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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

OCTOBER 6, 2000

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UNITED STATES

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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476th ACRS MEETING

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Conference Room 283

Two White Flint North

11545 Rockville Pike

Rockville, Maryland

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Friday, October 6, 2000

The above-entitled meeting commenced, pursuant to notice, at 1:30 p.m.

MEMBERS PRESENT:
Dr. Dana A. Powers, Chairman
Dr. George Apostolakis, Vice-Chairman
Dr. Thomas S. Kress, ACRS Member
Dr. Robert L. Seale, ACRS Member
Dr. William J. Shack, ACRS Member
Dr. Robert E. Uhrig, ACRS Member
Dr. Mario V. Bonaca, ACRS Member
Mr. John D. Sieber, ACRS Member
Dr. Graham B. Wallis, ACRS Member
Mr. Graham M. Leitch, ACRS Member

OTHERS PRESENT:
John T. Larkins, Executive Director, ACRS
Noel F. Dudley, ACRS Staff
Michael T. Markley, ACRS Staff
Howard J. Larson, ACRS/ACNW Staff
Ralph Beedle, Senior Vice President, Nuclear Energy Institute
Alex Marion, Nuclear Energy Institute
Lynette Hendricks, Nuclear Energy Institute
Doug Walters, Nuclear Energy Institute
Doug Walters, Nuclear Energy Institute
Tony Pietrangelo, Nuclear Energy Institute
Mike Mayfield, Office of Nuclear Regulatory Research, NRC
Ed Hackett, Office of Nuclear Regulatory Research, NRC
Safish Aggarwal, Office of Nuclear Regulatory Research, NRC
Robert Lofaro, Brookhaven National Laboratory
Amarjit Singh, ACRS Staff
Jose Calvo, Office of Nuclear Reactor Regulation, NRC
Richard P. Savio, ACRS Staff
Paul A. Boehnert, ACRS Staff
Mark Cunningham, Office of Nuclear Regulatory Research, NRC

P R O C E E D I N G S

[1:30 p.m.]

DR. POWERS: The meeting will now come to order. This is the second day of the 476th meeting of the Advisory Committee on Reactor Safeguards.

During today's meeting, the committee will hold a discussion with industry representatives concerning industry issues.

We will also discuss GSI-168, equipment qualification; generic guidance documents associated with license renewal; future ACRS activities; and, have a report of the Planning and Procedures Subcommittee.

We will reconcile ACRS comments and recommendations and discuss proposed ACRS reports.

The meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. Howard Larson is the designated Federal official for the initial portion of the meeting.

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

A transcript of portions of the meeting is being kept and it is requested that speakers use one of the microphones, identify themselves, and speak with sufficient clarity and volume so that they can be readily heard.

With that little piece of business out of the way, Ralph Beedle, welcome to the meeting with the ACRS. As I commented earlier, we have gotten just absolutely heroic service from members of your staff here supporting us and pursuing various individual issues.

We never get a chance to sit down and talk philosophy, talk approaches, talk strategic plans, and we have had a chance to examine your strategic plan and I congratulate for a well written and very useful document.

We hope to be able to cover four or five areas of great interest, but I'll turn it to you to give any opening comments you'd like to make.

MR. BEEDLE: Thank you very much, Dr. Powers. I appreciate the opportunity to join you today.

Let me, I guess, follow-up on your admonition. My name is Ralph Beedle. I'm the Chief Nuclear Officer for the Nuclear Energy Institute, here in Washington, D.C.

With that, I would like to start with kind of a brief overview of NEI. NEI, Nuclear Energy Institute, is about six years old. We were a result of the consolidation of NUMARC, the technical group within the nuclear industry that interacted with the NRC on a variety of licensing and technical issues, as well as the ANEC, the lobbying organization.

So we tried to combine those and provide an

industry focus to the collection of lobbying, advertising and the technical issues that were being dealt with by the industry.

There are about 126 people at the NEI organization. I believe you have an organization chart that shows the basic organizational structures, divisions that represent nuclear generation, basically the power reactor, the technical side, business operations that are looking at issues associated with benchmarking of perhaps new plant construction in the future. Also, their focus is on Yucca Mountain and the activities associated with high level waste disposal. Then we have the typical communications and administration.

More importantly, the organization was -- there was a recent change in it, where we created a division under Angie Howard to focus on policy. That, in large measure, is a result of the consolidation with the industry and we see our roughly 200 members decreasing in number as both the utilities consolidate and as the NSSS vendors consolidate.

We expect we will see considerably more of that activity as time goes on.

So with that, the question is how do we provide the services and support for our members and as a result of trying to answer that question, we created this group under Angie Howard to provide some clear focus on that.

We are involved in a great many activities, and they, as you can imagine, range from activities on the Hill. We support Congressional information trips to Yucca Mountain and to other nuclear facilities, to help inform our elected representatives of what the nuclear business is all about.

We also spend a great deal of time in the communications area. As you drive to and from work in the Washington, D.C. area, you probably hear some Nuclear Energy Institute ads on the radio, tune into WTOP-1500 on your AM dial and you'll hear those.

And, again, those ads, I think, have an effect in the long haul. They, combined with the performance of the industry, the increased focus on electricity and demand, energy issues are becoming more and more a subject of conversation, and the net result is that nuclear is looked at differently today than it was four years ago, even three years ago, and, in large measure, that's a result of the effort on the part of a lot of people to try and educate the policy-makers.

We have often that it would be almost mission impossible to try and educate the public. It's the desire to go into the public school system and provide educational devices and programs. It's almost impossible to do that.

So our focus has been on the policy-makers, the people that are making these decisions that affect our

day-to-day life. It's the decision to release or not release oil from the strategic reserve. Those things have a profound impact on whether or not you're going to have home heating oil in New England next winter or whether or not you're going to have gasoline next summer.

And part and parcel to that is a better understanding of the entire regime of energy supply within this country.

As a philosophical approach to this whole process, NEI has been endeavoring to make sure that people understand the value that nuclear brings to this country. Nuclear is not a religious event. It's a business. We operate businesses based on a technology called nuclear and if we can't make money in that business, you're not going to stay in business. It's as simple as that.

One of the reasons that we have not built a new plant in this country for roughly ten years is the fact that the cost of construction is high and the rate of return isn't all that great.

Not only that, the tremendous uncertainty associated with the regulatory process makes it a tremendous risk on the part of any business venture that you might undertake.

So our effort has been to try and develop a stable regulatory environment, one in which there is predictability

and surety for the licensees as they go forward in the operation of these plants.

I would argue that the license renewal program, as successful as we deem it to be, is successful only because of the surety that we have in the licensing process and in the operational process that we have today through the revised reactor oversight process. A little later, we'll talk about both of those programs.

So this approach that we have of trying to get clarity, surety, objectivity in the regulatory process and environment is a necessary ingredient if the nuclear programs are going to survive in this country.

So that, coupled with the significance of 20 percent of the generation in the country being produced by nuclear generation is rather significant. We look at the 20 percent capacity basically and almost every year we see that that is exceeded in terms of generation, and we generate somewhere in the 23 to 25 percent, simply because of the reliability of these power plants.

We find more and more effort on the part of the utilities to provide that reliability. I'm sure you're all familiar with the problems associated with power supply in the Illinois area, with ComEd, and the relatively low capacity factors, and then with Oliver Kingsley and his new approach to management of that company. It was all ten all

summer, this past summer, and they did a very good job at doing that.

The energy supply issue in the center of the country isn't near as critical as it was last year, simply because of the performance of the plant. But nonetheless, it points out the value that nuclear adds to that mix.

The other element of the nuclear equation is the clean air and with the Kyoto Accord and the focus on clean air, there is only one way that you and I are going to achieve clean air in this country, and that's through the use of nuclear as a key ingredient in the energy mix.

If we were unable to keep license renewal on track, we would have a very significant problem in trying to meet those accords.

So the combination of clean air, regulatory, and the emphasis clean air puts on this energy source, the license renewal process, improved environment, all that has caused nuclear to become more and more of a subject of discussion within the Administration, within the political leadership in this country, and I think we're going to see eventually a major shift in that focus, such that we will have an environment in which we can produce new nuclear generating facilities.

Let me ask, are there any questions about NEI and what we're trying to do?

DR. POWERS: I guess I'd like to understand a little more what you mean about stability in the regulatory process, because we may be working at cross purposes here. We've got a committee that historically is, for as long as I've known the ACRS, and it's getting to be pretty close to 26 years that I've appeared on one side of the table or the other in front of this institution, has endorsed a move toward a risk-informed regulation or even a risk-based regulation.

That's a pretty profound change and that doesn't seem to be consistent with the idea of regulatory stability.

MR. BEEDLE: Well, I would take a little bit different view. I think risk-informing the regulation is very much consistent with stability.

When we look at the reactor oversight process, and I think that is really the fundamental change that's taken place in the last couple years, and it is the single most significant thing that has occurred that's produced some stability in the regulatory environment.

And it's an interesting situation because we went into this revised reactor oversight process with the objective of having clearly defined performance criteria through the performance indicators and the various categories and from that, then, a predictable outcome.

I would say that prior to this revision, there was

not a chief nuclear officer in the industry that didn't feel that he was only one event away from the watch list. One event away from the watch list. And there wasn't one chief that didn't feel that way, because what they saw happening in the industry is the event occurred and then the NRC would send their inspection team in and they would spend as much time as necessary to develop a catalog of problems and we had an uncanny ability to make mountains out of molehills and we said every problem is important and you have to fix every problem that we've identified before you can ever start up again, and we were automatically in a $200 million fix, get well program and about two years to accomplish it.

It was predictable in that sense. You had an event. If we could have just figured out how to write a check for $200 million and be done with it, I think most chief nuclear officers would have been glad to do that.

So that unpredictability and inability to look long haul and say I can guarantee that I will be able to operate, it's not to say you aren't going to have some problems, but to have some reasonable outcome when you do examine some of the problems, that was what we were after.

So we go into the oversight process and we have the set of performance indicators, on the one hand, and we said, well, that's going to really help us out because if I'm in the green band, you kind of leave me alone, let me do

my job; if I'm in the white band, you increase the inspection hours and we try and determine what caused you to be in the white band, and we accept that, we'll go figure out how to make things -- improve the performance and get back in the green band.

So, I mean, if you give me a target, I know how to achieve performance to match that target. It's when you say shoot at the wall and then you draw the target that we have our problems.

So the oversight process gave us some targets that yielded predictable outcome on the part of the inspection group.

DR. POWERS: Maybe it gave you more. It gave you trends so that you didn't have this roll-off-the-table kind of phenomena, that you can see when things are becoming -- maybe your performance was beginning to lag a little bit.

MR. BEEDLE: Absolutely. Absolutely. And with those trends, though, as you cross thresholds, you knew what would occur as a result of that change.

The other component in this oversight process was the inspection and there is no question about the fact that there are many, many things that take place in this power plant operation that don't lend themselves to performance indicators.

And, indeed, the idea of the performance

indicators was developed with the idea that once you have a set of indicators, if the indicators indicate a declining performance trend, it then gives the NRC the ability to use those indicators to focus their inspection resources and go examine those areas that represent the declining performance, and you focus on that as a way of getting better understanding of the problems and ultimately improve the performance, as opposed to the just send in and inspect everything.

You could have a problem with a steam generator and they'd be in there inspecting the rad waste system. You say what's the purpose of that; well, we're just looking for problems, you know. So anyway, you end up with this performance indicator process.

In order to evaluate the significance of the findings that are developed during the inspection process, the NRC constructed a process called significance determination. And so the SDP or significance determination process is probably the single most important element to come out of the revised reactor oversight process, because it helps the NRC and the licensee understand the significance of an event, of a finding, of some disturbance in the normal order of business.

It tells you whether or not something is of safety significance or it is not, and, based on that, you can

disposition it with reasonable surety that you're doing the right thing.

Now, the value of that significance determination process as it applies to the inspection program has been recognized in many areas and we have significance determination processes for each of the cornerstone areas in the oversight process.

We find that fire protection has one now. We've got one in just about every area where you need to answer the question of how significant is the finding or the concern that you're trying to address, and that, I think, is the item that has helped us understand better how to treat the various discrepancies that may be uncovered in the inspection program or identified by the utility, as well.

DR. WALLIS: I thought Dr. Powers had a somewhat broader question about the effect of a move to change the regulations in some fundamental way using risk information.

MR. BEEDLE: I'll get to that. I have not forgotten that.

DR. WALLIS: Thank you.

MR. BEEDLE: But I think this is important that you understand what we have managed to do in this revised reactor oversight process; this ability to define the significant versus the insignificant, the relevant versus the irrelevant.

DR. SEALE: Is it fair to say then that the real message in that process is not in the color, but in the determination of the significance of the event?

MR. BEEDLE: I think the answer is yes.

DR. SEALE: And that's what drives the actions of the utility and of the inspectors. And as long as the outside process continues to focus on colors, then you don't have the adverse consequences of over-sensitivity to the relationship between the NRC inspection process and the operators of the plant.

MR. BEEDLE: I think they are very closely linked, because the construct of the performance indicator is such that its thresholds are set to tell you how far you are, on a relative scale, from something that looks to be unacceptable from a risk point of view.

DR. SEALE: Yes.

MR. BEEDLE: Presumably, the margin to safety is less if you're in the red area than if you're in the yellow area than if you're in the white area, and the green area represents kind of the nominal performance of the industry and, in fact, the definition says that if you're in the green area, you are operating within the industry norms.

If you're in the white area, you're starting to depart from the industry norms. If you're in the yellow area, you have some reduction in the margin to safety or

margin of safety, and then if you're in the red area, you have a significant reduction.

DR. SEALE: Is there an event significance determination for something that allows you to remain in the green area?

MR. BEEDLE: When we have an event or a finding through an inspection process, then that event is evaluated through the significance determination process and a color is assigned. So you can have lots of events where it's green.

DR. SEALE: But you're still worried.

MR. BEEDLE: The fact that you're green does not mean that you don't go address the problem. What happens is if you have, let's say, a valve fails to operate the way it's supposed to and you evaluate it and it's green, we don't just walk away and say the valve broke and let it remain that way.

DR. SEALE: No.

MR. BEEDLE: We put that into our corrective action program and we go about the process of correcting that deficiency, just as though we had discovered that thing ourselves, which is more than likely the case.

Similarly, if you have an event that would place you in the white area or in the red area or yellow area, then what that -- I mean, the utility is going to go ahead

and resolve that problem.

DR. SEALE: Yes.

MR. BEEDLE: But that would then bring with it a change in the inspection routines that the NRC inspectors would conduct, and they would go increase their level of inspection as a result of that.

Now, this whole process is not possible unless you have an understanding of risk calculation and the ability to predict and calculate these things. So the risk-informing of the regulation I think is a necessary follow-on to the application of these risk insights that we are using in this oversight process.

DR. APOSTOLAKIS: Isn't it also necessary, though, for each unit to have a decent PRA?

MR. BEEDLE: Yes, but even with that statement, we have an oversight process that is built on the results of the IPEs that were developed back in 1988 or so.

Now, I'm not suggesting that we stop the clock and just stick with that, and I'll cover that in a minute, but what I'm saying is we don't have to have a detailed PRA in order to use risk insights in the operation of these plants.

Now, if I am going to go to a risk-informed regulatory basis, yes, we need the use of the PRA, a good, solid, well founded PRA to do that. There is no question about that.

DR. APOSTOLAKIS: Yes. I'm not talking about a detailed PRA, but maybe, for most units, something that's a little better than the IPE, because the IPEs are, after all, 12 years old now.

MR. BEEDLE: Yes.

DR. APOSTOLAKIS: Or not 12, but a number of years old, and I think the process would be much more efficient if both the licensee and the NRC inspectors have access to probabilistic models that people can believe and do these determinations.

MR. BEEDLE: The NRC, when we put together these SDP processes, they started out using the information that they had here in their offices in the form of the IPEs, which it was our obligation to submit as a result of a generic letter in the 1988 timeframe.

But they went out and visited the plant and validated the SDP process with the plant's PRA as it stood as recent as a year and a half ago.

So they have looked at those PRAs. I mean, it's not a case of the utility has this PRA and they're not going to let anybody look at it. In fact, that PRA has been used by the inspectors and, in fact, the inspectors will go back to that PRA when they're trying to determine the outcome of an SDP process.

The question, and this has come about over the

course of the last several months, about quality of PRA and the comment that the NRC staff doesn't have all these current PRAs at their disposal, we're trying to examine ways to develop an improved or increased level of confidence on the part of the staff in the development of these PRAs.

One of the things has been the peer review process that we've got ongoing. We expect to have that completed by the end of 2001. That's kind of coupled with some issues on ASME code development and so forth.

But there are some very robust PRAs out there. There are probably a half a dozen plants that probably need to go spend some more time in their PRA. We know that and we're working on those plants.

But by and large, those PRAs are pretty solid and well constructed and are providing good results.

DR. POWERS: So I take it, just an anecdote to embroider what you're saying, I think, the committee had a chance to visit Davis-Bessie and I think they were one of those plants that maybe people thought hadn't espoused risk-informed regulation as much as some of the others.

When we got there, we found that these guys are doing an incredible amount with the resources that a single unit has, which is not an infinite number of resources, but they were taking maximum advantage of things like owners groups' efforts and things like that and doing great things

to improve their PRAs to come up to snuff, so much so that they raised questions, in my mind, whether this SDP process might not be running into difficulties because of the quality of computational tools available to the staff.

That if, in fact, the PRA capabilities of the licensee were vastly superior than cruder tools available to the NRC staff, you might get conflicts based on differences in technology.

It's a question that came to our mind during this visit to the Davis-Bessie plant.

MR. BEEDLE: Well I don't think that that is really a major issue. I mean, as you get further and further down the SDP process, I mean, you could get to the point where you're really trying to get down to the third decimal place to figure out something.

But by and large, the band in which you're operating is so huge that you never really get to that point.

Let's just take one parameter that we measure, and that's the reactor scram or reactor trip. We've got a threshold that sits around the four mark to get you into the white band, but to get in the red, you've got to have about 21 of those things. It's like diesel reliability. We're shooting for a 99.99 percent reliability, but the truth is you can operate with about an 80 percent reliability or 75

percent and still not be in red.

And what that ought to tell us is that the margin of safety, the robustness of the design is tremendous. We're operating like, you know, a tenth of a second is going to make the difference between core melt or not, and that's called science fiction, gentlemen.

DR. SEALE: But, Ralph, aren't we getting -- you come back to the IPEs and Dana says, yes, but they're 12 years old and so on.

And by inference, you certainly led me to recognize, and I think I knew it before anyway, that the guys who are really on top of it are so much beyond the status or the capability as reflected in their original IPE that there's really very little relationship between that IPE and what they have now to evaluate.

They've sharpened their tools. They've gone back when they had a problem that had to do with this particular train and represented that train more discreetly, so they could really look at what the interactions were in it and so on.

Granted, there are still some utilities who haven't looked at the fourth page in the original IPE yet, but most of them have done much, much beyond that. Aren't we under-representing the capabilities, the understanding that now exists in these utilities, when we

refer to their database as being the IPEs?

MR. BEEDLE: I agree, absolutely. Absolutely.

DR. SEALE: But, see, there are a lot of people on the outside who also know that IPEs were pretty rudimentary. So they say, well, your representation of your PRA is primitive.

MR. BEEDLE: Well, I think that comes from our regulatory focus on things. I mean, you can't deal with regulatory posture unless you have things docketed and on the record and submitted in triplicate, one of those kind of things, and that's what we're dealing with.

All those IPEs were submitted. There was no requirement to submit your PRA.

Now, in fact, a lot of plants, this thing we're calling IPE, they're actually PRAs.

DR. SEALE: Yes.

MR. BEEDLE: Because when we looked at what it costs to do a PRA versus what it costs to do the IPE, we said I'd be foolish to do an IPE and make the static analysis, let's do a PRA so we can take some advantage of it and learn something about our plant.

So we developed the PRA and we made an effort to try and keep the thing up-to-date, and that's what was submitted to the NRC.

So a lot of these things that we're calling IPEs

are, in fact, PRAs.

But set that aside for a moment. The fact that we're able to, I think, with a great deal of validity, address the SDP processes on the basis of that 1988 analysis ought to tell us something about the robustness of that analysis technique.

It tells you a lot about how you can analyze the comparative risk of one sequence versus another, this component's failure and its effect on the outcome and the performance of the plant. These are really pretty good systems that have been developed.

Granted, the details and the level of detail that you put into the thing, whether or not you're using third decimal place data for reliability or fourth decimal place, turns out to be, in my opinion, really on the margin. It has not had a lot of difference. It hasn't produced a lot of difference in outcome.

But as a result of this whole process of analysis, we've seen a lot of improvement in the plant performance. We've looked at putting in systems that weren't originally designed that have improved our results of the PRA.

So it's been, I think, an extremely successful venture on the part of the NRC and the industry.

So all of that said, in order to take advantage of that process, we need to risk-inform the regulations so that

we are focused on the right things.

I would suggest that spending thousands of dollars on a pump that is no different than the $150 pump only to be covered by a piece of paper does not make a lot of sense, and that is only a small cost, because it then gets layered with maintenance routines and operational tests and performance checks and qualifications of people.

We've put all these trappings around it and it really doesn't buy us anything in terms of reliability. And the way you gauge that is through risk-informing the processes that help you categorize and determine the level of attention needed for those various systems, and that's precisely what we're trying to do with the risk-informing of regulation, and we'll talk about that in just a moment.

So in answer to your question, Dr. Wallis, that really is where the value in this comes and if we can figure out how to separate the significant from the insignificant in terms of our treatment, both from a procurement and an operational and a maintenance point of view, I think the industry will be much better off.

DR. WALLIS: I was wondering, though, in the long-term, if you didn't see a bigger kind of benefit from risk-informing, where actually a lot of the excess margins were better understood and could perhaps be reduced and so on, where there was actually a more realistic regulatory

process, and if you didn't see real advantages maybe five or ten years down the road from that.

MR. BEEDLE: Well, I think that that would maybe be a follow-on activity for us. For example, if we look at some of our design criteria, there's a tremendous amount of margin in there. Now, how do you play this margin in design versus risk in terms of performance of the system is something that really would have tremendous benefit in terms of construction costs, time and so forth.

But our focus at this stage of the game in trying to risk-inform the regulation is saying do you need to have regulatory purview over that system, that component, and that structure, and, if not, then what is the proper treatment for it, and that's the struggle we're going through right now in trying to deal with the Option 2 issues.

DR. BONACA: Mr. Beedle, I have a question. If we pointed out the significance of the corrective action program, really it's almost like a cornerstone element, together with the significance determination process.

One question we've been wrestling with is should there be indicators regarding the performance of the corrective action program. We realize that the indicators on the corrective program, or some indicators, would be almost like some more indicators of culture, to some degree.

If you have, for example, an insignificant event and you have a repeat, a repeat, and a repeat, it tells you something about the fact that your corrective actin program may be not be working right.

I would like to have your thoughts about that. The reason why I'm asking is that the utilities pay a lot of attention and they look at a corrective action program, the way it works, as an element of the health of the organization and does it have a worth in regulatory space.

MR. BEEDLE: The corrective action program is one that I think has matured over the last roughly ten years. INPO has had a significant -- has been significant in influencing the utilities in how to construct an effective corrective action program. They follow-up with their periodic inspections of the plants to look at the execution of that program.

More importantly, I say more importantly, it's a device and a mechanism used by plant management to ensure that problems are resolved. So it's a very significant program. It's not just something that sits on the side and collects things that the NRC inspectors find.

It's an active, very useful, necessary mechanism employed by the utility to improve the performance of their facilities.

Now, if the inspector finds a problem and it's

judged to be green, and it is a problem and it needs to be fixed, so it goes in the corrective action program, how many of those green problems do I have to have to make a white?

That's the question that I think is underlying a lot of this angst over the corrective action program.

DR. BONACA: No, no. I said they repeat, another repeat of another insignificant issue. I'm only saying that you do have an issue, you say it's not very significant. There may be some intermediate significance.

I mean, I'm not specific about the measurement of this significance determination process. You put it in the corrective action program and later on you find that you have another problem identical to that. The root cause of the first one hasn't been fixed yet, and so on and so forth.

Now, that's one issue that is significant, they pay attention to those.

MR. BEEDLE: That's part of the corrective program, is whether or not the problem you're trying to address today is one that existed in the past and whether or not that root cause had been addressed.

DR. BONACA: That's right.

MR. BEEDLE: And if the problem comes up today and you judge that you obviously have missed the target, you didn't quite get the root cause, you go fix it again and you keep working that. There's a little feedback loop in there

that says what have you had in the past.

So that's part of the corrective action program.

DR. BONACA: I'm saying in some cases it may not work, the feedback, and I'm saying that should there be something there for which there is an indicator.

MR. BEEDLE: I think that's the whole process that we're trying to address here, is what should you take regulatory purview of and what shouldn't you. And I would suggest that if it's green, it's green, let the utility deal with it.

You have inspection modules that look at the corrective action program and if you find that there is some failure in the corrective action program because they don't have that feedback mechanism, then you address it through that process.

DR. BONACA: Okay.

MR. PIETRANGELO: But there's another issue. Your question, Dr. Bonaca, was specifically on whether the CAP should have its own EIs. There's the PIs on the equipment that are in the revised oversight process, but I would also add that the maintenance rule sets performance criteria on a lot bigger scope of SSCs than just are in the revised oversight process and if you hit the performance criteria, you're required to do root cause analysis, take corrective action, and set a goal to determine the effectiveness of the

corrective action.

I would argue that just based on the equipment alone, under the scope of that rule, there's ample indication to monitor the effectiveness of the corrective action program and until that's proven that it doesn't work very well, and I don't think it has yet, I don't think there's a basis to -- I understand your point very well.

It could, I suppose, have some indication on the culture of the organization, but I think just on the hard equipment itself, there's a lot of indication already.

DR. BONACA: The reason why I asked the question is that clearly there is -- we're going towards an environment where we rely much more on the instruments of the utility to repair problems than on the regulatory intervention.

As we do so, then we have to be confident that those instruments work and the corrective action program is a fundamental instrument and that's why we're asking the question.

I agree with your comment that, in fact, the maintenance rule provides another window.

MR. PIETRANGELO: And that's in the regulatory purview. That's not just the licensees looking at that.

MR. BEEDLE: There has been a question raised probably once a year or so, somebody says what's the

connection between economic performance of a utility and the safety performance, do they go hand-in-hand.

INPO has attempted to answer that question a number of times. I think the is yes, there's definitely a linkage, because the same people, the same management philosophy that's driving your good economic performance is also driving your safety performance.

And there is not one utility executive that wants to have a safety problem at the plant, because a safety problem means failure on the economic front, and everybody understands that. No question about it.

So I think that the -- you know, if you look at the economic performance of these, I'm not suggesting we have an indicator here, yet --

DR. POWERS: You're among friends. This committee is dead set opposed to economic indicators.

MR. BEEDLE: The first six months of this year, the industry produced six percent more electricity than they did last year for the same six-month period. You don't achieve -- and we're already at about 90 percent capacity factor.

I mean, you don't achieve that kind of performance just on a whim and you don't do that setting aside all your focus on safety.

So these things really work hand-in-hand and I

think Tony's comment that the performance of the plant will be reflected in the way the plant material condition is carried out, and that is going to tell you something about that corrective action program.

The corrective action program and self-assessments that have been fostered through the INPO process over the last ten years have probably done more to improve performance at the utilities than any other thing.

They've caused the utilities to become more familiar with their equipment. They look at problems. They take that problem, correct it, feed it back into their maintenance systems, and, as a result, you see improved performance across the board.

I hope that answers the question.

Dana, let me turn to a couple other areas here, if I may.

DR. POWERS: Please.

MR. BEEDLE: I've got Tony Pietrangelo, who is the Director of our Licensing Strategic Group.

MR. PIETRANGELO: Not anymore.

DR. POWERS: We hardly know Tony at all.

MR. MARION: Whatever is says on the chart.

MR. BEEDLE: Alex Marion, Lynette Hendricks, and Doug Walters. Tony is going to talk a little bit about the risk-informing regulation and some of the interactions we've

had with the ACRS and the staff and give you some insight into that.

Alex is going to discuss a little bit about the oversight process. Lynette is going to touch on decommissioning activities, and I know that was an issue this morning when you were talking with the Commissioners, and then Doug will talk a little bit about the license renewal.

But before they do that, let me just make kind of an observation on ACRS. ACRS is, I think, a relatively unique element in the regulatory process and I talk about the regulatory process as opposed to advisors to the NRC Commissioners.

You are an integral part of the regulatory process. You're important to the Commissioners and I think they underscored that with some of their comments this morning. And you're important to the industry.

Your judgments, or lack thereof, your definitive recommendations or ambiguous suggestions create problems for the industry and we have to address them, deal with them in some fashion, because they have an effect on the staff and, consequently, an effect on us.

DR. APOSTOLAKIS: They never solve any problems?

MR. BEEDLE: They do solve some problems.

DR. APOSTOLAKIS: Some problems.

MR. BEEDLE: I'm saying they're on both sides of that fence.

DR. APOSTOLAKIS: Now you say it.

MR. BEEDLE: The direct ones, some of the not so direct ones.

DR. APOSTOLAKIS: Fine.

MR. BEEDLE: And my comment, I think, would have to be considered to be somewhat in synch with the feedback that you got from the Commissioners today, and say, hey, what do you expect me to do with that recommendation. I can't do anything with that recommendation. What do you want me to do?

So that's part of, I think, your challenge, to deliberate on issues that you think are important, that the Commissioners need to hear about, and give them some good, solid recommendations. I don't think this half of the ACRS can give them recommendation A and this half can give B and you send that to the Commissioners and ask them to auctioneer. That doesn't help them.

DR. WALLIS: I think we can't go too far. We can point out things, but we can't do everything. Resolving a problem sometimes involves capabilities from elsewhere, not just the ACRS.

MR. BEEDLE: Well, I guess I would take a little bit different view of that. I don't think that it's

sufficient to just point out there may be a problem there or I'm uncomfortable with that result or I think that's a little bit too high or that's a little bit too low.

That doesn't help them. If you feel that there is an issue in which the staff has not come up with the right answer, you have this gut feel, your intuition tells you that there is a problem with the fidelity of the process, then you need to go ferret out that problem.

You can't just walk in and tell the Commissioners I've got a stomach ache. It doesn't help. They don't know what to do with that.

I would submit that you do that on almost every issue. Somebody could have some angst over just about everything that goes on in this industry, but I don't think that's particularly helpful to the Commissioners and it certainly doesn't help me.

DR. WALLIS: But somebody else is working these problems, as well as us.

MR. BEEDLE: That ought to be part of your answer then. Anyway, I just want you to know that you are an important element in this regulatory process and you're important to the Commission, obviously, and you're important to the industry.

We end up frequently up here making comments and observations, we the industry, and I think that ought to be

testimony to the value that we put in it. We would encourage you to continue to look at lots of issues, but focus on providing good, sound advice to the Commission that is not ambiguous.

So with that, let me turn to Tony and ask him to talk a little bit about risk-informing regulation and some of the things that he's been involved with, when he was the licensing manager.

DR. APOSTOLAKIS: What are you now, Tony?

MR. PIETRANGELO: I'm the -- go ahead, Ralph, my title.

DR. POWERS: Risk and Performance-Based Regulation Director.

DR. APOSTOLAKIS: So this is up-to-date.

MR. PIETRANGELO: Yes, that's the new one. I actually had responsibility for our risk activity several years ago and had a lot of interaction with this committee, and then we were kind of to the point we are now, I think, with a lot of the activities and then we went through what I term our blue period, from 1996 through 1999, where I think some of the things Ralph talked about before, trying to get stability back into some key regulatory processes was of greater importance than trying to reform the regulations with risk insights.

So I tried to get out and they pulled me back in,

George, to risk-informed regulation. So here we are.

DR. APOSTOLAKIS: They did that very well.

MR. PIETRANGELO: Let me start just by saying that there's already a lot of industry interest in risk-informed regulation, and it's present today in the regulatory process. Just to name a few items, the monitoring, the level of monitoring done under the maintenance rule is risk-informed. The new A-4 configuration risk management process is certainly risk-informed.

The reactor oversight process is risk-informed in terms of the significance determination process, as well as the areas that the inspection process focus on. Sixty plants are getting ready to submit risk-informed in-service inspection requests and almost all plants have gotten some kind of allowed outage time extension through risk-informed tech specs.

So the fact is that risk insights are already being used in the regulatory process to a great extent today, even though, and I think this was mentioned before, but maybe not this way, there is no requirement for PRA in the regulation.

All we have is that IPE generic letter, which was just do you guys want to do one and if you do, can you send it to us. And you're right, we've come a long way since then and I think as part of the effort going forward, and

that's kind of the where are we now part, I think, as an industry, we recognize that that old information that was docketed as part of the IPEs is insufficient as a foundation for moving forward with risk-informed regulation.

So both on a macroscopic level, from the fleet of plants, risk information, from the risk information that's submitted on a plant-specific level, we've got to put something on the docket that's available to the public, that's transparent, so that to make some of the changes we're talking about in risk-informed regulation, that has to become part of the licensing basis and has to be very visible.

We're analyzing several alternatives now on how to do that best and I think you'll be hearing from us in the near future on that.

DR. SEALE: Tony, could I ask a question? This morning, you were there, I believe.

MR. PIETRANGELO: I was not there, Bob.

DR. APOSTOLAKIS: Ralph as.

MR. PIETRANGELO: Ralph was there.

DR. SEALE: One of the comments that was made was that in several contexts, we find that the process of docketing something has a tendency to ossify what's done. So when you say you want to put the PRA in the docket, yes and no, in the sense that we sure would like to have the PRA

on the docket, because that's something that everybody then has some access to.

And so the unfounded impugning of the level of consideration of risk issues would be hopefully diminished if someone was willing to look at the PRA that would be available. But at the same time, we would hate to think that if you put the PRA on the document, that you would then be reluctant to upgrade it at appropriate intervals so that it continued to be a living document.

So somehow -- and I don't think there is a provision for this right now.

MR. PIETRANGELO: There is not.

DR. SEALE: But somehow, between yourselves, and clearly you're a party to it, the Commissioners and, I guess, this committee is an honest broker, hopefully honest anyway, we have to come up with an idea of how we docket something that also satisfies the idea of being a living document.

MR. PIETRANGELO: And that's one of the things. I don't think we said we're going to put the PRA on the docket, but in the same vein, though, I think some of the things we're thinking of, for example, even with the ALWRs, there was a summary of the PRAs put in the FSAR.

The FSAR is updated on a regular basis. You could have the main contributors. You could have some of the

metrics that are associated with the PRA. It could be updated on an ongoing basis.

I think as part of the application, if you're going to be a player in risk-informing the special treatment requirements in Part 50, you're going to have to put something on the docket and have to keep that updated over time.

There's already mechanisms in the current licensing basis to do that, to put it in your CLB, whether it's the FSAR or a commitment or somewhere else in the licensing basis, and they already have mechanisms to update and even change control processes for those kind of things.

DR. SEALE: Okay.

MR. PIETRANGELO: And I think that's -- because we really haven't had much discussion on that yet, that may have been driving some of the issues that have come up in risk-informing Part 50, particularly in Option 2. We've had a lot of talk about the PRA standards and the prescriptiveness of it, the detail of the Appendix T for 50.69.

And because we don't have something that the regulator has direct oversight over in the licensing basis, kind of using these longer levers to try to get control over the PRA quality, and maybe that's not the best way to do it.

So the other thing I think that I want to talk to

you all about, and I think your letters and deliberations have been helpful already, is that we need to understand the process of how this is going to work to be able to put the individual pieces in, like the PRA standard and like the peer review process, and, yes, the prior staff review, prior to the application.

I think in some of the documents you've seen, the objective for the detailed Appendix T and the detailed standard being no prior NRC staff review and I think that's probably a false premise for the kinds of applications we're talking about in risk-informing Part 50, Option 2 and 3.

There is going to be a need for prior staff review. Reg Guide 1.174 is about the staff's review of licensee submittals to change their licensing basis with risk insights.

I think the process we envision is that some of these pieces, like the standard and the peer review process, can help facilitate the staff's review. We can even get it down to a template such that the thing doesn't take the time that South Texas is taking right now to process their exemption request and that those could be done in a very efficient way.

The risk-informed ISI submittals are down to templates. This committee has looked at a lot at risk-informed ISI over the years. One of the specific reg

guides is on ISI and IST, and we've got the submittal down to a template. It's not the FSAR-like volumes of work that were done to support ISI, but it lifts the pertinent information out that the staff needs to conduct its review, and I think we can get to that same point on risk-informing Part 50, Option 2.

DR. APOSTOLAKIS: I think we're running out of time real quick. So I h tow questions that I would like to ask you.

We hear -- in fact, the Commission had asked this morning, but we heard it, some in the industry think that perhaps we're going too far in trying to risk-inform Part 50 and you hear things about low-hanging fruit and so on.

MR. PIETRANGELO: There is no -- we'll have to get that out of the lexicon. There is no low hanging fruit in the regulatory process.

DR. APOSTOLAKIS: But do you -- is NEI's sense that we are going too fast?

MR. PIETRANGELO: No.

DR. APOSTOLAKIS: Okay. Good. Second question. I think sometimes one learns from one's not so successful efforts and -- how to put it in a more straightforward way -- do you think that any of the views that the ACRS has expressed in the last several years have, in fact, not been helpful or they missed the mark or whatever?

MR. PIETRANGELO: No. I think the views the ACRS expressed, that have been expressed by the ACRS have been pretty good and on point. I just wish it wouldn't take you so long to do it.

I mean, it took almost four years to get that series of reg guides out.

DR. APOSTOLAKIS: So you're not just blaming the ACRS for that.

MR. PIETRANGELO: No. But I think this is to underscore Ralph's point. You're not just deliberating here off-line. You are part of the process and I think as an industry, our sense of time needs to change a little bit. Some of the generic safety issues that the staff and the ACRS reviews have been in that log for a long, long time and you start to ask yourself, well, how important can that thing be if it's been there for 15 years.

So I think in the industry, with deregulation and other things, that our timeline has to change a little bit in terms of how long it takes to do some of these things, because you can't sustain that level of resources to focus on that problem for that many years.

We've got to have something that's either step-wise growing up to the end goal or decide it's not worth it and get out of it, because it's a lot of resources for us to support your meetings. I know it's a lot of

resources on the staff to support your meetings.

I wanted to compliment you on waiving your review of the final reg guide on 50.59. I think you recognized that you done a good job on the preliminary reg guide, there weren't that many changes on it, and there was no -- was going to be no value added by another ACRS review.

I think you should look at that more often in the future. And on the risk-informed stuff, your insights are vital to the process and for public confidence in the process.

But I think what I'm trying to get at is we can find a way to get them in or at least think about the times that you really want to weigh in. Do you want to weigh in on the front end or do you want to let the staff kind of bake something and interact with us and then bring you something or when?

DR. APOSTOLAKIS: What do you think of that? Because that has been a criticism of the committee from some quarters, that if we get involved from the beginning, then we are not independent.

MR. PIETRANGELO: That's right.

DR. APOSTOLAKIS: On the other hand, if you look at the history of this committee, up until maybe ten or 15 years ago, it was very common that the staff would invest two or three years into a project, then appear before this

committee, but the committee would disagree and you would have all sorts of acrimonious debates.

It's unfair to the staff because they have already invested a lot of time, but it's unfair to the committee, too, to say, at the end, well, gee, you know, we've invested so much time, you better go along.

On the other hand, you are accused that you are not independent.

MR. PIETRANGELO: Sure.

DR. APOSTOLAKIS: It seems to me you can be both, but I would like to know what you think.

MR. PIETRANGELO: And I think it depends on the situation, of course. There's a balance between -- you're not line management for the NRC.

DR. APOSTOLAKIS: Yes, we are aware of that.

MR. PIETRANGELO: I don't know how many meetings I've walked into where the first slide was ACRS concerns. Well, you know, the thing is just starting out and I think it's something to think about with each of the issues the committee deals with, about when you interact, is it the right time, and not to just assume some rote schedule for that interaction.

I think I've already seen some things about backing off some of the process type issues and focus in more on the safety standards type issues. I think that

makes perfect sense for this committee.

But overall, and there's no right or wrong answer to your question, George, I think it's got to be a balance and it's got to be a consideration in the back of the committee's mind of when you weigh in and is it the right time in the process.

DR. APOSTOLAKIS: And sometimes, of course, that's beyond our control.

MR. PIETRANGELO: That's right.

DR. APOSTOLAKIS: When we get an SRM, we have to respond.

MR. PIETRANGELO: Absolutely. Absolutely.

DR. POWERS: One of the motivations for this, we were so anxious to have this meeting and, of course, we do do a self-assessment of ourselves.

MR. PIETRANGELO: Right.

DR. POWERS: And, in fact, one of the assessments that we did, we looked at the number of issues that we were trying to tackle and said it's too many and set up some criteria for when to, as you say, not weigh in, because it's outside of our expertise or we really didn't have anything to contribute.

We do keep metrics on ourselves and I'm proud to say that whereas our metrics are not as good as the -- the performance metrics are not as good as the nuclear

industry's, we are on an effector.

MR. BEEDLE: I hope most of them are green.

DR. POWERS: Since we get to set the color bands, we're white in two and green in the rest.

MR. PIETRANGELO: Doug is going to talk about license renewal in a second, but I know this committee is thinking about license renewal and not too long, probably every month, you're going to be deliberating on someone's application for license renewal, and that's a statutory requirement for this committee to do that and you are part of the process, make no mistake about that.

And it's worked well thus far. We know we can process two at a time or three at a time now and in a couple of years, that's going to be eight to ten. Again, if you don't get on top of this when you interact in the process thing, when you're having that kind of workload coming down the stream, I think you're going to put yourself in a critical path position on some of these. So it's something to think about.

MR. BEEDLE: Dana, we have until three on your agenda, is that correct?

DR. POWERS: Sure.

MR. BEEDLE: I just wanted to try and make sure we didn't run over.

DR. POWERS: We got a little slop.

MR. BEEDLE: Why don't we touch on license renewal, Doug?

MR. WALTERS: Good afternoon. I'm Doug Walters. I have responsibility for renewal. As Tony said -- well, let me start off by, I guess, saying that we've been fairly successful, as you know.

I think you've had the opportunity to review at least two applications. We have three that are under review now and by our own assessment, there's somewhere on the order of 30 more units that will come in with applications between now and about 2003-2004.

So the interest in renewal is swelling and as Tony said, you do play an important role in that process.

I know that you're going to talk about the GALL and the standard review plan and the other guidance documents, and that's really our focus in the industry right now. We're reviewing those documents.

With the exception of the applications that have been submitted, I think these documents represent probably the most significant thing that's come out of renewal in a while, and these are extremely important documents for the follow-on applicants because they intend to rely on them.

And I would point out that in the review of Calvert Cliffs and Oconee, the number is somewhere between 85 and 90 percent of all the programs that were credited

were existing programs.

So what we really need to focus on is that remaining, whatever the number is, ten to 15 percent and make sure that we understand what enhancements are needed or what new programs might be necessary.

To pick up on a point that Ralph made about ACRS and the role you have in that process and the impact that you have, I just thought of two examples that I will share with you.

One is the environmental effects of fatigue, which has probably been debated to death and nobody wants to regurgitate, and I understand that. I feel that way myself.

But I would just point out to you that it's not that we're whining about where that issue came out. I think what we would like to see, though, is perhaps more consistency.

For example, if you read the staff's letter, they indicate that this is not an issue for ALWRs. Yet, they use the same, at least as I understand it, ALWRs use the same methods for evaluating fatigue as we did on the operating plants.

And somehow, on the operating plants, for renewal, we come out with a different result. And when we know an issue like that is coming to an independent technical body, we're anxious to see how you look at that and is there

consistency across the issue.

And I'm not so sure, in this case, and I'm not an expert in the fatigue area, but based on what I read and what I do know of the issue, I'm perplexed by that.

The impact of that, though, is we now, as an industry, have to go out and figure out a way to deal with environmental effects only from year 40 to 60 and we go to the ASME code, they haven't changed the curves, I think something is underway perhaps, but it presents a real problem for us, because it's up to the applicant, the renewal applicant to deal with that issue and we're not quite sure how we do that.

We'll get there. It's not to say it's not a real phenomenon, but when a decision is rendered that, yes, this is something you need to address in renewal, we need to do that.

Another area is rule changes, when there is a change to a regulation, and I will mention 50.55(a) and the adoption if IWE and IWL, and there is an example where we have an opportunity to look at that rule change and say, okay, if we adopt this change to IWE and IWL, how does that impact renewal.

I think in this case, the staff concluded that what they were doing in the rule change would cover the license renewal period.

Now, the renewal staff came back and published a reg guide and disagreed with that. So, again, we're in a predicament that we've got a regulation that says IWE, IWL, and, specifically, the focus is in accessible areas, and we have a regulation that says that should be okay for renewal, but we have also a reg guide or a NUREG that says, no, we don't agree with that.

We need somebody besides ourselves to kind of look over the broad spectrum and say is there consistency there, and I think these are two examples, not necessarily -- it's being candid with you. I'm not trying to be critical with you.

But we need that kind of broad overview to say are we being consistent technically. The process issues we can deal with.

So as we go forward, we hope that that's the kind of keen eye you will give to the GALL, principally the GALL. I think that's where all the technical meat is. And we need that document to be technically correct so that when these 30 or so renewal applicants come in over the next couple of years, we know we can rely on that document and there will be some success there.

That's all I have, unless you have any questions.

MR. BEEDLE: Okay.

DR. APOSTOLAKIS: Just out of curiosity, if we

have 30 units in the next four years, would risk-informing the process help a little bit or you don't want to touch anything? The process is working.

MR. WALTERS: I'm going to defer to the end of the table for the specifics. I will tell you that this is another consistency issue, in my view.

If I may put the risk-informing aside for a moment, it's curious to me that the maintenance rule, for example, has a scoping criterion safety-related and that scoping criterion is the same in license renewal for safety-related. Yet, we haven't figured out a way of how we can give credit for what we do under the maintenance rule.

If we go to risk-informed scoping, it seems to me that you ought to be able to apply that to license renewal. That would be, it seems me, the prudent thing to do. That makes it consistent.

But as Tony can explain to you, the way that Option 2 is working, if you do renewal, you can't do Option 2. I don't know if you want to expound on that.

MR. PIETRANGELO: Yes. There is a perverse consequence of a staff position on not applying the risk-informing Part 50, Option 2 to Part 54.

For the near-term applicants in the queue who are already in the process of preparing their applications, it has absolutely no effect, because this rulemaking is going

to take a couple of years. It's not even slated to go out for public comment until late next year.

So it will not have an impact on the near-term applicants. Rather, if one of those near-term applicants wanted to also take advantage of Option 2, you would -- the way the process is going to work is the safety-related, low safety-significance box, the RISC-3 box, there would be some kind of minimum requirement in lieu of the special treatment requirements for those components.

In the license renewal process, there is a demonstration that the effects of aging are being managed effectively, and a lot of those come from the special treatment requirements.

So you're asking -- unless the staff wants to stipulate up front that whatever that minimal requirement is would be adequate for the demonstration, you're going to undo a lot of the things you did in risk-informing Part 50, Option 2, and it's going to be a disincentive to moving forward.

So we think that Part 54 should be included in the special treatment requirements. We think it will not have an impact on the applicants that are in the queue. It will make the process more efficient and coherent across Part 50 and Part 54 for the remaining 60 to 70 plants that are going to come through the license renewal process in the future.

I just think it's just not consistent. This was Douglas' point that says we can us risk insights to focus our resources on the right things in Part 50, but we don't want to do that for Part 54. To me, that's not consistency and coherency in the regulatory process.

MR. BEEDLE: I think it points out some of the difficulties that the staff has and the industry, as well, in trying to figure exactly how you take this risk-informing and lay it across all the regulations.

Short of just taking a clean sheet of paper and starting to develop these regulations, I think you're going to continue to run into these sort of problems. But we would hope that there would be more thought given to the statements that you find in SECYs, for example, because those things carry a lot of weight. They carry an awful lot of weight.

That's, in part, the challenge that you gentlemen have in trying to provide advice and counsel to the Commissioners. You make a statement and the staff uses that and they act on it. They think that that's --

DR. POWERS: We are well aware the Commission today asked us both questions, are we going too fast and should we be working on 50.54.

I think, in sympathy to lots of people suffering from future shock, they have to be a little patient here.

I'm sure there's going to be some dislocations.

But you're talking to a committee that, if they had their druthers, would have taken out a clean sheet and written the whole thing in risk language and moving 54 in there would have -- I mean, when that decision not to have license renewal be risk-informed was made, I think we understood the practicalities and the time pressures at the time, but I think we were disappointed that that didn't happen.

MR. PIETRANGELO: I think the concern is upsetting the apple cart and I think that's a false --

DR. POWERS: And I think that's a good point, Tony. I think I'd like to have you come down here and make that point to us a couple more times.

MR. PIETRANGELO: Ralph made this point to the Commission in a briefing last week.

DR. APOSTOLAKIS: It takes us three times.

DR. POWERS: It is a problem which we have right now, which is an inconsistency between one end of the table and the other, and we've been whistling along saying, well, we'll evolve toward it, and I think what you're telling us is let's help Mother Nature evolve a little faster, let's do some genetic engineering here.

MR. WALTERS: Well said.

MR. BEEDLE: If we could, let's turn to -- do you

have anything else, Doug?

MR. WALTERS: No, I don't.

MR. BEEDLE: Turn to Lynette and a little bit of discussion in decommissioning activities.

MS. HENDRICKS: I'd like to take probably what little time I have and talk about risk-informing the decommissioning regulations. There were some other things on your agenda about cask process and decommissioning process, but if I had my druthers, I guess I'd like to say a few things first about the spent fuel pool risk study and how that's being used to risk-inform the decommissioning regulations.

I did not, unfortunately, have the opportunity to attend your briefing, but I do have the benefit of your slides and I concur with the position you're taking here, that when you start to risk-inform this special event over here with the pool, you're in different space, and I see that in your recommendations that the LERF may not be as appropriate as it had initially appeared to be when you start to look in more detail at the consequences.

I think the ACRS has been very helpful and very astute at trying to direct the staff's attention to refining the consequences, but I guess I would hope that since we are in different space, we would give the same emphasis to refining the probability.

What I mean here is that at this point, we are -- the whole event, as you know, is driven by the single, somewhat bounding seismic event, and that's different than what we have in operating space.

In fact, the same event is a background risk factor and I think we're going to have some unintended consequences if we are not equally careful in balancing the consequence refinement with the probability refinement.

I'll give you an example of that. It's in the SECY-00-145 that's before the Commission today, and understanding that that's going to change, but I guess what troubles us with that is it seems like we've missed some opportunities to apply real risk insights on a practical way by basing all of our concern on this single bounding seismic event, for which there are no mitigating factors.

I can say that more in pragmatic terms. What you end up with is a rulemaking that essentially layers deterministic requirements; in other words, you don't get out of your EP and you don't get out of financial protection until you can demonstrate the event cannot happen.

At the same time, the rulemaking plan proposes to layer these new requirements that we worked constructively with the staff to come up with to address all the other sequences.

We propose some real practical solutions to

identifying and mitigating and responding to these slow leaks and loss of cooling and we also put forward a seismic checklist that we were hoping would help screen out this event, which, actually, if you look closely at the implied requirements, really you're talking about a big imposition in a regulatory sense.

What it ends up with is you have a voluntary rule that industry is not likely to take advantage of at all. So you're going to have a status quo. All this rulemaking, all these risk insights for nothing, because the industry will have to look at that rule and say, jeez, you know, I've operated with this out here seismic risk and I have financial protection, I have EP, I shut down, I have one thing to worry about, just the pool, and I have this background event that's now predominant and I have to, in order to still have EP and financial protection, incur all the costs of these additional requirements.

It's kind of an untoward outcome in risk space. So to sum up, we certainly appreciate your --

DR. APOSTOLAKIS: Is there a good risk analysis that the industry has done on this issue that I can look at?

MS. HENDRICKS: If you will recall, we participated early on. We had ERIN Engineering provide input to when we were predominantly looking at these events.

Remember, the staff initially said this risk was

equivalent to an operating plant risk because there was very little credit for the long duration of the events and they've since refined their HRA analysis and now we're working very diligently on the seismic risk and we had hoped to sort of put that to bed.

DR. APOSTOLAKIS: If you do that, you deserve a statute. A seismic issue? In this context.

DR. POWERS: And one of the points we tried to raise with the Commission was that this bounding seismic analysis was strictly inconsistent with the whole philosophy we were pursuing everywhere else and it was expedient, but it was not useful. So I think we're sympathetic in that area.

I think we're looking for a much more stately approach to this than maybe is what you're looking for. We don't get the phenomenological things squared away and then proceed into the risk analysis and going, it seems to us, completely to risk, rather than a damaged frequency or something like that.

MS. HENDRICKS: Thank you.

DR. KRESS: We recognize from the start that the bounding seismic analysis that was used, the CFCLP concept, was very conservative and we knew if you were going to get any relief at all, that that's the end you would have to work on. I'm glad to hear that somebody is addressing the

real risk, not just bounding it, because actually there's two parts, there's the consequences and there's the frequency and you've got to have both of them.

And we really had no way to focus on the frequency, other than in our evaluation, all we could look at is consequences. Now, somebody has to look at the frequency and balance the two and I think that's what you're trying to say.

MS. HENDRICKS: We are and I think, to a certain extent, it poses a challenge because we're sort of changing horses, too. For operating plants, we use the sort of a more deterministic approach to seismic, with the safe shutdown earthquake and you look at the tectonics and say this is worst case, with some dealing with the uncertainty, whereas now we're deciding, well, let's embrace probability.

So we pick up either the Livermore report or the EPRI report. When you try to look at the whole scheme, you're always going to have an over-focus on these very large, very low probability events.

So I know this is coming back to you and I know the staff is looking at it, but if we would think even beyond, well, kind of what we've gotten from the staff is, well, you wanted probability and here's the number you get, but that's not looked at in the consequence of one event driving the whole sequence. We may come out with funny

screening numbers.

DR. KRESS: I think what you're saying there is if you have just one event driving your whole risk, that your risk acceptance criteria might be viewed differently --

MS. HENDRICKS: Exactly.

DR. KRESS: -- than if you had a whole lot of things, and I think there's some truth to that.

DR. POWERS: Not only that. I think you run into the challenge of interfacing defense-in-depth concepts.

DR. KRESS: That's an additional depth to this thing.

DR. POWERS: You've got to think very carefully about how you're going to be consistent with the defense-in-depth philosophy when you've got one dominant initiator.

DR. KRESS: Absolutely.

DR. POWERS: It's a strange thing.

MR. BEEDLE: Well, it's not an issue that's going to be resolved this afternoon, which I judged from the Commissioners' comments this morning.

Let me turn to Alex and ask him to provide a few comments on the revised reactor oversight process.

MR. MARION: Thank you, Ralph. My name is Alex Marion. All I can tell you at this point is I think I work for Ralph.

DR. POWERS: It says licensing and programs.

DR. SEALE: He thinks so, too, I take it.

MR. MARION: Just very briefly. I know we're pressed for time. Let me just indicate that overall, we think the process has been very successful in that we have been working very closely with the NRC staff and other interested stakeholders to make sure that the entire community of interest understands what the indicator system is all about, understands what the thresholds for regulatory action that Ralph alluded to earlier in terms of inspection is all about, and that entire process is scrutable.

As you all know, the first year of implementation is getting close to being completed. They're into the third quarter. The second quarter data has been already provided. Third quarter data is going to be submitted to the NRC, I believe, the 21st of October.

It doesn't indicate that everyone is in the green area. It's starting to identify a mix and I think as we go through that process, we'll be able to evaluate the indicators and the thresholds and the action and draw some conclusion as to whether or not it's doing what we expected it to do in terms of the overall scheme of things.

The NRC has just recently announced the formation of a FACA panel, similar to the pilot plant evaluation panel, that will start the effort to begin the lessons

learned review of the process during this first phase, this first year of effort.

That panel is scheduled to have the first meeting, I believe, early November, November 1st and 2nd. Again, that body will, as necessary, include various stakeholders to provide the overall assessment of the process in terms of internal NRC benefit, understanding scrutability to external stakeholders, as well. So we find that to be very positive. There is one performance indicator that's being changed. It begins with the letter S, dealing with counting of automatic and manual scrams.

We have reached an understanding with the NRC on alternate indicator and we're going through the implementation phase of benchmarking or testing that indicator through a pilot process. We have 21 units involved and that process began this month and will continue through March of next year.

And fundamentally, if it's found to be acceptable by NRC, then we expect it to be implemented third quarter of next year. We find that to be positive.

So it is a dynamic process. It seems to be working well. We're, quite frankly, pleased. We believe that the changes that have been identified and agreed to are necessary changes and there will likely be changes in the future, and we're just pleased to see everyone working on it

and applying their best efforts and making sure that it's accomplishing its intended objectives.

DR. POWERS: One of the issues that we have debated around this table, to no successful resolution, except an accommodation, was that the cross-cutting issues that include things like human performance, will they, in fact, be revealed adequately early by the other performance indicators.

I think the accommodation the committee came to within itself over that was to say this is an untested assumption and it needs to be considered as we get into this assessment and whatnot.

Is that one of those things that you're paying attention to at all?

MR. MARION: Yes. It is being considered. I wish I could provide you a definitive answer at this point in time. But I suspect as we go through this cycle, we will probably have a more confident feeling on how that particular element is being considered in the overall program. But it's something that everyone is aware of.

DR. POWERS: Yes, that's good. The other area that the committee has not spent any time on, because of a variety of things, is the significance determination process. We understand what it is, but we have not gone through the details of it, especially for those things where

there is not a PRA capability available, things like the significance determination process for fire protection issues and things like that.

MR. BEEDLE: Well, there are a number of them; fire protection, security.

DR. POWERS: Security.

MR. BEEDLE: And if you'll recall, security, EP, rad protection, are not elements that are amenable to the PRA focus.

DR. POWERS: The current PRAs can't do that.

MR. BEEDLE: But they were nonetheless important elements in this overall assessment process for the facility and we aged with the inclusion of those pieces as cornerstones and the necessary outcome was to have some sort of a significance determination process.

We have, just for an example, an SDP in the rad protection area, talks about if you have a planned maintenance evolution with a target exposure and you are approaching that and you go over that exposure calculation, then that puts you in white. That makes that a white finding.

Well, safety significance is zero, but we agreed that that is something that is important and we understand the ground rules. Again, if I know what the target is, I can figure out how to deal with it.

Well, there is a provision to go in and change that target and then you get into the philosophical argument of whether or not it's best to change your target or not change your target, what's the effect on people and how do they deal with that whole issue of management control.

So we've got that behind us. Now, that's a good example of where a very deterministic pre-determined course of action would be taken, given a certain set of circumstances. We understand that, and there are a lot of areas like that.

DR. POWERS: I guess what we were concerned most about is it seems like some of those non-PRA things, the thresholds are a good deal more stringent than the corresponding ones that are treated with a probabilistic risk assessment, and we worried are we losing the advantage of focus by putting in very stringent thresholds on some cornerstones and not so stringent on the others.

MR. BEEDLE: I think that's a very valid question to be asking and I guess maybe the corollary to that is what's the effect on does it divert management attention and are you really looking at the right thing and so forth.

So I think we'll have to continue to look at that. We'll get our FACA panels to look at that.

DR. POWERS: I think it would be interesting to pursue that, because I think there's -- my own feeling is there is

discontinuity when you go away from those that are subjective to quantitative assessment to those that are more qualitatively or traditionally assessed.

MR. BEEDLE: I would suggest that the underlying principle involved here is don't let go of anything. So we've got to have that cornerstone. I can't let go. I know it's not safety-significant, it's trivial in the grand scheme of safety, but I don't want to let go of it.

I've always managed that, I've always had to look at it, I've always had some inspection activity there. So the staff is looking for some element.

Now, the other part of it is public perception. It doesn't serve the industry or the NRC well to not have something in there that speaks to protection of the public to radiation exposure limits, along with emergency planning.

DR. POWERS: I think I don't want to provoke concerns by the public. But I think when we set thresholds, that those are a little more arcane than whether you have a cornerstone or not.

MR. BEEDLE: That's true. Well, back to your question on the cross-cutting. The cross-cutting issues are important to the industry, no question about that. They're important to the NRC.

I think that over the course of the last year, the cross-cutting issues of safety-conscious work environment,

corrective action program, human performance have taken on increased significance.

There has been more discussion of those issues and those programs and focus by the NRC staff on those issues today than there was a year ago, two years ago, three years ago.

And I do believe that they are self-revealing in the performance of the facilities.

DR. POWERS: Commissioner Diaz argues that the corrective action program is the unspoken third element of the new risk-informed regulatory process. Three attaches a great deal of significance to that cross-cutting issue.

MR. BEEDLE: Yes. I don't have anything else to add.

DR. POWERS: Well, this has been truthfully excellent, in my point of view. I especially like it when Tony can come in and tell me things I'm supposed to be doing, and that's good, because I need to be reminded often and I'm glad to have him do it, because he does it in a very gentlemanly way.

And I appreciate all the presentations and --

MR. BEEDLE: And he's not even Irish.

MR. SIEBER: That helps.

DR. POWERS: I appreciate all your program directors and their comments and whatnot and I hope that

they will feel free to come to us and say, hey, these are the things we need you to pay attention to and give us the high sign occasionally, because we are very much in the situation of having a lot more issues come to us than we can possibly handle and we have to do some picking and choosing.

And I kid you not, we do track our own performance metrics on things that we are declining to review and things that we do accept to review, and we'll take all the help we can in making that selection, because it's sometimes hard to do.

So I appreciate all the comments you made and taking time to come down here and talk to us. It's been very, very useful, for me at least.

MR. BEEDLE: Thank you very much, Mr. Chairman.

DR. POWERS: With that, I will recess us for 15 minutes.

[Recess.]

DR. POWERS: Let's come back into session. We are now going to turn to the subject of GSI-168 and equipment qualification. Professor Uhrig, I think you're going to provide the leadership here.

DR. UHRIG: Today we're talking about the safety-related electrical cables, primarily low voltage associated with transmission of signals from plant to I&C devices and instruments, as well as medium voltage that

conducts power to safety-related devices.

The business of environmental qualification started about 1971 or thereabouts. There are three categories of plants today; one, those that started construction before '71; those that started construction after '71, they had the IEEE Standard 323, the 1971 version involved.

The trial standard did not address aging and required dynamic -- required a systematic program of analysis, testing and quality assurance, whereas those that were before '71 were held to high industrial quality as the primary standard. And after the plants with CPs after 7/1/74, there was a '74 version of the standard.

So that's a little of the background. The 1982 equipment qualifications rulemaking process led to the 10 CFR 50.49. The Commission did not backfit this to the older plants and today, we have, again, three separate categories of plants, the largest being a group that were grandfathered, some 70-odd, if I understand correctly, to the original standards.

So we'll hear more about this and with that, I guess, Mike, do you want to say a few words before you start?

MR. MAYFIELD: Yes, just briefly, to frame this. We had hoped to come to the committee at this meeting with a

proposed resolution to this generic safety issue. However, as you'll hear, sort of the last bullet in the slide package, we're still considering some of those closure options.

So we're not prepared today to talk about the closure. What we wanted to do was to come and present to you what we have done, what we have found, and looking both at the testing that was done and at the risk evaluations, the scoping studies that have been performed, and to solicit any input, any questions you might have, any areas that you think we should specifically be prepared to address when we do bring the closure package.

So it's something of a status briefing, but at the same time, we're hoping to see if there are any insights you particularly want us to make sure we address when it comes to the committee.

DR. UHRIG: Are you asking for a letter in conjunction with this?

MR. MAYFIELD: I think at this stage, a letter would be premature, because we don't have the closures to propose. If the committee chose to write a letter, of course, that's obviously your prerogative, but we are not specifically seeking one.

When we bring to you the proposed closure package, at that point, we would need a letter.

DR. SEALE: When do you expect to have closure?

MR. MAYFIELD: I had hoped to have it for this meeting.

DR. SEALE: I understand.

MR. MAYFIELD: At this stage, hopefully yet this year. We are on a list that goes down to Capitol Hill that shows closure by December 31. So I am hoping to make that milestone, but I also wouldn't want to prejudge this. I'm not trying to give you a flip answer. It's just while the staff is still debating this, I'm hesitant to venture a strong guess.

DR. SEALE: We appreciate your incentives.

MR. MAYFIELD: With that, I'd like to turn it over to Ed Hackett, who will start the briefing.

DR. POWERS: Ed, before you start, I noticed that, in looking through your viewgraphs, that some of the research was done by Sandia National Laboratories.

I have some vague association on a very episodic basis with that organization, and so I may have a conflict with this.

MR. HACKETT: Okay. I guess, like Mike said, on the schedule, we're actually revising our operating plan milestones just today and we'll hopefully still be able to live with some of the ones we put forth there.

I guess some introductions are in order here. The

folks at the table here, myself, I'm Assistant Branch Chief for Materials Engineering Branch, in the Office of Research. On my right is Dr. Bob Lofaro, from the Brookhaven National Laboratory, who is the actual researcher who has performed a lot of the research under contract for NRC.

To my left, immediately, Satish Aggarwal. Dr. Aggarwal is the RES Program Monitor for the program at Brookhaven and has done the bulk of the work in this area, along with Dr. Jit Vorah from the Office of Research, and Jit is over there behind Mike.

And to the far left is Mark Cunningham, who is the Chief of the Probabilistic Risk Assessment Branch in Research, and Mark will be addressing some of the risk significance aspects of the work.

I'm sorry. Satish just reminded me. Jose Calvo just joined us, also, from NRR. He is at the table next to Mike. So with that kind of talent at hand, we ought to be able to hopefully -- don't want to get too cocky here, but hopefully we ought to be able to address some of the issues.

DR. APOSTOLAKIS: Finish it up today.

MR. HACKETT: In terms of a purpose or objective, I think Mike covered that, but just to restate it here, we had hoped to have sort of a resolution path or approach to discuss with you in more detail today.

Obviously, as Mike said, we're not going to be able to do that today. So what we want to do is basically review the technical background and the regulatory background to the issue and then just give you sort of status of where we are in a technical and regulatory sense.

I think Dr. Uhrig covered an awful lot of the background, but I'll go into some more of that in a block diagram.

Before that, I had one I was going to put up that is not in your package. I debated whether to put this up or not, but since there are a variety of different folks and backgrounds represented in the room, I thought I would at least mention some of this in the way of background, and I hope I'm not offending anybody here.

But, basically, what we're looking at here, as Mike Mayfield has characterized many times, is less of an electrical engineering problem, actually more of a polymer materials engineering problem in terms of degradation.

You've got the polymeric materials, basically the jackets and insulators that are degrading. They are subjected to obviously thermal and irradiation environments in the nuclear plants.

DR. POWERS: Can you give me some sort of feeling about the total doses that these jackets are getting?

MR. HACKETT: I cannot, but maybe Bob, Satish.

DR. AGGARWAL: We plan to cover that when we discuss the test program with you. Would that be all right?

DR. POWERS: That would be fine.

DR. WALLIS: These are not subjected to ultraviolet or something?

MR. HACKETT: Not at -- don't worry about it, Jit, I'll do it from here.

DR. WALLIS: There's no ultraviolet radiation effect.

MR. HACKETT: Not that I'm aware of.

DR. WALLIS: They're away from bright lights.

MR. HACKETT: They're in the containment, mostly.

DR. AGGARWAL: The cables are qualified to all TID source term and that's what these require for all nuclear power plants, TID source term.

MR. HACKETT: This was, again, just, also, in terms of setting the stage, but like a lot of these types, we just briefed the committee yesterday on neutron irradiation embrittlement of reactor vessels.

Like that, this degradation is progressive with age, like you would expect, results in embrittlement. I think Dr. Aggarwal has some samples here we'll pass out at an appropriate time to show you the extent some of this embrittlement can take. It can be pretty dramatic.

And, obviously, the embrittlement increases their

susceptibility to cracking, and that almost goes without saying. A lot of times, the failure mechanisms are then from moisture intrusion, which can either lead to gross failures or shorts in the cables or potentially leakage currents, undercurrent type situations, which could give you misleading information in terms of instrument and control.

So that's just in the way of sort of setting the stage.

DR. WALLIS: So there's no humidity effect or anything. You say thermal and irradiation. It seems to me a lot of the things degrade --

MR. HACKETT: Yes, absolutely. I didn't mean to imply there's not a humidity effect. That's obviously there and it's synergistic with the other effects, too.

So with that, what I would do is move on to the next slide in the package, sort of an attempt to run through how this is set up and I think Dr. Uhrig covered a lot of this, so we don't need to be overly redundant.

But, obviously, this goes back to the regulatory basis, including an EQ rule, which was promulgated in 1982. There's a Regulatory Guide 1.89 which is part of the process that endorses IEEE standard, that basically set a qualified life or a qualified envelope type of approach to qualification of these cables.

However, on the slide you see here, the EQ aging

research that was conducted at Sandia, as Dr. Powers noted, showed some failures of low voltage I&C cables and in some cases here, you'll see, Dr. Aggarwal is going to go into greater detail on an upcoming table here, but there were percentage failures that increased with time in different cable categories, and we'll go into some more details there.

This was about vintage 1992, that this research was completed. There were information notices that were issued by the Office of Nuclear Reactor Regulation to cover this area.

There were also issues associated with connectors.

DR. APOSTOLAKIS: Are these accelerated tests?

MR. HACKETT: They are accelerated tests, and that's part of what will be covered, too, the aging.

DR. APOSTOLAKIS: It will be covered.

MR. HACKETT: Yes.

DR. SEALE: You say 18 at 20 years, 23 at 40 years, 32 at 60 years. Are those aggregates? That is, is the increment between 20 and 40 the difference between 18 and 23?

MR. HACKETT: I'd turn that over to Satish.

DR. AGGARWAL: The numbers are actually -- they did the tests on 20, 40 and 60 years.

DR. SEALE: Yes.

DR. AGGARWAL: When they did the testing at 20

years, 18 percent of the cables failed had low IER. When they were doing it for 40 years, it was 23 percent failure.

DR. SEALE: Twenty-three percent more.

DR. AGGARWAL: Of the set.

DR. SEALE: Of the set. So that included the 18, plus five more.

DR. AGGARWAL: No. We studied the independent test. They are doing three tests.

DR. SEALE: Okay.

MR. HENDRICKS: One for qualified life equivalent to 20 years.

DR. APOSTOLAKIS: It's cumulative.

DR. SEALE: There are separate ones, but --

DR. UHRIG: Separate tests.

DR. SEALE: Yes, okay.

DR. UHRIG: Not the same cables.

DR. SEALE: Not the same cables, but presumably comparable sensitivities.

DR. UHRIG: Yes.

DR. APOSTOLAKIS: And clearly it's not linear.

DR. WALLIS: The rate slows down.

DR. SEALE: Well, it's saturating.

DR. SHACK: You can only get so dead.

DR. SEALE: That's right. That's the truth.

MR. HACKETT: Dr. Shack's comment is probably

particularly appropriate. When we pass some of these samples around, I think you will see that some of these, that the failures can be fairly dramatic, particularly with the bonded jacket cables.

DR. SEALE: Now, let's don't make bad comments about geriatric activities.

MR. HACKETT: Okay.

DR. APOSTOLAKIS: You will talk about these tests later?

DR. AGGARWAL: Yes, sir, if you'd like to hear.

DR. APOSTOLAKIS: Well, if you talk, I'll hear.

MR. HACKETT: Trying to move across the chart here. Out of the research work and the regulatory summaries that were issued, that coupled with some knowledge of what was going on in terms of operating experience is what you see on the center of the chart, led to some additional staff actions.

There was an EQ task action plan which was promulgated in 1993, which was at least one of the issues that was to be addressed in that task action plan was looking at accelerated aging and was accelerated aging indeed a valid way of coming at this thing.

And for those of you who have been involved in this, this involves the Arrhenius methodology. I think the bottom line is what comes out of that is, yes, that's a

valid methodology, as long as you're not changing the mechanisms of the cable aging or failure as you're going through that process.

The EQ task actin plan was actually closed by the NRC in 1998. The long-term research aspects of that were transferred into a new GSI, 168 at the time, which is the subject of why we're here.

Then there was ongoing research, obviously, associated with that GSI. Forth-three technical issues, you'll see, at the bottom of the slide, that were identified and that was in NUREG-CR-6384 in 1996.

Those research issues have been ongoing or addressed in ongoing research for us at the Brookhaven National Laboratory.

I should also point out that the industry has also been active in this area, even more so now with the EPRI/DOE NEPO program. There is continuing work at Sandia and elsewhere under EPRI funding working in this area, too.

Some of the cable types that are addressed you can see under the box that has the EQ aging research under Brookhaven identified. We've seen failures across many different types of manufacturers.

Again, Satish and Bob maybe will get into some better definition here as we go through what is or isn't a failure, some of that is problematic in how you define these

things.

But to the -- maybe just the final point, the top of the chart, obviously, considering license renewal, I think one of the things we'll come to in summary is that the situation for the operating plants I don't think we feel is any dire situation by any stretch.

For the license renewal period, on the other hand, we think something is going to need to be addressed. The something and the process and the approach for doing that, like Mike was saying, remains to be determined or proposed by the staff, but that's sort of where we are now.

DR. WALLIS: Excuse me. Your 18 percent at 20 years is the result of some research program.

MR. HACKETT: That's correct.

DR. WALLIS: There have been plenty of cables out there for 20 years already. So how do they do? Do they fail at the same rate?

DR. AGGARWAL: When you're talking about 20 years cable, you're talking about the operating plant and their operating environment. When we are talking about the test here, we're talking about an axial cable and LOCA test. We are not reporting here these are expected failures in the operating plant in normal life.

DR. WALLIS: How do we relate these numbers to reality out there in the plant?

DR. AGGARWAL: I'm going to talk about it as we proceed.

MR. HACKETT: That part will come. As a matter of fact, what I will do at this point is just outline the remainder of the presentation. I will turn this over at this point to Dr. Aggarwal and he will summarize some of these tests, and Bob Lofaro is here, also, from Brookhaven to assist with that, if needed.

In the part of your package that goes to the risk considerations, Mark Cunningham will address those.

At this point, I guess I would say, though, if there are any overall questions on this background for any of the staff that are here present, this would probably be a good time to hear those. Otherwise, we'll just go ahead and move on.

Hearing none, I will turn this over to Dr. Aggarwal.

DR. AGGARWAL: Thank you, Ed. Before I talk about the program, and what we have done or not done, I would like to take the opportunity to pass the board, on my right side, which shows you the typical I&C cable which are used in a nuclear power plant and these are new cables.

On my left, I am going to pass some photographs of the cables which are degraded conditions during the test. Anther example I am going to hand you is the Okonite 40 year

post-LOCA cable, and please look at the condition what we found.

The next sample I have is the anaconda cable, three-conductor, No. 12, unbundled cable.

DR. UHRIG: These are used primarily for signals, I&C signals.

DR. AGGARWAL: That's right. All the cables which you are looking at are used in a nuclear power plant for instrumentation and control only. We are not discussing any power cables at all.

DR. UHRIG: What voltage?

DR. AGGARWAL: Normally, they are rated 600 volts, but in a plant, they may be 24 volts.

DR. UHRIG: Twenty-four volts mostly.

DR. AGGARWAL: Right. I am going to pass another sample of a Rockbestos cable, which is a two-conductor XLPE neoprene. This is the 40-years aging and you will see the cracks which are visible for -- without glasses you can see them. At the same time, you will see the jacket is brittle.

I am going to pass two samples, one on this side and one on that side. These are the Samuel Moore cables, which are two-conductor, No. 16, EPR Hypalon bonded, which fail during our look at test No. 4.

Before I go further, that we were, in other program, looking at only three types of these cables, which

are most popular and commonly used in nuclear power plant, and the sample which I've passed on to you, the big board has all those three kind of cables and the other sample which I am passing on are essentially the cables which failed or did not meet our acceptance criteria.

Now, this two-sample, Samuel Moore, which I passed on, you will see some cable mark, black spot. This is where the cable failed. One rad conductor was punctured.

The next sample I have is a Rockbestos XLPE neoprene, 60 years, which is similar to test No. 4. And if you look at it, you will see how the jacket is cracked and is brittle.

Another sample I have here to show to you is after LOCA test and, again, this is Rockbestos XLPE neoprene jacket, which undergone 60 years of aging and post-LOCA.

DR. UHRIG: I want to make sure I understand. This is aged to 60 years and then --

DR. AGGARWAL: To a LOCA.

DR. UHRIG: Then to a LOCA.

DR. AGGARWAL: Bob, if you like, I can run down basic program how we do the testing.

DR. UHRIG: I think it would be useful to at least give us a quick review of that.

DR. AGGARWAL: Let me do that. Let me finish one more sample and I go back to that.

DR. UHRIG: All right.

DR. AGGARWAL: This cable is the Okonite cable, 60 years of aging, post-LOCA, and look at the -- this thing completely failed. You could see the conductor through all the length.

DR. WALLIS: If we handle this, it will fail some more.

DR. AGGARWAL: I just wanted you to have a feeling what you're going to look at.

This is the Anaconda cable, which is 40 year and post-LOCA, and you could see, again, the cable here.

DR. WALLIS: Is it the LOCA that does this to it or is it in pretty lousy shape before?

DR. AGGARWAL: It depends on what kind of insulation you are looking at.

DR. UHRIG: Do you have any test where you apply the LOCA to brand new cable?

DR. AGGARWAL: Yes, sir. Each cable, we had a controlled sample.

DR. UHRIG: Controlled sample.

DR. AGGARWAL: Yes. Let me go through the process very quickly and that will give you some understanding.

As discussed earlier, you know that our requirement is 10 CFR 50.49, the EQ rule, the reg guide, they require that cables be qualified and qualification here

is a verification of design.

Namely, we want to ensure or assure us that these cables will perform their intended safety function in the expected environment.

It is a one-time test. Although the reg guide makes it implicitly that this qualification should be maintained for 40 years, qualified life. But there is no explicit requirement in our regulations which require that we do any kind of monitoring.

Keeping that in mind, let me try to explain the qualification process to you. What we do here, we will take a brand new cable, and our goal here is to bring that cable to the end of life, qualified life.

If it is 40 years, then we want to bring that cable to the equivalent to at the end of 40 years, and the reason being, a LOCA can take place at 39 years and 364 days.

So we are trying to bring that cable to end of life condition. How do I do that? Because we don't have a nuclear power plant which have seen 40 years of natural aging.

So we had to go and look at the Arrhenius theory and see what does it tell me. Coupled with the activation energy, we come out with a certain number. That for so many hours, if you preheat the cable at this temperature, then we will consider that this is equivalent to 40 years.

Now, NRC paid no role in arriving those conditions. The manufacturers were told that go ahead, we understand their limitation of the Arrhenius theory, but come back with those parameters and those parameters were picked up by each manufacturer as he deemed necessary.

And it is also interesting to note, many times, you find the same kind of material, but different manufacturers. They came out with different numbers.

Again, NRC was not dictating those numbers, they were there. In our test program, we decided that we will use the same parameters which were originally used by the manufacturer. We will make no deviation whatsoever in terms of the rate of aging.

So what we do now, we'll take a cask sample, brand new, put in an oven at a certain temperature, and for so long time in each case as dictated by the manufacturer.

When that is done, then we will put, on the same cable, the operation type radiation and then we go to the accident rating.

Once that is done, then we go into what we call a LOCA test. The guidance for test, how you do all these things, is provided in IEEE 323.74, which is endorsed by Reg Guide 1.89.

Now, this particular standard for wide profile are for B's and B's and they are typical and these standards

clearly state that you can follow them, they are typical, or you can have plant specific.

My experience tells me that the industry chose to use those profiles. The profiles were two peak profiles and a single peak profile and, again, these profiles were provided to us many, many years by manufacturer, vendors, and they are typical in nature.

This is a two-peak LOCA profile and it's definitely more conservative compared to a single peak.

Now, again, some manufacturers chose to qualify their cables to two-peak rather than one peak and NRC accepted both.

DR. WALLIS: You test in water. Are you going to get to that?

DR. AGGARWAL: Yes, sir.

DR. WALLIS: Are you going to say what the water is?

DR. AGGARWAL: Yes.

DR. WALLIS: Because there are all kinds of water.

DR. AGGARWAL: Then there are certain tests which are called post-LOCA testing. What we are doing here, we take the sample, which has come out of the LOCA test, after doing some condition monitoring and so on, we apply what we call the strain test. The cables are now submerged in water.

This is a requirement of IEEE 383.1974 that these cables must meet this requirement. The water is ordinary tap water and it the cable is somewhat into it and we apply 80 volt per mil. Usually insulation is 30, so you see about 24 on the board.

Now, note it is not always necessary that cable will fail at 2,400 volts. It can fail at any intermediate range.

Any failure which cable, if it fails to withstand water 2,400 or lower will be considered as failed.

DR. WALLIS: There's nothing about the chemistry of the water. It's just some sort of tap water.

DR. AGGARWAL: It is tap water. This is what is required under the standard and this is how the industry has done.

DR. WALLIS: We don't have tap water in containment after a LOCA.

DR. AGGARWAL: True. That's very much true, but, again, we are just meeting acceptance criteria in the 1970 timeframe and -- I'm just telling you what industry doing or what we have done.

DR. SHACK: Again, so you're not irradiating the cables. You're simulating all the damage by some sort of aggressive thermal history. Is that the idea?

DR. AGGARWAL: No, we are putting radiation doses,

too, as a part of the pre-aging. We go through the sequence of thermal aging and then the normal radiation and then the accident radiation.

DR. APOSTOLAKIS: So the normal radiation you use some kind of a law like the Arrhenius law again to determine the time?

DR. AGGARWAL: Generally, as I said earlier, the industry came and 50 mega rad was considered to be standard number that the industry has used, not only in this country, but throughout the world, for qualification.

One may argue, and that is my next point, people have argued that these tests are too conservative and I want to present my personal point of view, not NRC staff point of view, my personal point of view are these tests are really conservative.

The first point is that pre-aging environment, which we are preconditioning the cables to, as I told you earlier, you take the activation energy, the Arrhenius theory tells you so many hours equivalent.

DR. APOSTOLAKIS: But that's for temperature.

DR. AGGARWAL: That's the temperature, the time.

DR. APOSTOLAKIS: Not for radiation.

DR. AGGARWAL: No.

DR. APOSTOLAKIS: Okay.

DR. AGGARWAL: So now people say, well, in a

nuclear power plant, you never see those conditions. All right. Sitting here, I don't know any better matter to bring a cable to the end of condition 40 years life. Only thing I know of the limitation, the Arrhenius theory, and this is what we do --

DR. APOSTOLAKIS: I don't understand this. You never see what conditions? The temperatures that you are -- that is not the idea of an accelerator test.

DR. AGGARWAL: The idea of accelerator test is to bring the cable to the end of condition.

DR. APOSTOLAKIS: Right.

DR. AGGARWAL: Forty year. What industry argued is that the tests are unrealistic. In real life, cable never sees these kind of temperatures and the point I am making there, the only criteria in the consensus standard was to bring the cable to the end of life, 40 years, and they came with a number.

Bottom line, I'm saying, in my opinion, those numbers are not very conservative.

DR. APOSTOLAKIS: So if we put it in a different way, the argument is that if you have a cable subjected to temperature T-1 for 40 years and then you have an accelerated burst at a higher temperature for 260 hours, the result of the test, the damage to the cable is not the same as you would get for T-1 for 40 years.

DR. AGGARWAL: Some people argue. Let me make another --

DR. APOSTOLAKIS: Is there any basis for that?

DR. AGGARWAL: Yes. Another argument -- may I put -- from the industry's point of view, in my 30 years in EQ at NR, what I found, any failure in the EQ area can always be explained and you can declare victory.

I have not found, it is not because of requirement are not very clear, explicit, they require single prototype be tested.

If it fails, the staff didn't know. Industry is not required to report, but declare cables are qualified and they are there in the plant.

DR. WALLIS: Can you tell me more about this accelerated test? You don't have to just do it at T-1 for N hours. You can do it at a lot of temperatures for a lot of different times and show that this fits on a curve and it's all -- that, therefore, your theory is kind of valid. You don't just do one test.

Isn't that done?

DR. AGGARWAL: No.

DR. SHACK: Was it done once upon a time?

DR. APOSTOLAKIS: Well, when Arrhenius proposed the law, I guess he did it.

DR. SHACK: That's a long time ago.

DR. APOSTOLAKIS: It was a long time ago.

DR. SHACK: I mean, for the particular cable, I presume that somebody did a test over a range of temperatures and demonstrated a kind of linear behavior.

DR. AGGARWAL: No. They used the activation energy and the Arrhenius theory and came up with a number.

MR. MAYFIELD: This is Mike Mayfield, from the staff. If you go back into the polymer science, you'll find that that kind of work has been done and the Arrhenius applies for it, just like it does in metallurgy, as long as you stay within the same degradation mechanism. If you go high enough in temperature, the mechanism changes, the whole thing is over.

From the test reports I've seen that we've acquired, when they qualified a cable, they did not run at a series of temperatures. They set out to qualify it for a set of conditions where you could operate the cable ostensibly at this set of conditions for 40 years and the tests were run to qualify the cable to operate at those conditions.

There weren't a series of tests run, but this -- now we're talking about the practical implementation of a piece of science. The series of temperatures, that type of work was done in the research labs effort the standard was written.

So there is science that says as long as the degradation mechanism doesn't change, this methodology holds.

DR. SHACK: But, I mean, you've established that the range we're extrapolating over is within the range that people had demonstrated.

MR. MAYFIELD: Yes. Now, there's been subsequent work done at Sandia looking at -- because some of the polymers exhibit, which called non-Arrhenius behavior, and Ken Gillen out there at Sandia has done some work looking at why that occurs, when it occurs, and how to predict it.

And for the work we have here, we didn't feel like it was much of an issue, but it's something that is being followed up both through the DOE/EPRI NEPO program, as well as stuff that we're at least following what's going on.

So there is continuing work in this area sort of at the basic technology. What we are presenting today is the application end of it. But the underpinning, the scientific underpinnings are there.

It's just they're not -- it's not done for each qualification test.

DR. WALLIS: Where does the conservative adjective come in? I would think the question is are these realistic tests. What is the difference?

MR. MAYFIELD: Well, the concern -- I think your

characterization is exactly right, Dr. Wallis.

DR. WALLIS: Are they realistic tests?

MR. MAYFIELD: It's are they realistic versus conservative, the argument being that, oh, they're too conservative, but then are they realistic, and I think it's a fair question.

The issue was to try and qualify cables within an envelope, if you will, for unrestricted use in the nuclear power plant.

DR. WALLIS: Conservative, to me, would mean that you look at the errors in the Arrhenius theory, the deviations from it. You've got some kind of a bounding thing because of the uncertainties and then you go to that bounding test, and no one has said that anyone has done any bounding test.

It looks as if this is some sort of an average realistic type test that's being done. So we don't know the limits in terms of a bounding conservatism.

DR. AGGARWAL: That's correct.

DR. WALLIS: Maybe the word conservative is irrelevant in describing these tests.

DR. AGGARWAL: I was just trying to pose -- well, concluding that, we do the same task, where I explained to you, that some is in the water.

DR. WALLIS: And this is just tap water.

DR. AGGARWAL: Yes, sir.

DR. SHACK: Let me go back just to the question again. Now, we did the pre-aging and then the irradiation. Have people examined the effect of the sequences?

DR. AGGARWAL: Yes, sir, they have and there are different conclusions. Incidentally, I've been already reminded twice about the time. Last night I told my wife that don't wait for dinner for me. So I will be here as long as you want me. The pleasure is all yours.

DR. APOSTOLAKIS: But we will not.

MR. MAYFIELD: Dr. Shack, this is Mike Mayfield, from the staff. The tests done at Sandia, in fact, do simultaneous temperature and radiation exposures, but the IEEE standard has sequential exposures.

I guess I personally don't know if someone has swapped irradiation versus temperature, but I know that we got somewhat different results and I think you'll see some of that in the next couple of slides that Satish presents, when we do simultaneous thermal and irradiation exposures versus sequential.

The sequential appears to be more severe than the simultaneous.

DR. UHRIG: What is the radiation test? Gamma?

MR. MAYFIELD: It's gamma.

DR. UHRIG: Is it Cobalt-60?

MR. MAYFIELD: Cobalt-60 sources.

DR. UHRIG: So it's not the same energy spectrum that you might expect in a plant.

MR. MAYFIELD: It is not the same energy spectrum. It was a TID source term estimation and they take a cumulative gamma dose and irradiate the cables using the Cobalt-60 sources.

DR. WALLIS: I guess all these questions wouldn't be so important except that the failure rates are a significant percentage, and therefore, we do have to worry about the meaningfulness of the test.

DR. AGGARWAL: Bill, to your question, I just want to add that in certain part of the world, for certain type of insulation, they have found that if you do the radiation first, and thermal things later, it's more conservative for some type of insulation, not all, and it is consistent with the conclusion what Sandia reached some time ago.

And, incidentally, I may also point out, in this program, we have produced that many reports which have been circulated around the industry and public for their comments and their input will all be incorporated.

Now, I would like to move on to page 3.

DR. WALLIS: I'm sorry. This temperature test is uniform temperature?

DR. AGGARWAL: Yes, sir.

DR. WALLIS: Are these cables carrying current? They're not subjected to --

DR. AGGARWAL: Yes, sir. They are energized in the nuclear power plant.

DR. WALLIS: They just set an environmental temperature. There's no heating because of the current in the cable.

DR. AGGARWAL: Right.

DR. WALLIS: Is that right?

DR. AGGARWAL: The temperatures, we tried to maintain, what we came out, we are not giving any kind of credit for the heating created by the current going through the cable, because these are very small cables.

All we have a very limited current. So really there's not a heck of a lot of current.

DR. WALLIS: Right, as long as someone has assessed it.

DR. AGGARWAL: Yes. Well, we have taken those temperatures which the manufacturers had taken. We did not make an attempt how --

DR. WALLIS: It's just if you have a lot of cables bundled up in a tray and they're all generating small amounts of heat, it might affect the temperature in a way which isn't just the environmental temperature.

DR. AGGARWAL: You're right, but again, normally,

on a controlled cable, you only allow 60 percent and there's plenty of space and these cables are hardly getting any current. They are control and indication type cables.

In this, all I want to tell you, if you go to the bottom line, you will note this is what they found in Sandia, two out of five fail in the 20 year, one out of eight fail in 40 years, and five out of 11 fail, then we are talking about 60 years

DR. WALLIS: Show us on the table where those are?

MR. SIEBER: The two and five are -- two failures and five -- what is the category here, marginal criteria?

DR. AGGARWAL: Right.

MR. SIEBER: A and B, down here at the bottom.

DR. UHRIG: You had two failures and five marginal is what that means.

MR. SIEBER: Out of 39.

MR. LOFARO: So seven had a problem out of the 39.

DR. UHRIG: Seven out of the 39.

MR. LOFARO: Two of them were failures and five were just marginal.

DR. WALLIS: So two failed in that 20 years and one failed in 40 years. So one that was failed recovered.

DR. AGGARWAL: It's a separate --

DR. WALLIS: I know it's a different test, but if you think it's meaningful, that would look as if one

recovered.

DR. UHRIG: It's within the error of the experiment.

DR. WALLIS: But then it seems a very small number to rely on, doesn't it? If there is that sort of behavior.

DR. AGGARWAL: Well, it all depends, again, how you define your acceptance criteria.

DR. WALLIS: I'm not defining anything. I'm asking, really.

DR. AGGARWAL: In that particular test, the criteria was that if you have higher value, they're lower, or you blew a one-amp fuse, then it would be considered a failure or marginal.

DR. WALLIS: But if I drew a curve of sort of failure rate versus time and I had tow and then one and then five, with these numbers, I wouldn't have much reliance on the meaningfulness of the result, would I? Very small sample size and not even consistent with the trend.

DR. AGGARWAL: You're right. You're right. And, again, we --

DR. WALLIS: So who decided these were adequate tests?

DR. AGGARWAL: Who decided? They came out of the IEEE Standard 323, which is a national consensus standard. This is what EQ experts are telling is the right thing to

do.

DR. APOSTOLAKIS: Do they specify the size of the sample?

DR. AGGARWAL: They don't talk, but it's implicit that you take -- well, let me rephrase it. There's no explicit statement in the standard what industry have done, they test one sample and if that passes, you declare victory.

DR. WALLIS: And if it doesn't?

DR. AGGARWAL: You test again.

DR. APOSTOLAKIS: We should risk-inform that.

DR. AGGARWAL: That is one of the concerns we have, whether we should be doing.

DR. UHRIG: That's what the manufacturer does. That's not what you did here.

DR. AGGARWAL: We reported what we found.

DR. UHRIG: You had about ten kinds of cables here.

DR. AGGARWAL: Right.

DR. UHRIG: And I notice you had five specimens, some you had two. Was there --

MR. SIEBER: Some you had one, the Anaconda.

DR. POWERS: Yes. And the question is how was that number determined. On the basis of the amount of that cable that was used?

DR. AGGARWAL: Not really. The number of the cable size, then we had -- This will go, again, a little more in detail. Some of the cables were around the mandrill. Some were in the tray. And it's different --

DR. WALLIS: But does the failure rate depend on how long the cable is? Is there one-inch cable or one-meter cable and they're looked at the same way?

DR. AGGARWAL: I believe you use a ten-foot long sample.

DR. WALLIS: The whole thing seems somewhat strange.

DR. UHRIG: It also looks like certain cables, like Anaconda, unbounded very well in this first test.

DR. AGGARWAL: Right.

DR. UHRIG: And on the other hand, it didn't do very well over in the 40-year test on the second page.

DR. AGGARWAL: Correct. The second page you are looking at are the tasks which we did at Wylie Testing Lab.

DR. UHRIG: It says Brookhaven here.

DR. AGGARWAL: Yes. Brookhaven don't have the lab, the testing. They're actually Wylie Lab.

DR. UHRIG: So Brookhaven supervised it.

DR. AGGARWAL: Right. They have a contract on this program. If I turn over to the next slide, again, this is a summary of six tests which we did. And you see the

results. And I will be willing to answer your questions and explain to you what those failures were

DR. WALLIS: Tell me. If you do five feet of one foot of cable, is that different from doing one length of five foot of cable? What's the difference? So why is it five tests?

MR. LOFARO: What we did in the test program is we used links of cable as recommended in the IEEE standard, which is they suggest you use about ten feet so you get the proper effect.

Obviously, if you took one foot of cable, you might miss something. So you want to take a sample that's at least representative of what the cable might actually see in the plant.

DR. WALLIS: So they do specify a length.

MR. LOFARO: They recommend a length of about 10 feet, and that's what we use in our program. And what they do is our program we actually wrap it around the mandrill, so that there was a good ground plane.

DR. WALLIS: These five samples are put in the same testing apparatus or they're tested at different times?

MR. SIEBER: They were all tested exactly the same time. What we did is --

DR. WALLIS: So if I had 50 feet of cable, it would be like having five pieces of ten foot.

DR. AGGARWAL: Right.

DR. WALLIS: Because they all put through the same test.

DR. POWERS: They are all put through the same test.

MR. PIETRANGELO: They go the

DR. AGGARWAL: Right. They go through the same process.

MR. LOFARO: Well, what we wanted to do is we wanted to have multiple samples in there so that we could do some -- have some statistical accuracy on the samples. We put control sin there that did not get aged. We also put samples in there that were pre-aged to different years. Some tests were 20 years, some tests --

DR. WALLIS: I'm sorry. The cable, the ten-foot cable fails, does it fail in one place or in many places or all over?

MR. LOFARO: Well, that's one of the things that we were looking for and what we actually found is that some of the cables had a global degradation. For example, the Okonites I think that will be touched on.

We found some cables that only failed locally, where most of the cable was in excellent shape, but when we subjected it to a subjected it to a submerged high pot test, there were single point failures in the cable.

So it depends on the type of cable you're looking at and the materials they're constructed of and what conditions they're exposed to.

DR. WALLIS: But you never seem to get five out of view. Still, if you put these links in and one survives and the others don't.

MR. LOFARO: If we had a case where there were five out of five failures, I think that would clearly point to a problem.

DR. WALLIS: I'm just kind of surprised that you'd take five lengths of identical cable and do exactly the same test, you'd think that in many of these tests, you either get the all pass or they fail.

You wouldn't get many cases where one fails and the others don't.

MR. LOFARO: Well, unless they're reaching a point where the degradation is just borderline. Maybe there's a problem, maybe there's not.

DR. APOSTOLAKIS: That means you have alliatory uncertainty. That's exactly what you have.

DR. AGGARWAL: I think it's very difficult to predict how many will pass or not. For example, Okanite cable, three sampled or three failed out of three.

DR. WALLIS: But these cables are sort of identical. The manufacturer --

DR. AGGARWAL: Yes. They are coming out of the same reel. Mike wants to add something.

MR. MAYFIELD: I was just going to reiterate something that I guess Satish had said earlier and ask you to please keep in mind the qualifications standard is based on one successful prototype test. The issue that we were addressing with these cables is, is that realistic. If you, in fact, test more than one sample, do you get all passes.

The notion that one prototype are ten foot length, nominally, tested and successfully passes the IEEE test qualifies all cable of that particular type is one of the things we were challenging through this research.

So whether we got all passes or all fails, and, Dr. Wallis, I think you talked earlier about are the tests conservative or are they realistic, the part of the notion is to put the cables through their original qualification and with multiple samples, whether it's three or five, to determine whether or not this notion that qualify one sample and, therefore, all cables are qualified, is that really a legitimate notion.

And I think at least these test results raise some questions about that and it's a dialogue that we will continue to have with IEEE.

DR. WALLIS: It may well be that to answer the question, you need to test 100 of them.

MR. MAYFIELD: That's the question, is how large would the sample have to be. Conversely, do you accept the notion that this qualification standard doesn't get you to all cables pass and, therefore, you test perhaps more than one and then try and establish some failure frequency.

DR. WALLIS: Don't you have just experimental theory that you're relying on to reach conclusions here?

MR. MAYFIELD: Say again, please, sir.

DR. WALLIS: Don't you have some kind of a theoretical background about failures and statistics which tells you whether or not this is a significant experiment, what it means? I mean, this is a well worked area of planning experiments and deducing things, making conclusions when there are random variables.

DR. AGGARWAL: I'm aware, in Sweden, they use some statistics and they came out with a sample size of ten, but in U.S. it is one.

I think, as I recall, in that time arena, what IEEE was worrying about, that if you do ten samples, or hundred, for that matter, and they argued that nine out of ten pass or 95 of 100 pass, do you declare victory or you don't. And there were no criteria for them. So they decided you just do the one test and the sense of the standard now and with the whole work to do that.

Now, we can debate the numbers and --

DR. WALLIS: Well, victory should be based on some logic.

DR. AGGARWAL: When we look back now and think, you're right.

MR. MAYFIELD: Again, Professor Wallis, our objective here was to challenge what was being done and to see if it seemed to hold together. I believe the test results here suggest there are some concerns. I think the kinds of things you're raising, we agree with you. We're not here to try and defend the standard, simply to report this is what we followed and it seems to be raising some questions.

DR. AGGARWAL: If I might turn to the next viewgraph and give you some basic data out of the operating experience. This is an EPRI report, July 1994, where they collected some data from '68 to '92, and they found there was 87 events which identified degradation of in-containment cables.

We know that we have problem with the splices at operating power plants. We also know that in our test, we had the problem with splices in all the tests, test number one, two and three.

Two passed without a problem, but first and three, they said there was a moisture intrusion.

DR. WALLIS: Where did the moisture come from?

DR. AGGARWAL: Steam.

DR. WALLIS: There's a steam environment?

DR. AGGARWAL: Yes. It's a LOCA test.

DR. WALLIS: It's a LOCA test. I'm sorry. They had actually had LOCA in operating experience?

MR. SIEBER: No, they tested it.

DR. AGGARWAL: I'm just making two points. One was that there had been a problem --

DR. WALLIS: This is to support an LER, so it can't be a LOCA test.

DR. AGGARWAL: No, no. Two points. There are real life problems.

DR. WALLIS: But you said moisture intrusion in an LER. So the moisture came from somewhere --

DR. AGGARWAL: No, I jumped a gear.

DR. WALLIS: I'm sorry.

DR. AGGARWAL: I think went to the second point to make, that in our test, we also found problems with the splices and there we have the LOCA.

DR. UHRIG: But you also have problems with splices at the operating plants.

DR. AGGARWAL: That's right. That is the point I'm making.

DR. UHRIG: There was not a moisture problem there.

DR. AGGARWAL: No.

DR. UHRIG: That's probably a faulty splice.

DR. AGGARWAL: One of the reasons. But you know when many of the LER do not go to root cause analysis and tell you what really happened. But I know on a personal experience that you ever try to splice cracked jackets, splice it, you'll never succeed.

MR. CALVO: Jose Calvo, from the NRR staff. The problem that we found with the splices in the operating plants was just the way they was done, in the installation. The procedures was not followed, they didn't make it long enough.

Sometimes moisture was found in the terminal boxes and things like that.

I think it was mostly installation, they didn't follow procedures and I guess the same question was raised when we were doing this test with Research and maybe the way the splice was put together, it was not appropriate and that's why the issue of failures.

MR. LEITCH: How were the 87 events identified? Is that 87 LERs or how did they come up with the conclusion that there were 87 events?

DR. AGGARWAL: This is a proprietary report of EPRI, which I cannot really go more in detail. But the conclusion, it is reasonable to conclude that those 87

events were independent events in different nuclear power plants over the period.

MR. LEITCH: I would think there could be a considerably larger number.

DR. AGGARWAL: Again, everyone is not reported. You have in a plant, an MOV fails. What do you do? You go there, you look at the cable, and you see, well, it doesn't look very good, you disconnect the cable, put a new cable and connect it up.

Do you report it to NRC as related? No.

MR. LEITCH: That's my point. There could be many more than 87.

DR. AGGARWAL: Exactly. Exactly. In the LER and the NPRDS data, we also found that there were specific problems with the neutron monitoring systems and failures were due to high temperature and moisture intrusion.

DR. WALLIS: Where did the moisture come from?

DR. AGGARWAL: In an operating plant, you might have --

DR. WALLIS: Are these outdoor plants?

MR. SIEBER: It's in containment.

DR. AGGARWAL: It's in containment.

MR. SIEBER: If you get a little leak someplace, humidity goes to 100 percent and --

DR. WALLIS: So these are associated with some

other event, like a leak.

DR. AGGARWAL: Right.

DR. UHRIG: Why was the neutron detecting cable so sensitive?

DR. AGGARWAL: Radiation.

DR. UHRIG: Neutron monitoring cable.

DR. AGGARWAL: Radiation. And as I was talking to you earlier today, my basic concern is every plant had hot spots.

DR. UHRIG: Right.

DR. AGGARWAL: And my concern is do the plants really know where their hot spots are, are they really monitoring those environments, are they really doing something, I have no idea.

Then we talked to the industry informally, they say, yeah, many utilities do, but are they all doing, I cannot answer that question.

MR. SIEBER: I don't think that you survey to find every place where there is a neutron beam. A lot of times a cable would fail on a power range monitor at the connector.

DR. AGGARWAL: Right.

MR. SIEBER: Because it's exposed there and it's in a pretty high neutron flux. Find the same things on the top of the reactor head and a lot of utilities will end up shortening and shortening and shortening the cable until

they run out of cable because it ages right where the connector is.

DR. AGGARWAL: And they made choose to make a splice there.

MR. SIEBER: Well, other ones may have. Splices are more trouble than you can imagine.

DR. AGGARWAL: I would like now to turn over the rest to Mark. The only point I want to make, that cable aging can be this significant and let the expert take over.

MR. CUNNINGHAM: Thank you, Satish. I've got a couple of slides to talk about the context of what the implications are of aging I&C cables might be to risk assessment.

Over the years, there's been about three studies done, risk studies done to look at this issue. All of them have really been in the form of sensitivity studies, because you get to -- basically, get to a -- you require a level of information to go beyond the sensitivity study, which we just don't have.

We don't have the information to work with. These studies have generally shown that the risk of aging I&C cables could be significant under a certain set of conditions.

The studies looked at basically a spectrum of pipe breaks or LOCAs in the containment and tried to deal with

the fact that the LOCAs would create an environment, a hot spot, if you will, either very locally in a small break or very broadly in a large break that could compromise these cables, as we've seen.

Then the question becomes, well, if the cables fail, what does that do to the function that's associated with those cables or does it give a set of indications to the operator that could mislead or confuse them.

So the cable failures, either the gross cable failures or the leakage types of failures have the potential to certainly complicate the accident or remove equipment, make equipment unavailable, or to confuse the operators.

To go beyond anything like kind of a general sensitivity study, that you need a fair amount of information that we don't have, and that's kind of itemized on slide seven.

In the context of the cables themselves, you need to have a sense of what types of cables are associated with what types of equipment in the containment and what are the more critical pieces of equipment in the containment. You also need to have a sense of the extent of aging of those cables, those particular cables and then relate that to the cables and the location of the cables to the potential environment.

Again, the offer of what's the relationship

between the hot spot from a pipe break or something like that with a cable of a certain type for an important piece of equipment. The other part of that is given these types of things, how would the operators respond. Do partial failures of cables cause more problems than complete failures and that sort of thing.

So the risk study in this case is, in one sense, simple. It could be important. We don't have enough information on the details of where the cables are and the functions and the types of cables and that sort of thing to take it much more than saying it could be.

DR. WALLIS: You're saying this is what you would have to do if you were to do a risk assessment, but essentially a risk assessment has not been done.

MR. CUNNINGHAM: A risk assessment has been only done in a very general sense, gross sense, that's right.

DR. UHRIG: So one of the considerations you have under study is to seek this information from the utilities.

MR. CUNNINGHAM: That comes back to Mike's discussion earlier of the options for pursuing this generic issue.

DR. UHRIG: This is one of the options then.

MR. CUNNINGHAM: That's one of the things we talk about, yes, is trying to obtain this information from licensees.

MR. LEITCH: Would you expect that BWRs would be significantly different than PWRs in this case? I'm thinking about under the bottom hood of the BWR, there's just a real rat's nest of cables under there.

MR. CUNNINGHAM: I couldn't tell you whether that would be more important or not.

MR. MAYFIELD: One of the scoping studies looked at BWR versus PWR and the B's came in somewhat lower, but, again, it went to -- I wouldn't want to put a lot of credibility in the number simply because of the level of uncertainty and the level of information we don't have to do it.

But they weren't -- it wasn't night and day, but the B came in lower than the P.

DR. UHRIG: What about international studies, what else is going on? I remember hearing a report about five or six years ago on some work in Sweden, I believe it was. A, do you have access to it, and, B, is it comparable results?

MR. MAYFIELD: We have had and continue to have dialogue with the international community. There was work in Sweden. In fact, we had talked with the plant manager from Oskarshamn about the possibility of getting -- they re-cabled the plant when they basically rebuilt it.

We've had some dialogue with them about trying to get aged cable samples for testing. We've had dialogue with

the Germans, fairly active dialogue with the Germans, as well as with the French. The Japanese have ongoing programs and we've had some dialogue with them.

I think, in general, the observations are consistent. I wouldn't want to say that there have been strict comparison tests.

There was a coordinated research program with IAEA that Bob Lofaro was involved in looking at this. So there's been a fair bit of international dialogue. The staff does have access to, I guess, most of that information.

DR. UHRIG: Are they carrying out any of the kind of analysis that you would -- a risk analysis for which this type of data would be sought?

MR. MAYFIELD: I guess that I don't know. I'm not aware of any of those studies, unless Mark is.

DR. AGGARWAL: If I may, different country have different approaches. When you look at Germans, they don't go in PRA. What they do, they put sample, what they call cable deposits, and then they do the testing every five years and then they determine whether they have level of confidence or not.

When you talk to the French, their LOCA profiles are somewhat lower than ours and they qualify the cable using IEEE standard.

Sweden, we have all the reports you describe in

our office here and we have looked at them. We have visited Sweden several times and our conclusion is theirs are totally consistent with ours.

IAEA program, which Mike just mentioned, they are coming out with a guidance document, a guide and the recommendation is this is the international feeling that these cables you qualify one time, you simply can't walk away from these cables and do nothing. They want to see some kind of condition monitoring be done.

IAEA is going to come soon, the guide will be printed there recommending condition monitoring in certain areas.

DR. UHRIG: And yet we have 70 percent of our plants grandfathered to where no additional monitoring or any additional work is being done.

DR. AGGARWAL: Actually, 100 percent plants are of that view. We do not require any kind of monitoring. If you turn over to my next slide --

MR. MAYFIELD: If I could -- I want to come to that. It gets to be an important distinction, I think, between what we require versus what the industry may or may not be doing.

DR. UHRIG: Some of them are doing something and some are not.

MR. MAYFIELD: I think that's an important

distinction. We are not in a position today to tell you exactly what they are or are not doing. We know that some have aging management programs, if, for no other reason or for no other examples than the Calvert Cliffs and Oconee plants in their license renewal applications.

So we know that there are programs in the industry. We can't tell you definitively how widespread they are or how effective they are, but I would not want to leave the committee or the public with the impression that nothing else is being done just because it's not required.

DR. UHRIG: But you do have resident inspectors in every one of the plants.

MR. MAYFIELD: Yes, sir.

DR. UHRIG: Do they undertake to report this type of thing?

MR. MAYFIELD: No, they do not.

DR. UHRIG: They do not.

MR. MAYFIELD: It's not part of their regular inspection program.

DR. UHRIG: It's not part of their responsibility.

MR. MAYFIELD: No, sir.

DR. POWERS: Can we come back to the risk significance? Give me a feel for what happens in a sequence where instrument aging becomes -- loss of instrumentation becomes important? I can imagine it in a long-term station

blackout for a boiler. What PWR sequences get me in trouble here?

MR. CUNNINGHAM: You can take -- I guess I'd start with LOCAs, LOCAs where you have some -- if you have some unfortunate interplay between the location of the pipe break, the type of cable that might be in that vicinity, and the function that that cable is associated with, that if you could first compromise the function by not causing actuation or something like that.

DR. POWERS: Sure, I understand. But what am I trying to actuate?

MR. CUNNINGHAM: Again, it depends on the different types of plants, what type of equipment could be important, but, again, small LOCAs, you'd be interested in the relationship of cables that might actuate high pressure injection, for example, or perhaps, more importantly, cause signals to either the automatic signals or the signals in the control room on that equipment to be either wrong or confusing or that sort of thing.

MR. SIEBER: But the valves and the pumps are in the aux building.

MR. CUNNINGHAM: Yes.

MR. SIEBER: What you're really trying to do is trip the plant right away and usually you can see that on a loss of pressure before the containment environment gets so

bad that it will wipe out the cables. Then the other thing you have is you get a phase A and B containment isolation, and almost all the isolation valves are air operated valves with solenoids, but they fail closed if it were to short out or the fuse would blow.

But you're talking a hundred of those that have to operate probably. And beyond that, everything else is outside containment, except you probably -- if everything went, you couldn't monitor pressurizer level, pressurizer pressure, reactor pressure, steam generator levels.

You would be able to monitor pressure because the isolation valve for the steam generators is outside containment.

DR. POWERS: What you are concerned about is an increasing fraction of accidents ordinarily terminated benignly that go on to core melt, is what you're concerned about.

MR. CUNNINGHAM: That's right. That's right.

MR. DUDLEY: This is Noel Dudley. Just to put it in another perspective, each step in your emergency operating plan is based on an indication, it's better supplied by one of these cables.

MR. SIEBER: That's right. It's either a go or a no-go to the next step.

DR. WALLIS: So something like pressurizer level,

if it was malfunctioning, gave a wrong indication, might really upset the operator's response.

DR. AGGARWAL: Yes, that's correct.

MR. CUNNINGHAM: Either change it or delay it or something like that, and that's a big aspect of the risk part of it that we don't have a good handle for.

MR. SIEBER: But that's practiced in the simulator a lot. That's part of operator training to simulate failed instrumentation and have the operator detect it and decide what to do. You've got several different level instruments.

MR. CUNNINGHAM: Just to be clear, we're not suggesting that this is a risk issue. We're saying it could be under a certain set of conditions.

MR. SIEBER: That would be hard.

MR. CUNNINGHAM: We're kind of caught and not able to go much further without a substantial increase in the amount of information that we have.

DR. POWERS: It's not going to increase the number of initiators and it's not going to change those accidents that we think go to core melt now, which is increasing the number, the sequences to go to core melt, that's all.

MR. SIEBER: A homemade success path.

DR. POWERS: Yes.

MR. HACKETT: Let's go ahead and see if we can move to our summary here, of what is obviously not the

prettiest of stories, let's say. I think that's been covered in significant depth here on some of the points Dr. Wallis made and I think they're very well taken and there's going to be more work to be done, suffice it to say.

But I think the first bullet we really covered, the regulations, as Dr. Aggarwal emphasized, don't require periodic inspection or monitoring and in some cases, we could get into a discussion of that being problematic, given access and so on and some of the techniques that are available, maybe push the state-of-the-art.

But there are periodic spec surveillance tests that do evaluate operability that these systems are energized, but, of course, they're not of the capability to evaluate aging and the degraded state of the cables and any pending failures that might result.

The operating experience that Dr. Aggarwal summarized does indicate some service-induced degradation that was attributable to the elevated temperature conditions and some moisture intrusion, but I think, also, as was pointed out, I'm sure there are plenty of other conditions that were not captured here.

In addition, there are things, cable failures related to other than specifically aging degradation.

Maybe the most important point so far is that the -- and I think Mike Mayfield summarized this pretty well.

The research results from both Sandia and Brookhaven and Wylie, which are separated by at least five or six years, and maybe emphasize some slightly different aspects of the qualification, both show that not all these cable types would do this qualified life type of function, even for 40 years, considering a LOCA.

And at 60 years, this becomes more problematic, but, again, this is assuming that you're operating these things at the rated temperatures.

The caveat at the bottom says, of course, that the realistic conditions are in-plant service generally less severe than the parameters used for these qualifications.

DR. WALLIS: How about 20 years? You said 40 and 60, but I thought many of your significant number failed in the 20-year.

MR. HACKETT: That's a good point.

DR. WALLIS: That's before license renewal.

MR. HACKETT: That's correct. I guess we're jumping ahead a bit. There's at least one of the summary pieces here that covers that.

DR. WALLIS: Okay.

MR. HACKETT: The next slide, Mark, again, just summarized pretty well. The risk studies can give you relatively high CDF values, again, conditioned on some of these situations, are all the cables failed during a LOCA.

The bottom line is I think we're in need of further research data to support a sufficiently low failure rate or to get the CDF values to an acceptably low level.

We are planning currently on Mark's branch doing some work in this area over the next year or two and we have budgeted for that in our budget cycle.

The risk studies, Mark, again, emphasized, are not as definitive because of lack of detailed information. One of the things that was discussed is that may be one of our -- at least one of the options under consideration by the NRC staff is to -- how to go about obtaining that information, if it's decided that that's needed to be done. That's one of the issues under consideration.

More data is obviously needed to really more carefully define the risk significance.

I think it's pretty clear, one of the messages, I think, we wanted to leave with the committee, it's pretty clear that these research data, at least as limited as they are, as Dr. Wallis pointed out, I think this is definitely one of those cases and experimental endeavors where you would certainly like to have more data, but these LOCA tests are expensive, we are resource limited.

There is certainly a strong indication there that something will need to be done for aging management for license renewal, some way this particular phenomenon will

need to be addressed for the license renewal period.

And at the bottom, that the staff is, at this point, still considering resolution options, I think, one of which was discussed here for the current license term, but the staff has not reached consensus on the resolution approach.

I guess with that, that summarizes what we had -- again, as Mike mentioned, when we came down here, we wanted to be able to tell you more about this resolution path and hopefully we'll be able to be back soon with a story for you there.

But at this point in time, that kind of summarizes what we had planned to say and be glad to take any questions.

DR. UHRIG: What other options are you looking at, other than a reporting requirement?

MR. HACKETT: Did you want to take a crack at that, Mike?

MR. MAYFIELD: We literally have been discussing things that range from no action, other than supporting what would -- what has gone in the license renewal world, up through the potential for a rule change to 50.49.

I would not want to suggest to you that any one of those is a favored approach at this point, but it's that full range of options that have been being discussed, ways

to solicit more information, generic communications, all of those regulatory devices are being discussed and we are just not in a position today to say yes, this is -- even the direction we're leaning.

But virtually all of those options have been discussed in one form or another.

DR. UHRIG: I gather from reading the document here that the Commission has faced this issue in the past and backed away from it, in the sense that they did not require backfitting.

MR. MAYFIELD: They did not require backfitting when they imposed 50.49.

DR. UHRIG: And the rule came along and they had not really imposed and the grandfathered plants.

MR. MAYFIELD: And when we saw the data, the Sandia data in the early '90s, the information notices went out, the staff went to the task action plan. A number of things were evaluated at that point.

We came to these 43 issues through a series of public meetings we held with the industry. We got a lot of additional information from the industry, additional test reports that helped us resolve most of those 43 issues.

We got it down to six that were being addressed through the specific research program.

So as we've laid this information out for the

industry, they very quickly provided significant additional information that we were able to evaluate and resolve most of those 43 issues.

DR. UHRIG: Could you identify the six issues that remain?

MR. MAYFIELD: Not off the top of my head, but I'm betting Satish can.

DR. AGGARWAL: I can. Bob, one more point I wanted to clarify before I go to the six issues.

Number one, when we were writing the rule and reg guide in 1981-82 timeframe, we did not have any data which indicated failure. The issue before the Commission of backfitting was not whether you require condition monitoring or not.

The issue at that time was that in '79 and 1980, in response to the Commission memorandum and order, plants were required either to meet the guidelines or NUREG-0588 requirements.

What the Commission ruled or decided at that time, that billions of dollars were spent in qualification, so they don't want to go back and ask the operating plants to do more requalification based on new requirement.

But there were no issues at that time that condition monitoring required or not required. When we wrote the Reg Guide 1.89, the staff was concerned and we did

put in our discussion portion that consideration should be given for some kind of monitoring, condition monitoring, because we cannot really bring any test lab a cable at end of life at 40 years.

So we must do something. If you read very carefully IEEE standard 323.74, it also encourages people to do something. The Commission was informed by a SECY paper that the staff feels, at that time, like '97, that we think some kind of condition monitoring should be done, and this is a part of the SECY paper.

Now, let me turn over to your question about those six issues.

Ed pointed out to you that we have 43 issues and our plan is to look only at the six.

The first issue we wanted to look at was basically a comparison between the accelerated aging techniques and also what we find in real life, how these properties compare.

The staff has concluded that the accelerated aging techniques are acceptable.

Issue number two was the people are using different numbers for the activation energy and we want to go back and look at what the limitations are, what the industry has done is right or wrong. Our conclusion is that, yes, they are using reasonable correct assumptions and

the staff is satisfied.

The number three was that do the multiconductor cables have different failure mechanisms as compared to single failure, single conductor, and if so, what are those mechanisms.

The staff has concluded that really there is nothing that measure, but we have problem with the Okonite cable which I told you earlier. They were bounded cable, which was the next item that do they have a failure mechanism, bounded cable compared to unbounded cable.

In multiconductor or single conductor cable, we did not find any major concern. But under the fourth issue, we did have the problem with Okonite and we are dealing with that problem or rather NRR with industry as to what to do.

DR. UHRIG: That's a one-brand problem.

DR. AGGARWAL: Right. We have found the next issue is what we looked at or referred to as any condition monitoring for determining cable condition, and our conclusion is yes, there are several techniques they are promising. They cannot be used for all kind of insulation, including visual examination, walk-downs during refueling and so on.

And the last issue was do we know if condition monitoring cable, which not only tells you the health of the cable, but can it predict whether the cable will survive a

LOCA, and the answer is we really do not have a definitive answer.

In a nutshell, we found there were problems with one of the cables. We found problems with the Samuel Moore in test No. 4, where two out of three cables failed, 60 years, pointed out to you several times, almost every cable had problem, either low value or simply failed.

In a nutshell, this is the story.

MR. HACKETT: Let me add one clarification, based on Dr. Uhrig's question. Bullet number four, basically, the bottom line there is that problem exists with any cable that has Hypalon bonded to EPR, or could exist, depending on what the aging parameters are.

So I guess I don't want to leave anyone with the misconception that it may be only an Okonite problem. With Hypalon EPR, that specific polymeric combination could lead to problems, depending on what the aging parameters are.

MR. LEITCH: I'm concerned about the confusion that could be caused in an operating environment post-LOCA and it seems to -- by misleading or failed cables.

It seems to me that there is a rather small subset of instrumentation in the control room that was especially -- that was environmentally qualified, and I'm remembering Reg Guide 1.33, I don't know if that's right number or not.

MR. SIEBER: 1.97.

MR. LEITCH: 1.97, was it?

DR. AGGARWAL: Post accident monitoring.

MR. LEITCH: Post-accident monitoring, yes. It would seem to me that that subset of equipment would take a higher priority in resolution than some of the other instrumentation.

MR. SIEBER: But I don't recall that it had anything special in terms of cable. It had independent circuits and independent power supplies and you were able to disconnect the control room part of that. And that goes to the shutdown panel and you can control the plant from the shutdown panel, but I don't recall anything special about the cabling.

MR. LEITCH: I'm not saying there's anything necessarily special about it, but a failure in that cable would be particularly distressing to the operators. They have been trained that that particular subset of instrumentation is dependable post-accident.

DR. AGGARWAL: Your observation is correct. In the rule, all post-accident monitoring equipment, cables included, must be qualified to the requirement.

MR. SIEBER: Right.

DR. AGGARWAL: Because those instruments are not treated safety-related, but the rule require if they are variable one and variable two, as defined in the reg guide,

must be qualified.

So this is the regulation.

DR. UHRIG: Any other questions from members?

DR. POWERS: It seems to me one of the issues that you need to chase down maybe a little more is the footnote on one of your slides that says the service conditions are a lot less hazardous, because you are working with an Arrhenius expression, which is an exponential expression.

That could be a very, very significant change. I'm not sure what your activation energies are here. I myself have never been satisfactorily persuaded that Arrhenius works that well for low temperatures, but I understand the database that exists for polymers here.

But it seems to me that I would look and see if perhaps there may be not too demanding in the aging condition that we're presuming takes place at the beginning, because I think you've got orders of magnitude there and everything else is factors of two.

DR. WALLIS: I'm wondering about the real cause of failures of cables. You seem to treat it as a chemical phenomenon, but if you take a cable and bend it, put this stuff under stress, then that changes the failure mechanism, doesn't it? There are all kinds of things that contribute to failure of a cable.

It's kinked or it's bent or it's under some other

kind of load or something, as well as the chemistry.

DR. AGGARWAL: That is true. Again, we were not trying to reinvent the wheel and find some new mechanism.

DR. WALLIS: The real question is when do these things fail or might they fail in a real plant, not some abstract test somewhere.

DR. AGGARWAL: True.

DR. POWERS: I mean, what happens in the polymers is that you start getting cross-linking and you lose plasticizers. A combination of things makes them --

MR. SIEBER: Brittle.

DR. POWERS: Brittle, yes. Real brittle, as a matter of fact. So anything that happens to it subsequently cause fractures.

MR. SIEBER: In fact, one of the questions I wanted to ask is when you wrap the wire around a mandrill to test it, it then is subjected to the radiation and the LOCA spray, do you unwrap it to do the voltage test? Because if you do, it's going to crack to smithereens. Or do you test it on the mandrill?

MR. LOFARO: We tested it on the mandrill. WE did not --

MR. SIEBER: So you didn't even get that stress.

DR. POWERS: I'm also reminded by Dr. Kress that Hypalon evolves hydrochloric acid as it ages, which has its

own ramifications.

DR. UHRIG: Any other comments? Any from the staff? Industry?

If not, Mr. Chairman, back you.

DR. POWERS: Thank you. I'm going to recess us for ten minutes. We can bring the transcription to a close at this point.

[Whereupon, at 4:51 p.m., the recorded portion of the meeting was concluded.]

REPORTER'S CERTIFICATE

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

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PLACE OF PROCEEDING: ROCKVILLE, 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.

Mark Mahoney

Mark Mahoney
Official Reporter
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