everything here looks real good.

MR. KARYDAS: By any chance, do you have any sort of comparative short exposed or exposed in the cross-section?

MR. BRADLEY: I don't have it here. I mean, we have it in the test reports --

MR. KARYDAS: You do?

MR. BRADLEY: -- but we don't have them in the slides here.

Again, here is a joint, typically. This one has been intentionally pulled apart. This shows you what the joint would look like.

MR. MICHELSON: You get halfway up the

installation there is that area that seems to be bridged. What was that?

MR. BRADLEY: This?

MR. MICHELSON: No, no. Further down.

MR. BRADLEY: Oh, right here?

MR. MICHELSON: What is that?

MR. BRADLEY: Let's see. That is a good question. I am not sure what that is, Carl.

Do you guys remember what that is?

MR. WEST: It looks like char that fell down.

MR. BRADLEY: Probably just a piece that fell down.

MR. MICHELSON: It has a strange pattern of black in it.

MR. WEST: We have seen some cases where during the fire test the trial grade material used to hold the panel together, which is Thermo-Lag, the same material as the panels.

During the test it can -- water can be driven off of that -- out of that, residual water. It creates a residue inside that is a darker color, and sometimes -- especially in the photographs, if you see a darker color and there is no burn through from the inspections, it is probably from that. It is usually like a caramel.

MR. MICHELSON: It shouldn't be black, though.

MR. WEST: No, it wouldn't be black. It is like a dark caramel color.

MR. MARION: This is Alex Marion. One of the things that may be useful -- and I will look for your Guidances -- we have test reports for each of these tests which includes a series of photographs capturing what you have seen except more comprehensive set of photographs.

Those reports have been transmitted to the NRC. I don't know if any of you folks are interested in seeing a copy. If you are, let us know and we can get a copy of one or two to you. I will leave it up to you.

MR. CATTON: In my case, not all of them. Thank you.

Next on our agenda is Dimitrius Karydas.

MR. CATTON. We are one hour and 12 minutes behind, but then we have plenty of time.

MR. MICHELSON: We want to adjourn at 4:00; we will just adjourn at 5:00.

[Pause.]

[Slide.]

MR. KARYDAS: You asked me to give you my ideas, my opinion, about relative pertinent standards and pertinent work. As a matter of fact, to tell you the truth, I was extremely pleasantly surprised when I read the packets about performance-based standard.

I would like to start from that because there is, without the overhead, there is a major trend internationally -- you probably know that -- to establish performance-based standards.

I would cite the starting activity at the Warren Center with Von Beck being the prime mover. There is a piece of work that has been submitted as a plan of law for legislation, and addresses code standards I had the opportunity to comment upon that earlier in terms of establishing performance parameters, which are risk -- the total risk, and does not eliminate existing codes.

On the contrary, it benchmarks the existing codes, and for those that cannot comply with existing codes, they have to prove, using the performance parameters, that alternative solutions are equally acceptable.

Similar activity is done in Canada by NRC Canada, the National Research Counsel, for residential activities, and currently it is being extended to industrial activities.

In a week from now -- two weeks on the 23rd of June the British Standards Institute will present in a public meeting their own performance-based standard on the relative codes worked out by the Warrington Fire Research Center. It covers generic issues as well as residential, as well as industrial.

The examples that they are going to be presenting address sports arena and warehouses.

Internationally, there is a coordinated activity under the main forum. Major countries concerned with fire protection issues are meeting regularly, twice I believe. This week they are meeting, and they address performance based coordination, performance-based development standards.

Representation in this forum is from Australia, Japan, Finland, Britain, Germany, I believe, and the United States. The United States is represented by the Director of the Center for Fire Research at NIST, Jack Snell, and the Chief Operating Officer of Factory Mutual Research Corporation.

They have been promoting the coordinated development of the coordinated performance-based standards. The performance parameter selected is risk.

I guess that much in terms of where the international community stands in performance-based fire protection standards. There are specific examples, and I will be referring to that.

For example, Factor Research, which is my employer, has been addressing the performance-based standards in one segment of the industry in this country, telecommunications industries in particular where the thermal and non-thermal damages are of significance when this is the general model of the performance standard, the philosophical architectural approach.

Let me try to explain what are the main components. This is the occupancy database from field activities. I guess this entire frame represents models. This entire block represents policies, and this is the model itself, the probablistic model.

Let me go first to this block which is divided into two elements, the deterministic models and probablistic models. Fire spread and growth, for example. Or smoke generation, smoke movement, smoke deposition, detection time, protection time, systems response time as a whole are deterministically calculated based on models, mathematical physical models, that are validated to the extent possible in small scale testing or large scale testing.

The entire block here represents deterministic modeling from the physical sciences to the entire testing and validation.

In association with that are probablistic models. What is the reliability of detection systems employed, protection. In other words -- I have heard several times today we are going to install sprinklers that are pretty dependable. I guess how much, the question is. When you quantify those things, how much.

We have developed and studied the reliability of the most popular systems, 208 systems, and we have calculated the reliability of those systems that ranges from 1.8 percent upon demand up to 15 percent upon demand on reliability, depending on what type of system.

So as a general rule, I don't know what you apply. I believe in the five methodologies there is 1.5 percent acceptable unreliability of protection systems, if I remember correctly, and I am not sure about that. But this is on the optimistic side, I would say. And that reflects only sprinkler systems.

How about detection system? What is the reliability of detection. I am talking only the reliability given that they are exposed to the right concentration of smoke, excluding stratification or other phenomena that are calculated or addressed in the deterministic aspects.

There are reliability fire protection systems such as fire walls, fire doors, penetrations. Fire doors, for example; 20 percent of them failed in the most recent survey. Failed to respond to the function that they are supposed to. Failed to close, in other words; not failed to sustain the fire endurance, but failed to close upon demand.

But these are specific aspects that when you examine the whole system you need to understand the failure modes and the failure probabilities.

So these are the models that we have been employing here, and are in association with the deterministic models.

The support elements of that are test data, calculations, other reliability models, failure models, failure rates, data and databases.

In terms of other activities, I heard the term "in depth defense." We are using a different terminology. We call it prevention and control because we divide the activity to the -- before initiation of the accident, which you can prevent, and after the initiation of an accident, you can control. So you have preventive as well as controlling functions.

And the preventing functions in this eventuary approach are those before or immediately upon the initiation and reflect the identification of hazards and possible elimination of hazards as well as the initiating events that will initiate -- given a standard -- initiate the accident. After the accident is initiated, you have only controlling devices that you can employ.

And the question is, like I heard in the previous presentation, that you may use walkdowns and individual examinations. How you quantifiably use those in order to adjust benchmark models are prototypical models. Probably the one you have in mind to get the Florida Power and Light or something similar as the prototypical plant. Then you need to examine the deviations from that particular plant in other sites.

One way of doing that is if you had the methodology to codify all of the preventive and controlling aspects, and I would give you a brief list of prevention and control elements.

[Slide.]

MR. KARYDAS: The prevention elements in our terminology and philosophy are those aspects, and controlling elements are those aspects, and some examples of them.

So the question is in this particular case in prevention and control where you have existing standards, how you dismantle the standards into specific questions that apply or do not apply --

[Slide.]

MR. KARYDAS: -- and you rate on a consistent way the compliance to existing standards. So the compliance to existing standards provides a weight, some kind of adjustment factor, to the benchmark models.

So this is the way we are using. We are using deterministic models, probablistic models to come up with a risk evaluation, and we make adjustment of those particular parameters in terms of prevention and control functions based on the compliance to engineering practices and existing standards.

In essentially these elements here, the main core of the performance-based standard, the performance examination.

We have practicality inputs, detection system reliability, protection system reliability, smoke management reliability, emergency response time, fire department response time and you have the various outputs like a normal PRA where you calculate -- depending upon the failure of that various protective or controlling function, the timing of the entire scenario as well as the consequences and the likelihood.

As an end result, you have the risk presentation, risk interpretation, risk reduction opportunities as well as cost benefit analysis. This is a very general framework. At this time, the status of that is we have developed experimentally the last eight year many of the deterministic models that are converted to computer codes.

You earlier indicated that there are several computer codes in the market. We have been in corporation with the most viable of those, and I would like to make a comment, an public comment that COMPBRN was good and revolutionary at the time of its conception. It is completely inadequate today to be used as a deterministic model. There are much more advanced models in the market, in the scientific community that have been tested, validated and so forth.

MR. DAVIS: I'm sorry to interrupt. Are you talking about the latest version of COMPBRN III?

MR. KARYDAS: Yes, I'm talking about the latest version which we have also worked upon. I am quite familiar with it. It is very inadequate to address all of those issues, design models and all of the other parameters that are in the current understanding of the fire growth development.

There are major elements missing, for example, fire growth. We have been talking in the previous slides how fire grows. Based on basic parameters and configurations of the burning material.

For example, a cable tray. There is much advancement in the work of the prediction of how flame will spread on a horizontal or vertical surface, and that becomes the source. COMPBRN does not provide that. As a matter of fact, the FAST code at NIST assumes -- prescribes the source, the fire source, and does not calculate based on specific elements, specific fundamental parameters of the combustible material in the configuration.

MR. DAVIS: Would you anticipate that COMPBRN gives you an optimistic results?

MR. KARYDAS: In some cases it is optimistic, and some cases pessimistic. It is inadequate because it is user dependent. What is the source you prescribe. There are many other interactive parameters. It is not considered how it interacts with its own environment. How it propagates. As I said it was revolutionary when -- upon its conception and in the first few years. It changed in error and gave the opportunity --

MR. CATTON: Our colleague Apostolakis will be very interested in hearing this.

MR. KARYDAS: Excuse me?

MR. CATTON: I said our colleague Apostolakis will be very interested in hearing this.

MR. KARYDAS: He certainly is.

MR. CATTON: On a more serious note, are there models available to fulfill the needs of that first block today?

MR. KARYDAS: Yes, today.

MR. CATTON: They are available. Are they available openly or are these proprietary or what? If NRC wished to have such tools, could they go get them? If the industry wished to have such tools, could they go get them?

MR. KARYDAS: I think they would get them. What is happening right now, we are talking about the integration of the various models. Because they are independently available, fire growth models, fire propagation models for some configuration of interest here, for example, cable trays, these are available.

There are available, I guess, zone models in terms of the zoning of the fire environment that you can predict the temperatures given that you have the right input. But at this time, internally with factory resources, we have integrated those codes and they work.

But currently we are in the process of cooperation with NIST to work with them to introduce in the FAST code, which is very similar to the code we are using in many ways, to introduce the source term there.

So the answer is it may not be this minute, but by the time the decision will be made to have performance-based standards, approach, examination, those will be absolutely available.

That gives you a general idea of what is the direction. At this point, all of the elements are present. There is an effort in a computer program to integrate all of those elements as well as to build up the basis which is extremely important.

[Slide.]

MR. KARYDAS: Now, in terms of the more specific question of the thermal barriers, I would like to address the work that Delichatsios has done in terms of one example, and he addressed fire walls as a whole. You may generalize this information with the appropriate information for fire barriers.

[Slide.]

MR. KARYDAS: The way the problem has been approached is this, this is the ASTM E119 curve, and this is the curve of this particular fire wall exposed to a particular fire load. I will give you the terms and assumptions. I just want to give you a number in terms of an example, and then I will go to more detail if necessary.

This particular temperature curve is the thermal response. I underlined the thermal response of this particular fire wall assuming that the fuel is infinite. If the fuel is not infinite, if you know how much it is, you can calculate the time it is going to stress this particular fire wall in this particular case, and I will indicate how.

The total fire direction is this much, a few hundred seconds. So if you go up here to the corresponding temperature, you will see that this is the temperature that you achieved in this fire duration based on the thermal response of this particular wall. If you extrapolate that to the fire curve, you will see that this corresponds to a three-hour duration.

In other words, the standard curve would respond to the same temperature of three hours. So that says that this particular fire load to this wall corresponds to 4,000 seconds, three hours and something load.

MR. CATTON: Let me see if I understand that. What it says is, that particular fire load would destroy a three-hour barrier in 100 seconds; is that what you were saying?

MR. KARYDAS: It says that this particular wall in this duration is going to achieve temperatures that are justified by three hours, 4,000 seconds, standard wall. So in order to withstand this particular load, you would have to have a three-hour wall.

If it was lesser duration, then probably you would need half-an-hour wall. If it were a longer duration, probably you would need a five-hour wall. So this is how you use a performance approach based on particular fire loading, the appropriate fire wall, the appropriate standard duration.

MR. CATTON: It is a translator.

MR. KARYDAS: Yes, which is based on the specific fire load, the specific response of the wall. The question is how you generate this particular curve -- that is the question -- because you have that as a standard temperature. The question is how you generate that and how you define the time.

In order to define the time, you need to know how much you have to burn at what heat release rate. So this is probably the easiest definable, if you identify your fire load. The question is to define this particular curve, and it is not an easy job.

MR. CARROLL: You keep looking over whipping over the roof collapse, what does that have to do with anything?

MR. KARYDAS: The particular scenario we are given, it is a very specific case, I will tell you exactly what are the assumptions. It was in a warehouse situation, so the assumptions are, after an initial growing period during which the fire wall is subject to low heat fluxes, the fire develops out of control throughout the warehouse. The second period of uncontrolled, a flashover, in other words, fire lasts up until the steel beams and roof and maybe side walls collapse.

When the steel beams temperature increases about 1,200 degrees F, following with the collapse of the roof and the sidewalls, the fire develops into a large open pool type fire. So the assumption is that we have an open fire, a pool fire.

MR. CARROLL: Four walls and a collapsed --

MR. KARYDAS: Right. The type of combustion is very important. It is fuel controlled or it is ventilation controlled, and I will just get into that. So you need to have it very well established. I will show you the general case that you may have depending on the ventilation, and I believe you alluded to that this morning. You are going to have a fire load that may be above the standard curve, maybe below the standard curve. If you are below the standard curve, you don't have a time limitation. If you are above the time curve, then for how long you are going to be burning your fuel is very important to define what is the duration required. So these are some of the assumptions.

Given the thermal properties of the wall, K-wall and C and its thicknesses, one first calculates the inside and outside wall temperature of the material when it is tested in the ASTM E119, and then for the same wall properties and thickness to inside and outside wall temperature are calculated for the fire scenario described above, namely the initial growing period is neglected, and the flashover fire is considered to occur at T-zero. That is why you have this really little bump over there. Practically you neglect that first and you consider the rest of the curve.

When the gas temperature throughout reaches 600 degrees C, this is the flashover temperature, after this period the heat flux to the fire wall is considered to be 150 kilowatts per square meter. This is the optimistic case, and it is experimentally supported.

So you consider, in other words, from the fire that you are going to receive upon your wall 150 kilowatts per square meter heat flux. The same heat flux is assumed to impinge on the fuel surface causing fuel vaporization. One of the reasons that you take the assemblies that we saw earlier outside the furnace is because, and you probably have extinguishment, is, first, you may have already consumed the material that generates reradiation and vaporization in the rest of the material after so many hours.

So the question would be in a real fire how that would behave, whether that would sustain the fire or not. You cannot make decisions just on the observation that you took it out after so many hours when you have burned most of the material. The question of, if you have sustained fire using that particular material or not will be if the first ignited material will generate sufficient heat flux for the adjacent material to evaporate and burn, and that is what would sustain the fire propagation.

The duration of the fire is estimated for a given fuel density like there is, you know, depending on the heat release rate and the mass that you have to burn, you can calculate the time. I guess the rest is this particular case.

The general case, if you assume a room of this nature, the opening which we call the equivalent geometric opening, it is a Factor F. I will show you just in a minute the opening factor which is inverse the square root of some complex formula involving openings and the height of this particular enclosure and for, in this particular case, a wall of thickness, concrete wall of thickness 20 centimeters. You have this particular configuration, the results.

[Slide.]

MR. KARYDAS: Here is the ASTM curve, and you see depending on this opening factor, in this case -- let me indicate first the two curves, one is the front and the other is the back surface of the wall, the exposed directly to the fire and the other. So that addresses your question, I guess, what happens at the other side if you have sufficient temperatures to propagate and ignite other materials. So it is important to calculate both the surface temperatures.

Depending on the opening of the room, which makes the fire ventilation controlled or fuel controlled, you will see that there are thermal responses of the wall that are below the ASTM curve, or thermal response curves that are above the ASTM curve, and that configuration here assumes infinite material burning.

Again, if we go back and the material that you are burning lasts for that long, then you have to use this translation from the real response to the thermal specification, the thermal bias specification.

[Slide.]

MR. KARYDAS: This is the back surface temperature. Earlier I misled you on something, the dashed surfaces here, the solid lines represent wall temperatures, the dashed lines represent the gas temperatures. So the gas temperature is what we calculate within the enclosure, and from that we calculate based on an extensive work the temperature profile, and this is the back temperature of the same walls with the same variable parameters.

This particular program exists in a computer code. The method of solving the set of differential equations here is, I guess, the set of equations that describe the heat transfer from the source to the wall, including radiation and reradiation. He used an integral approach and the computer code has been developed and is being used.

This particular project was a response, an internal response, of Factory Mutual that had the same problem that probably NRC had that the prescriptive mode of, in this particular case I needed a three-hour wall, in that other case I needed a one-hour wall, was kind of random, and probably too conservative, or in another case less conservative.

So the question is, based on the specific loads that I have, what am I supposed to use, what rating of fire barriers should I use, and that is the answer to this question. You establish your loads, you establish the thermal response of your barrier based on an infinite quantity of burning material and based on the exact quantity or the estimated quantity that you have, you evaluate the time that the combustion is going to take place, and from there you translate the thermal profile of your wall to a standard rating of a wall.

MR. CATTON: So you use a fixed burning rate so that the time scale translates?

MR. KARYDAS: Of the flashover, yes, it is a fixed burning rate because practically what you have in this particular situation is, you burn all the oxygen, and this is based on that. The heat release rate, the flashover situation is practically the air and that is why it is dependent on the openings.

The first stage is fuel controlled, but later on becomes ventilation controlled, which is defined by the opening we have in the enclosure. So it is a constant rate, yes. Certainly you cannot burn more than what you have.

MR. CATTON: I understand that. That is why you are able to do that translation.

MR. KARYDAS: That's right.

So this is another approach, a very deterministic and not probablistic approach to the question of performance-based evaluation of fire walls, in this particular case. The methodology, given that you have a specific date of the various configurations, practically conductivity, specific heat, thermal capacity and configuration will give you experimentally and analytically, following the same steps, and the same general methodology of solving your models, will give you a tool to evaluate on the basis of the performance of the fire load to evaluate what you need.

So I gave you two perspectives, I guess, in summary. In terms of integrating all the aspects of the performance-based, plus a specific aspect in thermal barriers, and what is the international trend which is full steam ahead in using performance criteria and not prescriptive standards.

MR. CATTON: If there are any questions from the staff, feel free?

[No response.]

MR. CATTON: I guess the bottom line is that it is doable?

MR. KARYDAS: Yes. It is doable.

MR. CATTON: And complete package availability is kind of imminent, you could do it very quickly if you were of a mind to do so?

MR. KARYDAS: And the packages are coming from various sources. The effort at this time is an effort of coordination. As I said, NIST and Factory Mutual have been coordinating, working together in many aspects. The international community is trying to focus, and go in parallel, and the various standard-making and regulatory agencies internationally have come to the point, not of discussing performance-based standards, but defending performance-based standards. They are out to defend.

MR. CATTON: Thank you very much.

MR. KARYDAS: Thank you.

MR. CATTON: It makes me feel a little bit better about Option 4. You still have to do it, but it sounds to me as if the research end of it has been done by others, and it is a matter really of bringing it together.

MR. MICHELSON: That is only part of the whole story, but it is an important part.

MR. CATTON: You would still have to do the analysis of the existing plants, and that means you have to do whatever you need to do.

MR. MICHELSON: The PIA is doable, too, it is quite doable, but no one has really done it.

MR. CATTON: The next item on our agenda is Shutdown Fire Risk Issues. Seeing how it is ten to three, how about let's take a 15-minute break and then we will get back to this.

[Recess.]

MR. CATTON: Before he starts, can you give me input as to the letter, Carl, Jay?

MR. CARROLL: Let me read your letter.

MR. CATTON: Just make a few comments and I'll make sure I get whatever you want into the letter.

MR. MICHELSON: I can give you comments of what I recommend.

MR. CATTON: Why don't you do that. If you can do the same, I would appreciate it.

MR. CARROLL: I don't know what the subject of the letter is exactly. Let me read your letter.

MR. CATTON: Okay, Pat, why don't you get started.

MR. MADDEN: I am Pat Madden with the NRR Plant Systems Branch. I have come here to address a little bit on the work we have done on shutdown risk associated with fire protection.

[Slide.]

MR. MADDEN: I will give you a brief background in shutdown risk, the particular rules and guidance that we currently have associated with fire protection are strictly looking at 100 percent power operation.

What I have itemized here is a little bit of the fire damage limits which could be -- could occur in a plant as a result of fire during various modes of operation.

Fire damage limits related to shutdown systems, while they are established strictly, like I said, power operations. Systems needed for a hot shutdown or a hot standby, of course, Appendix R requires one train to be free of fire damage.

MR. MICHELSON: How can you do that if you just have a two-train system and you have to do some maintenance while you shut down.

MR. MADDEN: That is one of the key issues in our shutdown risk.

MR. MICHELSON: It is hard to have one free of fire damage.

MR. CARROLL: That's for hot shutdown.

MR. MADDEN: I am giving you background on the regulation. It is all slanted toward power operations or 100 percent power.

MR. CARROLL: To make sure you can get there.

MR. MADDEN: The regulation is written, giving you the option of getting into cold shutdown and some of those modes of having that ability would first be you have a fire, the plant goes into hot standby and can hold there. If a fire happened to damage both trains of decay heat removal capability, you have the flexibility of going in and making repairs to gain or regain one train of decay heat and then bringing the plant on down to cold shutdown.

Of course, in the current regulations, both safety-related systems can be damaged also, any type of accident mitigation systems can be damaged by fire.

MR. CARROLL: Am I correct in believing then that Appendix R does not require protection for decay heat removal systems?

MR. MADDEN: That is correct. There is limited protection provided for decay heat removal capability.

MR. MICHELSON: At shutdown?

MR. MADDEN: If you are in any other mode, other than hot standby or a low pressure mode, those low pressure systems do not require the same separation criteria as the high pressure systems.

[Slide.]

MR. MADDEN: As a part of the initial shutdown risk activities, I went to two basic plants and did an assessment and both of these plants at the time were in refueling outage. So I had a good overview of what activities were going on in the plant and what conditions were occurring in the plant based on a PWR visit I did and this PWR facility elected to be in compliance with the regulation and allow repairs of the cold shutdown systems.

There were 30 plant areas I identified along with the licensee that had either A or B in some form of separation. And in addition, there were 15 plant areas that had both trains in it without any type of fire barrier separation, for example. You had train A on this side of the room and maybe a few feet away you had train B with no form of fire barrier protection or possibly sprinklers.

In all of these areas, generally, there were detection capabilities. Like I said, in this plant, the limited fire protection provided for cold shutdowns. So I asked one specific question there about the repair procedures that allowed them to do repairs, let's say, in one of these rooms you had a fire and you were going to go to cold shutdown and put the plant in an all cold shutdown position.

They identified for me that, based on the equipment they had on site, staged, ready to go for just this specific contingency plan that it would take them up to 16 hours to run a temporary cable. So if the plant was in a low-pressure mode, for example, and the fire occurred where the power cables for the RHR pump or both RHR pumps were damaged, it would take them up to 16 hours to run another temporary power cable to repower an RHR pump.

MR. CARROLL: When you are talking of 30 plant areas or 15 plant areas, a plant area could be --

MR. MADDEN: A corridor.

MR. CARROLL: A corridor that happens to have cabling in it?

MR. MADDEN: Right. I did see one case where the cables -- I walked down the cables, the routing of the cables, and right underneath here they had a lot of staging areas for outage type activities, which consisted of combustibles, plastics, PCs, et cetera, et cetera.

Not to say that those are a significant hazard in themselves, but if there was any welding or cutting going on around there it would be a potential fire course or a potential fuel source for a fire.

MR. CARROLL: Did those plants follow what I believe to be the normal practice and have a fire watch station when welding and cutting went on?

MR. MADDEN: Generally speaking, they have fire watches while welding and cutting does occur. All I can do is direct you to a recent fire in an information that we put out on Seabrook -- Shoreham, I'm sorry, it was Shoreham. They were doing welding and cutting in the dry well and they had a fire, a small fire which caught some of this plastic material on and it created havoc associated with it. But that was a decommission fire.

The same conditions could go on. And they did have a fire watch also.

MR. CARROLL: They did not get the fire out very quickly?

MR. MADDEN: No, they did not.

The BWR site visit, a similar condition except non-plant areas had the A and B trains. They elected not to do the repair aspects allowed by Appendix R. They protected one train with a fire barrier system.

However a question that came up is that in certain modes, you can take a whole train of decay heat removal out for maintenance when you are in a refuel outage. So assume --

MR. SHACK: What is the difference between bullet 2 and 3? I thought that meant you had no separation when you had an A and B.

MR. MADDEN: In this plant, we had A and B in there. They went ahead and applied the Appendix R separation criteria. So they put one train in a fire barrier system, for example. They elected that what they wanted to do when they were up at power was to go to straight cold shutdown and avoid any type of human error, equipment error or whatever, any delays in getting the cold shutdown, so they protected it.

MR. SHACK: And there was a sprinkler system?

MR. MICHELSON: The sprinklers are awful close to both RHR pumps.

MR. MADDEN: In most cases, we found the RHR pumps in their own cubicles, so they were in fairly good shape. Fire damage, they did not have any fire damage or repair procedures.

And the point I was making here, with the protected train unavailable due to an outage or maintenance-related activity, you could have a fire that could cause a loss of the unprotected decay heat trains. So in that facility, they did not have a contingency plan, for example, to get RHR back or a contingency plan to have a system available to feed the reactor in the event that they did lose this RHR train.

MR. CARROLL: When this plant implements the maintenance rules of 1996, they will have to have such plants, won't they?

MR. MADDEN: I cannot speak to that. If somebody else can help me with that? I don't think that is true.

MR. CARROLL: I think it is.

MR. MADDEN: It may be.

[Slide.]

MR. MADDEN: From these two plant visits --

MR. CARROLL: How typical were these two plants, or do you have really any idea? You just picked two plants?

MR. MADDEN: I picked two at the time when I did the visits that were in outages. As far as typical BWRs and PWRs, yes, they are fairly typical.

MR. CARROLL: Some of the things you talked about seemed to me to be management decisions. I am going to do this, I am going to protect this or I am not. And that could vary all over the map.

MR. MADDEN: Oh, yes, as far as the degree of protection, licensee prerogative, at the times that I did these outages or did these walkdowns, I was looking for two plants that were in a current outage.

A summary of the findings in my detailed analysis is in NUREG-1449. The summary of the findings is when I visited these fires, I looked at their fire reports for the fires that they actually had at the plant site. Most of those fires that occurred was over a two-outage period or 36 months. Most of those fires occurred during the refueling outage that they actually had reports on.

Fire could damage applicable train or trains of decay heat removal systems during shutdown. That is a potential, that both trains could be affected by a single fire, as based on the current regulation.

There is notably an increased intransigent combustibles and ignition sources during these outages because that's when they do most of their plant modifications and upgrades is during outages. Fire hazard analysis, the general fire hazard analysis currently on record, they do not address shutdown periods. They are all written specifically to address from 100 percent power conditions.

Like I said, the current fire protection requirements do not specify measures for maintaining decay heat removal capability. They do not have, you know, this mode of operation covered currently. And fire prevention administrative controls, in my opinion, during refueling and maintenance, this may be one area where they need to be enhanced or more controlled. Specifically in the areas where these decay heat removal trains are together.

Under the proposed rule, we tried to take some of that into account without really imposing a significant burden, but we have allowed a lot of the performance attributes to be managed and governed by the utility itself. Prior to entering shutdown or refueling mode, especially when they know which areas the work activity is going to take place in, they should evaluate the availability of fire protection features and plan realistically for possible fires that could occur associated with those work activities that may be associated with those areas at redundant trains of decay heat removal may be in common or have common locations.

If when they do this evaluation, if the evaluation shows that a fire could prevent the accomplishment of normal decay heat removal, they should take the measures to prevent that loss of decay heat. That may be remove those combustibles and move them somewhere else, these transients, or don't do welding at this given point in time or, if you do, make sure you have enhanced compensatory measures.

And the last --

MR. CARROLL: Isn't that taken care of by the maintenance rule? That is exactly what it envisions.

MR. MADDEN: I do not believe this is covered by the maintenance rule. I am not aware of the maintenance rule. I am working in my own little fire protection area here.

The other part is that if they have a fire and they can actually determine that they will have a fire that could potentially grow into a damaging fire as a result of the activity, that they have a contingency plan that ensures that they have alternative decay heat removal capability available to them or that they can get it back in a timely manner.

And that's about all I had to say on shutdown risk.

MR. CATTON: This proposed rule that you're -- is Option 4?

MR. CARROLL: No, no, no. This is something totally -- this is what we talked about last month. This would be bagged into the shutdown rule and I guess that --

MR. CATTON: I asked earlier if Option 4 would cover shutdown and somebody said, yes.

MR. MADDEN: Let's go back. I think I know where you're coming from now, now that I've got the gist.

MR. CATTON: We are probably coming from two different points.

MR. MADDEN: I think exactly which two points you are coming from.

MR. CATTON: Good.

MR. MADDEN: If Option 4 was truly, truly implemented, we would expect that this work would be captured under Option 4. But, just in case Option 4 does not become reality, right now the shutdown risk rule is going to cover some elements or aspects of fire protection as an interim.

MR. VIRGILIO: We can ask Mr. Marion. When we ask him earlier if the proposed rule from NEI would include shutdown operations, I believe the answer he gave was, no.

MR. CATTON: Maybe I just wanted to hear "yes."

MR. VIRGILIO: So did we, but we heard, "no."

MR. McCRACKEN: The other issue you cannot lose sight of is the proposed fire protection rule. Option 4 of the options paper is going to be something that will be totally voluntary.

This issue of shutdown risk would be implemented for all plants, regardless of whether that rule goes forward.

MR. VIRGILIO: With regard to the maintenance rule --

MR. CARROLL: Wouldn't a more logical approach, Conrad, be to modify Appendix R to include shutdown risk and provide people the option of performance-based rule? Appendix R really ought to cover shutdown risk.

MR. McCRACKEN: That would be another option. And certainly I have no objections to incorporating shutdown as all of the other things we do in fire protection. But tnat is not the way we are headed now.

MR. CARROLL: I guess I get a little impatient with the Staff over this fragmentation. For example, when it comes to maintenance, I have been making this speech for several years. The poor maintenance manager in the plant is going to be confronted with the maintenance rule. He is -- if his plant is going to get license renewal, he is going to be confronted with another form of maintenance rule called the Licence Renewal Rule. If he is a Part 52 plant, he is going to have to have an operational phase reliability assurance program, which is another kind of maintenance rule. We are doing the same thing in fire protection.

I guess I like things nice and clean. I like to be able to go to one regulation and say, here is where I find everything I need to comply with to deal with this area.

MR. McCRACKEN: We do not disagree with that philosophically. The shutdown risk issue that came along in fire protection actually is the little tail that wagged along on it compared to all the other issues. That isn't what brought it up but we put fire protection in with it.

When we go through rulemaking, it would certainly be our intent to take whatever went into shutdown risk and make sure that the fire protection rule was inclusive and did consider exactly identically what had been put in the other one, so it was all inclusive in one place.

Now, Steve wants to make a correction, which I was going to let go by.

Appendix R I did not want to talk about. I did not want to get into a discussion of which plants use Appendix R. It is not the fire protection regulation. Everybody says it as though it is and I have quit talking, trying to change it, for years.

MR. CATTON: You are just going to leave people like me in the dark? Okay.

MR. McCRACKEN: That's why they have licencing managers.

MR. CARROLL: But they don't have to get the maintenance done in the power plant is the problem.

MR. CATTON: Thank you, Pat.

Are we going to hear from NEI?

MR. MARION: Alex Marion. No, I made a statement during my presentation that we do not at this time intend to address any shutdown fire risk aspects in our petition for rulemaking.

I think our position is clear in the letter that we sent to the Chairman, as I understand it.

MR. CARROLL: It is not clear. I looked at the letter.

MR. MARION: It is clear from the standpoint, the concern that you have of dealing with fire protection in one regulatory element.

MR. CARROLL: No.

MR. MARION: It is not?

MR. CARROLL: I don't think so.

MR. MARION: On the second page of that letter to the Chairman we indicate that if anything additional is going to done in fire protection, it ought to be done under the NRC's regulatory improvement effort for 50.48 and Appendix R.

MR. CARROLL: It does not say that.

MR. MARION: It does on my copy.

MR. CARROLL: Maybe we have two different letters. I am talking May 25th.

[Pause.]

MR. MARION: On page 2 of that letter, the last paragraph at the very bottom, and I quote, "We believe consideration of these issues, first being additional level instrumentation for pressurized water reactors and fire protections be subsumed by existing NRC activities" and we indicate the regulatory improvement effort being spearheaded by Research.

The point is why have separate rulemaking and ultimately have two rules that deal with fire protection issues?

MR. CARROLL: I agree, but doesn't that logically then lead to NEI proposing a rule that covers shutdown?

MR. MARION: I have to fall back on comments that we submitted to NUREG-1449 that Pat alluded to. That was Staff review of shutdown duties at a number of plants and as I recall, the regulatory analysis that was provided in that and as some of the other staffers at NEI have indicated to me, on the regulatory analysis that was made available for the shutdown rulemaking effort that we think a lot more work is necessary and fundamentally the regulatory analysis does not justify the need for rulemaking -- the point being if the Staff wants a rulemaking on shutdown activities, then the obvious question is whether or not we have maintained the same level of regulatory authority while a plant is in operation versus when it is shut down, which is the more significant concern.

That is a question we are going to have to address in the answer of the high policy level both within NRC Management as well as within the industry.

MR. CARROLL: I think both modes are important from a fire point of view. I am just saying that if you are going to be involved in Option 4, which is a performance-based rule, I just don't see how you can escape the fact that you ought to include the shutdown mode of operation in such a rule.

MR. MARION: We will take a good careful look at that. At this particular time we haven't been considering it.

MR. CARROLL: Okay. That belongs in the letter.

MR. CATTON: You are going to help me put that in?

MR. CARROLL: I may.

MR. CATTON: Okay. I think that should end the formal part of the meeting.

It looks to me like everybody said what they were going to say and I would like to thank everybody for doing so and with that, that is the end of the record.

[Whereupon, at 3:27 p.m., the open portion of the meeting was adjourned.]

REPORTER'S CERTIFICATE

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

NAME OF PROCEEDING: ACRS Auxiliary & Secondary Systems

DOCKET NUMBER:

PLACE OF PROCEEDING: Bethesda, MD

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.

Barbara Whitlock
Official Reporter
Ann Riley & Associates, Ltd.

ACRS SUBCOMMITTEE MEETING

June 8, 1994

Conrad McCracken, Chief
Steven West, Section Chief
Patrick Madden, Sr. Fire Protection Engineer

Plant Systems Branch
Office of Nuclear Reactor Regulation

(504-2873)

OVERVIEW OF NRC FIRE PROTECTION REQUIREMENTS

June 8, 1994

Conrad McCracken, Chief
Plant Systems Branch

Office of Nuclear Reactor Regulation

FIRE PROTECTION BASIS

- Minimize the probability and effects of fires and explosions

- Achieve and maintain safe shutdown

  - Hot shutdown; one train protected, no repairs allowed

  - Cold shutdown; must be repairable within 72 hours using onsite capabilities

DEFENSE-IN-DEPTH
FIRE PROTECTION PHILOSOPHY

- Minimize fixed combustibles
- Administratively control transient combustibles
- Fire barriers and separation
- Fire detection and alarms
- Automatic suppression
- Fire brigades
- Shutdown procedures
- Compensatory measures

FIRE PROTECTION REGULATIONS

- Rely on defense-in-depth
- Do not include a design basis fire
- Promulgated in their entirety

FIRE BARRIERS

- 3-Hour

  - Conservative in many cases. However, appropriate for potential serious consequences (PSA results)
  - Allow ample time for suppression activities

- 1-hour with automatic detection and suppression is equivalent to 3-hour

- Tested to ASTM standard time-temperature fire

  - Barrier performance is based on test standard, not actual fire load

  - Test standard does not consider the presence of other fire protection features

CONCLUSIONS

- Fire PRAs demonstrate that particular aspects of fire protection are important
- Current fire protection regulations, when considered in their entirety, are adequate
- Modifications are achievable, but must consider all aspects of defense-in-depth

T-2, T-3

THERMO-LAG FIRE BARRIERS

June 8, 1994

Steven West, Chief
Special Projects Section

Office of Nuclear Reactor Regulation

OVERVIEW

- October 1993 - Commission briefing by staff

- November 1993 - Commission briefing by NEI

- Commission concerns

  - NEI test method. Results and applicability of tests
  - Timeliness of resolution

- Staff actions

  - ACRS meetings
  - NRR-NEI senior management meetings
  - 50.54(f) request for additional information
  - SECY-94-128, status paper - conclusions regarding 1- and 3-hour barriers
  - SECY-94-127, options and policy issues

OPTIONS FROM SECY-94-127

1. Require compliance with existing NRC requirements. Grant limited plant-specific exemptions in accordance with the regulations and past practice.

2. Study feasibility of developing new guidance for rating fire barriers on the basis of representative plant fire hazards.

3. Develop performance-based approach for resolving Thermo-Lag issues with lead plant.

4. Develop performance-based fire protection rule (SECY-94-090).

OPTION 1
COMPLIANCE WITH EXISTING REGULATIONS

- Fundamental objective of Thermo-Lag Action Plan
- 22 units have or plan to achieve compliance
- 1-hour barriers can be upgraded
- 3-hour barriers are a problem but alternatives exist
  - relocate cables and components
  - reclassify as 1-hour and install suppression
  - replace barriers
- Staff will consider limited exemptions
- NRC resources are planned for this option
- 2 to 5 years estimated to return to compliance

OPTION 2 - FEASIBILITY STUDY RATE BARRIERS BASED ON FIRE HAZARDS

- ASTM E119 may exceed fire severity in some areas
- Developing fire severity curves tailored to actual plant fire hazards may be technically feasible
- If feasible, new curves can be used to achieve compliance with existing regulations
- Developing and implementing new curves will be complex and resource intensive
- Staff study, if approved by the Commission, will address technical feasibility, resource estimates, and schedules
- If approved, staff will report results within 6 months

OPTION 3
PERFORMANCE-BASED SOLUTIONS

- Existing regulation is prescriptive
- Performance-based methods use fire models and probabilistic assessments to define fire protection
- Proposed for 22 sites (35 plants)
- Could be developed with lead plant and incorporated into new fire protection rule
- Will be technically challenging
- May require additional resources
- Policy issues

OPTION 4
PERFORMANCE-BASED RULE

- SECY-94-090 institutionalized program
- NEI plans to submit petition for rulemaking
- Staff proposes to provide comments to the Commission on the petition 6 months after receipt
- Results of work with lead plant (Option 3) could be incorporated into new rule
- NRC resources are planned for this option

STAFF RECOMMENDED APPROACH (FROM SECY-94-127)

- The staff recommends continuation of Option 1 (compliance with existing NRC requirements) consistent with the Thermo-Lag Action Plan.

- If the Commission approves this option, the staff will advise industry of the Commission position and request continued industry efforts to implement the option.

STAFF POSITION ON REMAINING OPTIONS (FROM SECY-94-127)

- If acceptable to the Commission, the staff will evaluate the technical feasibility and resource estimates for Option 2 and will report back to the Commission in 6 months

- The staff will not proceed further with Option 3 unless the Commission approves the use of performance-based approaches to resolve the Thermo-Lag issues.

- The staff will continue to be receptive to the performance-oriented, risk based rulemaking described in SECY-94-090. The staff will provide its comments on NEI rulemaking petition 6 months after receipt of the petition. (Option 4)

BACKGROUND INFORMATION

STATUS AS REFLECTED IN SECY-94-128

- Senior management meetings
- 50.54(f) request for additional information
- GL 86-10, Supp. 1, Fire Test Acceptance Criteria
- NEI and licensee fire endurance tests
- NEi application guide
- NRC full-scale fire and ampacity derating tests
- Staff position on 1- and 3-hour barriers
- Combustibility of Thermo-Lag

OPTION 2- BACKGROUND
STAFF-INDUSTRY INTERACTIONS

- September 1992 - NUMARC proposed to develop and use NPP-specific fire curves for rating fire barriers

- October 1992 - NUMARC changed its proposal and decided to use ASTM E119 for barrier tests because:

  - ASTM E119 is common with tests of all other assemblies and building components
  - Experience gained with ASTM E119
  - No new "standard" exposure can be defined to eliminate all objections
  - Utilities assess fire protection on basis of standard ASTM E119 exposure

REQUEST FOR ADDITIONAL INFORMATION

- Detailed information submitted on amounts
- Limited information submitted on installation methods and barrier parameters
- Limited information submitted on fire barrier designs outside the scope of the NEI program
- Evaluations of derating awaiting NRC acceptance of NEI program
- Alternatives - performance-based approaches (21 plants), exemptions, reevaluating shutdown methods and prior commitments.

GL 86-10, SUPPLEMENT 1
FIRE TEST ACCEPTANCE CRITERIA

- Issued March 25, 1994
- Clarifies previous guidance (GL 86-10)
- For future fire tests
- ASTM E-119 standard fire
- Provides options for hose stream tests
- Provides methods for addressing deviations

STAFF CONCLUSION REGARDING THERMO-LAG BARRIER PERFORMANCE

- 1-hour baseline Thermo-Lag fire barriers
  - Provide 20 to 30 minutes of fire endurance
  - Can be upgraded with Thermo-Lag materials
- 3-hour baseline Thermo-Lag fire barriers
  - Provide about 1 hour of fire endurance
  - Cannot be reasonably upgraded with additional Thermo-Lag materials

1 HOUR THERMO-LAG FIRE BARRIERS

- 14,000 lin. ft. on cable trays (33 units, 58% at 5 sites)
- 62,000 lin. ft. on Conduits (47 units, 62% at 5 sites)
- 5,500 sq. ft. on junction boxes (26 units)
- 1,400 sq. ft. on equipment enclosures (6 units)
- 800 sq. ft. as radiant energy shields (2 units)
- 200 sq. ft. as a fire wall (1 Unit)
- 142 sq. ft. as floor/ceiling assembly (1 Unit)
- 450 sq. ft. as penetration seals (2 units)
- 5,600 sq. ft. of miscellaneous applications (13 units)

3 HOUR THERMO-LAG FIRE BARRIERS

- 7,700 lin. ft. on cable trays (25 units, 60% at 3 sites)
- 25,000 lin. ft. on conduits (49 units, 52% at 7 sites)
- 3,300 sq. ft. on junction boxes (27 units
- 700 sq. ft. on equipment enclosures (7 units)
- 50 sq. ft. as radiant energy shields (1 unit)
- 10,000 sq. ft. as fire walls (6 units)
- 1,100 sq. ft. as floor/ceiling assemblies (2 units)
- 635 sq. ft. as penetration seals (9 units)
- 13,000 sq. ft. of miscellaneous applications (28 units)

NON-FIRE RATED BARRIERS

- 1,900 lin. ft. for physical independence (5 units)
- 700 lin. ft. to enclose combustibles (1 unit)

Industry Thermo-Lag Program

OBJECTIVE:

To re-establish the technical and licensing basis to qualify Thermo-Lag materials for use in one and three hour fire ratings as required by Appendix R

Thermo-Lag 330

- Predominant cable raceway fire barrier material used for Appendix R
- Large scope of installation:
  - 1 hour conduit: 69,000 linear feet
  - 1 hour cable trays: 16,000 linear feet
  - 3 hour conduit: 22,000 linear feet
  - 3 hour cable trays: 13,000 linear feet
- All previous tests declared indeterminate by NRC staff

NEI

Generic Fire Barrier Test Program

- Purpose:
  - Assess Thermo-Lag performance for representative plant cable raceway installations
    - » Baseline
    - » Upgrades using Thermo-Lag
    - » Upgrades using other materials
- Scope:
  - 13 test configurations
  - Phase 1 - six tests
  - Phase 2 - seven tests
  - Further tests may be undertaken

Phase 1 Test Results

- All Phase 1 tests were *upgrades* designed by TSI, using 330-1 material

- Phase 1 configurations exhibiting satisfactory performance

  - 1-hour rated conduits (3 sizes, steel and aluminum) and junction box

  - 3-hour rated straight run 24" steel cable tray

  - 3-hour rated junction box

  - 3-hour rated 3/4" conduit

Phase 1 Test Results (Continued)

- Phase 1 upgraded configurations with temperature exceedances in final 1 to 13 minutes of test, no cable damage observed
  - 3-hour rated 24" aluminum cable tray with "T" section
  - 3-hour rated wide span (36") steel cable tray
  - 1-hour rated wide span (36") steel cable tray
- Phase 1 upgraded configurations not demonstrating satisfactory performance:
  - 3-hour rated medium and large conduits
  - 3-hour rated air drop assembly

Phase 1 Test Results (Cont)

- "Limiting" baseline installations contributed to test results
  - Minimum material thickness
  - Minimum construction attributes
- Observed failure mechanisms considered in design of Phase 2 upgrades

Phase 2 Test Results

- Duration of satisfactory performance for one hour *non-upgraded* fire barriers:

– 3/4" conduit	27 minutes
– 2" conduit	39 minutes
– 4" conduit	48 minutes
– 6" conduit	50 minutes
– 6" cable tray	48 minutes
– 24" cable tray	21 minutes
– Boxed conduits (mounted to concrete)	60 minutes

NEI

Phase 2 Test Results (Cont)

- Duration of satisfactory performance for three hour *non-upgraded* fire barriers:

– 3/4" conduit	63 minutes
– 3" conduit	91 minutes
– 6" conduit	102 minutes
– 6" cable tray	85 minutes
– 24" cable tray	85 minutes

Phase 2 Test Results (Cont)

- Upgraded one hour configurations providing satisfactory performance for full duration:
  - 3/4" conduit
  - 3" conduit
  - 6" conduit

  - 6" cable tray
  - 24" cable tray
  - 36" cable tray (with internal barrier supports)

  - Conduits in box enclosure mounted to concrete

Program Applicability

- Many parameters of installation have been shown through testing to affect Thermo-Lag performance

  - material thickness
  - pre grouting of joints
  - direction of structural ribs
  - internal panel supports
  - band or tie wire spacing
  - type of joints
  - unsupported span distance
  - support protection
  - cable fill
  - raceway mass
  - raceway dimensions
  - raceway material
  - others

Industry Application Guide

- Purpose:
  - Provide guidance for use of test results, comparison to installed configurations
  - Address installation parameters
- Intent:
  - Achieve agreement with NRC on content, provide final version to industry ASAP

Industry Application Guide

- Makes use of all generically applicable test data
  - TUEC
  - TVA
  - NUMARC Phase 1 and 2
- Addresses evolution of test/acceptance criteria
- Will be updated to reflect further applicable test results
- Addresses baseline and upgrade testing

Chronology

- Draft submitted to NRC on March 4
- NRC meeting to discuss March 16
- Draft provided to WG on March 25
- Draft provided to industry on April 13
- Discussed in detail at April 20-21 industry meeting
- NRC staff comments received April 7

Chronology (Cont)

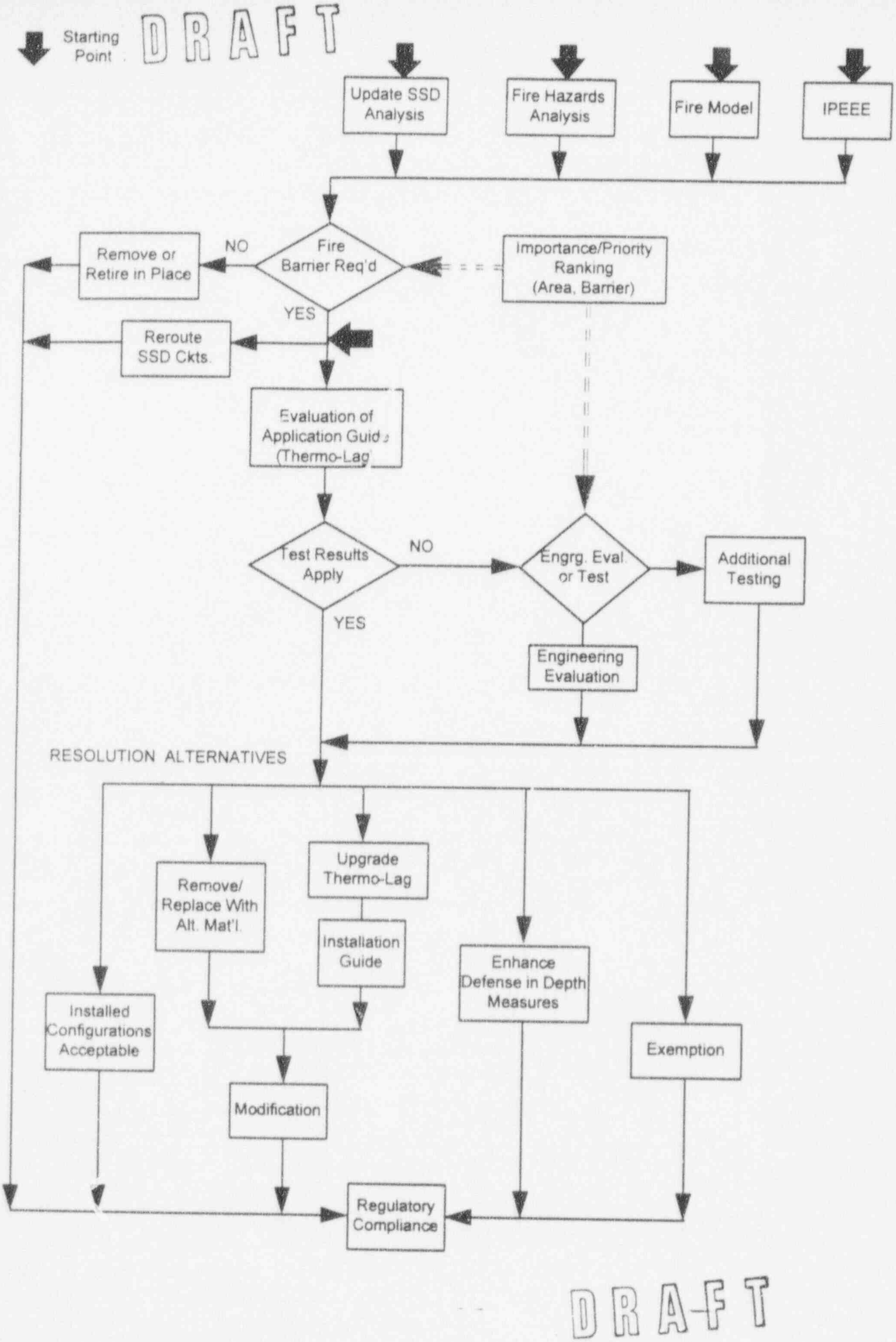
- NEI response to NRC staff comments: May 18

- Final revision underway

  - Address NRC and WG comments

  - Incorporate Phase 2 test results

- Will provide final revision to NRC on June 17



Starting Point
DRAFT
Update SSD Analysis
Fire Hazards Analysis
Fire Model
IPEEE
NO
Remove or Retire in Place
Fire Barrier Req'd
Importance/Priority Ranking (Area, Barrier)
YES
Reroute SSD Ckts.
Evaluation of Application Guide (Thermo-Lag)
Test Results Apply
NO
Engrg. Eval. or Test
Additional Testing
YES
Engineering Evaluation
RESOLUTION ALTERNATIVES
Remove/ Replace With Alt. Mat'l.
Upgrade Thermo-Lag
Installation Guide
Enhance Defense in Depth Measures
Installed Configurations Acceptable
Exemption
Modification
Regulatory Compliance
DRAFT

T-10

APPENDIX R RULEMAKING

- Special review of NRC regulations
  - Prescriptive regulations
- Elimination of requirements marginal to safety
  - Increased cost without commensurate safety benefit
- Chairman Selin's challenge to industry
  - Maturity of technology
- November 1992 Federal Register notice
  - NRC rulemaking initiation

PROPOSED REGULATION

- Ad Hoc Advisory Committee
  - First convened October 1992
  - Proposed regulation drafted March 1993
- Intent of existing regulation
  - Safely shutdown plant in the event of a fire
  - Prevent, protect, and detect
- Performance-based approach
  - Maintain existing regulation
  - Provide performance-based equivalent
- Interface with NRC staff
  - April 1993 Elimination of Requirements Marginal to Safety Workshop
  - November 1993-January 1994 meetings
- Petition submittal

-14

SHUTDOWN RISK

June 8, 1994

Patrick M. Madden
Special Projects Section
Plant Systems Branch
Office of Nuclear Reactor Regulation

BACKGROUND

- Fire-damage limits for safety-related and shutdown systems established for power operations
- Systems needed for hot shutdown or standby
  - One train remains free from fire damage
- Systems needed for cold shutdown
  - Both trains can be damaged by fire
  - Must be repairable within 72 hours using on-site capabilities
- Safety-related systems
  - Both trains can be damaged by fire

PWR SITE VISIT

- 30 plant areas had either "A" or "B" RHR trains
- 15 plant areas had "A" and "B" RHR trains
- Limited fire protection provided for cold shutdown functions
- Fire damage control/repair procedures established to restore operability of fire-damaged equipment. (For example, 16 hours estimated to run temporary power cable to one RHR pump.)

BWR SITE VISIT

- 17 plant areas had either "A" or "B" RHR trains
- 9 plant areas had "A" and "B" RHR trains
- Fire protection features provided to protect one RHR train where both trains are within the same fire area
- Fire damage control/repair procedures not required
- During shutdown, with protected RHR train unavailable, fire could cause total loss of decay heat removal capability

SUMMARY OF FINDINGS

- Most fires occurred during refueling outages
- Fire could damage the operable train or trains of decay heat removal systems during shutdown
- Increased transient combustibles and ignition sources present during outages
- Fire hazards analyses do not address shutdown and refueling conditions
- Current fire protection requirements do not specify measures for maintaining decay heat removal capability
- Fire prevention administrative controls may need to be enhanced

PROPOSED RULE

- Prior to entering cold shutdown or refueling condition, evaluate available fire protection features and plan realistically for possible fires

- If evaluation shows that fires could prevent accomplishment of normal decay heat removal

  - take measures to prevent loss of decay heat removal by fires

  - have a contingency plan to ensure an alternate decay heat removal capability exists

[G:\SLIDES\ACRSSDR.SLD, June 8, 1994]